March 1, 1966 R. G. JONES ETAL 3,237,555

APPARATUS FOR PRINTING ON ARTICLES SUCH AS BOTTLES OR THE LIKE

Filed Feb. 28, 1964 16 Sheets-Sheet 1

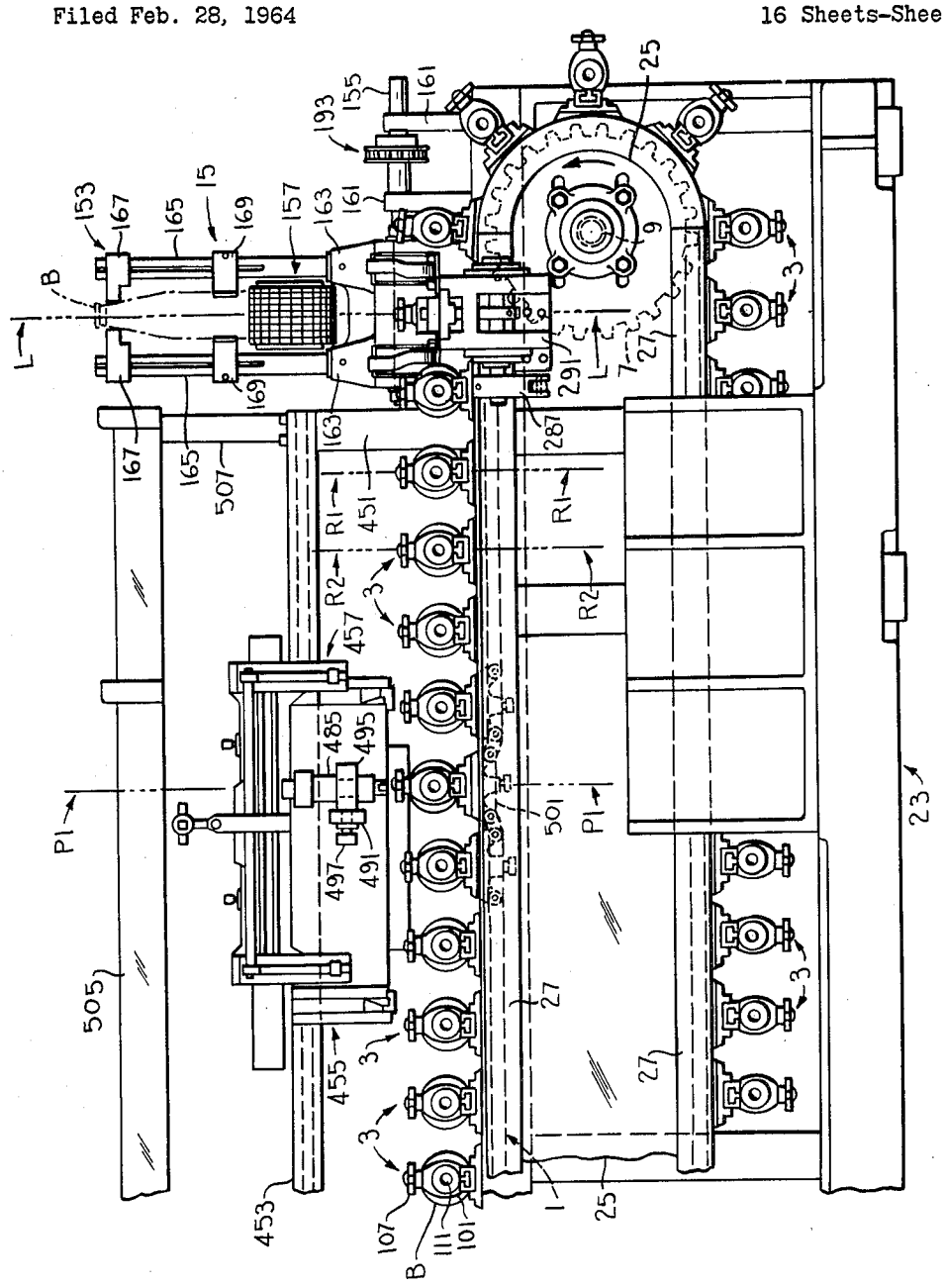


FIG. 1A.

Robert G. Jones,
Frank E. Winscott,
Inventors.
Koenig, Senniger, Powers and Leavitt,
Attorneys.

March 1, 1966 R. G. JONES ETAL 3,237,555

APPARATUS FOR PRINTING ON ARTICLES SUCH AS BOTTLES OR THE LIKE

Filed Feb. 28, 1964 16 Sheets-Sheet 2

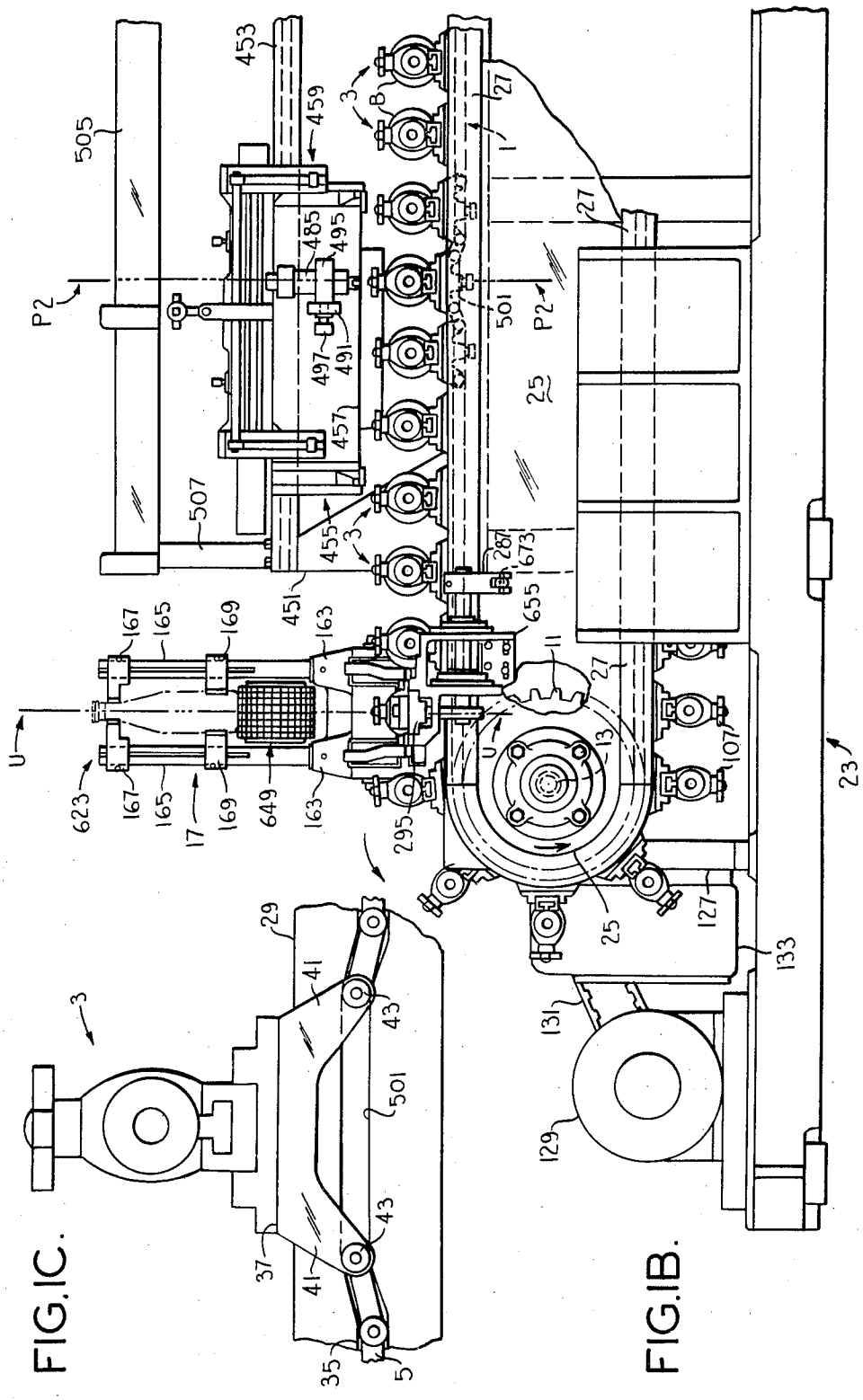


FIG.IC.

FIG.IB.

March 1, 1966 R. G. JONES ETAL 3,237,555

APPARATUS FOR PRINTING ON ARTICLES SUCH AS BOTTLES OR THE LIKE

Filed Feb. 28, 1964 16 Sheets-Sheet 3

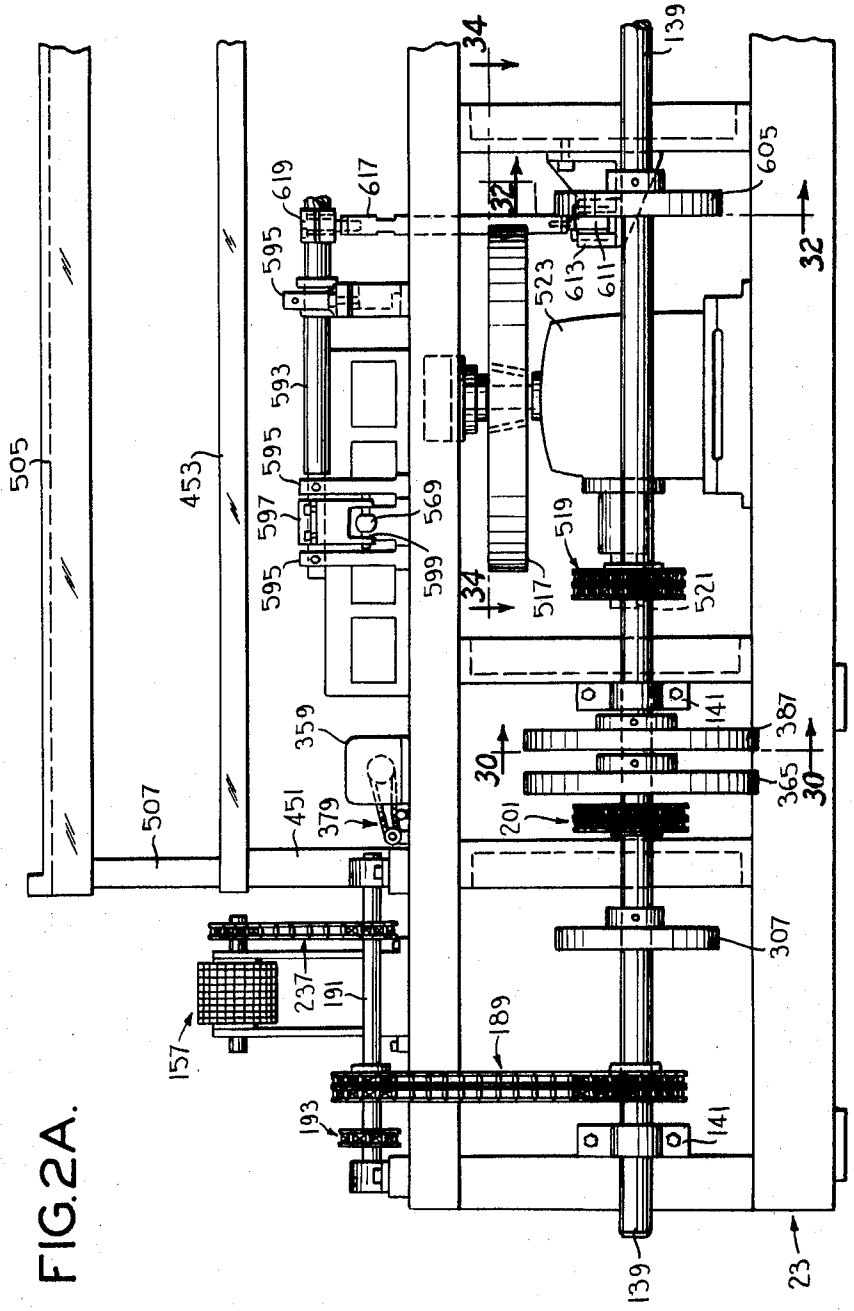


FIG.2A.

March 1, 1966 R. G. JONES ETAL 3,237,555

APPARATUS FOR PRINTING ON ARTICLES SUCH AS BOTTLES OR THE LIKE

Filed Feb. 28, 1964 16 Sheets-Sheet 4

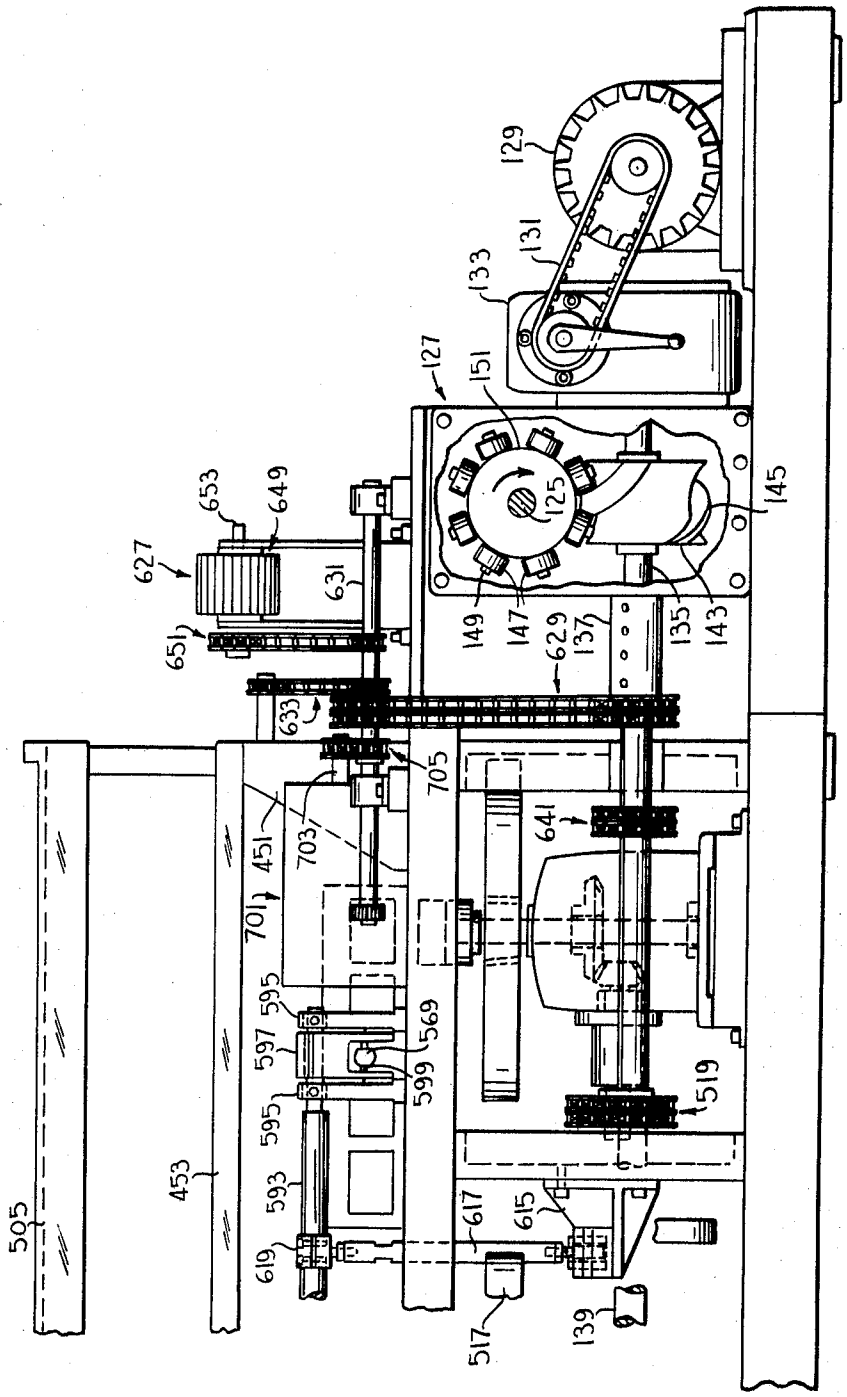
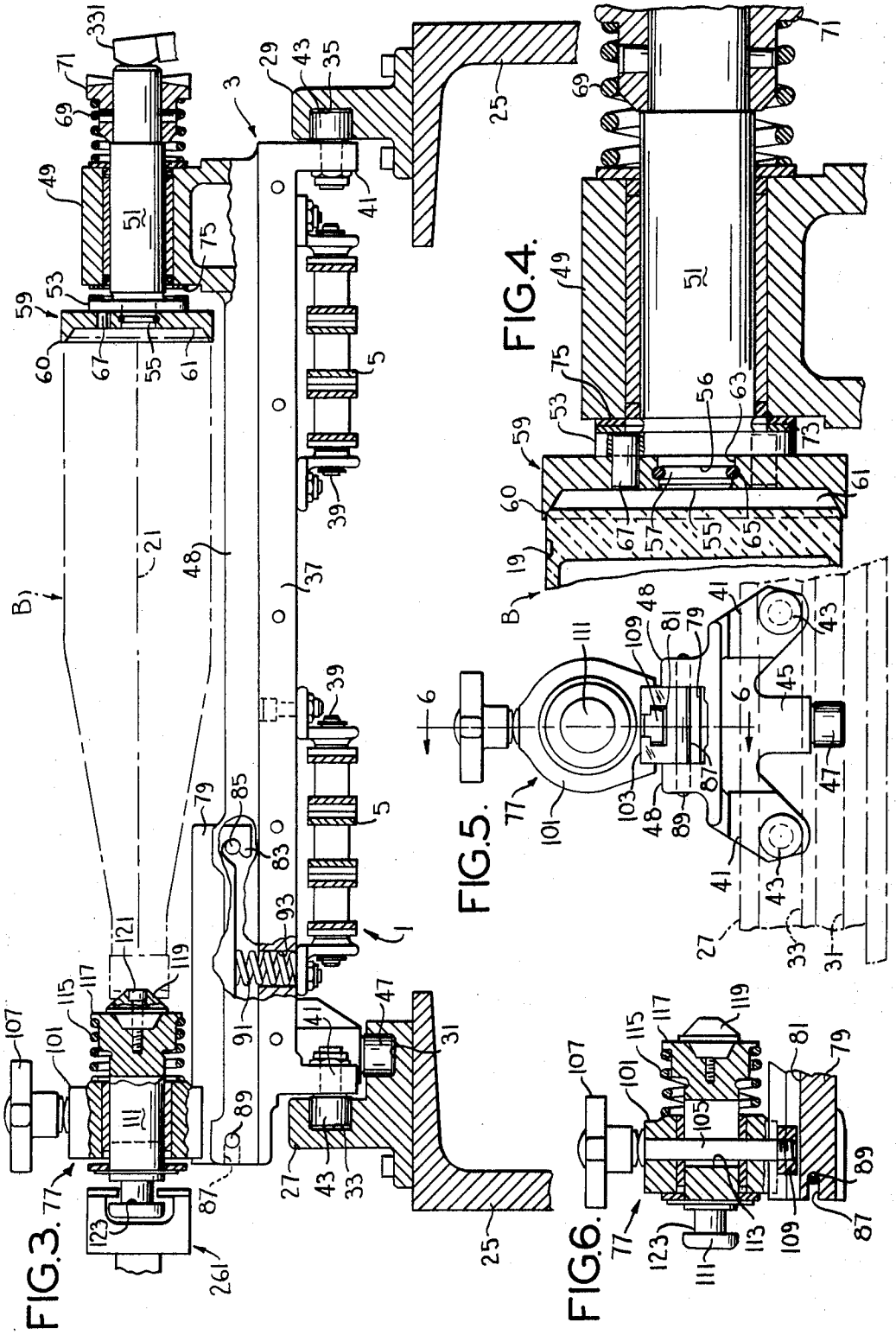


FIG.2B.

March 1, 1966 R. G. JONES ETAL 3,237,555

APPARATUS FOR PRINTING ON ARTICLES SUCH AS BOTTLES OR THE LIKE

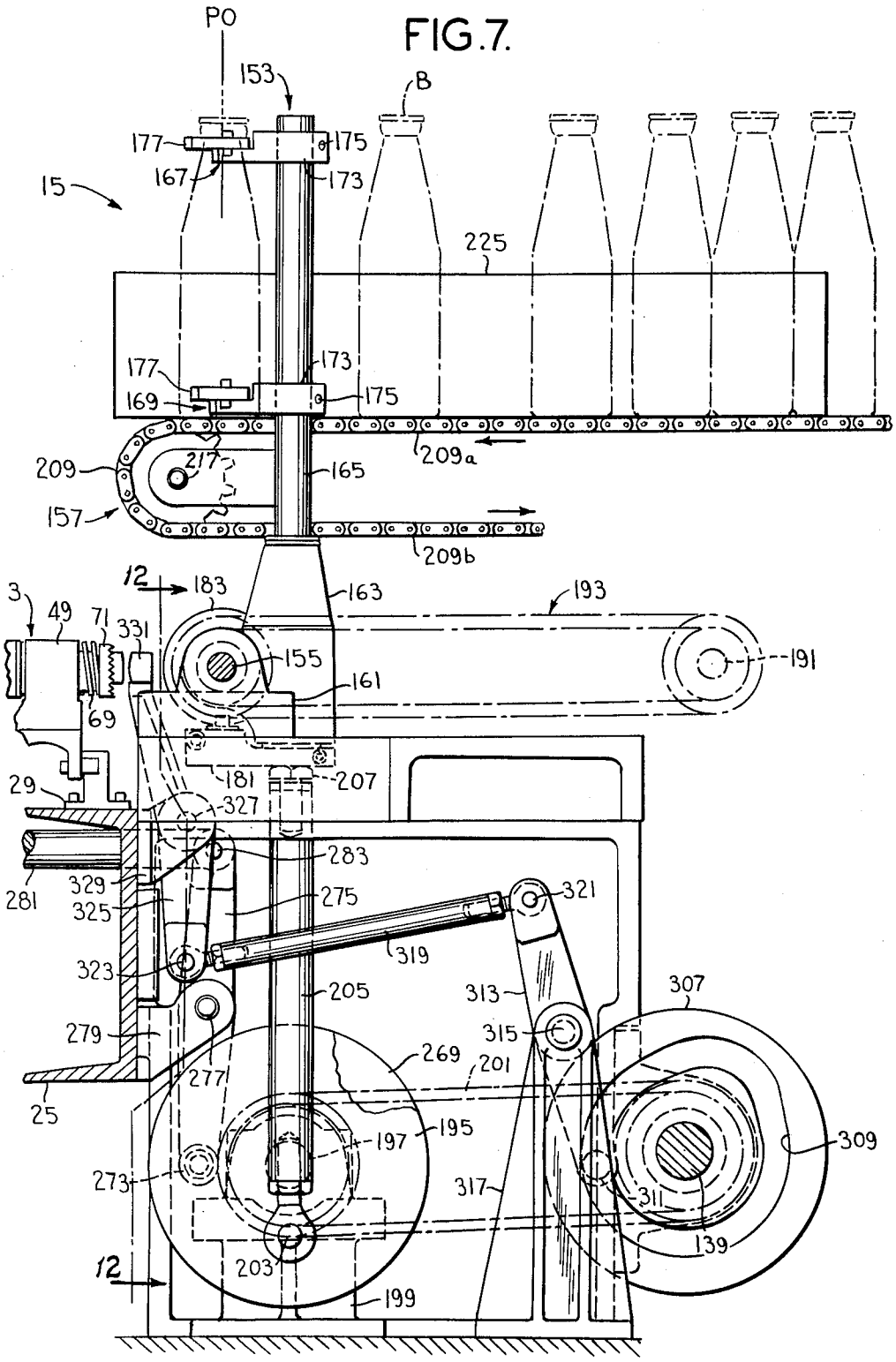
Filed Feb. 28, 1964 16 Sheets-Sheet 5



APPARATUS FOR PRINTING ON ARTICLES SUCH AS BOTTLES OR THE LIKE

Filed Feb. 28, 1964 16 Sheets-Sheet 6

FIG.7.



March 1, 1966 R. G. JONES ETAL 3,237,555

APPARATUS FOR PRINTING ON ARTICLES SUCH AS BOTTLES OR THE LIKE

Filed Feb. 28, 1964 16 Sheets-Sheet 7

FIG.8.

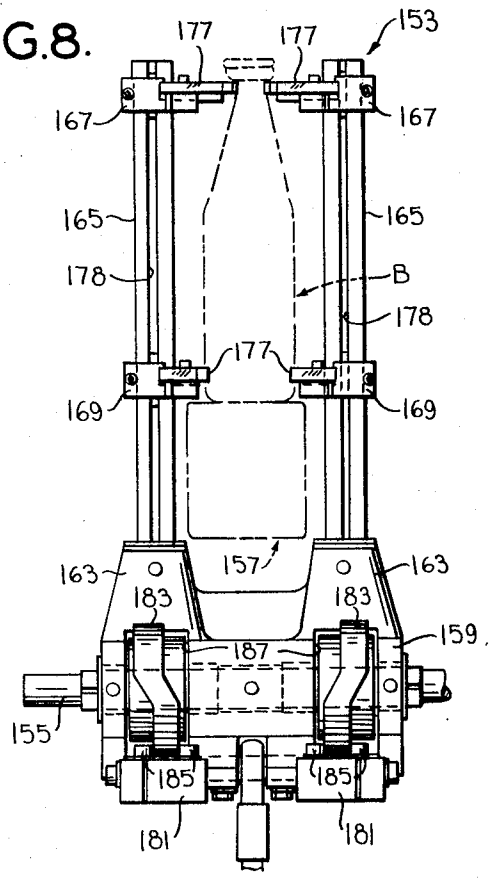


FIG.9.

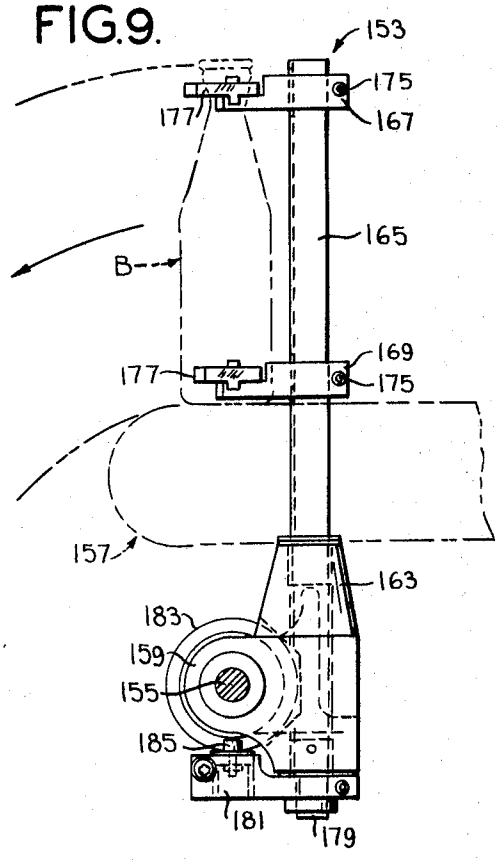


FIG.11.

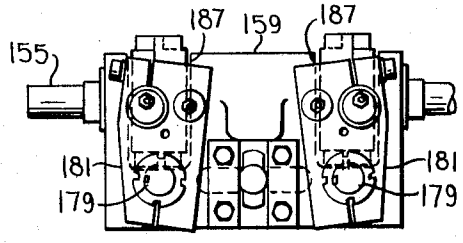
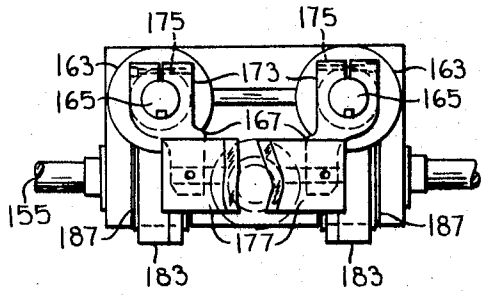


FIG.10.



March 1, 1966 R. G. JONES ETAL 3,237,555

APPARATUS FOR PRINTING ON ARTICLES SUCH AS BOTTLES OR THE LIKE

Filed Feb. 28, 1964 16 Sheets-Sheet 8

FIG.12.

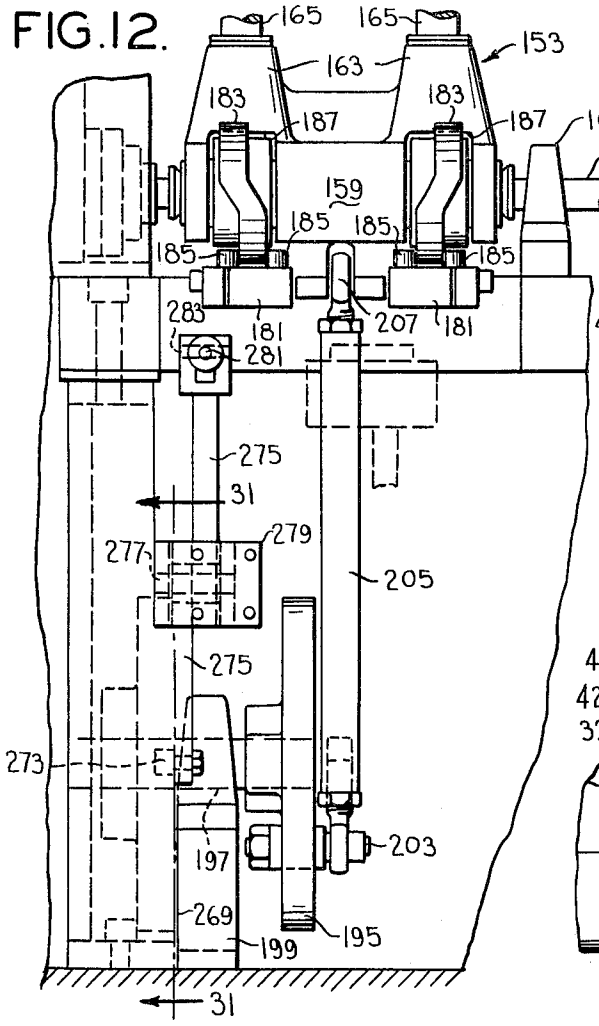
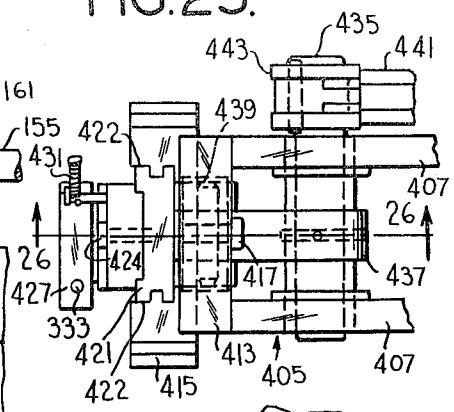


FIG.25.



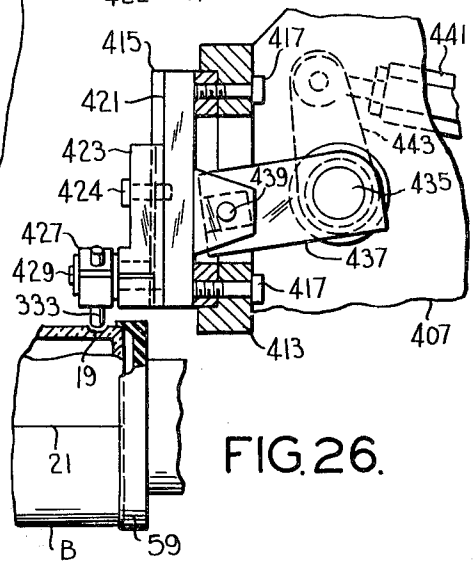
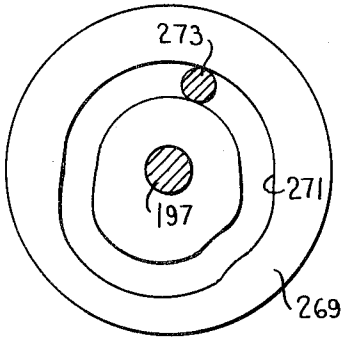


FIG.26.

FIG.31.



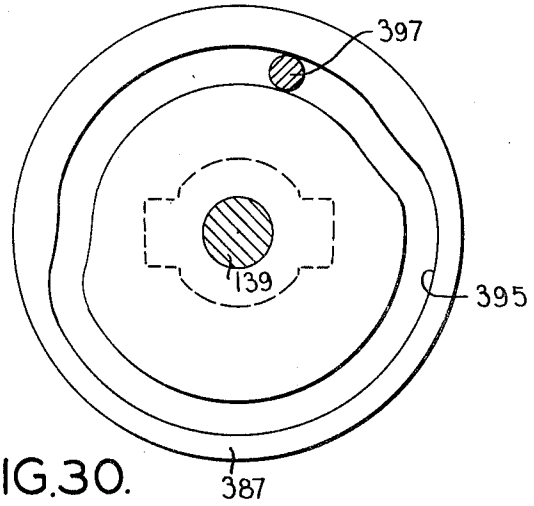


FIG.30.

March 1, 1966 R. G. JONES ETAL 3,237,555

APPARATUS FOR PRINTING ON ARTICLES SUCH AS BOTTLES OR THE LIKE

Filed Feb. 28, 1964 16 Sheets-Sheet 9

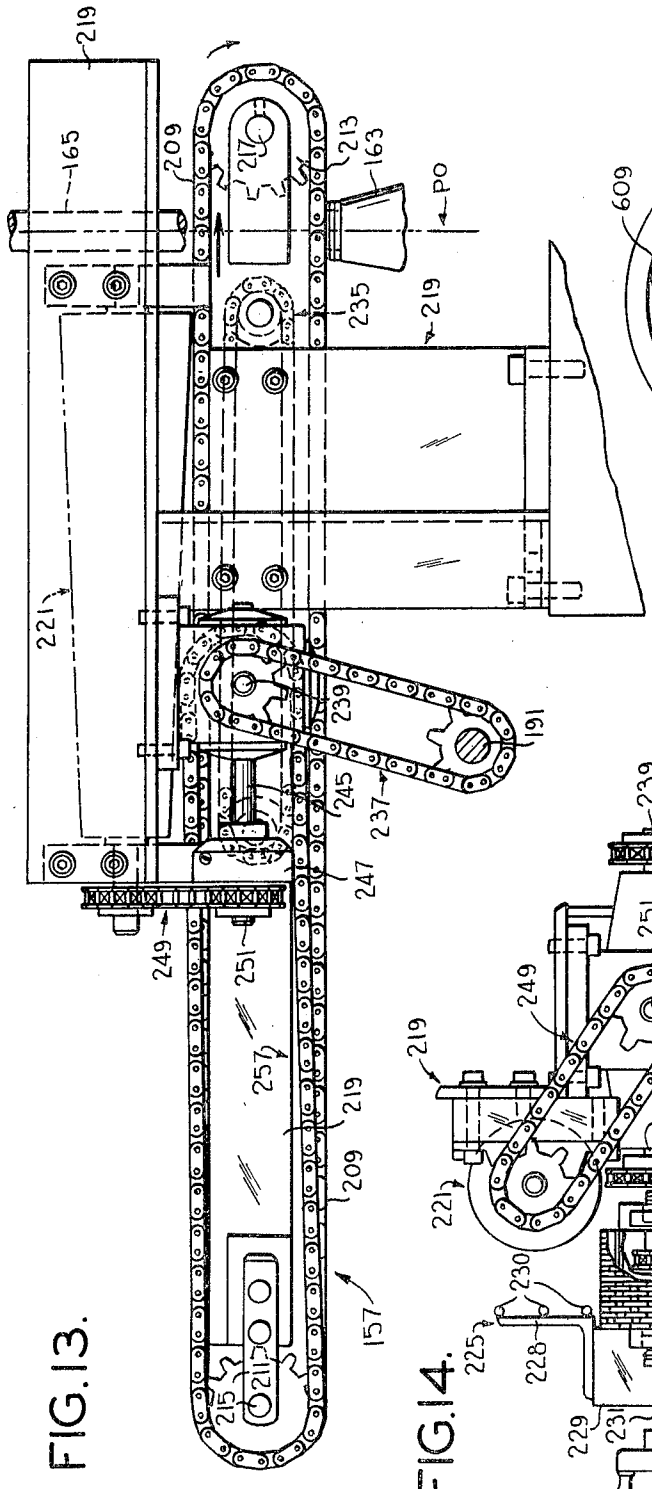


FIG. 13.

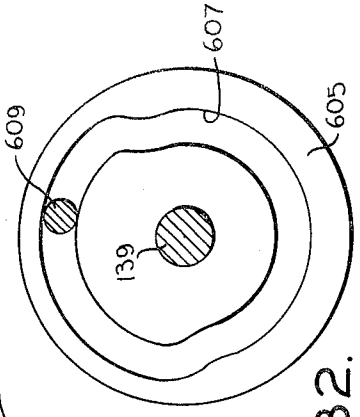


FIG. 32.

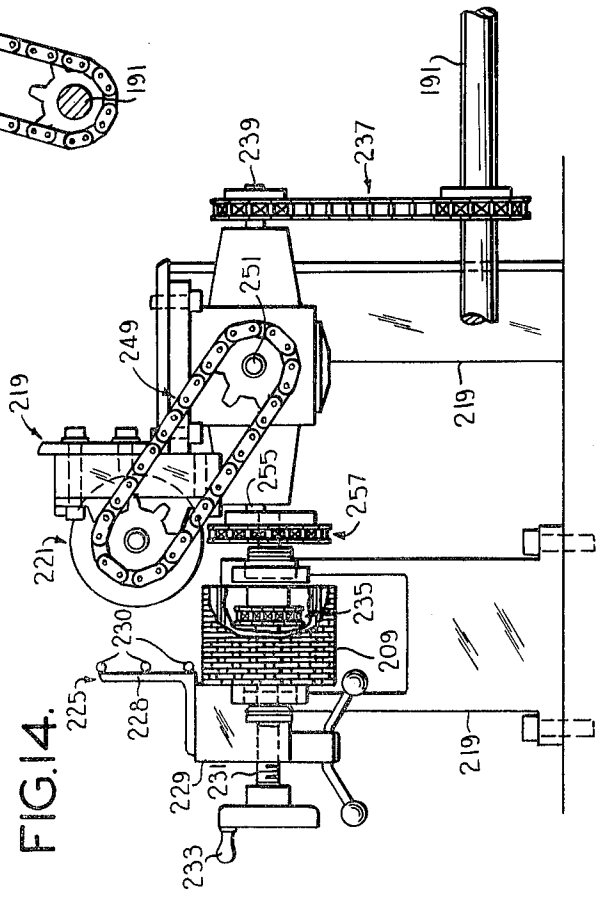


FIG. 14.

March 1, 1966 R. G. JONES ETAL 3,237,555

APPARATUS FOR PRINTING ON ARTICLES SUCH AS BOTTLES OR THE LIKE

Filed Feb. 28, 1964 16 Sheets-Sheet 10

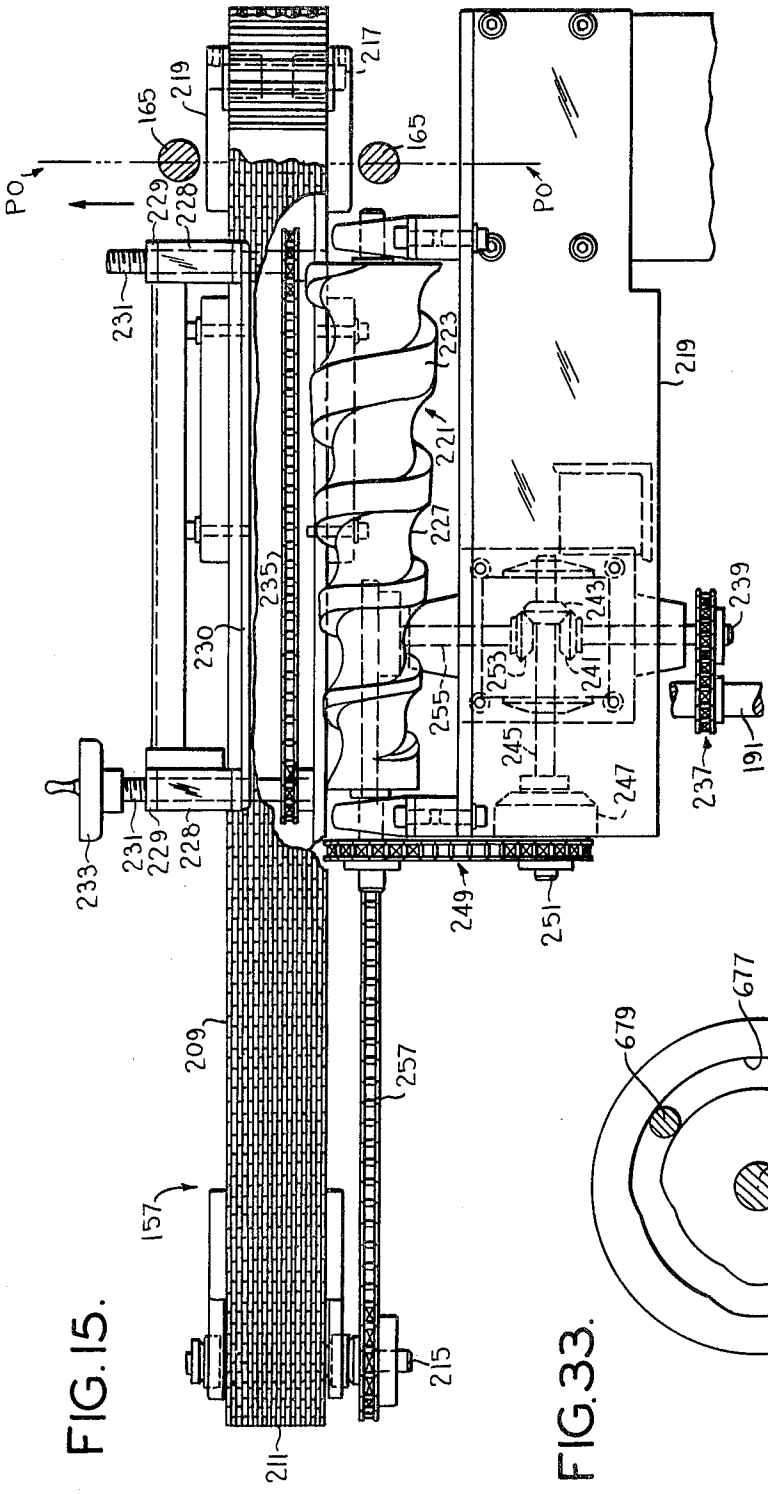


FIG. 15.

FIG. 33.

APPARATUS FOR PRINTING ON ARTICLES SUCH AS BOTTLES OR THE LIKE

Filed Feb. 28, 1964 16 Sheets-Sheet 11

FIG. 16.

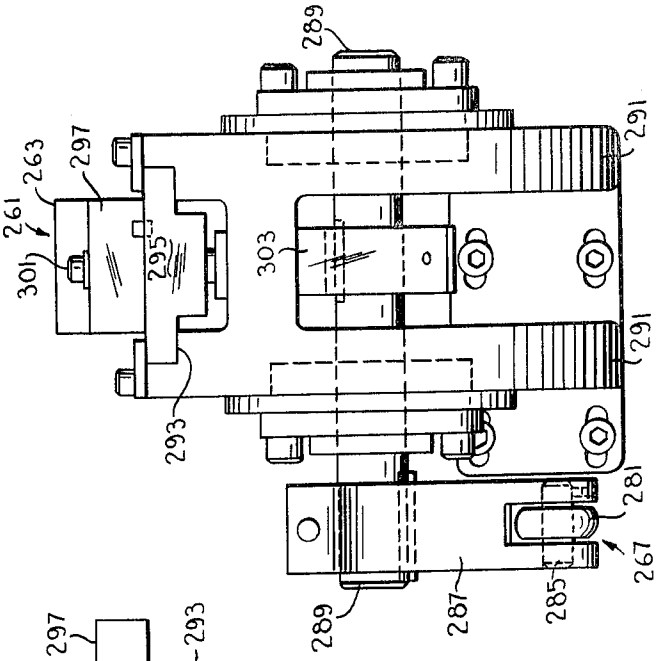
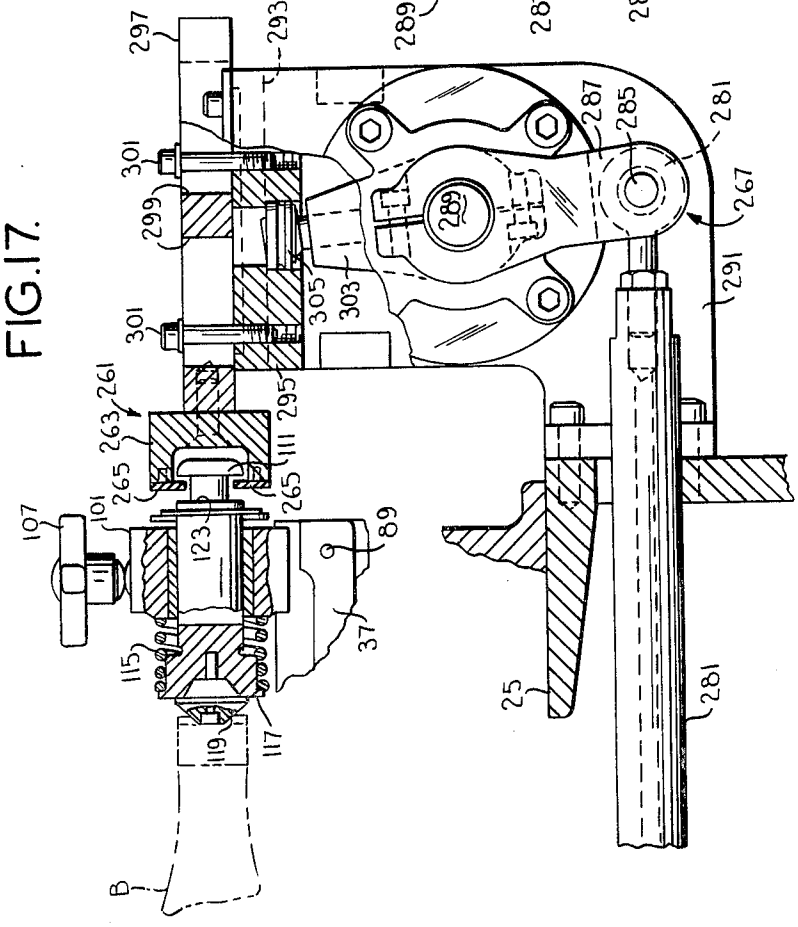


FIG. 17.



APPARATUS FOR PRINTING ON ARTICLES SUCH AS BOTTLES OR THE LIKE

Filed Feb. 28, 1964 16 Sheets-Sheet 12

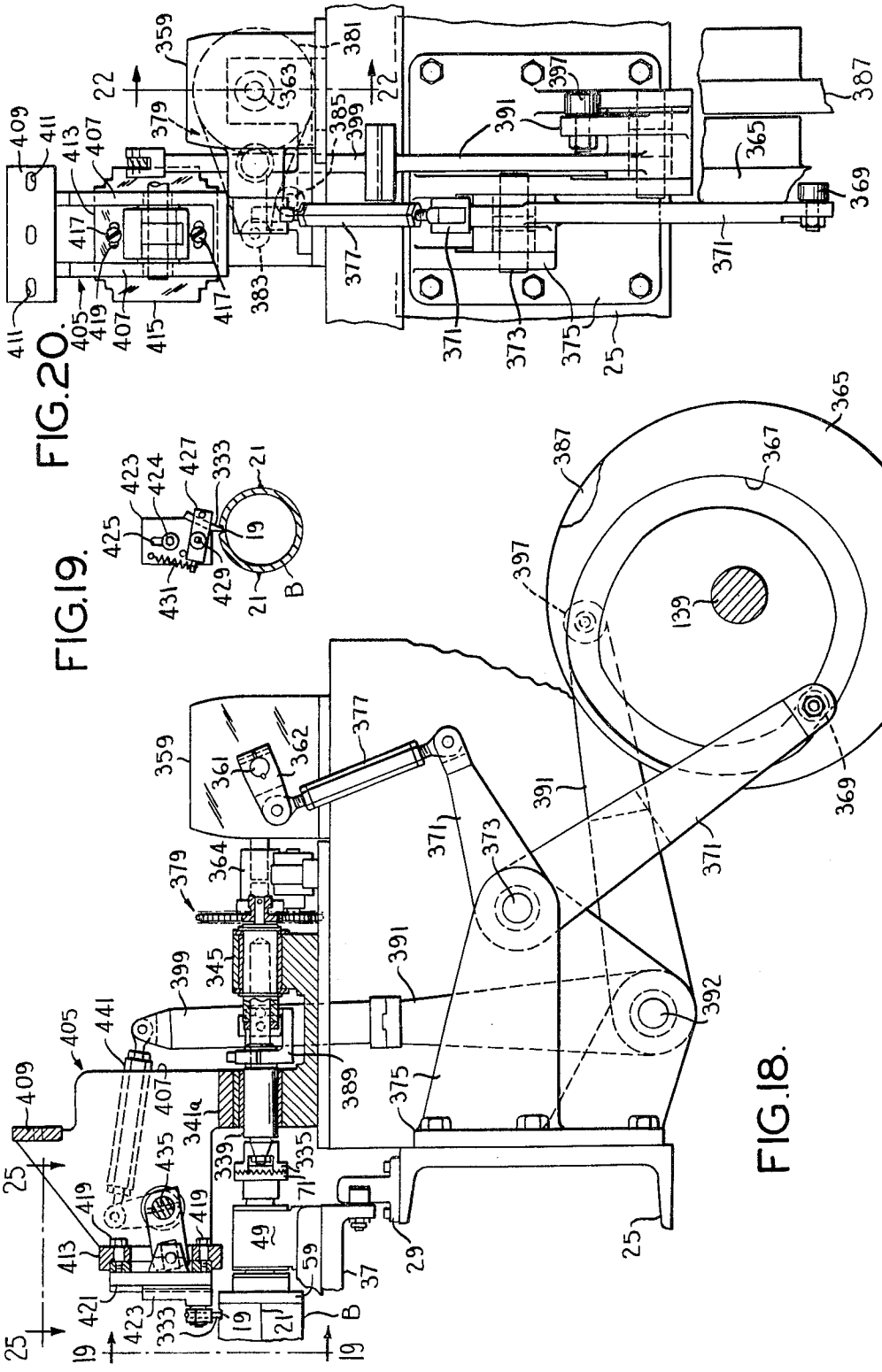


FIG.18.

FIG.19.

FIG.20.

March 1, 1966 R. G. JONES ETAL 3,237,555

APPARATUS FOR PRINTING ON ARTICLES SUCH AS BOTTLES OR THE LIKE

Filed Feb. 28, 1964 16 Sheets-Sheet 13

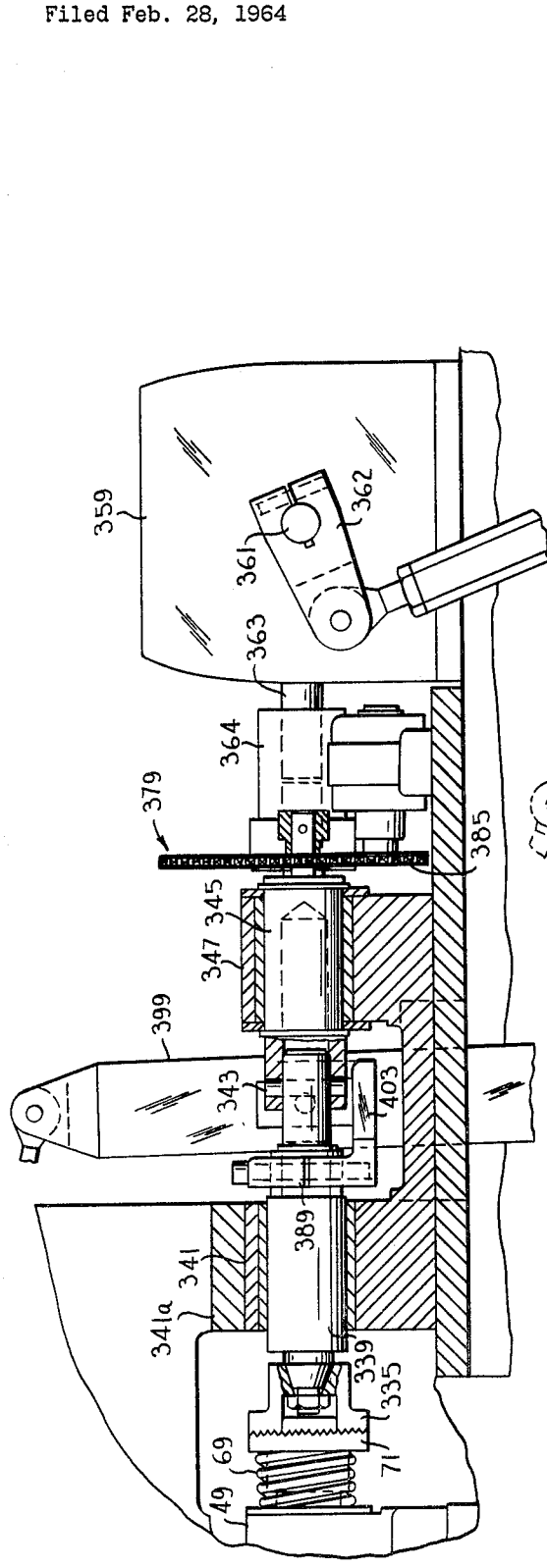


FIG. 21.

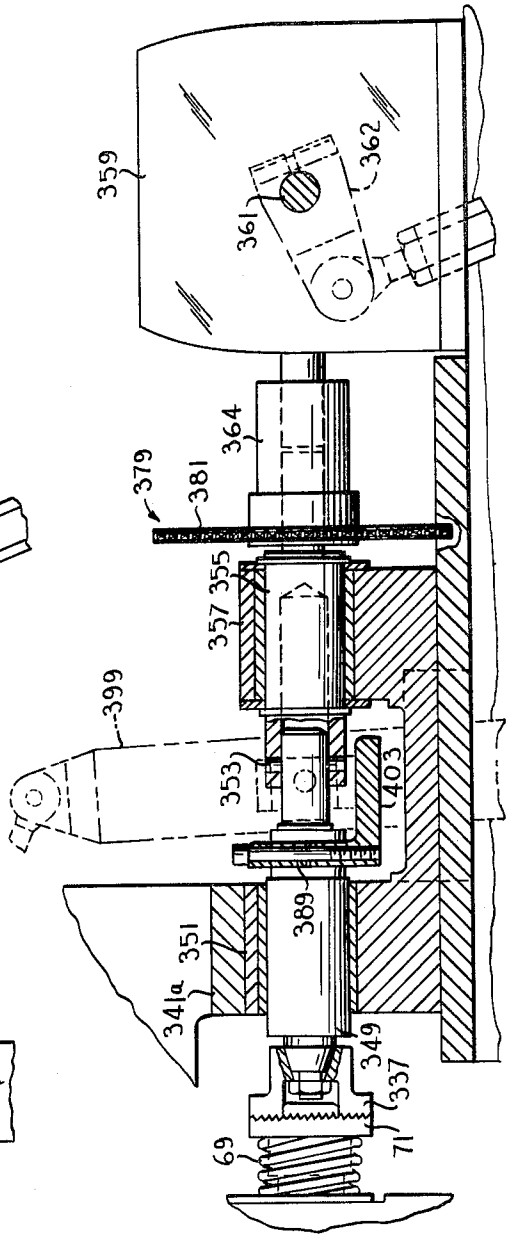


FIG. 22.

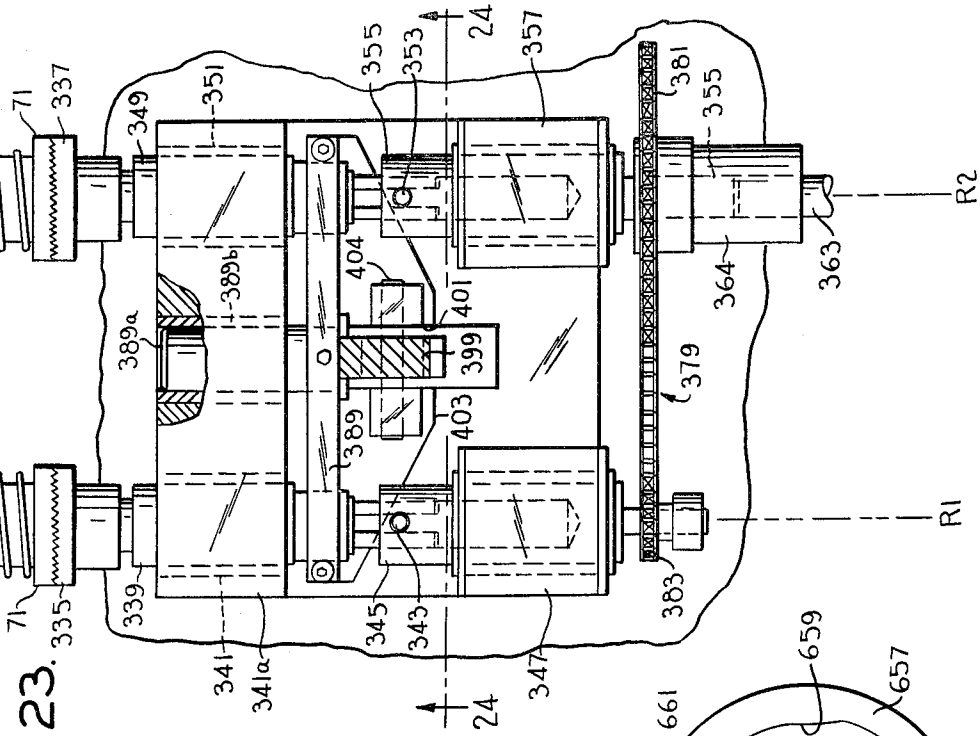


FIG. 23.

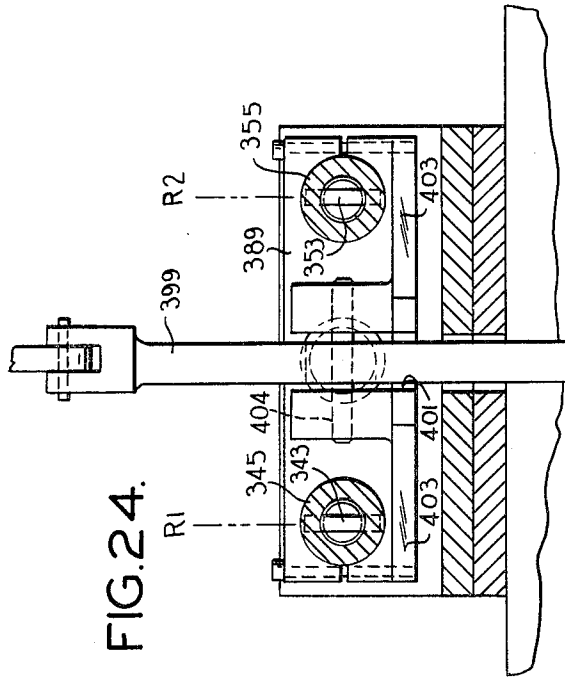


FIG. 24.

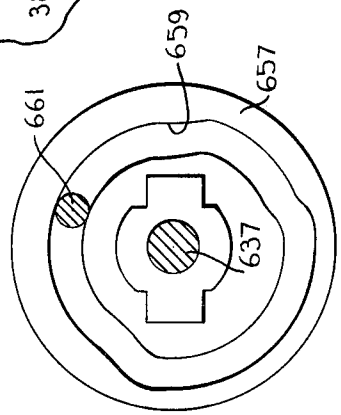


FIG. 35.

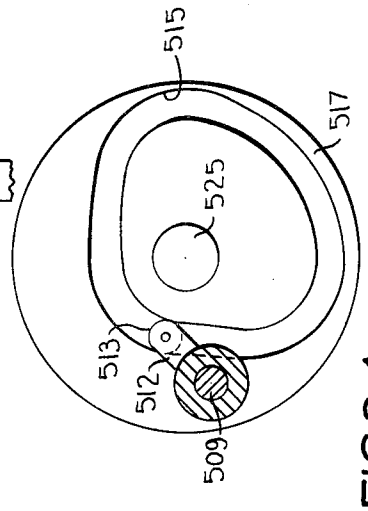


FIG. 34.

March 1, 1966 R. G. JONES ETAL 3,237,555

APPARATUS FOR PRINTING ON ARTICLES SUCH AS BOTTLES OR THE LIKE

Filed Feb. 28, 1964 16 Sheets-Sheet 15

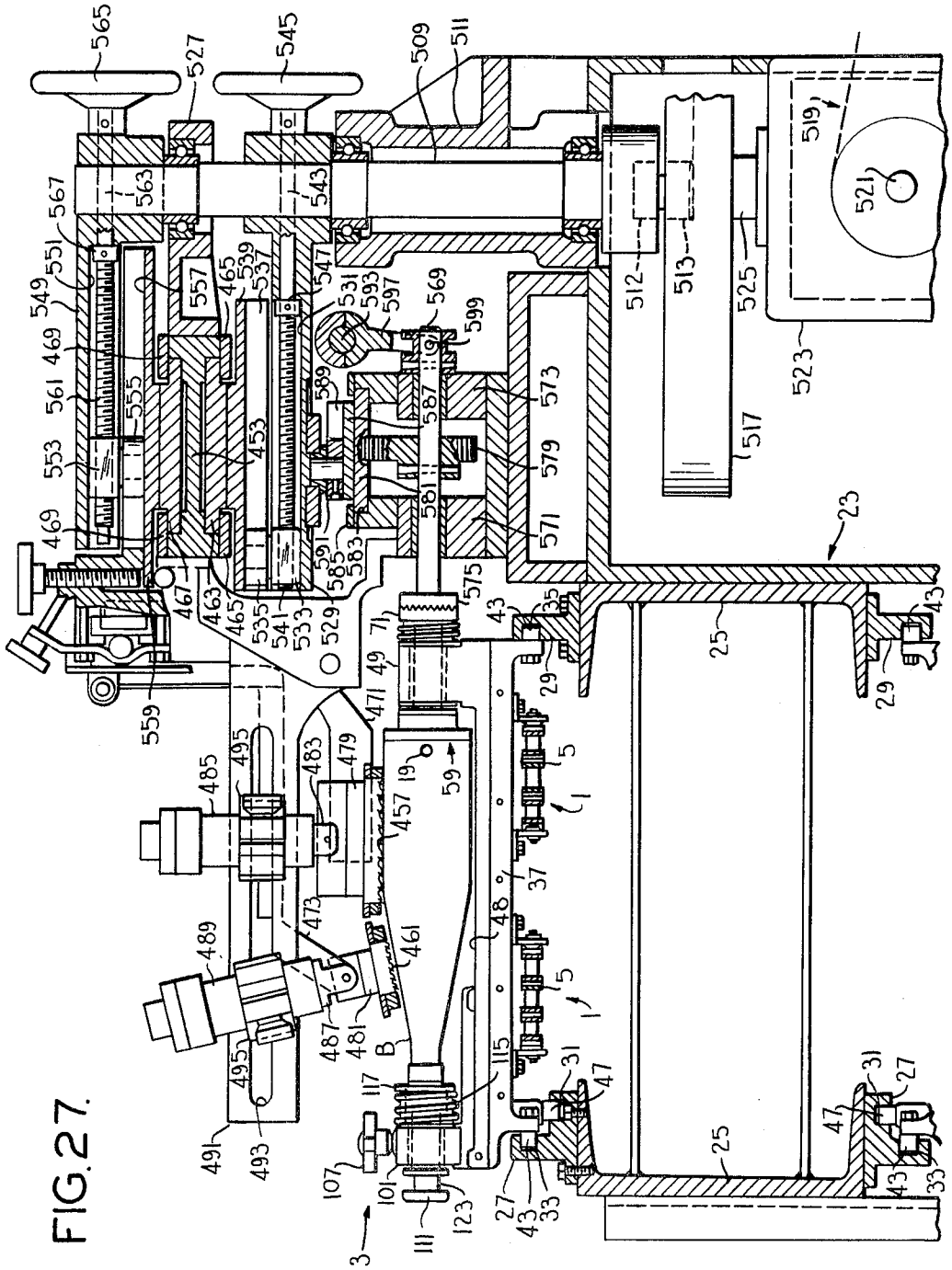


FIG. 27.

March 1, 1966 R. G. JONES ETAL 3,237,555

APPARATUS FOR PRINTING ON ARTICLES SUCH AS BOTTLES OR THE LIKE

Filed Feb. 28, 1964 16 Sheets-Sheet 16

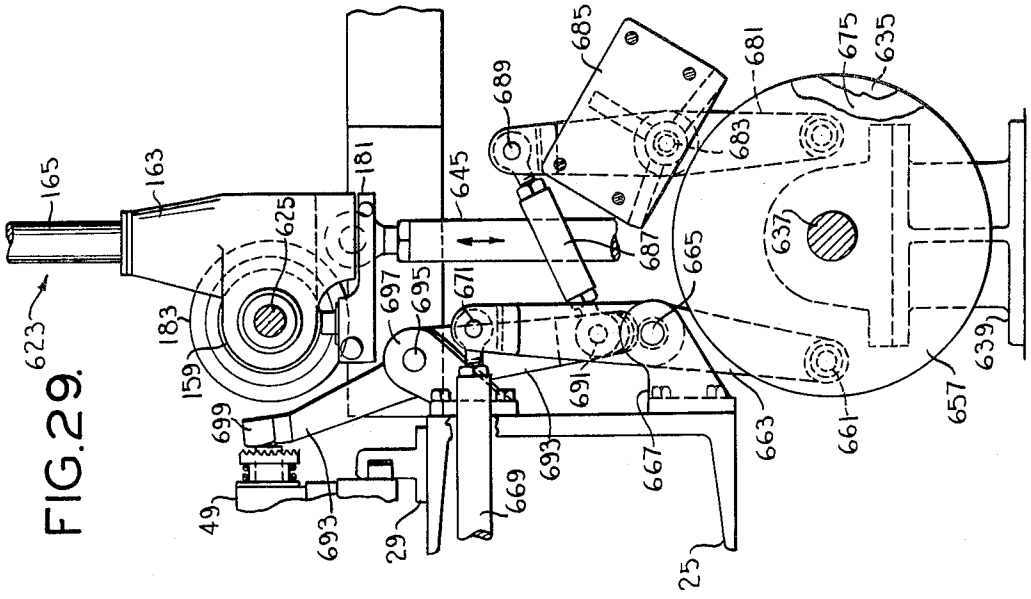


FIG. 29.

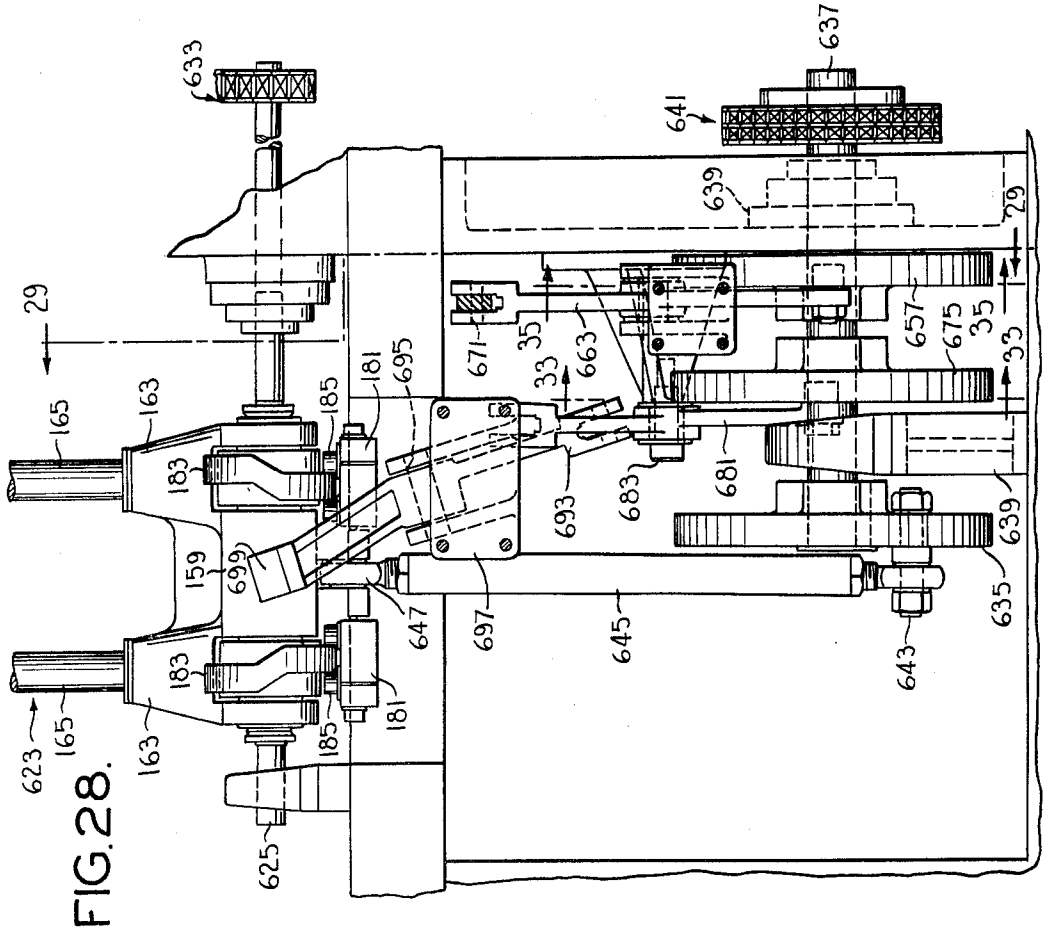


FIG. 28.

United States Patent Office 3,237,555 Patented Mar. 1, 1966

3,237,555

APPARATUS FOR PRINTING ON ARTICLES SUCH AS BOTTLES OR THE LIKE

Robert G. Jones, Sapulpa, Okla., and Frank E. Winscott, Rock Hill, Mo., assignors to Liberty Glass Company, Sapulpa, Okla., a corporation of Oklahoma

Filed Feb. 28, 1964, Ser. No. 348,144
53 Claims. (Cl. 101—38)

This invention relates to printing and more particularly to apparatus for printing on bottles or similar articles.

The invention is especially concerned with a bottle printing machine in which bottles are conveyed one after another to a printing station, at which printing is applied to the bottle by rolling contact, as by means of a stencil (e.g., a silk screen). For example, the bottle is chucked for rotation on its axis and the stencil is moved across the bottle in rolling contact with the bottle. Bottles are generally molded in a two-part mold and, as a result of such molding, have so-called seams extending from their mouth to their bottom in a diametrical plane of the bottle, these seams occurring at the parting lines of the mold. In printing on such bottles, it is desired that the printed matter be applied between the seams, without lapping over either seam. This necessitates that the bottle be presented to the stencil in proper register in relation to the stencil for application of the printing between the seams. This registration is effected by rotating the bottle on its axis to a registered position prior to conveyance of the bottle to the printing station. Also, it may be desired to print in two colors on the bottles, in which case each bottle, after having been printed in one color at a first printing station, is conveyed to a second printing station, where it is printed in the second color. This necessitates that the bottle be presented to the stencil at the second printing station in proper register in relation to that stencil for application of the second printing in register with the first printing.

Among the several objects of this invention may be noted the provision of an improved printing machine of the class above described in which bottles are automatically chucked in bottle carriers on a conveyor, carried through the machine by the conveyor, and automatically unloaded from the bottle carriers and in which each bottle, as it is carried through the machine, is registered and then presented to a printing station, and may be presented to a second printing station for two-color printing, under positive control so that there is no substantial drift of the bottle out of registered position in the course of its travel to the first printing station after registration, or in the course of its travel from the first to the second printing station in the case of two-color printing, without any necessity for a second registration between the first and second printing stations; the provision of a printing machine such as described in which bottles are handled gently to avoid bottle breakage, both in loading and unloading, and without application of high endwise pressure to the bottles by the chucks of the bottle carriers; the provision of a printing machine such as described adapted for quick and easy change-over to handle bottles of different sizes; and the provision of a printing machine such as described which is reliable in operation and adapted for printing bottles at a rapid rate. Other objects and features will be in part apparent and in part pointed out hereinafter.

The invention accordingly comprises the constructions hereinafter described, the scope of the invention being indicated in the following claims.

In the accompanying drawings, in which one of various possible embodiments of the invention is illustrated,

FIG. 1A is a front elevation of the right half of a machine of this invention, with certain parts omitted;

FIG. 1B is a front elevation of the left half of the machine, in continuation of FIG. 1A, with certain parts omitted;

FIG. 1C is an enlarged detail;

FIG. 2A is a rear elevation of that half of the machine shown in FIG. 1A, with certain parts omitted;

FIG. 2B is a rear elevation of that half of machine shown in FIG. 1B, with certain parts omitted;

FIG. 3 is a view showing a bottle carrier of the machine, with parts broken away and shown in section;

FIG. 4 is an enlarged fragment of FIG. 3, showing parts in a moved position;

FIG. 5 is a left end view of FIG. 3, with parts omitted and parts shown in phantom;

FIG. 6 is a vertical section on line **6—6** of FIG. 5;

FIG. 7 is a view illustrating the loading station of the machine, as viewed from the right of FIG. 1;

FIG. 8 is a front elevation of a bottle transfer mechanism used in the machine;

FIG. 9 is a right side elevation of FIG. 8;

FIG. 10 is a top plan of FIG. 8;

FIG. 11 is a bottom plan of FIG. 8;

FIG. 12 is a vertical section taken generally on line **12—12** of FIG. 7;

FIG. 13 (Sheet 9) is a side elevation of a bottle supply conveyor used at the loading station of the machine;

FIG. 14 (Sheet 9) is a left end view of FIG. 13;

FIG. 15 (Sheet 10) is a plan view of FIG. 13; with parts broken away;

FIG. 16 (Sheet 11) is an enlarged fragment of FIG. 1A, showing a chuck shifting mechanism of the machine;

FIG. 17 (Sheet 11) is a left side elevation of FIG. 16, with parts broken away and shown in section;

FIG. 18 (Sheet 12) is an enlarged vertical section taken on the line **R1** appearing in FIG. 1A, showing mechanism at a first registration station of the machine;

FIG. 19 (Sheet 12) is a detail view taken on line **19—19** of FIG. 18;

FIG. 20 (Sheet 12) is a right side elevation of FIG. 18;

FIG. 21 (Sheet 13) is an enlarged fragment of FIG. 18;

FIG. 22 (Sheet 13) is an enlarged vertical section taken on line **22—22** of FIG. 20, showing mechanism at a second registration station of the machine;

FIG. 23 (Sheet 14) is a plan view of the mechanism at the first and second registration stations;

FIG. 24 (Sheet 14) is a vertical section taken on line **24—24** of FIG. 23;

FIG. 25 (Sheet 8) is an enlarged view taken on line **25—25** of FIG. 18;

FIG. 26 (Sheet 8) is a vertical section taken generally on line **26—26** of FIG. 25;

FIG. 27 (Sheet 15) is a vertical section taken on the line **P1** appearing in FIG. 1A, showing mechanism at a first printing station of the machine;

FIG. 28 (Sheet 16) is a view showing mechanism at the unloading station of the machine;

FIG. 29 (Sheet 16) is a section taken generally on line **29—29** of FIG. 28;

FIG. 30 (Sheet 8) is a cam detail, being an enlarged vertical section taken on line **30—30** of FIG. 2A;

FIG. 31 (Sheet 8) is a cam detail, being a vertical section taken on line **31—31** of FIG. 12;

FIG. 32 (Sheet 9) is a cam detail, being a vertical section on line **32—32** of FIG. 2A;

FIG. 33 (Sheet 10) is a cam detail, being a vertical section on line **33—33** of FIG. 28;

FIG. 34 (Sheet 14) is a cam detail, being a horizontal section on line **34—34** of FIG. 2A; and

FIG. 35 (Sheet 14) is a cam detail, being a vertical section taken on line **35—35** of FIG. 28.

Corresponding reference characters indicate corresponding parts throughout the several views of the drawings.

FIGS. 1A and 1B should be placed side-by-side with FIG. 1A at the right and FIG. 1B at the left for a front view of the entire length of the machine. FIGS. 2A and 2B should be placed side-by-side with FIG. 2A at the left and FIG. 2B at the right for a rear view of the entire length of the machine.

Referring to the drawings, first more particularly to FIGS. 1A, 1B and 3, a bottle printing machine of this invention is shown to comprise a bottle conveyor generally designated **1** having a series of bottle carriers thereon, each generally designated **3**, these carriers being spaced at equal intervals along the conveyor. The conveyor comprises a pair of endless chains, each designated **5**, which are trained around sprockets **7** on a horizontal shaft **9** (FIG. 1A) at one end of the apparatus, which may be referred to as its loading end, and around sprockets **11** on a horizontal shaft **13** (FIG. 1B) at the other end of the apparatus, which may be referred to as the unloading end of the apparatus. The conveyor **1** accordingly has an upper horizontal reach, which is its working reach, and a lower horizontal reach, which is its return reach. As will appear, the conveyor **1** is intermittently indexed a distance corresponding to the spacing of the bottle carriers **3**, its upper horizontal working reach traveling forward from the loading end of the apparatus toward the unloading end of the apparatus (from right to left as viewed in FIGS. 1A and 1B), and the lower horizontal return reach travelling back from the unloading end to the loading end of the apparatus (from left to right as viewed in FIGS. 1B and 1A).

Each bottle carrier **3** is adapted to hold a bottle B extending transversely above the working reach of the conveyor **1**. As each bottle carrier travels up around the sprockets **7** at the loading end of the apparatus and reaches a loading station L at the trailing end of the working reach of the conveyor, a bottle is loaded into the carrier by a transfer mechanism generally designated **15**. Each bottle, carried by a respective carrier, is then indexed forward in steps equal to the spacing of the carriers, moving forward with the working reach of the conveyor (from right to left as viewed in FIGS. 1A and 1B).

Each bottle carrier **3** is adapted to convey the bottle B carried thereby to a first registration station R1, which may be referred to as the preliminary registration station, next to a second registration station R2, which may be referred to as the recovery registration station, then to a first printing station P1, then to a second printing station P2, and finally to an unloading station U at the leading (left) end of the upper working reach of the conveyor, where the bottle is unloaded from the carrier by a transfer mechanism generally designated **17**. As shown, the preliminary registration station R1 is two steps removed from loading station L, the recovery registration station R2 is one step removed from preliminary registration station R1, the first printing station P1 is three steps removed from the recovery registration station R2, and the second printing station P2 is, for example, six steps removed from the first printing station P1.

For registration purposes, it is necessary to have a reference index on each bottle, and the particular type of reference index utilized in the machine as herein illustrated is a reference recess or dimple **19** in the peripheral wall of the bottle B adjacent the bottom of the bottle (see FIGS. 19, 26 and 27). This recess **19** is generally located in a radial plane at right angles to the diametrical plane of the bottle seams (see FIGS. 3, 19 and 26).

Sprocket shafts **9** and **13** are journalled in suitable bearings in the base of the machine. The base, which is generally designated **23**, includes a pair of spaced-apart parallel channels **25** (see also FIG. 27) extending longitudinally of the machine. These channels are vertically arranged, and have front and rear guides such as indicated at **27** and **29** on their upper and lower flanges for guiding the bottle carriers **3**. Each of the front guides **27** has a vertical groove **31** and a horizontal groove **33**, and each of the rear guides **29** has a horizontal groove **35** only. The upper working reach of the conveyor **1** travels between the upper front and rear guides **27** and **29**, and the lower return reach of the conveyor travels between the lower front and rear guides **27** and **29** (see FIG. 27).

Each bottle carrier **3** (see particularly FIGS. 3–6) comprises an elongate narrow flat base **37** which extends transversely in respect to the conveyor chains **5**, and which is pin-connected to the chains as indicated at **39**. The bottle carrier base has divergent lugs **41** at both ends carrying rollers **43** which ride in the horizontal guide grooves **33** and **35**, and a central lug **45** at its front end carrying a roller **47** which rides in the vertical guide grooves **31**. The carrier base is formed with integral spaced-apart parallel flanges **48** extending lengthwise thereof (transversely in respect to conveyor **1**) on its outside face and is further formed with an integral headstock **49** at its rear end. This headstock extends outward from the outside face of the carrier base and has a spindle **51** journalled therein for rotation on an axis parallel to the base **37** in the central longitudinal plane of the base **37**. Spindle **51** has an integral flange **53** toward its forward end constituting a brake disk and a reduced-diameter forward end extension **55** having an annular peripheral groove **56**. Seated in this groove is a spring ring **57**. Removably snapped on extension **55** is a bottle bottom chuck **59** of shallow cup shape. This comprises a disk having a narrow peripheral inside-beveled rim **60** defining a shallow circular recess **61** for reception of the bottle bottom, and having a center hole **63** for reception of spindle extension **55**, with an annular groove **65** around the center hole for reception of the spring ring **57**. The arrangement is such that the chuck **59** may be readily snapped off and replaced by one or another of similar chucks of different bottom diameters. The disk **53** carries a pin **67** received in a hole in the chuck **59** for keying it to the spindle **51**.

The spindle **51** is axially slidable as well as rotatable in the headstock **49**, and is biased rearward (outward relative to the headstock) by a coil compression spring **69** reacting from the rear of the headstock against a toothed clutch member **71** pinned on the outer (rear) end of the spindle. The teeth of clutch member **71** face rearward at the outer end of the spindle, surrounding the rear end portion of the spindle. Brake disk **53** has a friction ring **73** on its rear face adapted for frictional engagement with a friction ring **75** on the front (the inside) of the headstock. Normally, these friction rings **73** and **75** are engaged under the bias of spring **69** (see FIG. 4) to brake the spindle **51** and chuck **59** and prevent them from drifting (i.e., from rotating). However, the spindle **51** is movable axially forward (toward the left as viewed in FIG. 4) against the bias of spring **69**, with accompanying release of the brake constituted by disk **53** and friction rings **73**, **75** to permit rotation of the spindle and chuck (see FIG. 3).

At the front end of the bottle carrier base **37** is a removable tailstock generally designated **77**. This comprises an elongate guide block **79** of generally rectangular cross section having a longitudinal T-slot **81** extending from one end thereof to the other at its outside face. This guide block fits in between the flanges **48** of the bottle carrier base **37** and has a hook **83** (see FIG. 3) at its inner end which is hooked around a pin **85** extending between the flanges **48**. The guide block **79** has a transverse slot **87** in its front end for reception of another pin **89** extending between the flanges **48**. Hook **83** is formed to lock the guide against endwise movement along carrier base **3** when the guide block **79** is pressed up against the bottom of pins **85** and **89**, and a coil compression spring **91** pocketed in a recess **93** in the carrier base **37** presses upward on the guide block for

such endwise locking of the guide block. However, the guide block may be readily removed by manually pushing it down against the bias of spring **91**, which permits the block to be slid rearward, and disengaged from the pins **85** and **89** for removal of the entire tailstock assembly **77** and replacement with another for handling bottles of different sizes.

The tailstock **77** further comprises a pedestal **101** carried by the block **79** for longitudinal adjustment relative thereto. For this purpose, the pedestal has a bottom recess **103** which receives the upper portion of the block **79** with a sliding fit thereon, so that the pedestal may be slid to various positions of axial adjustment on the block. A clamp rod **105** extends through the pedestal (see FIG. 6). This rod has a knob **107** on its outer end, and its inner end is threaded in a T-head clamp **109** which is slidable in the T-slot **81** of the block **79**. By turning the knob in one direction, the T-head clamp may be drawn up in the T-slot to lock the pedestal in longitudinally adjusted position, and by turning the knob in the opposite direction, the T-head may be loosened for longitudinal adjustment of the pedestal.

A spindle **111** is axially slidable but nonrotatable in the pedestal **101**, having a transverse slot **113** receiving the rod **105**. This spindle is biased rearward (inward) by a coil compression spring **115** reacting from the rear (inner) face of the pedestal against a collar **117** on the inner end of the spindle. At the rear (inner) end of the spindle is a bottle mouth chuck **119** of conical form for centering entry into the mouth of a bottle. The tailstock spindle **111** and bottle mouth chuck **119** are coaxial with the bottle bottom chuck **59**. The bottle mouth chuck **119** is held in assembly with the tail stock spindle by a screw **121** threaded in the spindle. Toward its front (outer) end, the tailstock spindle **111** has an annular peripheral groove **123**, for a purpose to be described.

The sprocket shaft **9** at the loading end of the machine is an idler and the sprocket shaft **13** at the loading end of the apparatus is a drive shaft for the conveyor, being intermittently rotated through such an angle and in such direction as to effect intermittent advance of the upper working reach of the conveyor **1** a distance corresponding to the spacing of the bottle carriers **3** on the conveyor. For this purpose, conveyor drive shaft **13** is directly coupled in line to the output shaft **125** (see FIG. 2B) of roller gear type drive mechanism **127** which effects intermittent rotation of the output shaft **125** through the requisite angle and in the requisite direction. Power to the roller gear drive mechanism is from an electric motor **129** via a belt and pulley drive **131** to a speed reducer **133**, the output shaft of the speed reducer being coupled to the input shaft **135** of the roller gear drive mechanism. The latter rotates continuously, and is directly coupled at **137** with a main drive shaft **139** which extends longitudinally of the apparatus at the rear thereof, being journalled in bearings carried by the base of the machine as indicated at **141**.

The roller gear drive mechanism **127** is of a known type which comprises a cam **143** on input shaft **135** having a rib **145** (see FIG. 2B). This rib tracks between follower rollers **147** which are journalled on stub shafts **149** extending radially outward from an indexing head **151** on the output shaft **125**. The rollers **147** are spaced equiangularly around the head, and the rib **145** is developed to provide for intermittent indexing of the head (and hence the conveyor **1**) with dwell intervals between successive indexing steps and with a positive lock of the head (and hence the conveyor **1**) during the dwell intervals.

Referring now more particularly to FIGS. 7–12, the bottle transfer mechanism **15** at the loading station L is shown to comprise a bottle gripper generally designated **153** of forked construction swingable through an arc of 90° about the axis of a horizontal shaft **155** between an upright bottle-receiving or pick-off position and a generally horizontal bottle-chucking position. Shaft **155** is located rearward of the upper reach of the conveyor **1** at the loading station L generally at the level of the chucks of the bottle carrier at station L. Bottles are delivered to the loader **153** by a bottle supply or delivery conveyor **157**. As shown, the forked bottle gripper **153** comprises a hub **159** which is rotatably mounted on the shaft **155**. The latter is journalled in bearings as indicated at **161** in FIGS. 1A and 12. The hub is integrally formed with a pair of tangentially arranged bearings **163** which extend crosswise of the hub and which are spaced apart a distance somewhat greater than the diameter of the body of a bottle of largest body diameter to be handled by the machine. A rod **165** of circular cross section is journalled for rotation in each of the bearings **163**. The two rods **165** extend outward from the bearings **163** generally tangent to the hub a distance corresponding to the height of the tallest bottle to be handled. These rods constitute the tines of the forked gripper construction. They have upper and lower pairs of gripper arms **167** and **169**, the upper pair of arms being adapted to grip the neck of a bottle and the lower pair of arms being adapted to grip the body of a bottle. Each gripper arm has one end formed as a split clamp **173** and has a clamp screw **175** for tightening this clamp end of the arm on the respective rod **165** in appropriately adjusted position axially with respect to the arm **165**. Each gripper arm **167** and **169** has a finger **177** of rubber or the like at its outer end for a cushioned grip on a bottle. The rods **165** have a keyway **178** accepting a key in the clamp ends of the arms **167** and **169**.

Rods **165** extend completely through the bearings **163** and have inner end portions **179** which project for a short distance out of the bearings. Cranks **181** are fixed on these end portions of the rods. Shaft **155** carries a pair of barrel cams **183**. Each crank carries a pair of cam follower rollers **185** which engage opposite sides of the rib of a respective barrel cam **183**. The barrel cams are accommodated in transverse slots **187** in the hub **159**. They are designed and oppositely phased to effect counterclockwise rotation of the left-hand rod **165** and clockwise rotation of the right-hand rod **165** (as viewed from above) when the rods swing to their upright position for gripping a bottle, and to effect clockwise rotation of the left-hand rod **165** and counterclockwise rotation of the right-hand rod **165** when they have swung down to bottle-chucking position for release of the gripper arms from the bottle after it has been chucked. Shaft **155** is driven from the main drive shaft **139** via a drive which comprises a chain and sprocket drive **189** (see FIG. 2A) interconnecting the main drive shaft and a countershaft **191**, and a chain and sprocket drive **193** interconnecting the countershaft and shaft **155**.

As previously noted, the forked bottle gripper **153** is swingable through an arc of 90° between its upright bottle pick-off position and its horizontal bottle-chucking position. Mechanism for effecting this oscillation of the bottle loader is shown in FIGS. 7 and 12 to comprise a crank disk **195** on a horizontal shaft **197** extending in longitudinal direction of the machine in front of the main drive shaft **139**. Shaft **197** is journalled in a bearing as indicated at **199**, and is driven from shaft **139** by a chain and sprocket drive **201** (see also FIG. 2A). The disk **195** has a crank pin **203**, and a connecting rod **205** extends between this pin and the hub **159**, being connected to the latter as indicated at **207**. The arrangement is such as to provide for the requisite 90° oscillation of the bottle gripper **153** on each revolution of the crank disk **195**.

The bottle supply conveyor **157** (see particularly FIGS. 1A, 2A, 7, 13, 14 and 15) comprises an endless chain belt **209** trained around sprockets **211** and **213** on sprocket shafts **215** and **217** journalled in a frame generally designated **219**. This conveyor is located at the rear of conveyor **1** in a vertical plane at right angles to the vertical plane of conveyor **1** and has an upper horizontal reach

which travels forward in the direction toward the conveyor 1 for conveying bottles to a pick-off position PO, and a lower horizontal return reach. Rods 165 of the bottle gripper 153 straddle the forward end of the belt 209 at the pick-off station PO when the bottle gripper swings up to its upright bottle pick-off position. Bottles are delivered one after another in contiguous relation onto the rearward end of the upper reach of the belt 209 by suitable means (not shown). As the bottles travel forward, they are accelerated by means of a timing screw 221 to become spaced apart for timing their delivery to the pick-off station PO to occur in time with the swing of the bottle gripper 153 to its upright pick-off position.

The timing screw 221 as shown in FIGS. 13 and 15, extends parallel to belt 209 above and toward one side of the upper reach of belt 209, and has a thread 223 of increasing pitch and radius for effecting spacing of bottles being fed forward by the belt. On the opposite side of belt 209 from the timing screw is a fence 225 for holding bottles in the helical groove 227 of the timing screw. This fence comprises angle end members 228 mounted on blocks 229 and carrying three rails 230 (see particularly FIG. 15). Blocks 229 have tapped holes receiving adjusting screws 231 rotatably carried by the frame 219. One of these screws has a handwheel 233, and the two screws are interconnected for rotation in unison by means of a chain and sprocket drive 235. By turning the handwheel 233 one way or the other, the fence 225 may be adjusted toward or away from the timing screw 221, remaining parallel to the axis of the latter.

The belt 209 and the timing screw 221 are continuously driven from the countershaft 191 via drive mechanism including a chain and sprocket drive 237 taken off the countershaft 191, and driving a shaft 239 carrying a bevel gear 241. The latter meshes with a bevel gear 243 fixed on a shaft 245 at right angles to shaft 239 connected to the driver element of an overload release clutch 247. A chain and sprocket drive 249 connects the driven element 251 of the clutch 247 and the timing screw 221. Gear 243 meshes with a bevel gear 253 on a shaft 255 in line with shaft 239. A chain and sprocket drive 257 connects shaft 255 and sprocket shaft 215 of belt 209 to drive the latter.

As each of the bottle carriers 3 reaches the loading station L, the respective headstock spindle 51 and associated bottle bottom chuck 59 are in their extreme rearward or outer position (their FIG. 4 position), being held in this position by spring 69, and the respective tailstock spindle 111 and associated bottle mouth chuck 119 are also in their extreme rearward or inner position (their FIG. 6 position), being held in this position by the spring 115. The bottle carrier 3 dwells at the loading station L for a brief interval, and during this interval the bottle mouth chuck 119 is retracted (i.e., moved out to the left away from its FIG. 6 position) to permit a bottle gripped by the bottle gripper 153 to swing down into chucking position generally coaxial with the chucks, after which the bottle bottom chuck 59 moves forward to its FIG. 3 position for chucking the bottle at its bottom and the bottle mouth chuck 119 moves rearward for chucking the bottle at its mouth. Retraction of the bottle mouth chuck 119 is effected by means of a reciprocating shifter fork 261 (see FIGS. 3 and 17) which receives the grooved outer end of the tailstock spindle 111 at the loading station L. This shifter fork 261 is reciprocable in transverse direction in relation to the conveyor 1 (axially in relation to the bottle carrier 3 at the loading station), and has upper and lower tines 263 with inwardly directed lips 265 at the rear ends of the tines adapted for engagement in the annular groove 123 at the outer end of the tailstock spindle 111. Mechanism for reciprocating the shifter fork is generally indicated at 267, and comprises a positive-motion plate cam 269 on the shaft 197 (see FIGS. 7 and 12) having a cam groove 271 (see FIG. 31) in one of its faces receiving a cam follower roller 273 on the lower end of a lever 275 pivoted intermediate its ends as indicated at 277 on a bracket 279 mounted on the base of the machine. A connecting rod 281 is pin-connected at 283 to the upper end of lever 275 and extends forward to a pin connection at 285 (see FIGS. 16 and 17) with a crank 287 on one end of a rock shaft 289. The latter is journalled in the sides of a bracket 291 of inverted U-shape (see FIG. 16) mounted on the front of the front channel 25 at the loading station L (see FIG. 1A). This bracket is formed at the top with a guideway 293 for a slide block 295 adapted to slide back and forth in lateral direction with respect to the conveyor 1 at the loading station L. Shifter fork 261 is fastened on the end of a stem 297 adjustably mounted on the slide block 295, the stem having elongate longitudinal slots 299 accepting screws 301 threaded in the block. A radial arm 303 fixed on the rock shaft 289 has a universal joint connection at 305 with the slide block. The groove 271 in the plate cam 269 is developed and phased to effect forward (outward) shift of the shifter fork 261 to retract (pull forward) the tailstock spindle 111 of the bottle carrier 3 at the loading station L just before a bottle is swung down into chucking position, and to return the shifter fork 261 rearward after a bottle has been swung down to chucking position and before conveyor 1 is indexed to carry the chucked bottle away from the loading station. It will be observed that the nature of the interengagement of the outer grooved end of the tailstock spindle 111 and the fork 261 is such as to allow the end of the spindle to move into the fork and then pass on out of the fork.

Mechanism for shifting the bottle bottom chuck 59 of a bottle carrier 3 at the loading station L is shown to comprise a positive-motion plate cam 307 on the main drive shaft 139 (see FIGS. 2A and 7) having a cam groove 309 in one of its faces receiving a cam follower roller 311 on the lower end of a lever 313 (see FIG. 7) pivoted intermediate its ends as indicated at 315 on a pedestal 317. A connecting rod 319 is pin-connected as indicated at 321 to the upper end of lever 313, and has its other end pin-connected as indicated at 323 to the lower end of a rocker arm 325 pivoted intermediate its ends as indicated at 327 in a bracket 329 mounted on the rear channel 25. Rocker arm 325 has a head 331 at its upper end for engagement with the rear end of the headstock spindle 51 of the bottle carrier 3 at the loading station L to shift the headstock spindle and the bottle bottom chuck 59 forward against the return bias of spring 69. The groove in the plate cam 307 is developed and phased to effect the forward (inward) shift of the bottle bottom chuck 59 just after a bottle has been swung down to chucking position and before conveyor 1 is indexed to carry the chucked bottle away from the loading station.

After a bottle has been chucked in a bottle carrier 3 at the loading station L, the conveyor 1 is indexed to carry this bottle carrier and the bottle chucked therein forward one step, and on the next successive indexing operation of the conveyor 1, the bottle carrier 3 and the bottle chucked therein are carried to the preliminary registration station R1 (two steps down the line from the loading station L). It will be understood that bottles are chucked in the bottle carriers 3 at the loading station L indiscriminately as regards the angular position of the bottle seams 21 and the reference recess 19. At the preliminary registration station R1, the bottle is rotated on its axis and arrested in a preregistered position wherein its seams 21 are in a generally horizontal plane, the rotation of the bottle being stopped with the bottle in this preregistered position by engagement of a stop finger 333 (see FIGS. 18, 19 and 26) in the reference recess 19 of the bottle when the recess comes around to the top. After the bottle has been thus preregistered at station R1, the conveyor 1 is indexed to carry it to the recovery registration station R2 (one step down the line from station R1). At station R2, the bottle is rotated 90° on its axis to bring the bottle to its final registered position

wherein the bottle seams are in a generally vertical plane, in which position the bottle is properly registered for the printing thereon at the first printing station P1 (and also at the second printing station P2) between the bottle seams without lapping over either seam. FIG. 27 shows the finally registered position of the bottle.

Rotation of the bottle at station R1 is effected by moving a toothed clutch member 335 (see FIGS. 18, 21 and 23) into mating engagement with the toothed clutch member 71 on the rearward (outer) end of the headstock spindle 51, and rotating member 335 through somewhat more than a full revolution. Rotation of the bottle at station R2 is effected by moving a toothed clutch member 337 (see FIGS. 22 and 23) into mating engagement with member 71 and rotating member 337 through an angle of 90°. Clutch member 335 is secured on the forward end of a shaft 339 which is rotatable and axially slidable in a stationary bearing 341 located in the plane of station R1. Shaft 339 has a splined connection at 343 (see FIG. 23) with a shaft 345 journalled in the line with shaft 339 in a stationary bearing 347 rearward of bearing 341. Shaft 345 is collared against sliding in the bearing 347. Clutch member 337 is secured on the forward end of a shaft 349 which is rotatable and axially slidable in a stationary bearing 351 located in the plane of station R2. Shaft 349 has a splined connection at 353 (see FIG. 23) with a shaft 355 journalled in line with shaft 349 in a stationary bearing 357 rearward of bearing 351. Shaft 355 is collared against sliding in bearing 357.

Intermittent rotation of shaft 355 through an angle of 90° is effected by means driven off the main drive shaft 139 and shown to comprise a right-angle gear box 359 mounted on the base of the machine. The input shaft 361 of this gear box carries a crank arm 362. The output shaft 363 of the rear box is directed-coupled to shaft 355 as indicated at 364. Shaft 139 carries a positive-motion plate cam 365 (see FIGS. 2A, 18 and 20) having a cam groove 367 in one of its faces receiving a cam follower roller 369 on one end of a bell crank 371 pivoted at 373 on a bracket 375 carried by the rear channel 25. The other end of the bell crank 371 is connected to crank arm 362 by an adjustable connecting rod 377. The groove 367 in cam 365 is so developed and phased as to effect 90° rotation of shaft 355 (and hence 90° rotation of shaft 349 via splined connection 353) once during each revolution of the main drive shaft 139, and to time this for rotating the bottle at station R2 through 90°.

Shaft 345 is driven off shaft 355 via a chain and sprocket drive 379. This drive is from a large sprocket 381 on shaft 355 to a small sprocket 383 on shaft 345 with the ratio of the diameter of these sprockets such as to drive shaft 345 through somewhat more than 360° on each 90° rotation of shaft 355. A chain-tensioning idler sprocket in this drive is indicated at 385.

Shafts 339 and 349 carrying clutch members 335 and 337 are simultaneously moved forward and rearward to shift these gears into and out of mesh with clutch members 71 on the headstock spindles 51 at stations R1 and R2 by shifter mechanism actuated by a positive-motion plate cam 387 on the main drive shaft 139 (see FIGS. 2A, 18 and 20). This shifter mechanism includes a shifter bar 389 attached to shafts 339 and 349 and actuated by a bell crank 391 pivoted at 392 in bracket 375 which is oscillated by the cam 387 on the main drive shaft 139. This cam has a cam groove 395 (see FIG. 30) in one face thereof receiving a follower roller 397 on the end of one arm of the bell crank 391. The other arm of bell crank 391 has an extension 399 which reaches up through a slot 401 (see FIGS. 23 and 24) in a bottom flange 403 on the shifter bar 389. Extension 399 has a pin and slot connection with the shifter bar as indicated at 404. The groove in cam 387 is developed and phased to effect shifting of clutch members 335 and 337 into mesh with clutch members 71 of the two bottle carriers 3 at stations R1 and R2 shortly after these carriers have been indexed to these stations, to hold them in mesh with members 71 for a dwell interval, and then to shift members 335 and 337 out of mesh with members 71 before the next indexing step of the carriers. Bar 389 carries a guide pin 389*a* slidable in a guide bushing 389*b* in the block 341*a* containing bearings 341 and 351.

Bell crank extension 399 also operates the stop finger 333 to retract it from the recess 19 in the bottle at station R1 before this bottle is indexed to station R2. Referring to FIGS. 18, 20, 25 and 26, there is indicated at 405 a bracket which extends forward at sation R1 over the rearward margin of the working reach of conveyor 1. This bracket has spaced side walls 407 and a vertical top flange 409 provided with slots 411 for receiving screws to fasten it to part of the frame of the machine. At the front side of side walls 407 is an integral vertical web 413. This has a transverse wide shallow groove in its front face in which is secured a plate 415. This securement is by screws 417 extending through horizontal slots 419 in the web (see FIG. 20) and threaded in the plate 415 allowing for lateral adjustment of the plate. A slide 421 is vertically slidable in guideways 422 in the plate 415. This slide carries an adjustment block 423, the latter being secured to slide 421 by a screw 424 extending through a vertical slot 425 in the block and threaded in the slide. Finger 333 is mounted in one end of a rocker arm 427 pivoted at 429 on the block 423. Arm 427 is biased to swing the finger downward by means of a tension spring 431 connected between the other end of the arm and the block. A rock shaft 435 spans the walls 407. This has a radial arm 437 extending through apertures in the web 413 and plate 415 to a pin and slot connection at 439 with the slide 421. An adjustable link 441 interconnects the upper end of bell crank extension 399 and a crank 443 on one end of the rock shaft 435. The arrangement is such that on retraction of extension 399 (movement thereof to the right as vewed in FIG. 18), slide 421 is raised to raise the finger 333 out of the recess 19 of the bottle at station R1. The timing is such that this occurs just before each indexing step of the conveyor 1. After completion of an indexing step of conveyor 1, slide 421 is lowered for engagement of the tip of the finger 333 with the body of the bottle which has come into position at station R1. On rotation of the headstock spindle 51 at station R1 by intermeshing of clutch members 335 and 71, the bottle at station R1 rotates to the point where recess 19 comes to the top, whereupon finger 333 drops into the recess 19 and holds the bottle against further rotation, while the bottle bottom chuck 59 continues to rotate until it completes its spin, slipping against the bottom of the bottle.

Extending upward from the base of the machine at the rear of the conveyor 1 and adjacent the ends of the machine are posts 451 supporting a beam 453 which is of flat H-shape in cross section, as appears in FIG. 27. This beam extends longitudinally of the machine at a level above the upper reach of the conveyor 1 and in a plane immediately rearward of the conveyor, with its web horizontal and its flanges vertical. It supports the printing mechanisms at printing stations P1 and P2. These printing mechanisms are essentially identical, each comprising a carriage generally designated 455 for carrying a stencil 457, e.g., a silk screen (see FIG. 27), for printing on the body of a bottle, which may be referred to as the body screen carriage and the body screen, and a carriage generally designated 459 for carrying a second stencil 461, e.g., a silk screen (see FIG. 27), for printing on the shoulder of a bottle, which may be referred to as the shoulder screen carriage and the shoulder screen. Each screen carriage is mounted for reciprocation longitudinally of the machine.

As shown in FIG. 27 for the printing mechanism at station P1, carriage 455 includes a slide plate 463 having a sliding fit in the bottom channel of the H-beam 453,

being retained therein by gibs 465 secured to the bottom edges of the flanges of the beam, and carriage 459 includes a slide plate 467 having a sliding fit in the top channel of the beam, being retained therein by gibs 469 secured to the top edges of the flanges of the beam. Carriage 455 includes arms such as indicated at 471 for supporting the body screen 457 in horizontal position above the upper reach of conveyor 1. Carriage 459 includes arms such as indicated at 473 provided with means for supporting the shoulder screen 461 in an inclined position corresponding to the slope of the shoulder of a bottle above the upper reach of conveyor 7. Suitable adjusting means is provided for vertical and lateral adjustment of the screens and for adjustable angling of the shoulder screen for accommodation to different bottles to be handled, such as shown, for example, in U.S. Patent No. 2,261,255.

Also as shown in FIG. 27 for the printing mechanism at station P1, a first squeegee 479 is provided for the body screen 457 and a second squeegee 481 is provided for the shoulder screen 461. The body screen squeegee is mounted on the lower end of the plunger 483 of an air cylinder 485, and the shoulder screen squeegee is mounted on the lower end of the plunger 487 of an air cylinder 489. The plungers of each of these cylinders are spring-returned. The cylinders are mounted on an arm 491 cantilevered forward from beam 453, with both squeegees in the vertical diametrical plane of a bottle at station P1. This arm has a slot 493 extending lengthwise thereof. Each cylinder is gripped in a clamp 495 (in which it is axially adjustable for appropriate positioning of the respective squeegee with respect to the respective screen). Each clamp 495 is adapted to be moved to various positions of adjustment along slot 493 and held therein by suitable means for the purpose such as indicated at 497. Cylinder 489 is swingable to various positons of angular adjustment for inclination of the shoulder screen squeegee 481 at the same angle as the shoulder screen 461.

Grooves 33 and 35 of the bottle carrier guides 27 and 29 have a rise 501 at station P1 for raising each bottle carrier 3 as it is indexed to station P1 to bring the bottle chucked in the bottle carrier into engagement with the screens 457 and 461 at station P1 (these screens having been initially adjusted heightwise to an elevation requiring such rise of the bottles at station P1 for engagement with the screens). After a bottle has been indexed to station P1 and raised into engagement with the screens at station P1, the bottle is positively rotated and the screens are reciprocated with the squeegees 479 and 481 lowered for printing on the bottle. On successive printing operations, the printing stroke of the screens is in opposite directions. At the end of each printing stroke, the squeegees are raised. Suitable means (not shown) for supplying ink to the screens is provided, and may be mounted on a horizontal bar 505 supported by posts 507 and extending above the beam 453. Grooves 33 and 35 have another rise 501 at station P2 for raising each bottle carrier as it is indexed to station P2 to bring the bottle chucked in the bottle carrier into engagement with the screens at station P2, and printing is effected at station P2 in the same manner as at station P1.

As shown in FIG. 27 for the printing mechanism at station P1, the mechanism for effecting reciprocation of the screens at station P1 comprises a vertical rock shaft 509 journalled in a vertical bearing 511 located at the rear of the beam 453 and below the level of this beam. Shaft 509 has a crank arm 512 on its lower end below the bearing 511 having a follower roller 513 received in cam groove 515 in the upper face of a horizontal positive-motion plate cam 517 (see also FIG. 34). This cam is driven from the main drive shaft 139 via a chain and sprocket drive 519 taken off shaft 139 to the input shaft 521 of a right-angle gear drive 523 having an upwardly extending output shaft 525, the cam being secured on the upper end of the latter. The rock shaft 509 extends upward from the bearing 511 through an upper outboard bearing 527. An arm 529 is secured to shaft 50 directly above the upper end of bearing 511 and extends below the lower slide plate 463. Arm 529 has an upwardly facing groove 531 extending lengthwise thereof in which is slidable a nut 533 carrying a follower 535 which tracks in a groove 537 in the bottom of a crossbar 539 secured to the bottom of slide plate 463. An adjusting screw 541 extends lengthwise of arm 529 through the rearward end portion of the arm and a hole 543 in the shaft 509, and through the groove 531, and is theaded in the nut 533.

This screw is held against axial movement by a knob 545 secured on its outer end engaging the rear end of the arm 529 and by a collar 547 secured intermediate its length engaging the rear end of the groove 531. Cam 517 effects intermittent oscillation of the shaft 509 and corresponding intermittent oscillation of the arm 529, and the latter effects reciprocation of the slide plate 463 and body screen 457 associated therewith via the follower 535 and groove 537. The stroke of the slide plate 463 is a function of the radial distance from the axis of shaft 509 to the follower 535, and this may be varied by turning knob 545 one way or the other to move the nut 533 in or out along the groove 531, to obtain the appropriate stroke of the body screen 457.

An arm 549 is secured to shaft 509 above the bearing 527 and extends over the upper slide plate 467. Arm 549 has a downwardly facing groove 551 extending lengthwise thereof in which is slidable a nut 553 carrying a follower 555 which tracks in a groove 557 in the top of a crossbar 559 secured to the top of slide plate 467. An adjusting screw 561 extends lengthwise of arm 549 through the rearward end portion of the arm and a hole 563 in shaft 509, and through the groove 551, and is threaded in the nut 553. This screw is held against axial movement by a knob 565 on its outer end engaging the rear end of arm 549 and by a collar 567 secured intermediate its length engaging the rear end of groove 551. Arm 549 oscillates with shaft 509 and effects reciprocation of the slide plate 467 and shoulder screen 461 associated therewith via follower 555 and groove 557. The stroke of the slide plate 467 is a function of the radial distance from the axis of shaft 509 to the follower 555, and this may be varied by turning knob 565 one way or the other to move the nut 553 in or out along the groove 551, to obtain the appropriate stroke of the shoulder screen 461.

The mechanism described above for effecting reciprocation of the screens 457 and 461 at station P1 is duplicated at station P2, and it will be understood that bottles are printed simultaneously at these two stations. As shown in FIG. 27 for station P1, a shaft 569 is journalled for rotation and axial movement in spaced bearings 571 and 573 coaxial with clutch member 71 on the rearward end of the headstock spindle 51 at station P1. This shaft has a clutch member 575 on its forward end adapted to mesh with the clutch member 71 at station P1 on forward movement of the shaft to the advanced position in which it is shown in FIG. 27. Shaft 569 has a pinion 579 secured thereon in the space between the bearings 571 and 573. This mechanism is duplicated at station P2.

The shaft 569 at station P1 is oscillated by means of rack 581 in mesh with pinion 579. This rack is reciprocated by the arm 529 at station P1. It is mounted for sliding movement longitudinally of the machine above the shaft 569 in grooves 583 in the bearings 571 and 573, being held in these grooves by gibs 585. Secured on the rack is a block 587 having an upwardly facing groove 589 extending crosswise of the rack receiving a follower 591 on the bottom of the arm 529. This mechanism is duplicated at station P2.

Mechanism for axially shifting the shafts 569 at each of stations P1 and P2 is shown to comprise a rock shaft 593 extending longitudinally of the machine above the rearward ends of shafts 569. This shaft 593 is journalled in bearings as indicated at 595 in FIGS. 2A and 2B. It carries two shifter forks 597, one for each of shafts 569,

each having a connection such as indicated at 599 with the rearward end of the respective shaft. Rocking of shaft 593 for shifting of the shafts 569 is effected by mechanism including a positive-motion plate cam 605 (see FIG. 2A) on the main drive shaft 139. This has a cam groove 607 (see FIG. 32) in one face receiving a cam follower roller 609 on one end of a lever 611 pivoted at 613 in a bracket 615. A link 617 interconnects the other end of the lever and a crank arm 619 on shaft 593. Cam 605 is developed so as to effect intermittent oscillation of rock shaft 593 once each revolution of shaft 139, and phased to effect this during the dwell of carriers 3 at the printing stations.

The bottle transfer mechanism 17 at the unloading station U is basically the same as the bottle transfer mechanism 15 at the loading station L, including a forked bottle gripper 623 identical in construction to the bottle gripper 153 at the loading station L. Bottle gripper 623 is swingable through an arc of 90° about the axis of a horizontal shaft 625 (see FIGS. 28 and 29) corresponding to shaft 155 between a horizontal bottle-receiving position for picking up a bottle from the bottle carrier 3 at the unloading station U and a vertical delivery position for transferring the bottle to a take-away conveyor 627. Bottle gripper 623 comprises a hub 159 having bearings 163, rods 165 mounted in these bearings, and gripper arms 167 and 169 identical to the corresponding elements of the bottle gripper 153 at the loading station. Rods 165 of bottle gripper 623 are oscillated by barrel cams 183 identical to cams 183 at the loading station. Shaft 625 is driven from the main drive shaft 139 via a drive which comprises a chain and sprocket drive 629 (see FIG. 2B) interconnecting shaft 139 and a countershaft 631 (corresponding to countershaft 191), and a chain and sprocket drive 633 interconnecting the countershaft 631 and the shaft 625.

Mechanism for effecting oscillation of the unloader bottle gripper 623 through its 90° swing is shown in FIGS. 28 and 29 to comprise a crank disk 635 on a horizontal shaft 637 extending in longitudinal direction of the machine in front of the main drive shaft. Shaft 637 is journalled in bearings as indicated at 639, and is driven from shaft 139 by a chain and sprocket drive 641 (see also FIG. 2B). Disk 635 has a crank pin 643, and a connecting rod 645 (corresponding to rod 205) extends between this pin and hub 159 of bottle gripper 623, being connected to the latter as indicated at 647. The arrangement is such as to provide for the requisite 90° oscillation of the bottle gripper 623.

The bottle take-away conveyor 627 is similar to the bottle supply conveyor 157, comprising an endless chain belt 649 like chain belt conveyor 209 having an upper reach which travels rearward for conveying away bottles transferred thereto by the unloader bottle gripper 623. The belt 649 is driven from the countershaft 631 via a chain and sprocket drive 651 connected directly to the rear sprocket shaft 653 of conveyor 627. No timing screw and fence such as associated with the bottle supply conveyor 157 are needed for the takeaway conveyor, and hence are omitted at the unloading station U. Rods 165 of the unloader bottle gripper 623 straddle the forward end of the belt 649 when the bottle gripper 623 swings up to its vertical delivery position (see FIG. 1B). Bottles are delivered one after another in spaced relation onto the forward end of the upper reach of the belt 649, and carried away thereby.

As each of the bottle carriers 3 reaches the unloading station U, it has a bottle chucked therein and it dwells at the unloading station for a brief interval. During this interval, the bottle mouth chuck 119 is retracted (i.e., moved out to the left away from its FIG. 3 position) and held retracted for a brief interval. During the initial phase of the retraction of the bottle mouth chuck, the bottle bottom chuck 59 is pushed forward so as momentarily to maintain the bottle chucked by the mouth and bottom chucks while shifting the bottle forward relative to the headstock 49 to a position such as shown in FIG. 3. At this time, the unloader bottle gripper 623 is down in its horizontal bottle receiving or pick-up position, and the rods 165 of the gripper 623 are rotated on their axes to cause the gripper arms 167 and 169 of gripper 623 to grip the bottle. The bottle mouth chuck 119 then completes its retractive (forward) movement and the bottle bottom chuck 59 is released for retractive (rearward) movement by the spring 69. This brings the chucks clear of the bottle so that it may now be swung upward by the unloader bottle gripper 623.

Retraction of the bottle mouth chuck 119 at the unloading station is effected by a shifter fork mechanism including a shifter fork 261 identical to the fork 261 used at the loading station L. The fork 261 at the unloading station reciprocates in transverse direction in relation to the conveyor 1 and axially in relation to the bottle carrier 3 at the unloading station, being mounted for sliding movement on a bracket 655 similar to the bracket 291 used at the loading station. Mechanism for reciprocating the fork 261 at the unloading station comprises a positive-motion plate cam 657 on the shaft 637 (see FIGS. 28 and 29) having a cam groove 659 (see FIG. 35) in one of its faces receiving a cam follower roller 661 on the lower end of a lever 663 pivoted intermediate its ends as indicated at 665 on a bracket 667. A connecting rod 669 is pin-connected at 671 to the upper end of lever 663 and extends forward to a pin connection at 673 (see FIG. 1B) with the crank 287 of a mechanism at the unloading station similar to the crank 287 and associated mechanism used at the loading station. The groove 659 in the cam 657 is developed and phased to effect forward shift of the shifter fork 261 at the unloading station U to retract the tailstock spindle 111 of the bottle carrier 3 at station U just after the carrier has been indexed to station U and just before the bottle is gripped by the bottle unloader gripper 623 (swung down to its horizontal pick-up position). It will be observed that the nature of the interengagement of the forward grooved end of the tailstock spindle 111 and the fork 261 at the unloading station is such as to allow the end of the spindle to move into the fork and then pass out of the fork.

Mechanism for shifting the bottle bottom chuck 59 of the bottle carrier 3 at unloading station U is shown to comprise a positive-motion plate cam 675 on shaft 637 having a cam groove 677 in one of its faces (see FIG. 33) receiving a cam follower roller 679 on the lower end of a lever 681 pivoted intermediate its ends as indicated at 683 in a bracket 685. A connecting rod 687 is pin-connected as indicated at 689 to the upper end of lever 681, and has its other end pin-connected as indicated at 691 to the lower end of a rocker arm 693 pivoted as indicated at 695 for swinging movement on an inclined axis in a bracket 697 mounted on the rear channel 25. Rocker arm 693 has a head 699 at its upper end for engagement with the rear end of the headstock spindle 51 of the bottle carrier 3 at the unloading station U to shift the spindle 51 and bottle bottom chuck 59 forward against the return bias of spring 69. The groove 677 in the cam 675 is developed and phased to effect forward shift of the bottle bottom chuck 59 concurrently with the retraction of the bottle mouth chuck 119 at the unloading station, and to retract head 699 for retraction of the bottle bottom chuck 59 just before unloader bottle gripper 623 starts swinging up.

Referring to FIG. 2B, there is indicated at 701 a programmer for timing the operation of the squeegees 479 and 481. As will be understood, this may include switches (not shown) operated by cams on a cam shaft 703 driven off the countershaft 631 by a drive as indicated at 705, and controlling solenoid valves (not shown) for controlling admission to and exhaust of compressed air from the squeegee cylinders 485 and 489.

Operation is as follows:

A cycle of operation of the machine may be regarded as starting at the conclusion of each indexing step of the conveyor 1. At this instant, the bottle carrier 3 which has just been indexed to the loading station L will be empty. Each of the other bottle carriers 3 along the upper working reach of the conveyor has a bottle chucked therein. Thus, each of the carriers at the first registration station R1, the second registration station R2, the first printing station P1, the second printing station P2 and the unloading station U has a bottle chucked therein. During the ensuing dwell of the conveyor 1, the following events occur:

(A) A bottle is picked off the delivery conveyor 157 by the loader gripper 153 and chucked in the bottle carrier 3 at the loading station L;

(B) The bottle chucked in the bottle carrier 3 at the preliminary registration station R1 is rotated for preliminary registration thereof, as effected by stop finger 333 dropping into the reference recess 19 in this bottle;

(C) The bottle chucked in the bottle carrier 3 at the recovery registration station R2 is rotated through 90° for its final registration;

(D) The bottle chucked in the bottle carrier 3 at the first printing station P1 (this bottle having been given the final registration at station R2) is given a first printing;

(E) The bottle chucked in the bottle carrier 3 at the second printing station P2 (which bottle has retained its registration) is given its second printing.

(F) The bottle in the bottle carrier 3 at the unloading station U is picked up by the unloader bottle gripper 623 and transferred to the take-away conveyor 627.

More particularly as to operation A (loading), it will be understood that when a bottle carrier 3 is indexed to the loading station L, its bottle bottom chuck 59 is in the outer retracted position shown in FIG. 4 under the bias of spring 69, and the bottle mouth chuck 119 is in its inner extended position of FIG. 6 under the bias of spring 115. The outer end of the tailstock spindle 111 (the bottle mouth chuck spindle) becomes hooked in the shifter fork 261 at the loading station L. The outer end of the headstock spindle 51 becomes opposed to the head 331 of the rocker arm 325. The first action to occur after the arrival of the bottle carrier at the loading station L is the outward shifting (retraction) of the tailstock spindle 111 and the bottle mouth chuck 119 by outward movement of the shifter fork 261 at station L as effected by the action of cam 269 via lever 275, connecting rod 281, crank 287, rock shaft 289 and slide block 295. This effects separation of the chucks so that a bottle may be positioned endwise therebetween for chucking.

As the bottle carrier 3 moves into position at the loading station L, the bottle loader gripper 153 is swinging down with a bottle gripped therein. It had picked up this bottle on its previous up-swing to its vertical pick-off position straddling the forward end of the delivery conveyor 157. The timing screw 221 delivers bottles to the pick-off station PO in timed relation to the swing of gripper 153 for presentation of a bottle to the gripper on each upswing of the gripper to its pick-off position. When the gripper 153 swings up to pick-off position, the barrel cams 183 at the loading station L effect rotation of rods 165 of gripper 153 on their axes to swing gripper arms 167 and 169 inward toward the bottle presented thereto for gripping the bottle, and the gripper arms maintain their grip on the bottle as the gripper 153 swings down to place the bottle endwise between the separated chucks of the bottle carrier 3 at the loading station.

As soon as the bottle gripper 153 completes its downward swing, bringing the bottle gripped thereby into chucking position, the shifter fork 261 at the loading station moves inward under the action of cam 269. The bottle mouth chuck 119 moves inward for gentle engagement in the bottle mouth. Generally simultaneously with this operation, rocker arm 325 is actuated by the cam 307 for engagement of the rocker arm head 331 with the outer end of the headstock spindle 51 and inward movement of the latter and the bottle bottom chuck 59 to chuck the bottle bottom. Inward movement of the bottle bottom chuck is against the bias of spring 69. Upon the gripping of the bottle by the chucks 59 and 119 (which is relatively gentle spring grip), the barrel cams 183 effect rotation of rods 165 of the gripper 153 for retraction of gripper arms 167 and 169 from the chucked bottle, and then the gripper starts swinging back up to pick the next bottle off the delivery conveyor 157. Rocker arm 325 is retracted by cam 307 for retraction of head 331 from the outer end of the headstock spindle 71, and chuck 59 shifts out to its FIG. 4 position, with accompanying shift of chuck 119 and the chucked bottle under the bias of spring 115.

More particularly as to operation B(preliminary registration) it will be understood that when a bottle carrier 3 is indexed to the preliminary registration station R1, the headstock spindle 51 is in its outer retracted position of FIG. 4 under the bias of spring 69, and that the reference recess 19 of the bottle chucked in the carrier is positioned at random, the bottle having been chucked in the carrier in random position at station L. After the arrival of the bottle carrier 3 at station R1, shifter bar 389 is shifted forward under the action of cam 387, bell crank 391 and its extension 399 to shift clutch member 335 on shaft 339 forward into engagement with clutch member 71 on the headstock spindle 51 of the carrier 3 at station R1. Block 423 carrying the stop finger 333 is lowered simultaneously with the forward shift of bar 389. Spindle 51 is pushed forward against the bias of spring 69 to release friction braking ring 73 from ring 75. Upon interengagement of clutch member 335 with clutch member 71, shaft 339 is rotated through somewhat more than 360° by cam 365 acting through bell crank 371, rod 377, crank 362, gear box 359, shaft 355 and chain and sprocket drive 379. This rotates the bottle at station R1 until the stop finger 333 drops into the recess 19 in the bottle and arrests the bottle in preregistered position with the recess on top, the shaft 339 and the bottle bottom chuck 59 continuing turning to complete their rotation, the chuck slipping against the bottom of the bottle. Following the above, cam 387 effects retraction of bar 389 to retract clutch member 335 from clutch member 71 and raising of block 423 to retract stop finger 33 to permit the next indexing step of conveyor 1. Upon retraction of the clutch member 335, spindle 51 moves outward (rearward) and friction ring 73 engages ring 75 to provide a braking action preventing drift of the bottle out of its pre-registered position upon the next indexing step of the conveyor 1, which carries the preregistered bottle to the recovery registration station R2.

More particularly as to operation C (final registration), it will be understood that when a bottle carrier 3 is indexed to the recovery registration station R2, the headstock spindle 51 will again be in its outer braking position under the bias of spring 69, and that the reference recess 19 will now be at the top. Shifter bar 389, in shifting forward under the action of cam 387, bell crank 391 and its extension 399, shifts clutch member 337 on shaft 349 forward into engagement with clutch member 71 on the headstock spindle 51 of the carrier 3 at station R2. This pushes spindle 51 forward against the bias of spring 59 to release ring 73 from ring 75. Upon interengagement of clutch member 337 with clutch member 71, shaft 349 is rotated through 90° by cam 365 acting through bell crank 371, rod 377, crank 362, gear box 359 and shaft 355, to rotate the bottle at station R2 through 90° for its final registration, in which the bottle seams 21 are generally in a vertical plane. Following this, cam 387 effects retraction of bar 389 to retract clutch member 337 to permit the next indexing step of the conveyor 1. Upon retraction of clutch member 337, spindle 51 moves outward (rearward) and ring 72 engages ring 75

to provide a braking action preventing drift of the bottle out of its final registered position as the bottle progresses to the first printing station P1.

More particularly as to operation D (the first printing), when a bottle carrier 3 is indexed to the printing station P1, the headstock spindle 51 will again be in its outer braking position, and the bottle will be in final registered position (preserved by the braking of spindle 51 in the course of the progression of the carrier 3 from station R2 to station P1). The bottle carrier is raised by the rise 501 in grooves 33 and 35 to raise the bottle into engagement with the screens 457 and 461. Shaft 569 is shifted forward by the action of cam 605 to engage clutch member 575 with clutch member 71 at station P1. This pushes spindle 51 at station P1 forward against the bias of spring 69 to release ring 73 from ring 75. Rock shaft 509 at station P1 is oscillated via the respective cam 517 and acts via arms 539 and 549 to reciprocate the slide plates 463 and 467. The screen 457 reciprocates with slide plate 463, and the screen 461 reciprocates with slide plate 467. During the printing stroke of the screens, the squeegees 479 and 481 are lowered for engagement with the screens to effect printing. Shaft 569 is rotated to rotate the bottle via movement of the rack 581, which is in mesh with pinion 579 on shaft 569. Following the printing operation, shaft 569 is retracted to retract clutch member 575 to permit the next indexing step of the conveyor. This re-establishes the braking action of rings 73 and 75 to prevent drifting of the bottle out of its final registered position which it reassumes on conclusion of the printing operation.

Operation E (the second printing) is essentially identical to the operation D (the first printing).

More particularly as to operation F (unloading), when a bottle carrier 3 is indexed to the unloading station U, its bottle bottom chuck is again in its outer FIG. 4 position, and the bottle mouth chuck is in its extended FIG. 6 position. The outer end of the tailstock spindle 111 becomes hooked in the shifter fork 261 at the unloading station U. The outer end of the headstock spindle 51 becomes opposed to the head 699 on the rocker arm 693. The first action to occur after the arrival of the bottle carrier at the unloading station U is the actuation of rocker arm 693 by the cam 675 for engagement of the rocker arm head 699 with the outer end of the headstock spindle 51 and inward movement of the latter bodily to shift the chucked bottle forward against the bias of springs 69 and 115.

As the bottle carrier 3 moves into position at the unloading station U, the bottle unloader gripper 623 is swing down (and empty), having just transferred a bottle to the take-away conveyor 627. When the gripper 623 swings down to horizontal position, the barrel cams 183 at the unloading station effect rotation of rods 165 of gripper 623 on their axes to swing gripper arms 167 and 169 on these rods inward toward the bottle chucked in carrier 3 at station U. These arms grip the bottle and maintain their grip while the chucks 59 and 119 separate. Separation of the chucks is effected by outward (forward) shift of the shifter fork 261 at station U to pull out the tailstock spindle 111 and the bottle mouth chuck 119, and by retraction of head 699 on rocker arm 693 to release the headstock spindle 51 and bottle bottom chuck 59 for outward movement by the spring 69. Then gripper 623, having the bottle gripped therein, is swung up by the action of crank disk 635 to vertical position. At this point, barrel cams 183 at station U effect rotation of rods 165 of gripper 623 to release the grip of arms 167 and 169 on the bottle for transfer of the bottle to the take-away conveyor 627.

Upon completion of a cycle of operation as above described, the conveyor 1 is indexed one step, bringing an empty bottle carrier 3 to loading station L, and loaded bottle carriers to stations R1, R2, P1, P2 and U, and the cycle is repeated.

From the above, it will appear that bottles B are automatically chucked in the bottle carriers 3 at loading station L, carried through the machine by conveyor 1, and automatically unloaded from the bottle carriers at unloading station U, and that each bottle, as it is carried through the machine, is registered at stations R1 and R2, then presented for printing at station P1, and again presented for printing at station P2 if two-color printing is to be effected, all under positive control without drifting of any bottle out of registration once it has been registered. This comes about because of the end-chucking of the bottles in the carriers 3 and the positive braking of the chucks and bottles during each indexing operation by the braking action of friction rings 73, 75. There is only one chucking operation (at station L) and the bottles are handled gently, without exertion of high endwise pressure on the bottles, thereby to avoid bottle breakage. Only one preliminary registration and one recovery registration are required, in view of the above-noted positive control, and hence only one bottle-stalling finger 333 is needed. The machine is capable of printing at a rapid rate (115 bottles per minute, for example), and is adapted for quick and easy set-up to handle bottles of different sizes by reason of the ready removability of the bottle bottom chucks 59 and the tail stock 77. It is contemplated that, instead of having the bottle bottom chucks and tailstocks separately removable, the entire headstock and tailstock assembly of each carrier 3 may be removable as a unit and replaceable with other units for handling bottles of different sizes.

In printing certain classes of articles, it may not be important or necessary to provide for registration of the articles prior to the first printing. In such instances, stations R1 and R2 may be omitted. Printing at the first printing station is then at random, but drift of the article out of its position at the conclusion of the first printing is avoided as the article is conveyed to the second printing station, so that registration of the second printing in respect to the first printing is assured.

In view of the above, it will be seen that the several 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 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 on articles such as bottles or the like, each article having a printing registration index, comprising an endless conveyor, a series of article carriers carried by the conveyor spaced at equal intervals along the conveyor, each carrier having a pair of chucks for end-chucking an article therein with the article extending transversely of the conveyor and rotatable on its axis, means for intermittently indexing the conveyor in steps corresponding to the carrier spacing with dwell intervals between successive indexing steps, said conveyor being adapted to convey each carrier to a loading station, a first registration station, a second registration station, a printing station and an unloading station, these stations being spaced along the path of travel of the carriers, loading means at the loading station for chucking an article in the carrier at the loading station during the dwell of the carrier at the loading station, means at the first registration station for driving one of the chucks of the carrier at this station to rotate the article chucked in this carrier on its axis during the dwell of the carrier at this station, means at the first registration station cooperable with the registration index on the article chucked in the carrier at this station to arrest the rotation of said article with the registration index in a predetermined position to effect a preliminary registration of the article, means at the second registration station for driving one of the chucks of the carrier at this station through a predetermined

angle for rotating the article chucked in the carrier at this station through said angle during the dwell of the carrier at this station to effect a final registration of the article, means at the printing station for effecting printing on the article chucked in the carrier at this station during the dwell of the carrier at this station, and unloading means at the unloading station for unloading the article from the carrier at this station during the dwell of the carrier at this station.

2. Apparatus as set forth in claim 1 wherein each carrier is provided with means for holding an article chucked therein against rotation as the carrier moves from the first to the second registration station and from the latter to the printing station.

3. Apparatus as set forth in claim 2 wherein the driving means at each of the registration stations acts to release said holding means of the carriers at these stations.

4. Apparatus as set forth in claim 1 wherein the chucks of each carrier are mounted in the carrier for axial movement, each carrier having spring means for biasing both chucks axially in one direction to a braking position, and braking means for holding an article chucked in the carrier against rotation as the carrier moves from the first to the second registration station and from the latter to the printing station, the driving means at each of the registration stations acting to shift the chucks of the carriers at these stations in the opposite direction out of braking position to permit rotation of the articles at these stations.

Apparatus as set forth in claim 1 wherein the printing means comprises a reciprocable stencil and a squeegee, the endless conveyor having means for bringing the article chucked in each carrier into engagement with the stencil as the carrier is indexed to the printing station, and wherein means is provided at the printing station for driving one of the chucks of the carrier at this station for rotating the article chucked in the carrier at this station during the dwell of the carrier at this station.

6. Apparatus as set forth in claim 5 wherein each carrier is provided with means for holding an article chucked therein against rotation as the carrier moves from the first to the second registration station and from the latter to the printing station, the driving means at each registration and the printing station acting to release said holding means of the carriers at these stations.

7. Apparatus as set forth in claim 6 wherein the chucks of each carrier are mounted in the carrier for axial movement, each carrier having spring means for biasing both chucks axially in one direction to a braking position, and braking means for holding an article chucked in the carrier against rotation as the carrier moves from the first to the second registration station and from the latter to the printing station, the driving means at each of the registration stations and the printing station acting to shift the chucks of the carriers at these stations in the opposite direction out of braking position to permit rotation of the articles at these stations.

8. Apparatus as set forth in claim 1 wherein said loading means comprises means for effecting separation of the chucks of the carrier at the loading station to allow an article to be positioned endwise therebetween, means for delivering articles one after another to the loading station, and means for gripping each delivered article and moving it into position extending endwise between the chucks.

9. Apparatus as set forth in claim 1 wherein said unloading means comprises means for effecting separation of the chucks of the carrier at the unloading station to allow an article to be unloaded therefrom, and means for gripping the article chucked in the carrier at the unloading station prior to separation of the chucks and delivering it to a take-away conveyor upon separation of the chucks.

10. Apparatus as set forth in claim 1 wherein each carrier has a headstock and a tailstock, a spindle journalled in the headstock carrying one chuck, a spindle mounted in the tailstock carrying the other chuck, the headstock spindle carrying a clutch member, the driving means at each of the registration stations comprising a clutch member movable into and out of engagement with the headstock spindle clutch member at the respective station.

11. Apparatus as set forth in claim 1 wherein the printing means corprises a reciprocable stencil and a squeegee, the endless conveyor having means for bringing the article chucked in each carrier into engagement with the stencil as the carrier is indexed to the printing station, wherein means is provided at the printing station for driving one of the chucks of the carrier at this station for rotating the article chucked in the carrier at this station during the dwell of the carrier at this station, and wherein each carrier has a headstock and a tailstock, a spindle journalled in the headstock carrying one chuck, a spindle mounted in the tailstock carrying the other chuck, the headstock spindle carrying a clutch member, the driving means at each of the registration stations and the printing station comprising a clutch member movable into and out of engagement with the headstock spindle clutch member at the respective station.

12. Apparatus for printing on bottles which have a printing registration recess in their periphery adjacent their bottom comprising an endless conveyor having a generally horizontal upper working reach and a lower return reach, a series of bottle carriers carried by the conveyor spaced at equal intervals along its length, each carrier having a headstock and a tailstock, a spindle journalled in the headstock and carrying a bottle bottom chuck, a spindle mounted in the tailstock carrying a bottle mouth chuck, said chucks being separable for positioning a bottle endwise therewith and movable relatively toward one another for chucking a bottle with the bottle extending transversely of the conveyor and rotatable on its axis, means for intermittently indexing the conveyor in steps corresponding to the carrier spacing with dwell intervals between successive indexing steps, said conveyor being adapted to convey each carrier to a loading station, a first registration station, a second registration station, a printing station and an unloading station spaced along the path travel of the upper reach of the conveyor, loading means at the loading station effecting separation of the chucks of the carrier at this station, positioning of a bottle endwise therebetween, and closing of the chucks for chucking a bottle in the carrier at the loading station during the dwell of the carrier at the loading station, means at the first registration station for driving the headstock spindle of the carrier at this station to rotate the bottle chucked in this carrier on its axis during the dwell of the carrier at this station, a stop engageable in the registration recess of the bottle chucked in the carrier at the first registration station to arrest the rotation of the bottle with said recess in a predetermined position to effect a preliminary registration of the bottle, means at the second registration station for driving the headstock spindle of the carrier at this station through a predetermined angle for rotating the bottle chucked in this carrier through said angle during the dwell of the carrier at this station to effect a final registration of the bottle, means at the printing station for effecting printing on the bottle chucked in the carrier at the printing station during the dwell of the carrier at this station, and unloading means at the unloading station for gripping the bottle chucked in the carrier at this station, separating the chucks of this carrier, and then removing the bottle from this carrier during its dwell at this station.

13. Apparatus as set forth in claim 12 wherein the tailstock spindle of each carrier is axially slidable in the tailstock, the carrier having spring means biasing the tailstock spindle in the direction toward the bottle bottom chuck for spring-gripping of a bottle in the chucks, said loading means including means for retracting the tailstock spindle of the carrier at the loading station against the

spring bias, said unloading means including means for retracting the tailstock spindle of the carrier at the unloading station against the spring bias.

14. Apparatus as set forth in claim **13** wherein the headstock spindle of each carrier is axially slidably in the headstock, the carrier having spring means biasing the headstock spindle in the direction away from the tailstock to an outer position, said loading means including means for moving the headstock spindle and bottle bottom chuck of the carrier at the loading station inward against the spring bias in the direction toward the bottle mouth chuck for engagement of the bottle bottom chuck with the bottom of a bottle after the latter has been positioned endwise between the chucks, and said unloading means having means for shifting both spindles and chucks of the carrier at the loading station in the direction toward the tailstock prior to the gripping of the bottle, and then releasing the headstock spindle and bottle bottom chuck for outward movement under the spring bias to their said outer position.

15. Apparatus as set forth in claim **14** wherein each carrier has braking means for its bottle bottom chuck operative when the latter is in its said outer position.

16. Apparatus as set forth in claim **15** wherein said braking means comprises interengageable braking elements associated respectively with the headstock spindle and the headstock which are engaged when the headstock spindle is in its said outer position and disengaged when the headstock spindle is moved inward.

17. Apparatus as set forth in claim **16** wherein the headstock spindle of each carrier has a a clutch member at its outer end, and the driving means at each of the registration stations comprises a driving clutch member mounted for movement coaxially with the headstock spindle at the respective registration station into and out of engagement with the clutch member on the headstock spindle at the respective station and acting to move the headstock spindle inward upon movement into engagement with the clutch member on the headstock spindle.

18. Apparatus as set forth in claim **17** wherein the printing means comprises a reciprocable stencil and a squeegee located above the working reach of the endless conveyor, said conveyor having means for raising a carrier for engagement of the bottle chucked therein into engagement with the stencil as the carrier is indexed to the printing station, and wherein means is provided at the printing station for driving the headstock spindle of the carrier at this station for rotating the bottle at this station during the dwell of the carrier at this station comprising a driving clutch member mounted for movement coaxially with the headstock spindle at the printing station into and out of engagement with the clutch member on the headstock spindle at this station and acting to move the headstock spindle inward upon movement into engagement with the clutch member on the headstock spindle.

19. Apparatus as set forth in claim **12** wherein the tailstock on each carrier is mounted on the carrier for adjustment lengthwise of the carrier.

20. Apparatus as set forth in claim **12** wherein the chucks of each carrier are removable and replaceable for handling bottles of various sizes.

21. Apparatus as set forth in claim **20** wherein the tailstock of each carrier is removable and replaceable.

22. Apparatus as set forth in claim **21** wherein the headstock spindle of each carrier carries the respective bottle bottom chuck for removal and replacement.

23. Apparatus as set forth in claim **12** wherein said stop is biased to engage the periphery of the bottle being rotated at the first registration station and to drop into the recess when the recess arrives at the stop, and wherein means is provided at the first registration station for lifting the stop out of the recess after the preliminary registration has been effected and before the next indexing step of the conveyor.

24. In an apparatus for printing on articles such as bottles or the like, an endless conveyor, a series of article carriers carried by the conveyor spaced at equal intervals along the conveyor, means for intermittently indexing the conveyor in steps corresponding to the carrier spacing with dwell intervals between successive indexing steps, said conveyor being adapted to convey each carrier to a loading station along the path of travel of the carriers, and loading means at the loading station during the article in the carrier at the loading station during the dwell of the carrier at the loading station comprising a delivery conveyor for delivering articles one after another to a pick-off position at the loading station, an article gripper having a pair of rods swingable about an axis alongside said endless conveyor between a pick-off position straddling the delivery conveyor at the pick-off position and a placement position with respect to the carrier at the loading station, said rods being rotatable on their own axes and carrying gripper members for gripping an article, and means for rotating the rods when in their pick-off position for effecting gripping of an article at the pick-off position by the gripper members on the rods and for oppositely rotating the rods when in their placement position for releasing the article.

25. In an apparatus for printing on articles such as bottles or the like, an endless conveyor, a series of article carriers carried by the conveyor spaced at equal intervals along the conveyor, means for intermittently indexing the conveyor in steps corresponding to the carrier spacing with dwell intervals between successive indexing steps, said conveyor being adapted to convey each carrier to a loading station along the path of travel of the carriers, and loading means at the loading station for placing an article in the carrier at the loading station during the dwell of the carrier at the loading station comprising a delivery conveyor for delivering articles one after another to a pick-off position at the loading station, an article gripper comprising a hub swingable about an axis alongside the endless conveyor and having a pair of bearings spaced along its length with their axes crosswise of the hub, a pair of rods each journalled in a respective bearing, workpiece grippers on the rods, means for oscillating the hub about its axis for effecting swinging of the rods between a pick-off position straddling the delivery conveyor at the pickoff position and a placement position with respect to the carrier at the loading station, and means for rotating the rods on their axes to effect gripping of an article by the grippers when the rods are in pick-off position and oppositely rotating the rods to effect release of the article when the rods are in placement position.

26. In an apparatus as set forth in claim **25**, a shaft on which said hub is rotatably mounted, with means for driving the shaft, and said means for rotating the rods comprising cam means on the shaft.

27. In an apparatus for printing on articles such as bottles or the like, an endless conveyor, a series of article carriers carried by the conveyor spaced at equal intervals along the conveyor, means for intermittently indexing the conveyor in steps corresponding to the carrer spacing with dwell intervals between successive indexing steps, said conveyor being adapted ultimately to convey each carrier with an article therein to an unloading station along the path of travel of the carriers, and means at the unloading station for unloading an article from the carrier at the unloading station during the dwell of the carrier at the unloading station comprising an article gripper having a hub swingable about an axis alongside the endless conveyor and having a pair of bearings spaced along its length with their axes crosswise of the hub, a pair of rods each journalled in a respective bearing, article grippers on the rods, means for oscillating the hub about its axis for effecting swinging of the rods between an article pick-up position with respect to the carrier at the unloading station and a delivery position,

and means for rotating the rods on their axes to effect gripping of an article by the grippers when the rods are in pick-up position and oppositely rotating the rods to effect release of the article when the rods are in delivery position.

28. In an apparatus as set forth in claim 25, a shaft on which said hub is rotatably mounted, with means for driving the shaft, and said means for rotating the rods comprising cam means on the shaft.

29. Transfer mechanism for workpieces such as bottles or the like comprising a hub swingable about a predetermined axis and having a pair of bearings spaced along its length with their axes crosswise of the hub, a pair of rods each journalled in a respective bearing, workpiece grippers on the rods, means for oscillating the hub about its axis for effecting swinging of the rods between two transfer positions, and means for rotating the rods on their axes to effect gripping of a workpiece by the grippers when the rods are in one transfer position and oppositely rotating the rods to effect release of the workpiece when the rods are in the other transfer position.

30. Transfer mechanism for workpieces such as bottles or the like comprising a shaft, means for driving the shaft, a hub mounted on the shaft and rotatable relative to the shaft, said hub having a pair of bearings spaced along its length with their axes crosswise of the hub, a pair of rods each journalled in a respective bearing, workpiece grippers on the rods, means for oscillating the hub on the shaft for effecting swinging of the rods between two transfer positions, and means for rotating the rods on their axes to effect gripping of a workpiece by the grippers when the rods are in one transfer position and oppositely rotating the rods to effect release of the workpiece when the rods are in the other transfer position comprising cam means on the shaft.

31. In an apparatus for printing on articles such as bottles or the like, an endless conveyor, a series of article carriers carried by the conveyor spaced at equal intervals along the length of the conveyor, each carrier comprising a base extending transversely of the conveyor, a headstock at one end of the carrier base, a tailstock at the other end of the carrier base, a spindle journalled in the headstock and axially slidable therein, said headstock spindle having an inner end inward of the headstock and an outer end outward of the headstock, a chuck on the inner end of said headstock spindle, a spindle axially slidable in the tailstock, said tailstock spindle having an inner end inward of the tailstock and an outer end outward of the tailstock, a chuck on the inner end of the tailstock spindle, a clutch member on the outer end of the headstock spindle, the outer end of the tailstock spindle being formed for engagement with a tailstock spindle shifter, each carrier having spring means for biasing the headstock spindle outward to an outer position, and spring means for biasing the tailstock spindle inward.

32. Apparatus as set forth in claim 31 wherein each carrier has means for braking the headstock spindle when in its said outer position.

33. Apparatus as set forth in claim 32 wherein said braking means comprises interengageable braking elements associated respectively with the headstock spindle and the headstock which are engaged when the headstock spindle is in its said outer position and disengaged when the headstock spindle is moved inward.

34. In an apparatus for printing on articles such as bottles or the like, an endless conveyor, a series of article carriers carried by the conveyor spaced at equal intervals along the length of the conveyor, each carrier comprising a base extending transversely of the conveyor, a headstock at one end of the carrier base, a tailstock at the other end of the carrier base, a spindle journalled in the headstock and axially slidable therein, said headstock spindle having an inner end inward of the headstock and an outer end outward of the headstock, a chuck on the inner end of said headstock spindle, a spindle axially slidable in the tailstock, said tailstock spindle having an inner end inward of the tailstock and an outer end outward of the tailstock, a chuck on the inner end of the tailstock spindle, each carrier having spring means for biasing the headstock spindle outward to an outer position and spring means for biasing the tailstock spindle inward, means for intermittently indexing the conveyor in steps corresponding to the carrier spacing with dwell intervals between successive indexing steps, said conveyor being adapted to convey each carrier to a loading station along the path of travel of the carriers, a tailstock spindle shifter at the loading station movable between an inner position and an outer position, said shifter and the outer end of the tailstock spindle of each carrier being formed for interengagement as the carrier is indexed to the loading station and for disengagement of the outer end of the tailstock spindle from the shifter as the carrier is indexed away from the loading station, and means at the loading station engageable with the outer end of the headstock spindle of the carrier at said station for shifting the headstock spindle inward.

35. In an apparatus for printing on articles such as bottles or the like, an endless conveyor, a series of article carriers carried by the conveyor spaced at equal intervals along the length of the conveyor, each carrier comprising a base extending transversely of the conveyor, a headstock at one end of the carrier base, a tailstock at the other end of the carrier base, a spindle journalled in the headstock and axially slidable therein, said headstock spindle having an inner end inward of the headstock and an outer end outward of the headstock, a chuck on the inner end of said headstock spindle, a spindle axially slidable in the tailstock, said tailstock spindle having an inner end inward of the tailstock and an outer end outward of the tailstock, a chuck on the inner end of the tailstock spindle, each carrier having spring means for biasing the headstock spindle outward to an outer position and spring means for biasing the tailstock spindle inward, means for intermittently indexing the conveyor in steps corresponding to the carrier spacing with dwell intervals between successive indexing steps, said conveyor being adapted ultimately to convey each carrier to an unloading station along the path of travel of the carriers, a tailstock spindle shifter at the unloading station movable between an inner position and an outer position, said shifter and the outer end of the tailstock spindle of each carrier being formed for interengagement as the carrier is indexed to the unloading station and for disengagement of the outer end of the tailstock spindle from the shifter as the carrier is indexed away from the unloading station, and means at the unloading station engageable with the outer end of the headstock spindle of the carrier at said station for shifting the headstock spindle inward.

36. In an apparatus for printing on bottles which have a printing registration recess in their periphery adjacent their bottom, an endless conveyor, a series of bottle carriers carried by the conveyor spaced at equal intervals along the conveyor, each carrier comprising a base extending transversely of the conveyor, a headstock at one end of the carrier base, a tailstock at the other end of the carrier base, a spindle journalled in the headstock, said headstock spindle having an inner end inward of the headstock and an outer end outward of the headstock, a chuck on the inner end of said headstock spindle, a spindle mounted in the tailstock, said tailstock spindle having an inner end inward of the tailstock and an outer end outward of the tailstock, a chuck on the inner end of the tailstock spindle, means for intermittently indexing the conveyor in steps corresponding to the carrier spacing with dwell intervals between successive indexing steps, said conveyor being adapted to convey each carrier to a first registration station and then to a second registration station spaced along the path of travel of the carriers, means at the first registration sta-

tion for driving the headstock spindle of the carrier at this station to rotate a bottle chucked in this carrier during the dwell of the carrier at this station, a stop engageable in the registration recess of the bottle chucked in the carrier at the first registration station to arrest the rotation of the bottle with said recess in a predetermined position to effect a preliminary registration of the bottle, and means at the second registration station for driving the headstock spindle of the carrier at this station through a predetermined angle for rotating the bottle chucked in this carrier through said angle during the dwell of the carrier at this station to effect a final registration of the bottle.

37. Apparatus as set forth in claim 36 wherein the headstock spindle of each carrier has a clutch member on its outer end, and the driving means at each of the registration stations comprises a driving clutch member mounted for movement coaxially with the headstock spindle at the respective registration station into and out of engagement with the clutch member on the headstock spindle at the respective station.

38. Apparatus as set forth in claim 37 having a first drive shaft for the driving clutch member at the first registration station, a second drive shaft for the driving clutch member at the second registration, means for intermittently oscillating one of said drive shafts through a predetermined angle, and means interconnecting said drive shafts for simultaneous oscillation thereof and effecting oscillation of the first drive shaft through a greater angle than the second drive shaft.

39. Apparatus as set forth in claim 38 having means for simultaneously shifting said driving clutch members into and out of engagement with the clutch members on the respective headstock spindles.

40. Apparatus as set forth in claim 36 having means for moving the stop to a retracted position prior to each indexing step of the conveyor and returning it to an operative position at the conclusion of each indexing step of the conveyor.

41. Apparatus as set forth in claim 36 wherein said stop is mounted for adjustment longitudinally of the conveyor to effect arrest of the rotation of the bottle at different predetermined positions.

42. Apparatus as set forth in claim 36 wherein said stop comprises a finger carried by a pivoted arm, and wherein means is provided for biasing the arm to swing the finger into engagement with the periphery of a bottle in the transverse plane of the bottle which includes the recess.

43. Apparatus as set forth in claim 42 wherein said arm is carried by a vertically movable member and means is provided for moving said member upward to retract the arm and finger prior to each indexing step of the conveyor and returning it downward to operative position at the conclusion of each indexing step of the conveyor.

44. Apparatus as set forth in claim 43 wherein said arm is pivoted on a block vertically adjustable on said member.

45. Apparatus as set forth in claim 44 wherein said member is adjustable longitudinally of the conveyor.

46. Apparatus for printing on articles such as bottles or the like, each article having a printing registration index, comprising an endless conveyor having an upper working reach and a lower return reach, a series of article carriers carried by the conveyor spaced at equal intervals along its length, each carrier having a pair of chucks for end-chucking an article therein with the article extending transversely of the conveyor and rotatable on its axis, means for intermittently indexing the conveyor in steps corresponding to the carrier spacing with dwell intervals between successive indexing steps, said conveyor being adapted to convey each carrier to a loading station at the trailing end of the upper working reach of the conveyor, thence through other stations and ultimately to an unloading station at the leading end of the upper working reach of the conveyor, means at the loading station for effecting separation of the chucks of the carrier at the loading station for an interval during the dwell of the carrier at the loading station and then closing the chucks, means for conveying articles in vertical position to a transfer point adjacent the loading station, means for gripping an article conveyed to said transfer point, turning it to horizontal position, and positioning it endwise between the separated chucks of the carrier at the loading station during the interval in which these chucks are separated, means operable on one of the chucks of a carrier after an article has been chucked therein for rotating said one chuck to rotate the article chucked in said carrier, means cooperable with the registration index on the article being so rotated to arrest the rotation of the article with the registration index in a predetermined position to effect a preliminary registration of the article, and thereafter rotating one of the chucks through a predetermined angle to rotate the article chucked in the carrier through said angle to effect a final registration of the article, means operable at a station after the final registration for effecting printing on the article chucked in the carrier at this station during the dwell of the carrier at this station, and means at the unloading station for unloading the article from the carrier at this station during the dwell of the carrier at this station, said unloading means comprising means for gripping an article, removing it from the chucks of the carrier at the unloading station, and turning the article to upright position for placement on a take-away conveyor.

47. Apparatus as set forth in claim 46 further comprising means for holding an article chucked in the chucks of each article carrier against rotation as the carrier moves from station to station after the final registration of said article.

48. Apparatus as set forth in claim 46 wherein the printing means comprises a stencil above the upper working reach of the conveyor and a squeegee, and said apparatus has means for bringing the article chucked in each carrier into engagement with the stencil as the carrier is moved to the said printing station, and means at the printing station for driving one of the chucks of the carrier at this station for rotating the article chucked in the carrier at this station during the dwell of the carrier at this station.

49. Apparatus for printing on bottles which have a printing registration recess in their periphery adjacent their bottom comprising an endless conveyor having a generally horizontal upper working reach and a lower return reach, a series of bottle carriers carried by the conveyor spaced at equal intervals along its length, each carrier having a headstock and a tailstock, a spindle journalled in the headstock carrying a bottle bottom chuck, a spindle mounted in the tailstock carrying a bottle mouth chuck, said chucks being separable for positioning a bottle endwise therebetween and movable relatively toward one another for chucking a bottle with the bottle extending transversely of the conveyor and rotatable on its axis, means for intermittently indexing the conveyor in steps corresponding to the carrier spacing with dwell intervals between successive indexing steps, said conveyor being adapted to convey each carrier to a loading station at the trailing end of the working reach of the conveyor, thence through other stations and ultimately to an unloading station at the leading end of the working reach of the conveyor, means at the loading station for effecting separation of the chucks of the carrier at the loading station for an interval during the dwell of the carrier at the loading station and then closing the chucks, means for conveying bottles in vertical position to a transfer point adjacent the loading station, means for gripping a bottle conveyed to said transfer point, turning it to horizontal position, and positioning it endwise between the separated chucks of the carrier at the loading station during the interval in which these chucks are separated, means operable on

the headstock spindle of a carrier after an article has been chucked therein for rotating said headstock spindle to rotate the bottle chuck in said carrier, a stop engageable in the registration recess of the bottle being so rotated to arrest the rotation of the bottle with the registration recess in a predetermined position to effect a preliminary registration of the bottle, means for thereafter rotating the headstock spindle through a predetermined angle to rotate the bottle chucked in the carrier through said angle to effect a final registration of the bottle, means operable at a station after the final registration for effecting printing on the bottle chucked in the carrier at this station during the dwell of the carrier at this station, and means at the unloading station for unloading the bottle from the carrier at this station during the dwell of the carrier at this station, said unloading means comprising means for gripping a bottle, removing it from the chucks of the carrier at the unloading station, and turning the bottle to vertical position for placement on a take-away conveyor.

50. Apparatus as set forth in claim **49** further comprising means for holding the headstock spindle of each carrier against rotation as the carrier moves from station to station after the final registration of the bottle chucked therein thereby to hold the bottle against rotation as it moves from station to station after the final registration.

51. Apparatus as set forth in claim **49** wherein the printing means comprises a stencil and a squeegee, and said apparatus has means for raising each carrier to bring the bottle chucked therein into engagement with the stencil as the carrier is moved to the said printing station, and means at the printing station for driving the headstock spindle of the carrier at this station for rotating the bottle chucked in the carrier at this station during the dwell of the carrier at this station.

52. Apparatus for printing on articles such as bottles or the like, each article having a printing registration index, comprising an endless conveyor having an upper generally horizontal working reach and a lower return reach, a series of article carriers carried by the conveyor spaced at equal intervals along its length, each carrier having a pair of chucks for end-chucking an article therein with the article extending transversely of the conveyor and rotatable on its axis, means for intermittently indexing the conveyor in steps corresponding to the carrier spacing with dwell intervals between successive indexing steps, said conveyor being adapted to convey each carrier to a loading station at the trailing end of the upper working reach of the conveyor and thence through other stations including a printing station and ultimately to an unloading station at the leading end of the upper working reach of the conveyor, means at the loading station for chucking an article in the chucks of each carrier at the loading station, means operable on one of the chucks of a carrier after an article has been chucked therein for rotating said one chuck to rotate the article chucked in said carrier, means cooperable with the registration index on the article being so rotated to arrest the rotation of the article with the registration index in a predeermined position to effect a preliminary registration of the article, and thereafter rotating one of the chucks through a predetermined angle to rotate the article chucked in the carrier through said angle to effect a final registration of the article, a printing stencial above the upper working reach of said conveyor at the printing station and a squeegee for said stencil, means for raising each carrier at the printing station to bring the article chucked therein into engagement with the stencil, means at the printing station for driving one of the chucks of the carrier at this station for rotating the article chucked in the carrier at this station, and means at the unloading station for unchucking an article from the chucks of each carrier at this station.

53. Apparatus as set forth in claim **52** wherein said means for raising the carriers at the printing station comprises follower rollers associated with each carrier and stationary cam means operable on the follower rollers.

References Cited by the Examiner

UNITED STATES PATENTS

2,718,847	9/1955	Jackson et al.	101—40
2,721,516	10/1955	Campbell et al.	101—126 X
3,112,692	12/1962	Cookson	101—38
3,146,704	9/1964	Johnson	101—124 X

ROBERT E. PULFREY, *Primary Examiner.*

WILLIAM B. PENN, *Examiner.*