PATENT SPECIFICATION

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COMPLETE SPECIFICATION

DRAWINGS ATTACHED

Improvements in or relating to Decorating Synthetic Plastics Containers

We, THE METAL BOX COMPANY LIMITED, a Company Incorporated under the laws of Great Britain, of 37, Baker Street, London, W.1, England, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to decorating exterior sides of a synthetic plastics container, for example a bottle blow-moulded from material such as polyethylene, which has a non-circular cross-section presenting two opposed sides which are of arcuate or even substantially flat form and which when inflated can be transported so that a side thereof is moved in an arcuate path while decoration is applied to the desired area thereof by a silk-screen printing process. Such containers will hereinafter be referred to as "flat bottles".

As is well understood, silk-screen printing process are preferred in most instances for flat bottles but the processes used hitherto are relatively slow, particularly when it is desired to effect multicolour printing because it is necessary that drying of one colour be effected before the application of the next colour.

It is one object of the present invention to provide apparatus for automatically printing each of the opposite sides of a flat bottle by a silk-screen process and a second object is to provide a machine which, in a reasonably small space and a reasonably short time, can print the desired number of colours and dry the inks. The machine preferably is operable automatically thereby eliminating handling of the bottles.

According to the invention there is provided apparatus for printing on the opposite sides of flat bottle made of synthetic organic thermoplastic material, comprising a silk screen printer mounted for reciprocation, first and second bottle-holding devices associated with the printer and arranged each to engage one flat side of a bottle with the silk screens of the printer during movement in one direction thereof, each said device consisting of a bottle holder and a nozzle through which inflation of the bottle is effected prior to printing thereon and being rotatable at an angular velocity such that a flat surface of a bottle carried thereby is moved in the same direction as and at the linear speed of the printer during printing on said surface, and transfer means operable to transfer bottles from the first to the second bottle-holding device, the arrangement of the printing apparatus being such that while the printer is printing a first side of one bottle it is also printing the second side of a bottle the first side of which has been printed by the printer.

Further, according to the invention there is provided apparatus for printing on the opposite sides of flat bottles made of synthetic organic thermoplastic material comprising a plurality of printing stations located in line and in spaced relation, each of said stations including a silk screen printer mounted for reciprocation, actuating means connected with said printers to effect simultaneous reciprocation thereof, first and second bottle-holding devices associated with each printer and arranged each to engage one flat side of a bottle with the silk screen of a printer during movement in one direction thereof, each said device consisting of a bottle holder and a nozzle through which inflation of the bottle is effected prior to printing thereon and being rotatable at an angular velocity such that a flat surface of a bottle carried thereby is moved in

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the same direction as and at the linear speed of the printer during printing on said surface, drying stations located respectively between successive printing stations and following the last printing station, conveyor means associated with each drying station and including bottle-gripping devices operable to engage and support bottles for movement through the drying station, and transfer means operable respectively to transfer bottles from said first to second bottle-holding devices, from a second bottle-holding device of one printing station to a drying station bottle-gripping device, and from a drying station bottle-gripping device to the first bottle-holding device of the next succeeding printing station, the arrangement of the printing apparatus being such that at each printing station while the printer is printing a first side of one bottle it is also printing the second side of a bottle the first side of which has been printed by the printer.

In order that the invention may be clearly understood one embodiment thereof will now be described, by way of example, with reference to the drawings accompanying the Provisional Specification in which:—

Fig. 1 is a side elevation of apparatus according to the invention;

Fig. 2 is a view, partly in section, of a part of the apparatus shown in Fig. 1;

Fig. 3 is a diagrammatic illustration of the path of a bottle during movement thereof through a printing station,

Fig. 4 is a section on line IV-IV, Fig 1;

Fig. 5 is a section on line V-V, Fig. 2.

Fig. 6 is an elevation, partly in section of a bottle-holding device employed in the apparatus,

Fig. 7 is a view illustrating the mode of operation of the bottle-holding device,

Fig. 8 is a section on line VIII-VIII, Fig. 6;

Fig. 9 illustrates the method of release of a bottle from the bottle-holding device,

Fig. 10 illustrates a part of the driving mechanism for the apparatus, and

Fig. 11 illustrates a bottle-gripping device used with drying means embodied in the apparatus.

Referring to the drawings, the apparatus comprises first, second and third printing stations 1, 2 and 3, Fig. 1, and first, second, and third drying stations 4, 5 and 6 all supported by framework indicated generally by the reference 7. The bottles 8 are delivered to the apparatus in succession by any suitable form of conveyor 9, Fig. 1, which delivers them to the first printing station 1. The bottles are carried through the drying stations by endless conveyors 10, 11, 12 each of which is provided with a plurality of bottle-gripping devices described below. The bottle-gripping devices of conveyor 10 receive bottles from the first printing station 1 and deliver them to the second printing station 2; the gripping devices of conveyor 11 receive bottles from station 2 and deliver them to station 3; and the gripping devices of conveyor 12 receive bottles from station 3 and deliver them to a delivery conveyor or to a receptacle, not shown.

Each of the printing stations is of like construction and only station 2 will therefore be described in detail.

At each printing station there is provided a silk-screen printer 13 which, being of well known construction is not described herein. The printers 13 are supported by carriages 13a for reciprocation lengthwise of a guide 14 by actuating means which comprises a rod 15, Figs. 1 and 4, common to all of the printers, simultaneous reciprocation of the printers 13 is effected by a rocking arm 16 which is connected to one of the printers 13, is pivoted at 17 and is operated by a cam 18, Fig. 4, on a shaft 19 driven by gears 20, 21, 22, Figs. 4 and 10, from a worm wheel 23, Fig. 10, and a worm 24 carried by a shaft 25 rotated by a belt 26. The arm 16 is connected with the printer 13 at station 2 by a link 27. Each silk screen printer 13 is arranged to print first one side of a bottle and then the other side thereof.

First and second bottle-holding devices are located beneath the silk-screen printer at each station and each said device consists of a bottle-holder 28 and a nozzle 29, Figs. 4 and 6, and is arranged to engage a flat side of a bottle with a silk-screen printer during movement of the printer in one direction, being the direction to the right as viewed in Fig. 1. The bottle-holder 28 and nozzle 29 are rotatable with a hollow shaft 30, Fig. 6, the bottle holder 28 being carried by a bearing 31 rotatable with shaft 30 and including an ejector pad 32 having a hollow spindle 33 slidable axially in the bearing 31 against the action of a spring 34 retained in position by a pin 35 and a steel ball 36 which engages a fixed plate 37 secured to the frame 7. The pin 35 extends into slots 38 in the spindle 33 and the spring is compressed by a bottle gripped between the holder 28 and nozzle 29. When the nozzle is withdrawn from the mouth of the bottle the spring moves the ejector pad to the left as viewed in Fig. 6, to displace the bottle from the holder 28.

The nozzle 29 is carried at the end of a hollow spindle 39 and is provided with orifices 40, Fig. 6, which open into the bottle 8 when the latter is gripped between the nozzle and the bottle holder 28. The nozzle is supported for movement length-

wise of the hollow shaft by a spindle 39 which is slidable axially in a bearing 41 rotatable with the hollow shaft 30 and is movable out of engagement with the mouth of the bottle by stationary cams 42 and is urged into engagement with the mouth of the bottle by a spring 43. The axial movements of the nozzle are controlled by a hollow operating rod 44 which is concentrically located in the hollow shaft 30. The nozzle is coupled to rod 44 by a fork 45 pivoted at 46 and a second fork 47, pivoted at 48, Fig. 7, carries a follower roller 49 which co-operates with the cams 42. The forks 45, 47 are displaced relative one to the other by ninety degrees, as shown in Fig. 8, but in Fig. 7, for ease of illustration, the forks are shown as being aligned.

Rotation of the hollow shafts 30 is effected by cranks 49 connected to an actuating bar 50 common to all of the cranks and driven by the gear 22, Fig. 10.

As is customary when printing bottles made of synthetic plastics material, the bottles are inflated prior to printing thereon and this is effected through the hollow operating rod 44 which at one end is connected by a flexible hose 51, Fig. 6, to the hollow spindle 39 and at the opposite end opens into the end of the hollow shaft 30 which is provided with orifices 52 communicating with the interior of a chamber 53 connected by a hose 54 with a pump 55, Fig. 6, through a valve 56 operation of which is controlled by mechanism, not shown, which in timed relation with the rotation of shaft 30 controls the admission of pressurised air to the bottle following insertion of the nozzle 29 into the mouth of the bottle, and the cutting off of the air supply when the nozzle is removed from the mouth of the bottle.

The bottle-holding devices 28, 29, are rotated in adjacent circular paths 57, 58, Fig. 3, the first holding device, which is movable in path 57, being arranged to receive a bottle from the conveyor 10 from the drying station 4 via transfer means described below, and the second holding device, which is movable in path 58, being arranged to receive a bottle from the first bottle-holding device 28, 29 via similar transfer means. The conveyor 11 for the drying station 5 receives a bottle from the second bottle-holding device 28, 29 via another similar transfer means.

Each of the transfer means is of like construction and comprises a cradle 59 secured to a carriage 60, Figs. 2, 4 and 5, having an arm 61 provided with a slot 62, Fig. 2, in which a slider 63 is disposed for sliding movement lengthwise of the slot under control of a first operating member 64 to which it is pivoted at 65. The first operating member 64 is common to all of the cradle arms 61 and slides in bearings 64*a*, 64*b*, Fig. 1, of which the bearing 64*a* is connected at 66, Fig. 2, to a first operating lever 67 pivoted to frame 7 at 68. The lever 67 is connected through an arm 67*a*, Fig. 1, to one end of a first operating link 69 the opposite end of which is connected to one arm of a bell crank lever 70, Figs. 1 and 4. The other arm of lever 70 is connected to the bearing 64*b*. The lever 70 is pivoted at 71 to the frame 7 and carries a follower roller 72 engaged in a track cam 73 rotatable with the shaft 19. The first operating member is also connected to a second operating link 74 which in turn is connected to a lever 75, Fig. 4, pivoted at 76 and carrying a cam follower 77 which is engaged with a cam 78, Fig. 4, rotatable with shaft 19.

The slider 63 is pivoted at 79, Figs. 2 and 5, to a second operating member 80 which is common to all of the sliders and which is slidable in fixed bearings 80*a* one of which is shown in Fig. 4. The second operating member 80 has a third operating link 81 connected thereto at 81*a*, Fig. 2 The opposite end of link 81 is connected to a lever 82, Figs. 1 and 4, pivoted at 76 and carrying a cam follower 83 which is engaged with a cam 84, Fig. 4, rotatable with shaft 19.

During a bottle-transfering operation the cradle 59^1 first occupies the datum position thereof shown in full lines in Fig. 2 and as the bottle carried by the first bottle-holding device 28, 29 moving along path 57, Fig. 3, approaches the cradle a cam 42, Figs. 4 to 6, causes the bottle to be released by the bottle holding device 28, 29 so that the bottle is engaged in the cradle for movement therewith. At this time the bottle is not fully disengaged by the device 28, 29 and the cams 73, 78 combine to effect concurrent lengthwise and, in a vertical plane, transverse movement of the first operating member 64 so as to move the cradle in a downward direction in the same sense and at the same speed as that of the device 28, 29 until the device 28, 29 is fully disengaged from the bottle and the cradle is in the lowermost position of the downward movement, this being a position the same as that indicated at 61*a*, Fig. 2 in connection with cradle 59. The cam 84 then reciprocates the second operating member 80 so that the cradle 59^1 moves horizontally along the path 85, Fig. 3, and assumes a position the same as that indicated at 61*b*, Fig. 2, this being the lowermost position of the upward movement of the cradle.

At this time the bottle in the cradle is aligned with the second bottle-holding device 28^1, 29^1, Fig. 2, moving along path 58, Fig. 3. The cams 73, 78 combine to

effect movement of the cradle in an upward direction the same sense and at the same speed as that of the second device 28^1, 29^1 and the second device 28^1, 29^1 is caused to grip the bottle and effect inflation thereof so that when the cradle again reaches the datum position thereof, that is the full line position thereof in Fig. 2, the bottle is removed from the cradle 59^1 and is carried by the bottle-holding device into engagement with the silk-screen printing device. Transfer of a bottle from conveyor 9 to the first printing station is effected in the manner just described and transfer of a bottle to and from the conveyors 10, 11, 12 of drying stations 4, 5, 6 is also effected in the manner described.

The bottle-gripping devices carried by the conveyors 10, 11 and 12 are similar to the devices 28, 29 but because it is not necessary that the bottles be inflated during drying they do not include the bottle inflating means described above. Fig. 11 illustrates the construction of the bottle-gripping devices for the drying stations. From Fig. 11 it will be seen that each bottle-gripping device comprises a pad 28*a* and a nozzle 29*a* but in this instance the nozzle is not provided with the orifices 40. The pad 28*a* and nozzle 29*a* are carried by the conveyors 10, 11 or 12, as appropriate, which consist of chains running in guides 85. The nozzle 29*a* is urged by a spring 86 into the bottle-engaging position thereof end carries a com follower roller 87 which, as appropriate, is engaged with a stationary cam 88, Fig. 2, to move the nozzle against the spring 86 preparatory to releasing a bottle for engagement by the first bottle-holding device 28, 29, or with a cam 89 in preparation to engage a bottle to be received from the second bottle-holding device 28, 29.

When the apparatus is in operation a bottle is delivered from conveyor 9 and is transferred therefrom by a cradle 59 to the first bottle-holding device 28, 29 of the first printing station which carries the bottle into engagement with the silk-screen printer 13 at the first printing station to effect printing on one side of the bottle. The bottle is then transferred by another cradle 59 to the second bottle-holding device which, because the bottle is moved by the second bottle-holding device in the same sense as that in which it was moved by the first bottle-holding device, carries the opposite side of the bottle into engagement with the printer 13 at the first printing station. The bottle, now printed on both sides, is transferred by a third cradle 59 to a bottle-gripping device 28*a*, 29*a* on the conveyor 10 of the first drying station and the bottle is conveyed through the drying station where the ink is dried by hot air or other suitable means.

After drying the bottle is transferred from conveyor 10 by a cradle 59 to the first bottle-holding device 28, 29 of the second printing station and the cycle of printing and drying is repeated. Following a third cycle of printing at station 3 drying is effected in like manner at drying station 6 and the bottle is then released from conveyor 12 to a delivery conveyor or into a receptable. Thus the bottle may be easily printed, on both sides, in three colours, or by more colours by increasing the number of printing and drying stations.

It is to be understood that, if desired, each silk screen may be designed to print a different colour on to the front and the reverse side of a bottle. Further, the silk screens may be so designed as to permit different coloured inks to be applied to the upper and lower halves of one or both sides of a bottle.

It will be understood that, although there has just been described the passage of one bottle through the apparatus, when the apparatus is fully operative there will be two bottles simultaneously transferred and printed at each of the printing stations thus the printing of the bottles is effected in a simple, expeditious, and continuous manner.

WHAT WE CLAIM IS:—

1. Apparatus for printing on the opposite sides of flat bottles made of synthetic organic thermoplastic material, comprising a silk screen printer mounted for reciprocation, first and second bottle-holding devices associated with the printer and arranged each to engage one flat side of a bottle with the silk screen of the printer during movement in one direction thereof, each said device consisting of a bottle holder and a nozzle through which inflation of the bottle is effected prior to printing thereon and being rotatable at an angular velocity such that a flat surface of a bottle carried thereby is moved in the same direction as and at the linear speed of the printer during printing on said surface, and transfer means operable to transfer bottles from the first to the second bottle-holding device, the arrangement of the printing apparatus being such that while the printer is printing a first side of one bottle it is also printing the second side of a bottle the first side of which has been printed by the printer.

2. Apparatus for printing on the opposite sides of flat bottles made of synthetic organic thermoplastic material, comprising a plurality of printing stations located in line and in spaced relation, each of said stations including a silk screen printer mounted for reciprocation, actuating means connected with said printers to effect simul-

effect movement of the cradle in an upward direction the same sense and at the same speed as that of the second device 28^1, 29^1 and the second device 28^1, 29^1 is caused to grip the bottle and effect inflation thereof so that when the cradle again reaches the datum position thereof, that is the full line position thereof in Fig. 2, the bottle is removed from the cradle 59^1 and is carried by the bottle-holding device into engagement with the silk-screen printing device. Transfer of a bottle from conveyor 9 to the first printing station is effected in the manner just described and transfer of a bottle to and from the conveyors 10, 11, 12 of drying stations 4, 5, 6 is also effected in the manner described.

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It will be understood that, although there has just been described the passage of one bottle through the apparatus, when the apparatus is fully operative there will be two bottles simultaneously transferred and printed at each of the printing stations thus the printing of the bottles is effected in a simple, expeditious, and continuous manner.

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2. Apparatus for printing on the opposite sides of flat bottles made of synthetic organic thermoplastic material, comprising a plurality of printing stations located in line and in spaced relation, each of said stations including a silk screen printer mounted for reciprocation, actuating means connected with said printers to effect simul-

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taneous reciprocation thereof, first and second bottle-holding devices associated with each printer and arranged each to engage one flat side of a bottle with the silk screen of a printer during movement in one direction thereof, each said device consisting of a bottle holder and a nozzle through which inflation of the bottle is effected prior to printing thereon and being rotatable at an angular velocity such that a flat surface of a bottle carried thereby is moved in the same direction as and at the linear speed of the printer during printing on said surface, drying stations located respectively between successive printing stations and following the last printing station, conveyor means associated with each drying station and including bottle-gripping devices operable to engage and support bottles for movement through the drying station, and transfer means operable respectively to transfer bottles from said first to said second bottle-holding devices, from a second bottle-holding device of one printing station to a drying station bottle-gripping device, and from a drying station bottle-gripping device to the first bottle-holding device of the next succeeding printing station, the arrangement of the printing apparatus being such that at each printing station while the printer is printing a first side of one bottle it is also printing the second side of a bottle the first side of which has been printed by the printer.

3. Apparatus according to Claim 1 or Claim 2, wherein each transfer means comprises a cradle and operating means co-operating therewith to effect movement thereof to and from a datum position thereof at which a bottle is located in the cradle by a first bottle-holding device or a bottle-gripping device as appropriate, said operating means being operable first to move the cradle in a downward direction in the same sense and at the same speed as that of a bottle-holding device or a bottle-gripping device, as appropriate, to permit disengagement of said device from the bottle located in the cradle, next to move the cradle into the path of a further bottle-holding device or bottle-gripping device ,as appropriate, which is to remove the bottle from the cradle, and then to move the cradle in an upward direction to the datum position in the same sense and at the same speed as said further device which said further device is engaged with the bottle to effect removal thereof from the cradle when the cradle is restored to the datum position thereof.

4. Apparatus according to Claim 3, wherein each cradle is mounted on a carriage provided with a slot which extends lengthwise from the bottom of the cradle and in which a slide is located for movement lengthwise of the slot, and wherein the operating means comprises a first operating member common to all of the cradles and to which the cradles are pivoted for movement therewith and rocking movement relative thereto, a first operating lever connected with the first operating member and operable by a cam to effect movement of the first operating member in a vertical plane, an operating link connected with the first operating member and operable by a cam to effect lengthwise movement of the operating member concurrently with the movements thereof by the first operating lever simultaneously to effect said downward and upward movements of the cradles, a second operating member common to all of the cradles and to which said sliders are pivoted for movement therewith and rocking movement relative thereto, and a further operating link connected to said second operating member and operable by a cam to effect lengthwise movement of the second operating member simultaneously to move the cradles from the lowermost positions of the downward movements thereof to the lowermost positions of the upward movements thereof.

5. Apparatus according to Claim 2 or to Claim 2 in combination with Claim 3 or Claim 4, wherein said actuating means comprises a rod connecting the printers at each of the printing stations for simultaneous reciprocation, a rocking arm, a link connecting the rocking arm with the printer at one of the printing stations, and a cam co-operating with the rocking arm to effect reciprocation of the printers.

6. Apparatus according to Claim 2 or to Claim 2 in combination with any one of Claims 3 to 5, wherein the first and second bottle-holding devices at each of the printing stations are rotated by cranks individual thereto and said cranks are rotated by an actuating bar common thereto to effect simultaneous rotation of the cranks.

7. Apparatus according to Claim 6, wherein each crank effects rotation of a hollow shaft with which the bottle-holder and nozzle are rotatable, the bottle-holder includes an ejector pad urged by a spring to the ejecting position thereof, and the nozzle is supported for movement lengthwise of the hollow shaft into and out of engagement with a bottle.

8. Apparatus according to Claim 7, wherein movement of the nozzle lengthwise of the hollow shaft is effected by an operating rod coupled to the nozzle by a pivoted fork, said operating rod being urged by a spring to the bottle-engaging position of the nozzle and connected with a second pivoted fork carrying a roller engageable with stationary cams arranged to

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effect movement of the operating rod against the action of the spring acting on the operating rod to disengage the nozzle from the bottle.

9. Apparatus for printing on the opposite sides of flat bottles made of synthetic organic thermoplastic material, substantially as herein described with reference to the drawings accompanying the Provisional Specification.

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