May 10, 1966 G. USCHMANN 3,250,212

MACHINE FOR THE AUTOMATIC PRINTING OF HOLLOW PLASTIC ARTICLES OR THE LIKE

Filed May 1, 1964 3 Sheets-Sheet 1

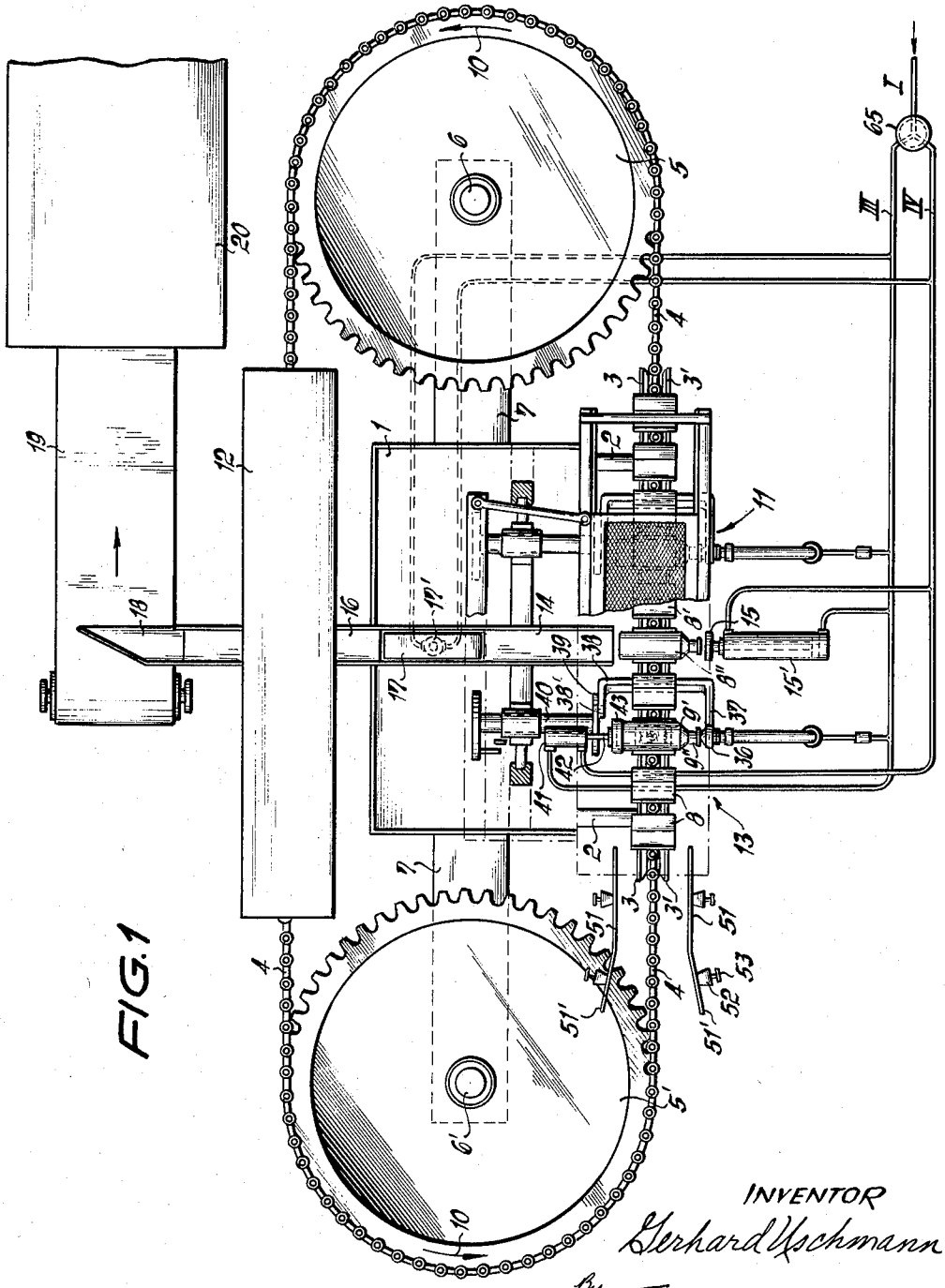


FIG. 1

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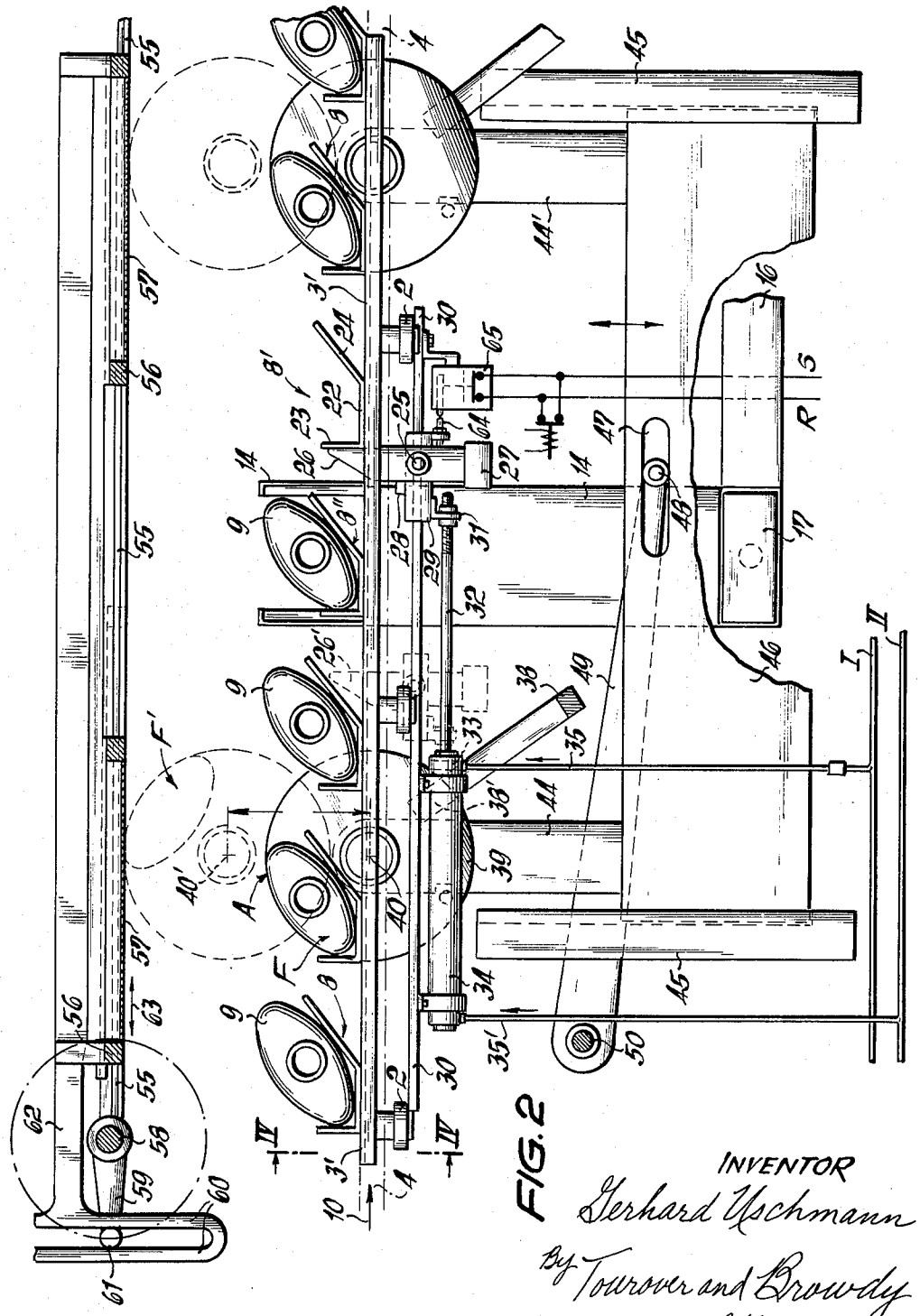


FIG. 2

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FIG. 3

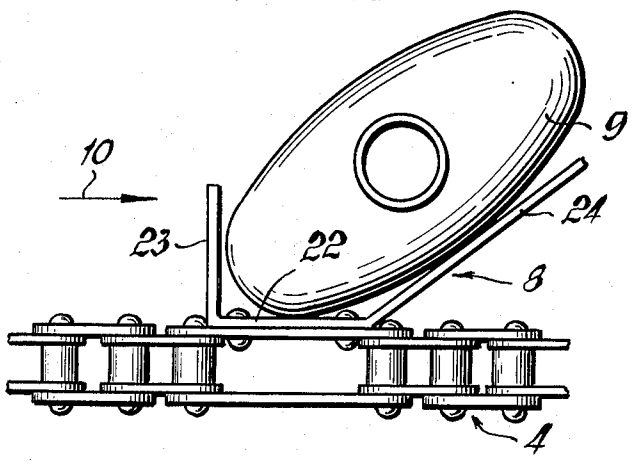
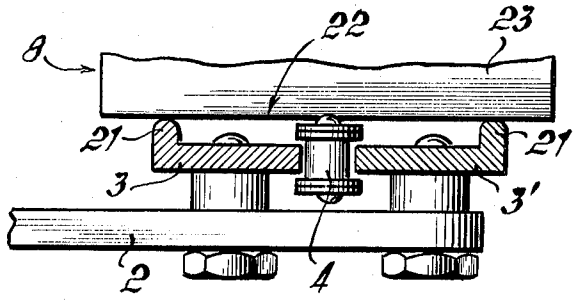


FIG. 4



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3,250,212

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MACHINE FOR THE AUTOMATIC PRINTING OF HOLLOW PLASTIC ARTICLES OR THE LIKE

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Claims priority, application Germany, May 2, 1963,
D 41,466
6 Claims. (Cl. 101—40)

Plastic bottles, cups or other hollow articles, more particularly those made of thermoplastics, are today frequently printed in one or more colors. The screen printing process is mainly used for this purpose, the inks being forced through a screen by a doctor and transferred to the articles bearing against the underside of the screen. Screen printing requires accelerated drying at elevated temperature for each print before the next print can be made.

Screen printing machines for printing hollow plastic articles or the like are known wherein the article for printing is manually introduced into a support which then closes mechanically and is moved, by a motor-actuated transmission, up against the underside of the screen or screen frame. The bottle rocks in its support during the printing operation so as to roll against the underside of the reciprocating screen. The bottle retainer is lowered after the printing operation. The printed bottle passes to a conveyor belt and is then fed to a drying oven or some other drying system from which—in the case of multi-color printing—it is fed to a second and similar printing machine. This arrangement has various disadvantages.

First of all, a separate complete printing machine has to be provided for each individual print. Also, the individual printing stations have to be comparatively far apart, so that it is impossible for them to be watched or supervised by one operative. Also, it is difficult if not practically impossible to drive all the printing stations from one motor with a rigid mechanical coupling between them. Separate means are also required for accurate register between the individual prints.

The object of the invention is to obviate these disadvantages, and to this end, according to the invention, the rotatable retainer for the article for printing is disposed on a substantially U-shaped bearer which engages around the conveyor belt, on which the articles are supplied and on which they are re-deposited after printing, the conveyor belt being conventionally provided with a drive for the conveyance of the bottles.

The U-shaped bearer reciprocates vertically so that the article clamped in the retainer is moved against the underside of the screen and is then lowered again to its initial position.

This arrangement of the retainer enables the conveyor belt to pass successively through all the printing stations and associated drying systems, the printing stations operating independently of the drive for the position of the conveyor belt. An important feature of the invention is that independently of the treatment equipment provided, such as drying ovens, drying flames or the like, the printing stations can be disposed close together and mechanically so coupled that they operate in exact synchronism with very high register accuracy. The printing stations may be disposed consecutively in the horizontal or vertical direction, depending on the path followed by the

endless conveyor belt. They can be supervised by a single operative without the latter leaving his station, even in the case of three or four-color printing.

The drawing illustrates one advantage embodiment of a printing machine according to the invention, intended for bottles having an oval body.

FIG. 1 is a top elevation and partial section of the complete printing machine.

FIG. 2 is a larger-scale side elevation of the printing station parts in the machine shown in FIG. 1.

FIG. 3 is a larger-scale detail showing part of a conveyor chain together with one of the channel-shaped supports provided on the chain for the bottle it is required to print and

FIG. 4 is a section on the line IV—IV in FIG. 2 to a larger scale.

In the embodiment illustrated, the housing **1** contains the drive and power transmission means for the printing elements and their movement. These parts of the machine are known per se and are therefore not shown in detail.

Two guide rails **3**, **3'** are mounted on bearer arms **2** at the front of the housing **1**. An endless flat-link chain **4** runs between the guide rails **3**, **3'** and outside the region of the latter the chain runs over sprocket wheels **5**, **5'** which are rotatable on vertical journals **6** and which are secured to bearer arms **7** of the housing **1**.

The channel-shaped supports **8** for the bottles **9** it is required to print consist of appropriately bent sheet steel or the like and are so secured to the endless flat-link chain at regular intervals that the bottles lie substantially perpendicularly, for example, to the direction of movement of the chain **4**.

The general operation of the machine illustrated is as follows:

Chain **4** is advanced intermittently in the direction of arrow **10** by an amount equal to the between-centres distance of two adjacent bottle containers **8**. While the chain **4** is stationary, the bottles for printing are individually introduced into the support **8** automatically or manually, the support **8** being situated within the region of the guide rails **3**, **3'** at the place denoted by reference **8'**. As the chain **4** advances, the bottles for printing first come into the range of the first printing station, which has been given the general reference **11**, and at this station they receive the first print. The printed bottle is then again deposited into its support **8** on the chain and passes over sprocket wheel **5** to a drying oven **12**. The bottles intermittently move through the drying oven passage, where the ink print is dried or cured, for example by infra-red radiation and treatment with cold or hot or superheated air or a flame. The bottle treated in this way then passes over the sprocket wheel **5'** to the left-hand entry of the guide rails **3**, **3'** and thus reaches the second printing station having the general reference **13**. The bottle printed at this station is again deposited on the chain and finally assumes the position **8''**. In this position the bottle is situated in front of the opening of a passage **14** into which the bottle is pushed by an ejector **15**. The bottle slides down the inclined passage **14** and thus reaches the opening of a horizontal passage **16** into which the bottle is pushed by a movable thrust plate **17** via a chute **18** onto a conveyor belt **19** which passes through a second drying passage **20** in which final drying and ink curing of the print take place.

With reference to FIG. 4, it will be seen that the guide rails **3**, **3'** have at each end an upwardly extending

rounded edge strip 21, on which the bottom part 22 of the bottle support 8 (FIG. 3) slides. A vertical wall 23 of the support adjoins the base 22, and an inclined wall 24 adjoins the base 22 at the other side. The parts 23, 22 and 24 thus form a kind of channel which is open at both ends and into which the bottle 9 for printing is freely inserted so that it assumes the inclined position shown in FIGS. 3 and 2.

Advantageously, a plurality of pairs of fixed parallel guide rails 51 are disposed over the length of the path of movement of the bottle supports 8, and the bottles resting on the supports 8 enter and are uniformly aligned between the divergent ends 51' of the rails 51. The latter advantageously extend over the entire length of the track from the beginning of printing station 13 to the end of station 11, the rails being omitted at the ejection station.

As will be apparent from FIG. 2, the chain is advanced by a driver 26 which is pivotable about an axis 25 and which engages behind the front wall 23 of the bottle supports 8. The driver 26 is in the form of a double lever. A counterweight 27 is disposed at its free end and resiliently holds the driver against the stop 28 mounted on a slide 29 bearing the pivot 25. The slider 29 is movable on rails 30 mounted on the bearers 2 for the chain guides 3, 3'.

A piston rod 32, whose piston 33 is movable in the compressed air cylinder 34 parallel to the rails 30, adjustably engages an angular projection 31 on the slide 29. Cylinder 34 has compressed air inlets 35, 35' at the ends so that the piston 33, piston rod 32 and slide 29 together with the drivers 26 can be moved to the left or right as required.

If slide 29 is moved to the left out of the position shown in FIG. 2, it moves downwards as it strikes the adjacent bottle support 8'' and finally rises into the end position 26' shown in broken lines, in which the driver engages in the space in front of the support 8''. If the driver 26 is then pushed back to the right into its initial position, it presses the support 8'' into the position previously occupied by the bottle support 8'. The entire endless chain together with the bottle supports secured thereto participate in this movement and the bottle supports thus intermittently move forward by an amount equal to the between-centres distance of two adjacent bottle supports. As a result of this intermittent movement, all the bottles introduced at 8' (FIG. 1) successively pass the two printing stations 11, 13 and finally reach station 8'' after being printed in two colors, and they are ejected out of the range of endless chain 4 by ejector 15 at station 8'' so as to reach the final drying oven 20.

The operations at the two printing stations 11, 13 are as follows:

The bottle 9', for instance, reaching the printing station 13, is situated with its mouth 9'' in the region of a centering mandrel 36 when the conveyor chain movement is concluded. The mandrel 36 is disposed on the free arm 37 of a U-shaped bearer 38 so as to be fixed or axially movable with respect to the bottle. The U-shaped bearer 38 is secured to a disc 39 at its other end 38'. Disc 39 is keyed on shaft 40. A compressed air cylinder 41 is secured coaxially of the pin 36 at the back of the disc 39 and its piston rod 42 bears a cup-shaped plate 43 having a cavity adapted to the shape of the bottom of the bottle 9', so that the container part 43 engages with a matching fit around the base part of the bottle 9' without the said part 43 projecting laterally beyond the profile of the bottle 9' or transversely of the bottle axis. As soon as the piston rod 42 is moved forward by the introduction of compressed air into the cylinder 41, the bottle 9' is clamped between the pin 36 and the cup 43. Parts 41 and 36 are so disposed in relation to the conveyor chain 4 and its guide rails 3, 3' that a bottle 9 situated on the bottle support 8 in the position shown in FIG. 3 and reaching the printing station 13 is resiliently clamped between the centering pin 36 and the cup 43 without any substantial change of position with respect to the channel-shaped support 8.

As soon as the bottle is held by the retainers formed by the disc 39 and the U-shaped member 38, it is lifted out of the support 8 arriving at the printing station 13. To this end, the bearer shaft 40 is mounted in a support 44 disposed on a cross-head 46 vertically slidable in the two guides 45 of the machine frame. Cross-head 46 has a slot 47 in which engages the driver pin 48 of a lever 49 mounted on a shaft 50 of the machine frame, shaft 50 being periodically rotated in the anti-clockwise direction and then returned to the initial position shown in FIG. 2. The gearing required for this purpose is known per se and not illustrated.

Thus, on operation of lever 49 cross-head 46 rises, shaft 40 reaching the position for printing as shown at 40'. The travel of the shaft 40 during this movement is denoted by reference *a* in FIG. 2.

Above the printing station, an undivided or possibly divided screen printing frame 56 containing a printing screen 57 for each color of the required print, is longitudinally slidable on rails 55 in the machine frame. The screen printing frame 56 reciprocates, the movement being produced by the shaft 58 via a crank 59 and a pin 61 mounted in a slotted link 60. The latter is mounted on an extension 62 of the screen printing frame 56. It will be immediately apparent that the printing frame 56 reciprocates in the direction of arrow 63 on rotation of shaft 58.

In the raised position 40', the screen printing frame is so disposed in relation to the shaft 40 that the bottle F for printing first touches the printing screen 57 approximately at A when the shaft 40 is lifted, the point A being the beginning of the required print. When point A of bottle F meets the printing screen 57 from below, the periphery of the disc 39 connected to the shaft 40 also bears against the longitudinal member of the printing frame or a friction rail connected thereto. The resultant frictional engagement between the frame 56 and the disc 39 causes the latter to be turned to the right on the movement of the frame 56, the printed side of the bottle F rolling on the underside of the printing screen 57 until the bottle reaches the end position F'. The print is thus concluded as required.

On completion of the printing operation, the shaft 40 and the bottle move down by an appropriate movement of the lever 49 so that the bottle is moved away from the screen. Immediately thereafter the bottle is returned to the initial position shown in FIG. 2, in which the bottle is redeposited on to the support 8. As soon as the bottle lies on the support, or just before that, the clamping mechanism 43 is released by operation of the compressed air cylinder 41. The bottle is now free. The conveyor chain advances by one step so that the next bottle comes into the range of the clamping system. The operations then repeat accordingly.

A corresponding arrangement is provided at the second printing station 11 and consists of the U-shaped member 37, disc 39 and shaft 40 etc. These parts are retained by the support 44' of cross-head 46 (FIG. 2). If more than two colors are to be used for the printing operation, a corresponding printing station with the mechanisms as described must be provided for each color.

The screen printing frame 56 is provided with ink feed means and doctors in known manner. For the sake of simplicity, these parts are not shown in the drawing.

Instead of the oval bottles shown in the exemplified embodiment, the printing machine according to the invention can be used for printing bottles having a cylindrical body, for example. In such cases, of course, it is advantageous for the bottle to have a mechanical or optical registration system so that the bottle is fed to the

various printing stations in exactly the same angular positions and so that the respective prints begin at the required point of the bottle periphery.

The machine according to the invention can also be used for printing square or polygonal bottles. In such cases, of course, the printing must be done by a surface printing process, shaft **40** being locked so that it performs no rotary movement during raising and lowering of the cross-head and hence of the clamped bottles. The bottle supports **8** must be of different construction in such cases. With a surface printing process the screen printing frame **56** also remains stationary. The ink in such cases is forced through the printing screen **57** by reciprocating doctors, which in such cases are advantageously connected to the crank drive **59**.

Instead of a single-track path for the bottles, the printing machine according to the invention may be provided with a plurality of tracks, and the bottle formats and the prints on the two tracks may either be identical or different. The advantage of this arrangement is that the drying equipment and the drives are the same in practice for all the operating tracks.

The machine according to the invention is controlled as follows:

When the feed piston **33** and the piston rod **32** connected thereto reach the end position shown in FIG. 2 of the drawing, rod **60** actuates the diagrammatically illustrated limit switch **61**. An electromagnetic clutch associated with the drive motor for the shafts **50** and **58** is thus actuated so that said shafts are turned in the required manner. This may be effected, for example, through the agency of gear or cam transmissions between the motor and the shafts **50**, **58**. The power transmission must be so designed that the cross-head **46** is first raised by the shaft **50** and, when the article for printing touches the screen **57**, the shaft **58** rotates, the return movement to the initial position shown in FIG. 2 of the drawing taking place during the lowering of the cross-head **46**. Alternatively, the frame **56** can be moved into the position shown in FIG. 1 just during the movement of the cross-head **46**, and then the frame **56** can be moved (from left to right in FIG. 2) with the cross-head stationary, and then the frame can be stopped and the cross-head re-lowered.

The upward and downward movement of the crosshead **46** can also be used to control the compressed air conduits I, II. These conduits extend through an appropriate four-way valve which on the upward movement of the cross-head is so adjusted that compressed air is fed to the right-hand side of the cylinder **34** through conduit **35** and piston **33** moves to the left, and on completion of the downward movement of the cross-head **46** the four-way valve is so adjusted that the left-hand side of the cylinder receives pressure medium via conduit **35'** so that the piston **33** and with it the piston rod **32** advance the conveyor belt **4** by one step.

The compressed air conduit I, II also contains a second four-way valve **65** (FIG. 1) to control the supply of pressure medium to the clamping cylinder **41**, cylinder **15'** of ejector **15** and cylinder **17'** of advancer **17**.

The four-way valve **65** is moved into the position shown in FIG. 1 by the feed piston **33** or the piston **32** connected thereto, and in this position pressure medium flows from conduit I to conduit III. The bottle **9'** situated in front of the clamping system is thus clamped by actuation of the cup-shaped part **43**, before the cross-head **46**—and just prior thereto—the clamping system begins its upward movement. The ejector **15** is actuated at the same time and the advancer **16**, so that the bottle in the support **8''** is laterally moved out of the range of the conveyor belt **4** and room is formed for the supply of a fresh unprinted bottle. For the sake of clarity, the drawing does not show the loading mechanism for the new bottle fed to the support **8'**. It comprises a rod similar to the ejector **15** and associated with a suitable magazine or the like from which the unprinted bottle is taken for transfer to the support **8'**. Instead of a separate loading mechanism, the printed bottle can be moved out of the range of the conveyor belt **4** from the support **8''** by the ejector **15** with the interposition of an unprinted bottle. The advancer **17** is withdrawn by pressure medium fed from conduit III to cylinder **17'** of the advancer, so that the mouth of the passage **16** is freed for the printed bottle carried off by the ejector **15**.

Four-way valve **65** is adjusted to its other position just before the end of the downward movement of the cross-head **46**. Pressure medium thus flows into conduit IV with the following result:

The piston of the clamping system is moved away from the printed bottle; ejector **15** returns to the initial position shown in FIG. 1 of the drawing and advancer **17** is moved forward out of position shown in FIG. 1 so that it pushes on the bottle situated at the mouth of the passage **16**. Conduit III is simultaneously connected to atmosphere.

I claim:

1. A machine for the automatic printing, by multicolor or multi-line printing, of hollow plastic articles by the screen printing process comprising an endless conveyor belt disposed in an elongated loop, supports on said belt in spaced relationship adapted to hold said article, at least a first and a second printing station asociated with said loop, a first drying system located between said first and said second printing station for drying the wet printing ink on articles coming from said first printing station, an ejector system located between said second printing station and said first printing station for removing articles with wet printing ink coming from said second printing station, a second drying system located outside the loop of said endless conveyor belt, a conveyor for conducting said articles from the ejector system to said second drying system and clamping means at each printing station for centering said article and including a substantially U-shaped bearer which engages the article around the endless conveyor belt, said U-shaped bearer having a free arm and a fixed arm, said clamping means further comprising a centering mandrel disposed on said free arm and a retainer means attached to said fixed arm, said retainer means including a cup-shaped plate complementary in shape to the article, said cup-shaped plate being capable of being reciprocated in relation to said centering mandrel, said retainer means further comprising means to reciprocate said cup-shaped plate to clamp and center the article generally between the arms of said U-shaped bearer.

2. A machine according to claim **1** wherein the first and second printing stations are closely adjacent to one another separated only by said ejection system.

3. A machine according to claim **1** wherein said retainer means includes a rotatable element connected to said fixed arm, a reciprocating printing screen disposed above said conveyor belt, and means for raising and lowering said clamping means from said conveyor belt to contact with said printing screen and back to said conveyor belt.

4. A machine according to claim **3** including means for driving said endless conveyor intermittently a distance equal to the space between adjacent supports, the period between movement of the conveyor being sufficient to permit the clamping of the article in said clamping means, raising into contact with the reciprocating printing screen and redeposit of the article in a support.

5. A machine according to claim **3** wherein said U-shaped bearer is pivotable about an axis non-coaxial with the bottle axis.

6. A machine according to claim **2** wherein a functionally common printing screen frame is associated with the closely adjacent printing stations and contains a printing screen for each station.

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