Jan. 20, 1970 C. H. DERRICKSON 3,490,363

SCREEN PRINTING OF FLEXIBLE BOTTLES OF SQUARE CROSS SECTION

Filed May 5, 1967 3 Sheets-Sheet 1

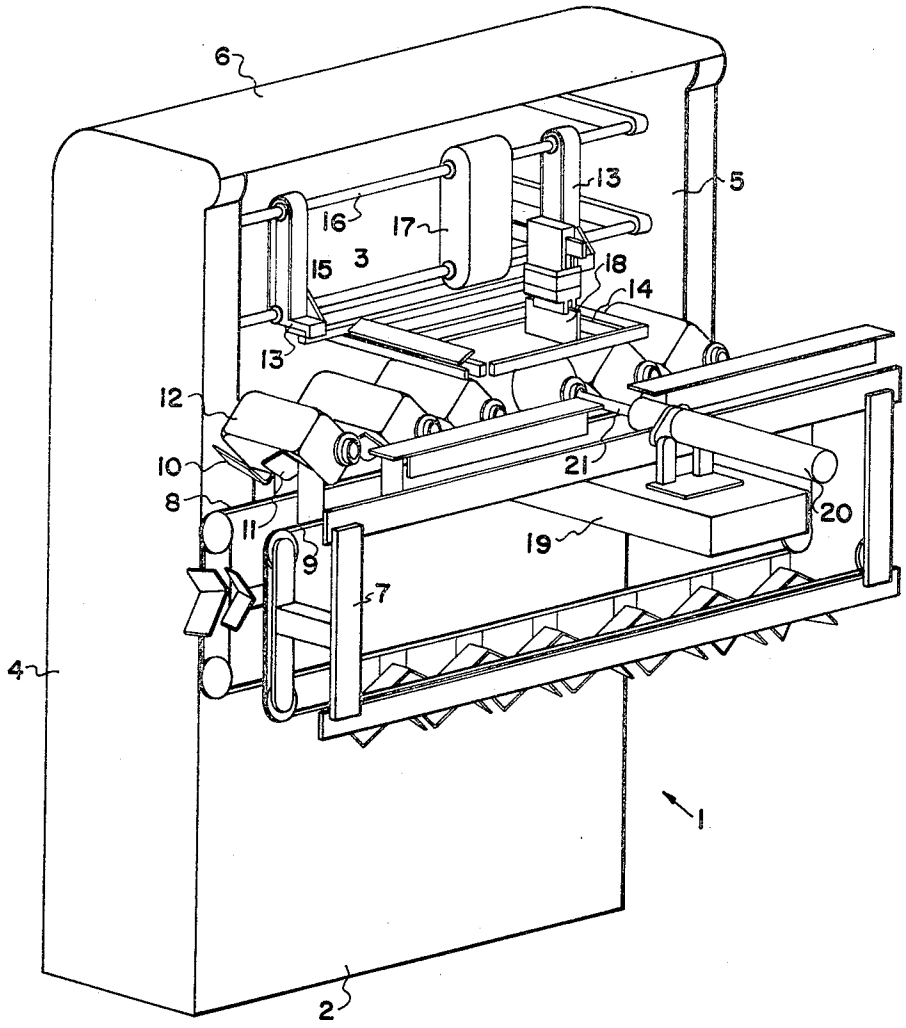


FIG. 1

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SCREEN PRINTING OF FLEXIBLE BOTTLES OF SQUARE CROSS SECTION

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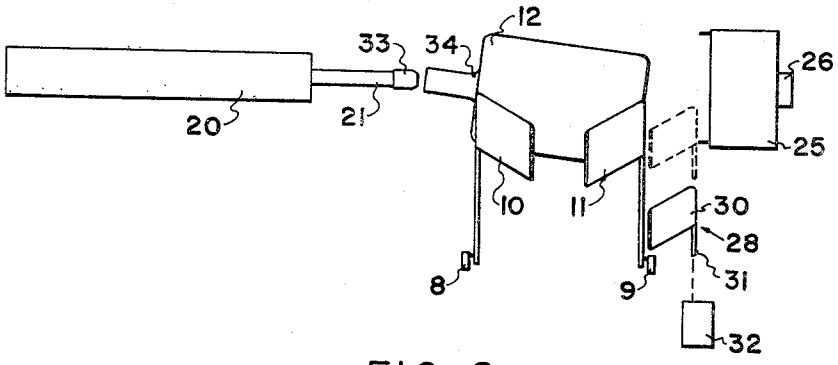


FIG. 2

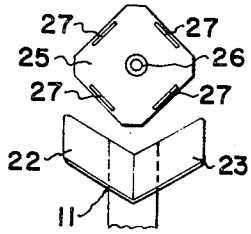


FIG. 3

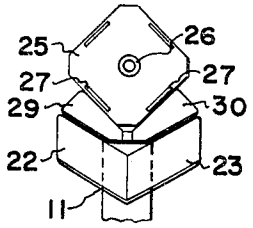


FIG. 4

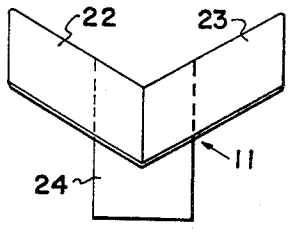


FIG. 5

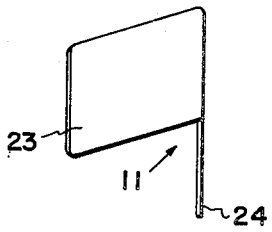


FIG. 6

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SCREEN PRINTING OF FLEXIBLE BOTTLES OF SQUARE CROSS SECTION

Filed May 3, 1967 3 Sheets-Sheet 3

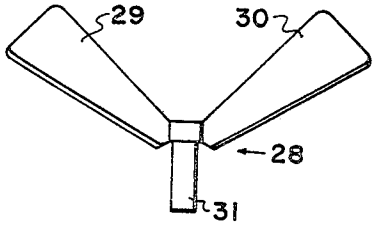


FIG. 7

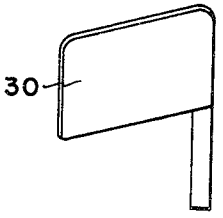


FIG. 8

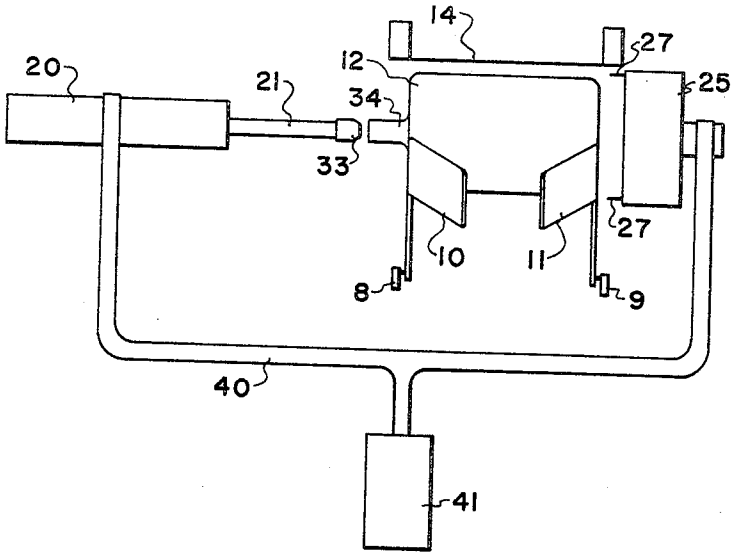


FIG. 9

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3,490,363

SCREEN PRINTING OF FLEXIBLE BOTTLES OF SQUARE CROSS SECTION

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Int. Cl. B41f *17/08;* B41l *27/00, 13/00*
U.S. Cl. 101—38 4 Claims

ABSTRACT OF THE DISCLOSURE

In the screen printing of cylindrical bottles, especially bottles of flexible plastic material, the bottles are held in a rotary holder and rotated while in printing relation with a screen stencil, the stencil being moved in relation to the squeegee while the bottle is rotated. Bottles of flexible material of square cross section are screen printed by applying sufficient internal air pressure to the bottle to convert it from square cross section to round cross section during the printing operation. The bottle is inflated to a round cross section and rotated in a rotary holder in the same manner as a cylindrical bottle to effect printing on the surface of the bottle. Means is provided for conveying bottles sequentially to the rotary holder for the screen process printing step and means are provided for effecting relative movement between the bottle and the conveying means so that the bottle can be rotated without interference with the conveyor.

BACKGROUND OF THE INVENTION

In the screen process printing of cylindrical objects, such as bottles and cans, the object is placed in a rotary holder and rotated while in contact with a screen stencil. The stencil is moved linearly while in contact with the surface of the object being printed and the object is rotated at the same linear speed so that there is no slippage in relation to the printing screen. The stencil is moved in relation to a squeegee which forces the printing ink through the screen stencil and makes the desired imprint on the surface of the object being printed. There are numerous machines available commercially for printing cylindrical objects in the aforementioned manner and many of these machines include conveyor arrangements for rapid handling of the objects to be printed both at the inlet and outlet side of the printing operation.

Recently, with the development of blow molded bottles and containers of cheap thermoplastic materials, such as polyethylene and polypropylene, many large size bottles and jugs are made in square cross section for more efficient storage. Many bottles or jugs of square cross section are made in half gallon and gallon sizes for milk containers. A short time ago, a technique was developed for printing bottles of flexible plastic which are of square cross section using screen process equipment of the type used for printing cylindrical bottles. In this printing technique for bottles of square cross section, the bottle or other object being printed is held in a rotary holder and sufficient air pressure is applied to the interior of the bottle to cause it to be temporarily inflated into a substantially cylindrical shape. While the bottle is in the cylindrical shape, it is rotated in contact with the screen process stencil in the same manner as a cylindrical object being printed. At the completion of rotation in contact with the screen process stencil, the air pressure is released from the interior of the bottle to allow it to return to its original square cross section. The amount of deformation of the bottle or other object being printed during inflation is sufficiently small that there is little distortion of the imprint. However, if the bottle being printed is of sufficiently large size, it may be necessary to make the screen stencil in a somewhat distorted configuration to compensate for the change in shape of the object being printed.

The apparatus which has been used for the printing of bottles or other objects of square cross section has been one in which the bottles or objects being printed were inserted manually into a holder which secured the base of the bottle for rotation and a compressed air nozzle inserted into the opening in the top of the bottle. This type of printing is rather slow since the bottles must be manually inserted into and removed from the printing operation. It has previously been impossible to utilize continuous screen process equipment in the printing of square bottles because of the fact that the size and shape of the square bottles tend to interfere with the conveyors used in conveying the bottles to the printing station.

STATEMENT OF OBJECTS AND FEATURES OF THE INVENTION

It is, therefore, one object of this invention to provide a new and improved apparatus for the screen process printing of bottles and other objects of square cross section wherein the object to be printed is held in a rotary holder and inflated so that it can be printed while in a cylindrical condition, the apparatus being automatically and continuously operated.

Another object of this invention is to provide a new and improved apparatus for the screen process printing of bottles or other objects of square cross section having an improved arrangement for lifting, holding, and rotating the bottles during the printing step, during which time the bottle is inflated by air pressure to a cylindrical shape.

One of the features of this invention is the provision in an apparatus for printing bottles of square cross section of an improved arrangement for effecting relative movement between the bottle being printed and the conveyor which brings the bottles to and away from the printing station.

Another feature of this invention is the provision of an improved arrangement for printing bottles or other objects of square cross section which includes means for lifting the bottle from a conveyor to a rotary holder positioned adjacent to a screen process stencil and simultaneously aligning the base of the bottle with the holder.

Other objects and features of this invention will become apparent from time to time throughout the specification and claims as hereinafter related.

BRIEF DESCRIPTION OF THE DRAWING

In the accompanying drawing, to be taken as a part of this specification, there are clearly and fully illustrated two preferred embodiments of the invention in which:

FIG. 1 is an isometric view of a screen process apparatus including a conveyor and stencil arrangement embodying a preferred form of this invention,

FIG. 2 is a detail view, which is somewhat diagrammatic, showing the relationship of a bottle being supported in the conveyor of the apparatus shown in FIG. 1, and illustrating the means for aligning and lifting the bottle into engagement with the rotary holder for supporting the bottle at the printing station,

FIG. 3 is a view in left elevation of the holder for the base of the bottle and the dihedral support for the bottle on the conveyor,

FIG. 4 is a detail view similar to FIG. 3, but showing the dihedral lifting mechanism for guiding the base of the bottle into the rotary support at the printing station,

FIG. 5 is a view in elevation of one of the dihedral supports on the conveyor,

FIG. 6 is a view in right elevation of the dihedral support shown in FIG. 5,

FIG. 7 is a view in elevation of the dihedral lifting mechanism interposed between the dihedral support on

the conveyor and the rotary support for the bottle, as seen in side elevation in FIG. 2,

FIG. 8 is a view in right elevation of the dihedral lifting mechanism, as seen in FIG. 7, and

FIG. 9 is a diagrammatic view of an alternate embodiment of the invention which includes a movable yoke supporting the bottle rotating member and operable lift bottle being printed at the printing station away from the conveyor.

SUMMARY OF THE INVENTION

This invention comprises a new and improved silk screen printing apparatus for the printing of non-rigid bottles or containers of square cross section. Recently, apparatus of the type used for the screen process printing of cylindrical bottles has been adapted for the printing of square bottles. In the printing of cylindrical bottles and containers, the bottle or container is supported at both ends and rotated while maintained in contact with a screen stencil which is moved linearly at the same rate as the linear rate of rotation of the bottle or container. In adapting this apparatus to the printing of bottles of square cross section, the bottles are impressed with a relatively high internal air pressure so that the bottle is deformed under pressure into an approximately cylindrical shape. The bottle, while deformed into this cylindrical shape, is held by a rotary holder and printed using an apparatus of the type used for the screen printing of cylindrical objects. After printing, the bottle is then restored to its original shape by release of the internal air pressure.

In this invention, the screen process printer is provided with a conveyor which is intermittently advanced through a printing station where the bottle is picked up from the conveyor, inflated to a cylindrical shape, and printed, and then deflated and moved on. The apparatus is provided with a means to effect a relative movement between the bottle an the conveyor and to guide the bottle into the rotary support. The relative movement between the bottle and the conveyor may be effected by moving the bottle and its support away from the conveyor after the bottle has been secured in the rotary printing apparatus at the printing station. Preferably, however, the printer is arranged with a dihedral shaped lifting device which is moved into position between the edge of the conveyor and the support for the square shaped bottle. When the member which is used to apply air pressure to the interior of the bottle is moved against the open end of the bottle, it pushes the bottle against the dihedral lifting mechanism and causes the bottle to slide into and to be aligned with the rotary support. The dihedral lifting device then is moved quickly out of engagement with the bottle and the bottle inflated, rotated, printed, and dropped back onto the conveyor.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawing, and more particularly to FIGS. 1 to 8, there is shown a preferred embodiment of the invention.

In FIG. 1, the screen process printer is generally designated **1** and comprises a housing or enclosure having front and back walls **2** and **3**, side walls **4** and **5** and top wall **6**. On the front of the housing, there is provided an angle iron framework **7** on which there is mounted a pair of conveyor chains **8** and **9**. Conveyor chains **8** and **9** are driven by a motor or other suitable drive mechanism (not shown). Conveyor chains **8** and **9** each carry a series of aligned dihedral supporting members **10** and **11** respectively. The dihedral supporting members are shown in more detail in FIGS. 2 to 6.

The apparatus is provided with a printing station for printing bottles **12** of square cross section. The printing station comprises support **13** on which there is mounted screen stencil **14**. Support **13** is mounted on support rods **15** and **16** which also carry supporting member **17** which supports squeegee **18**. Squeegee **18** is carried in fixed position above the printing station in relation to the bottle being printed. Support **13** and screen stencil **14** are arranged for lateral movement coordinated with the rotation of the bottle being printed. The apparatus also includes supporting member **19** on which there is mounted air cylinder **20** which has a movable piston **21** movable into and out of engagement with the opening in bottles **12** which are being printed in the apparatus.

In FIG. 2, the relationship of the dihedral supports **10** and **11**, bottle **12**, and air cylinder **20** and piston **21** is shown in more detail. It is seen that dihedral supports **10** and **11** are connected to and supported on conveyor chains **8** and **9**. Dihedral support **11** is shown in more detail in FIGS. 5 and 6. Dihedral support **11** includes separate dihedral plane members **22** and **23** which meet in a dihedral angle and which are secured on and integral with vertically extending supporting member **24** by which the dihedral is secured on its supporting chain. At the printing station, there is provided a rotary supporting member **25** which is positioned to receive the square base of bottle **12** during the printing operation. It should be noted that, when reference is made to a square cross section bottle, the term is intended to define any bottle having flat sides which would form a square in cross section if projected to the point of intersection. In actual practice, molded plastic bottles of square cross section actually have rounded edges. Support member **25** is provided with a supporting axis **26** for rotation and is operated by the mechanism of the screen printer which is not shown. Support member **25** is provided with a plurality of projections or ribs **27** which are positioned around its periphery and define a square receptacle for the base of the bottle being printed.

At the printing station, there is provided a movable dihedral lifting member **28**, seen in more detail in FIGS. 4, 7, and 8. Dihedral member **28** is provided with separate dihedral plane members **29** and **30** and vertically extending supporting member **31**. Dihedral lifting member **28** is actuated vertically by actuator **32** shown diagrammatically in FIG. 2.

At the printing station, air cylinder **20** is actuated to move piston **21** so that its conical nose piece **33** engages the opening **34** to plastic bottle **12** (which is tipped slightly upward at the printing station). Air cylinder **20** and piston **21** are positioned in alignment with the axis of rotation of support member **25**. When air cylinder **20** is actuated to move piston **21** and conical nose piece **33** into engagement with the opening **34**, actuator mechanism **32** moves dihedral lifting member **28** into alignment with the support member **25** and with the upper rear portion of dihedral member **11**. The dihedral plane members **29** and **30** of dihedral lifting member **28** are set at an angle such that the edge of members **29** and **30** are aligned with the edges of dihedral plane members **22** and **23** when in juxtaposition therewith and at the opposite end are at an angle aligned accurately with members **27** on support member **25**. The dihedral angle of dihedral lifting member **28** is thus positioned so that the portion which is adjacent to dihedral members **22** and **23** has an angle corresponding to those members, viz. 120 degrees, and the portion adjacent to the support member **25** has an angle of 90 degrees. As air piston **21** is moved to engage conical nose piece **33** with the opening **34** in bottle **12**, bottle **12** is moved laterally to the right, as seen in FIG. 2, and is moved up the surface of dihedral lifting member **28** and guided into the supporting recess formed on the surface of rotary support member **25**. Dihedral lifting member **28**, therefore, performs the dual function of lifting bottle **12** toward support member **25** and causing it to be accurately aligned with the supporting recess defined by supports or ribs **27**. In this position, air pressure is supplied through cylinder **21** and nose piece **33** to the interior of bottle **12**. Bottle **12** is thereby inflated to a

cylindrical shape along the surface which contacts screen stencil **14**. In this position and in this condition, bottle **12** is rotated by rotation of supporting member **25** and screen stencil **14** is moved simultaneously at the same linear speed as the surface of bottle **12**. This is effective to produce the desired imprint around all or any predetermined part of the periphery of bottle **12**. After the screen printing of the bottle is complete, the air pressure is released from within the bottle which then returns to its original square cross section.

OPERATION

The operation of the apparatus as a whole should be apparent from the description of the individual parts but will be re-described for clarification. The apparatus is arranged to be operated continuously and intermittently by electric motors or other suitable driving mechanism and suitable timing mechanism not shown. The apparatus represents an improvement over previous screen printing devices for the printing of bottles or containers of square cross section primarily in that it provides for a continuous feeding of bottles to the printing station and continuous removal of bottles therefrom. The conveyor formed by conveyor chains **8** and **9** and the plurality of dihedral supporting members **10** and **11** is operated intermittently to move bottles **12** to the printing station. Bottles **12** may be loaded into dihedral supporting members **10** and **11** manually or may be loaded from a continuously operating conveyor belt positioned adjacent to the apparatus. Bottles **12** are advanced by intermittent movement of a conveyor through the printing station and are discharged from the conveyor at the opposite side of the apparatus beyond the printing station. The bottles may be discharged from the conveyor to a suitable storage hopper or, if desired, may be discharged to a conveyor belt or other suitable means for conveying the bottles to a dryer for ensuring that the imprint is completely dried.

When the bottles are moved along the conveyor carried on the dihedral supports **10** and **11**, the bottles are not necessarily accurately aligned for printing at the printing station. The bottles may lie to one side or the other of the dihedral supporting members but are brought into proper alignment at the printing station. The bottles are normally of square cross section but are made of thin flexible plastic which may be deformed under pressure to assume a cylindrical shape. When the bottles reach the printing station, i.e. are positioned directly under stencil **14** and squeegee **18**, the conveyor stops and the printing station is actuated. In this position, bottle **12** is positioned and printed as previously described. Dihedral lifting mechanism **28** is moved into position between dihedral support **11** and rotary supporting base **25** as shown in dotted line in FIG. 2 and in full line in FIG. 4. In this position, air cylinder **20** is actuated to move piston **21** and nose piece **33** into engagement with opening **34** in the end of bottle **12**. This action moves bottle **12** laterally to the right where it is guided by dihedral lifting member **28** into the square supporting recess defined by ribs **27** on support member **25**. When bottle **12** is moved to this position, dihedral lifting member **28** is retracted by actuator **32** so that it is out of engagement with bottle **12**. Air pressure is then applied through piston **21** and nose piece **33** to the interior of bottle **12** to inflate the bottle into a cylindrical shape. While the bottle is maintained under pressure and in a cylindrical condition, support member **25** is rotated. Rotation of support member **25** is coordinated with movement of screen stencil **14**. Screen stencil **14** is geared to the rotary movement of support member **25** so that it is moved at the same rate of linear movement as the surface of bottle **12** while inflated to a cylindrical condition and maintained in contact with the screen stencil. The rotation of bottle **12** along with the movement of stencil **14** results in squeegee **18** forcing the printing ink through the screen stencil to produce the desired imprint on all or any predetermined portion of the periphery of bottle **12**. After the printing operation is complete, air cylinder **20** causes piston **21** to retract and releases the air pressure from within bottle **12**. Bottle **12** thereupon returns to its original square cross section and simultaneously drops back into supporting dihedral members **10** and **11**. The conveyor is then actuated to move the next unprinted bottle into printing relation and moves the printed bottle toward the point of discharge from the apparatus.

AN ALTERNATE EMBODIMENT

In FIGS. 1 to 8, there was described a preferred embodiment of the invention in which square bottles are conveyed to a printing station and the bottle elevated from the conveyor means and inflated to a cylindrical shape and printed as if it were a cylindrical object.

In FIG. 9, there is shown an alternate embodiment of the invention in which the rotary support and inflating means for the bottle are moved to lift the bottle out of engagement with the conveyor at the printing station.

The apparatus shown in FIG. 9 is substituted at the printing station while eliminating the lifting dihedral **28**. The conveyor and screen printing mechanism are as shown in FIG. 1. In FIG. 9, the bottle **12** is positioned at the printing station immediately beneath screen stencil **14**. Bottle **12** is carried on dihedral members **10** and **11** on chains **8** and **9**.

Support **25**, with ribs **27** forming a recess, is positioned to receive the square base of bottle **12**. Air cylinder **20** is positioned with piston **21** and nose piece **33** aligned with opening **34** in bottle **12**. When air cylinder **20** is operated, piston **21** is moved to insert nose piece **33** into opening **34** and push the base of bottle **12** into rotary support **25**.

Rotary support **25** and air cylinder **20** are supported on movable yoke **40** having any suitable actuator **41**. When bottle **12** is secured, by movement of piston **21**, against rotary support **25**, actuator **41** moves yoke **40** to lift bottle **12** into engagement with screen stencil **14**. The bottle **12** is in flated to a cylindrical shape and rotated and screen stencil **14** moved in coordination therewith to print all or any selected part of the peripheral surface of the bottle.

After the printing is complete, actuator **41** moves yoke **40** to lower bottle **12** to the conveyor. Air cylinder **20** is deactuated, piston **21** retracted, and bottle **12** deflated to its initial square cross section.

I claim:

1. In a screen process printer for bottles of flexible material of square cross section including a screen stencil, rotary supporting means having abutments spaced in the outline of a square to receive the end of a square bottle to support the same in juxtaposition to said stencil, gas pressure applying means to inflate a square bottle to a temporary cylindrical shape for printing, means to rotate the inflated bottle, in printing contact with said stencil while moving the stencil at the same linear speed as the peripheral surface of the bottle, and the bottle being deflated to its initial square cross section after printing, the combination with said printer of conveyor means having bottle supporting dihedral members to move said bottles intermittently into and out of juxtaposition to said screen stencil said conveyor means being positioned to support said bottles a predetermined distance below said rotary supporting means, and a dihedral member positioned for vertical movement from an initial position below the level of said conveyor means to a position aligned with the end of one of said dihedral supporting members and providing a pair of inclined planes extending from said dihedral supporting members to the spaced abutments on said rotary supporting means, means to move said bottle laterally against said movable dihedral member, said movable dihedral member being operable in said aligned posi-

tion to guide said bottle upon lateral movement thereof into registration with said spaced abutments, said movable dihedral member being moved to said initial position after said bottle is positioned in said spaced abutments so that rotation of said rotary supporting means may rotate the inflated bottle without engaging the bottle with said conveyor means or said movable dihedral member.

2. A screen process printer as defined in claim 1 in which said conveyor means comprises a pair of intermittently operated chains supporting said bottle supporting dihedral members in aligned relation.

3. A screen process printer as defined in claim 2 in which said bottle inflating means includes means to move said bottle laterally against said movable dihedral member to lift and guide said bottle into said supporting abutments on said rotary supporting means.

4. A screen process printer as defined in claim 3 including means to move said movable dihedral member into said aligned position when said bottle inflating means is actuated and out of said aligned position prior to rotation of said rotary supporting means during the printing of the peripheral surface of the inflated bottle.

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U.S. Cl. X.R.

101—124, 126