

CLAIMS

1. A continuously rotating, non-symmetric preform feed, stretch-blow-moulding machine dedicated to the stretch-blow-moulding of containers from non-symmetric injection moulded preforms; the non-symmetric preforms including an integral handle extending from a first junction point to a second junction point on a body of the preform; the body of the preform and the integral handle constituted from the same material; the machine including a preform orientation system to orient the handle of the preform into a known orientation at arrival at a pick off position.
2. The machine of claim 1 wherein preforms are in continuous motion from an initial preform pick off point through stretch-blow-moulding into the containers and ejection from the machine as stretch-blow-moulded containers.
3. The machine of claim 1 or 2 wherein the integral handle retains a shape of the handle as injection moulded through all stages of the stretch-blow-moulding machine to forming a handle on the stretch-blow-moulded container.
4. The machine of claim 3 wherein the stages of the stretch-blow-moulding machine include a handle orientation stage; all preforms arriving at the pick off point having the integral handle oriented in a predetermined direction relative to motion of the preform approaching the pick off position.
5. The machine of claim 3 or 4 wherein the stages of the stretch-blow-moulding machine include a continuously rotating first transfer system transferring preforms from a continuously rotating preform feeder wheel at the preform pick off position to a transfer to preheating position at a continuously rotating preheating stage.
6. The machine of claim 5 wherein a first pick and place apparatus of the first transfer system includes a preform grasping gripper; reciprocating rotation and linear displacement of the grasping gripper induced by a combination of a rotating carrier of the pick and place apparatus and two cam loci.

7. The machine of claim 6 wherein the rotating carrier is an arm of four radially extending support arms rotating about a common centre of rotation; an outer end of each support arm rotationally supporting a pick and place apparatus.
8. The machine of claim 8 wherein the support arms rotate above a fixed cam plate; the cam plate provided with an inboard cam channel for a first locus of the two cam loci and a periphery of the cam plate providing an outer cam surface for a second locus of the two cam loci.
9. The machine of claim 7 or 8 wherein a housing of a linear guide of the pick and place apparatus is rotationally mounted at the outer end of the supporting arm; an outrigger arm extending from the housing provided with a first cam follower locating in the cam channel.
10. The machine of claim 9 wherein a free sliding element of the linear guide is provided with a second cam follower; the second cam follower maintained in contact with the outer cam surface by a spring.
11. The machine of claim 11 wherein the grasping gripper of the pick and place apparatus is mounted to a rotary actuator supported from an outer end of the free sliding element; the rotary actuator adapted to rotate fingers of the grasping gripper 180degrees as a pick and place apparatus transits between the preform pick off position and the transfer to preheating position.
12. The machine of any one of claims 5 to 11 wherein the continuously rotating preheating stage includes a preform transport system; preform supporting mandrels travelling along a loop rail system; the preform supporting mandrels rotating preforms about a vertical axis of the preforms as preforms travel past banks of heating elements.
13. The machine of claim 12 wherein the preform supporting mandrels are provided with a heat shield; the heat shield comprising a channel projecting from a cylindrical collar.
14. The machine of claim 13 wherein the pick and place apparatus of the first transfer system brings a vertical axis of a perform into alignment with a vertical axis of the cylindrical collar of a preform supporting mandrel at the transfer to preheating position; the gripper of

the pick and place apparatus concurrently manoeuvring the handle of the preform between side elements of the channel of the mandrel.

15. The machine of claim 14 wherein the preform is lowered after the neck of the preform is released by the gripper of the pick and place apparatus so that the neck of the preform is located within the cylindrical collar of the mandrel.

16. The machine of any one of claims 12 to 15 wherein a preheated preform is extracted from a supporting mandrel by a pick and place apparatus of a second transfer system at a transfer from supporting mandrel position; the transfer from supporting mandrel position lying on a line joining respective centres of rotation of a proximate rotating guide wheel of the preheating transport system and the second transfer system.

17. The machine of claim 16 wherein the preform extracted from a preform supporting handle by a gripper of the pick and place apparatus of the second transfer system is rotated through 180degrees by a rotary actuator of the pick and place apparatus as an arm of the second transfer system rotates the pick and place apparatus towards a die loading position.

18. The machine of claim 16 or 17 wherein a combination of rotation of the arm of the second transfer system and rotation and linear displacement of the gripper induced by the loci of a first and second cam follower of the pick and place apparatus, brings a vertical axis of the preform into alignment with a vertical axis of a stretch-blow-moulding die as both the pick and place apparatus and an opened stretch-blow-moulding die approach the die loading position; movements of the gripper concurrently bringing the handle of the preform into alignment with a line joining respective centres of rotation of the stretch-blow-moulding die and the second transfer system.

19. The machine of claim 17 or 18 wherein a pick and place apparatus of a third transfer system extracts a stretch-blow-moulded container from the stretch-blow-moulding die as the stretch-blow-moulding die opens at a die unloading position; the die unloading position lying on a line joining respective centres of rotation of the rotating stretch-blow-moulding die and the third transfer system.

20. The machine of claim 19 wherein extracted stretch-blow-moulded containers are rotated from the die unloading position to a rotating outfeed wheel; the rotating outfeed wheel transferring the containers along a discharge channel and a container receiving bin.

21. A pick and place apparatus manipulating a non-symmetrical preform; the pick and place apparatus operating in a continuously rotating stretch-blow-moulding machine wherein a preform gripping gripper of the pick and place apparatus is urged into reciprocating rotation and linear displacement by a combination of a rotating support of the pick and place apparatus and two cam loci.

22. The pick and place apparatus of claim 21 wherein reciprocating rotation is about a vertical axis; linear displacement being in a horizontal plane.

23. A method of controlling paths of grippers of pick and place apparatuses of rotating transfer systems; the rotating transfer systems operating in a continuous non-symmetric preform feed stretch-blow-moulding machine; the paths of the grippers following respective loci of non-symmetrical preforms as preforms are transferred by the rotating transfer systems from a preform pick off position, inserted into and extracted from a preform support mandrel of a preheating stage and inserted into and extracted as a stretch-blow-moulded containers from rotating stretch-blow-moulding dies; the non-symmetrical preforms comprising a body portion and an integral handle extending from the body portion; the method including the steps of:

- rotationally mounting each of the pick and place apparatuses on a rotating arm of a respective rotating transfer system,
- urging reciprocating rotation of the grippers about respective vertical axes of the pick and place apparatuses controlled by a locus of a first cam follower and the rotation of the rotation of the rotating arm,
- urging reciprocating horizontal linear displacement controlled by a locus of a second cam follower and the rotation of the rotating arm, and,

wherein the locus of the first cam follower is determined by a cam channel of a cam plate; the locus of the second cam follower being determined by an outer cam surface of the cam plate.

24. The method of claim 23 wherein a first rotating transfer system transfers a non-symmetrical preform from a rotating preform feeder wheel to a rotating preform support mandrel of the preform preheating system.
25. The method of claim 24 wherein a second rotating transfer system transfers a non-symmetrical preform from a rotating preform support mandrel into a stretch-blow-moulding die.
26. The method of claim 25 wherein a third rotating transfer system extracts stretch-blow-moulded containers from the stretch-blow-moulding die to a rotating outfeed wheel.
27. A method of transferring a non-symmetric preform between stages of a continuous non-symmetric preform feed rotating stretch-blow-moulding machine; the non-symmetric preform being transformed into a stretch-blow-moulded container by a step of stretching and blowing the non-symmetric preform in a cavity of the stretch-blow-moulding die; the method including the steps of:
- orienting the non-symmetrical preform so that an integral handle of the preform has a known orientation at arrival at a pick off position in the machine,
 - gripping a neck of the preform in grippers of a pick and place apparatus of a rotating first rotating transfer system and rotating the preform to a preheating stage of the machine,
 - manoeuvring the gripper of the first pick and place apparatus so as to align the integral handle with a heat shield of a moving preform supporting mandrel and aligning an axis of a body of the preform with a neck supporting cylindrical collar of the mandrel,
 - removing the non-symmetric preform from the preform supporting mandrel with a gripper of a second pick and place apparatus of a rotating second rotating transfer system and rotating the preform to a rotating stretch-blow-moulding die of the machine in a second stage,
 - manoeuvring the gripper of the second pick and place apparatus so as to align the integral handle with a handle nesting portion of the stretch-blow-moulding die and a vertical axis of the preform with a vertical axis of the stretch-blow-moulding die in a third stage,

- manoeuvring grippers of a pick and place apparatus of a rotating third rotating transfer system in position to grasp the neck of a now stretch-blow-moulded container and extracting the stretch-blow-moulded container from the stretch-blow-moulding die in a fourth stage.

28. The method of claim 27 wherein movement of the grippers of the pick and place apparatus of any one of the first, second or third rotating transfer systems is controlled by a combination of rotation of an arm of the transfer system supporting the pick and place apparatus and rotation and linear displacement controlled by loci of two cam followers.

29. The method of claim 28 wherein locus of the first cam follower is determined by a cam channel provided in a fixed cam plate of each of the first, second and third rotating transfer systems; the locus of the second cam follower determined by an outer cam surface of the fixed cam plates.

30. A method of manipulating a non-symmetrical injection moulded preform into a stretch-blow-moulding die of a continuous preform feed stretch-blow-moulding machine; the method including the steps of:

- extracting a preform from a preform preheating stage with a pick and place apparatus of a continuously rotating transfer system such that an integral handle of the preform has a predetermined orientation, and

wherein manoeuvring of a preform supporting gripper of the pick and place apparatus is controlled by rotation of an arm of the transfer system in combination with rotation and linear extension of the gripper guided by loci of two cam followers.

31. The method of claim 30 wherein the method includes the further steps of:

- manoeuvring the pick and place apparatus to align the integral handle with a bisecting radial line of an open stretch-blow-moulding die as the bisecting radial line rotates into coincidence with a line extending between rotation centres of the stretch-blow-moulding machine and the transfer system,
- further manoeuvring the pick and place apparatus to align a vertical axis of a body of the preform with an axis of the die and the handle of the preform with a handle nesting portion of the die when opposing halves of the die close on reaching the line

between rotation centres.

32. A method of preventing distortion of an integral handle of a preform in a stretch-blow-moulding process in a continuous preform feed stretch-blow-moulding machine; the method including the steps of:

- preparing each half of a stretch-blow-moulding die with a handle nesting cavity conforming to at least a portion of the integral handle of the preform,
- manipulating the preform so that the handle is brought into coincidence with the handle nesting cavity as two halves of the stretch-blow-moulding die close on the preform.

33. The method of claim 32 wherein manipulation of the preform is by a pick and place apparatus; a gripper of the pick and place apparatus urged into rotational and linear motion by a combination of rotation of an arm of a preform transfer system to which the pick and place is mounted, and rotation and linear displacement controlled by two cam loci.

34. A method of controllably heating a pre-form to a die introduction temperature; the pre-form having a neck portion extending from a body portion; said pre-form further having a handle portion extending radially; said method comprising

- controllably transferring an integral handle PET pre-form onto a continuously moving conveyor;
- securing the preform by its neck portion to the conveyor whereby the preform is transported by the conveyor continuous from a pre-form entry location to a pre-form exit location;
- at least portions of the pre-form controllably heated to the die introduction temperature by the time it reaches the pre-form exit location;
- a controllable heater array distributed along the path arranged to direct heat to selected portions of the pre-form;
- the pre-form controllably transferred from the preform exit location into a die for stretch blow moulding of the pre-form thereby to form a blown container.

35. The method of claim 34 wherein the handle portion is solid and has a first end and a second end; the first end integrally connected at a first, upper location to the pre-form; the

second end integrally connected at a second, lower location to the pre-form.

36. The method of claim 34 or 35 wherein the first, upper location is located on the body portion.

37. The method of claim 34 or 35 wherein the first, upper location is located on the neck portion.

38. The method of any one of claims 34 to 37 wherein the second, lower location is located on the body portion.

39. The method of any one of claims 34 to 38 wherein elements are arranged in modules; the modules arrayed around the continuously rotating preform conveyer; the elements controlled as a group based on height wherein the top most elements of the modules are controlled to a predetermined temperature together whilst the next down in height elements are also controlled together to a predetermined temperature – and so on down to elements at the lowest level.

40. The method of any one of claims 34 to 39 wherein a processor controls the speed of rotation of a motor in order to control the continuous speed of advancement of the preforms.

41. The method of any one of claims 34 to 40 wherein a temperature sensor provides environment temperature sensing which is utilised by processor to modulate the degree of heating of all elements by a difference factor delta (Δ).

42. An orientation mechanism controlling orientation of a non-symmetric injection moulded preforms prior to entry into stages of a stretch blow-moulding machine; the non-symmetric preforms each including an integral handle extending from a first junction point below a neck of the preform and a second junction point on a body of the preform; the mechanism including a pair of contra-rotating drive wheels disposed along opposite sides of inclined rails; one of the drive wheels inducing rotation of the body of the preform moving down the inclined rails to rotate the handle of the preform into a preferred position.

43. The mechanism of claim 42 wherein the inclined rails include a pair of upper rails between the preforms are suspended by necks of the preform and a pair of lower rails which constrain the integral handles into approximate alignment with a long axis of the inclined rails; integral handles of the preforms constrained to either a leading or a trailing orientation.

44. The mechanism of claim 43 wherein the pair of drive wheels are located at a level coincident with a lower portion of the body of the preform below the lower rails and a lowest point of the integral handles; axes of the drive wheels normal to the long axis of the inclined rails.

45. The mechanism of any one of claims 42 to 44 wherein a gap between the pair of drive wheels is smaller than a diameter of the body of the preform; each guide wheel including at least one tyre of a sufficiently soft polymer material to allow passage of the body of the preform through the gap between the pair of drive wheels.

46. The mechanism of any one of claims 42 to 45 wherein directions of rotation of the pair of contra-rotating drive wheels draw preforms moving down the inclined rails through the gap between the drive wheels; a first of the drive wheels rotating in an anticlockwise direction with a second opposite drive wheel rotating in a clockwise direction.

47. The mechanism of any one of claims 42 to 46 wherein the drive wheels rotate at different rates of rotation; the ratio of rotation of the first drive wheel to the rotation of the second opposite drive wheel being of the order of 2:1.

48. The mechanism of claim 47 wherein the different rates of rotation of the drive wheels cause the second opposite drive wheel to rotate the body of the preform in an anticlockwise direction as the preform passes through the gap between the two drive wheels.

49. The mechanism of claim 48 wherein rotation of the body of the preform changes orientation of a preform with a leading handle at entry to the mechanism to a preform with a trailing handle on exit from the mechanism; a gap in the lower rail at the side of the lower rail adjacent the first drive wheel.

50. A method of orienting a non-symmetrical preform for entry to stages of a stretch blow-moulding machine; the none symmetrical preform including an integral handle extending from a first junction point below a neck of the preform to a second junction point on the body of the preform; the method including the steps of:

- Providing preforms to slide down inclined rails towards an orientation mechanism while supported by the necks of the preforms along upper rails of the inclined rails,
- Constraining integral handles of the preforms in either a leading or in a trailing position between lower rails of the inclined rails,
- Drawing preforms through a gap between a pair of contra rotating drive wheels of the orientation mechanism disposed along the inclined rails, and

wherein differential rates of rotation of the pair of drive wheels rotate the body of the preform from a leading orientation of the integral handle at entry to the orientation mechanism into trailing orientation of the handle at exit of the preform from the orientation mechanism.

51. The method of claim 50 wherein the pair of drive wheels are located coincident with a lowermost portion of the body of the preform below lower rails of the inclined rails and below a lowermost point of the integral handle.

52. The method of claim 50 or 51 wherein a first of the pair of contra rotating guide wheels at one side of the inclined rails rotates in an anticlockwise direction; the second of the pair of contra rotating drive wheels at an opposite side of the inclined rails rotating in a clockwise direction; the pair of contra rotating drive wheels acting to draw preforms through the gap between the drive wheels.

53. The method of claim 52 wherein the ratio of the rate of rotation of the contra rotating drive wheel to the rate of rotation of the clockwise rotating drive wheel is in the order of 2:1.

54. The method of claim 53 wherein the clockwise rotation of the clockwise rotating drive wheel rotates bodies of a preforms passing through the gap between the drive wheels in an anticlockwise direction such that a preform with an integral handle in a leading orientation is rotated so that the integral handle is in a trailing orientation.

55. An injection-moulded preform forming a stretch-blow-moulded container produced in the machine of claims 1 to 22; the preform comprising an open neck portion and a hollow body extending from the neck portion; the preform further including an integrally injection-moulded handle; at least a portion of walls of the hollow body varying in thicknesses.
56. The preform of claim 55 wherein at least a portion of an inner surface of the hollow body is non-concentric with outer surfaces of the hollow body.
57. The preform of claim 55 wherein the outer surfaces of the hollow body are defined by diameters centred on a central longitudinal axis of the preform to form a substantially cylindrical body.
58. The preform of claim 55 or 56 wherein cross sections of the at least a portion of the inner surface of the hollow body are ovoid in section.
59. The preform of claim 57 wherein centres of the cross sections of ovoid shape are centred on the central longitudinal axis of the preform.
60. The preform of claim 57 wherein centres of the cross sections of ovoid shape are offset from the longitudinal axes of the preform.
61. The preform of claim 56 wherein centres of circular cross sections of a portion of the hollow body are offset from a central longitudinal axis of the hollow body.
62. The preform of any previous claim wherein a core or mandrel forming the inner surface of the hollow body in an injection moulding step, comprises at least one portion of circular cross sections to form an upper region of the inner surface of the preform; portion of the mandrel comprising ovoid cross sections depending from a transition portion between a lower end of the at least one portion of circular cross sections and the portion of ovoid cross sections.
63. The preform of claim 62 wherein the mandrel comprises two portions of circular cross sections; an upper portion and a lower portion; the transition portion depending from the

lower portion.

64. The preform of claim 62 or 63 wherein the upper portion is of diameters equal to inner diameters of the neck portion of the preform.

65. The preform of claim 64 wherein the lower portion is of diameters smaller than the diameters of the upper portion.

66. The preform of any one of claims 64 to 65 wherein the transition portion forms an asymmetrical frustum of a cone; an upper end of the transition portion having a diameter equal to that of a lower end of the lower portion with the lower end of the transition portion conforming in cross section to the ovoid cross section of an upper end of the ovoid portion.

67. The preform of any one of claims 63 to 66 wherein each of the upper portions and the ovoid portion are tapering; the cross sections decreasing in area from respective maximum areas at upper ends of the portions to minimum areas at the respective lower ends.

68. The preform of any one of claims 55 to 67 wherein the diameters defining the outer surface of the hollow body decrease in dimension from a maximum diameter at a lower end of the neck portion to the lower end of the hollow body.

69. The preform of any previous claim wherein the preform includes an integral handle; the handle forming a loop of material extending vertically below the neck portion of the preform to a lower junction on the body of the preform.

70. The preform of claim 69 wherein a central vertical plane of the handle passes through the central axis of the preform.

71. The preform of any one of claims 66 to 70 wherein major axes of the cross sections of the ovoid portion of inner surface of the hollow body of the preform lie in the central vertical plane.

72. The preform of claim 71 wherein wall thicknesses of the preform in that portion of the preform in which the inner surfaces are defined by the ovoid cross sections, vary from a

maximum at opposite ends of the minor axes of the ovoid cross sections to minimum thicknesses at outer ends of the major axes.

73. The preform of claim 72 wherein the ratio of maximum wall thickness to minimum wall thickness of the ovoid portion lies in the range of 2:1 and 2.2:1.

74. The preform of claim 72 or 73 wherein polymer walls of the preform proximate maximum thickness are distributed predominantly to longer side walls of a rectangular cross section blown container; the polymer walls of the preform proximate minimum thickness predominantly distributed to shorter side walls of the blown container.

75. A method of optimizing wall thickness in a stretch-blow-moulded container formed in the machine of any one of claims 1 to 22; the method including the steps of:

- injection moulding hollow preforms in which at least a lower portion of each preform has internal cross sections non-concentric with external surfaces of the lower portion,
- bringing the preforms to a temperature suitable for stretch-blow-moulding,
- inserting the preforms into cavities of a stretch-blow-moulding machine,
- mechanically stretching the preforms and injecting air to form the container.

76. The method of claim 75 wherein mandrels for the injection moulding of the preforms include at least one upper region of circular cross sections.

77. The method of claim 75 or 76 wherein the lower portion of the preform has cross sections of an ovoid form.

78. The method of any one of claims 75 to 77 wherein the upper region of the mandrel includes an upper portion and a lower portion.

79. The method of claim 78 wherein a transition portion extends between a lower end of the lower portion and an upper end of the lower section.

80. The method of any one of claims 75 to 79 wherein external surfaces of the preform are defined by diameters centred on a central longitudinal axis of the preform.

81. The method of any one of claims 75 to 80 wherein an integral handle is formed on the preform extending in a loop between a first junction region below a neck portion of the preform and a second junction region on a body of the preform; a central vertical plane of the integral handle coincident with the central longitudinal axis.

82. The method of claim 81 wherein major axes of the cross sections of ovoid form of the lower section lie in the central vertical plane.

83. The method of claim 82 wherein wall thicknesses of the preform in the lower section vary from maximum thicknesses at opposite ends of the minor axes of the ovoid cross sections to minimum thicknesses at opposite ends of the major axes.

84. The method of claim 83 wherein in stretch-blow-moulding a container of generally rectangular cross section, polymer material proximate the maximum thicknesses is distributed to longer sides of the container and polymer material proximate the minimum thicknesses is distributed to shorter sides of the container.

85. A mandrel forming internal surfaces of an injection-moulded hollow preform; the preform forming a stretch-blow-moulded container on the machine of any one of claims 1 to 20; the mandrel including at least one portion with cross sections which are non-concentric with diameters defining outer surfaces of the preform.

86. The mandrel of claim 85 wherein the non-concentric cross sections are ovoid in form; the ovoid forms defining varying wall thickness of the preform.

87. The mandrel of claim 86 wherein major axes of the ovoid formed cross sections lie in a vertical plane containing a vertical central longitudinal axis of the preform; the vertical plane forming a mid plane of an integral handle formed on the preform depending vertically from a first junction region below a neck portion of the preform to a second junction point on a body of the preform.

88. A method of biasing distribution of polymer material from walls of at least one portion of a preform to selected side walls of a container stretch-blow-moulded from the preform on the machine of any one of claims 1 to 20; the method including the steps of:

- arranging a mandrel defining inside surfaces of the preform with cross sections of the at least one portion which are non-concentric with corresponding outer surfaces of the preform as defined by a cavity of a preform injection moulding die,
- arranging the mandrel in the injection moulding die such that major axes of the cross sections of the mandrel of the at least one portion are aligned with a central vertical plane of the cavity,
- injection moulding the preform,
- introducing the preform into a cavity of a stretch-blow-moulding machine such that the central vertical plane of the preform is aligned with a central vertical plane of a blown container of generally rectangular cross section, and

wherein the central vertical plane of the container is parallel to opposing longer sides of the container.

89. The method of claim 88 wherein cross sections of the mandrel in the at least one portion are ovoid in shape; major axes of the ovoid cross sections aligned with the central vertical plane; centres of the ovoid cross sections coincident with a central axis of a body of the preform.

90. The method of claim 88 or 89 wherein outer surfaces of the body of the preform are defined by diameters centred on the central axis.

91. The method of any one of claims 88 to 90 wherein the preform includes an integral handle forming an integral handle on the container; the integral handle of the preform extending vertically from a first junction below a neck portion of the preform to a second junction on a body of the preform; the integral handle centred on the central vertical plane of the preform.

92. The method of any one of claims 88 to 91 wherein in a blow moulding stage polymer material of walls of the preform in the at least one portion and on opposing ends of a minor axes of the ovoid cross sections are biased to the opposing longer sides of the container; polymer material proximate to opposite ends of a major axes of the ovoid cross sections biased towards the shorter side walls of the container.

93. A method of injection moulding a preform in which at least a portion of wall thicknesses of a hollow body of the preform varies along a length of the hollow body; the method including the steps of;

- Forming at least one pair of opposing cavities in an injection moulding die; the cavities defining external surfaces of the preform and an integral handle,
- Locating a mandrel in each of the at least one opposing cavities such that a central longitudinal axis of the mandrel is coincident with an axis of the cavity as defined by a neck portion of the hollow body,
- Closing the injection moulding die to form a cavity about the mandrel,
- Injecting a polymer into the cavity to form the preform, and

wherein the injection-moulded preform includes an integral, injection-moulded handle; the handle extending as a loop from a first junction point below a neck portion of the preform to a second junction point on the hollow body of the preform.

94. The method of claim 93 wherein wall thicknesses of the hollow body of the perform increase from below the neck portion to proximate a lower end of the preform.

95. The method of claim 94 in which cross sections of internal surfaces of the perform are concentric with cross sections of external surfaces of the preform.

96. The method of claim 94 wherein at least a portion of cross sections of internal surfaces of the preform are non-concentric with cross sections of outer surfaces of the preform.

97. The method of claim 96 wherein non-concentricity of the cross sections of internal surfaces of the preform with cross sections of the outer surface of the preform is from a portion of cross sections of the internal surface being of ovoid form.

98. The method of claim 96 wherein non-concentricity of the internal surfaces with the outer surface of the hollow body is from centres of cross sections of the internal surface being of offset from a central longitudinal axis of the preform.

99. A preform and a container stretch-blow-moulded from the preform by the stretch-blow-moulding machine of claims 1 to 20; the preform comprising a neck portion, a collar below the neck portion and a body extending from below the collar; the body including a first cylindrical portion having a first diameter and a second conical portion tapering from a diameter smaller than the diameter of the first portion to a minimum diameter proximate a bottom portion of the preform.

100. The preform and container of claim 99 wherein the preform includes an integral handle forming a loop extending from a first junction position proximate the collar to a second junction position along the body.

101. The preform and container of claim 99 or 100 wherein the first cylindrical portion extends from below the collar; the first portion being of a substantially constant diameter.

102. The preform and container of any one of claims 1 to 3 wherein wall thickness of the second conical portion tapers from a minimum thickness proximate the first cylindrical portion to a maximum thickness proximate a tangent line between the conical portion and a bottom portion of the preform.

103. A method of reducing material required to form a container stretch-blow-moulded from a preform in the stretch-blow-moulding machine of claims 1 to 20; the preform comprising a neck portion, a collar below the neck portion and a generally cylindrical body below the neck portion; the preform further including a handle extending from a first junction position below the collar to a second junction position along the body of the preform; the method including the steps of:

- Forming the body of the preform in at least two portions of different configuration; a first cylindrical portion and a second conical portion;
- Reducing a base diameter of the conical portion relative to a diameter of the first cylindrical portion.

104. The method of claim 103 wherein wall thickness of the second portion varies from a minimum thickness proximate the base diameter of the conical portion to a maximum thickness proximate a tangent line between the second conical portion and a bottom portion

of the preform.

105. A continuously rotating stretch-blow-moulding machine; the stretch-blow-moulding machine including an orientation device orienting integral handles of injection-moulded preforms from which containers with integral handles are stretch-blow-moulded in the machine; the orientation device including a pair of side by side contra-rotating auger screws located above spaced apart main support rails of a preform infeed track and centred about a vertical mid plane of the main support rails; configuration of diameters, pitch and flutes of the auger screws arranged to capture necks of the preforms and advance preforms along the preform infeed track; sides of preforms advancing along the auger screws contacting a friction strip inducing rotation of the preforms; rotation causing all preform integral handles to rotate from any random first orientation to a second predefined orientation.

106. The stretch-blow-moulding machine of claim 105 wherein preforms with integral handles are fed onto a pair of side by side contra-rotating rollers centred about the vertical mid plane of the pair of spaced apart rails of the preform feed-in track; the pair of contra-rotating rollers located before the auger screws; the pair of roller space apart sufficient to allow bodies and integral handles of the preforms to slide between the rollers into a position wherein the preforms are suspended between the rollers by collars below the necks of the preforms; the bodies and integral handles of the preforms constrained between spaced apart guide rails in the random first orientation; the guide rails located at a level below the main preform support rails proximate the middle of the handles.

107. The stretch-blow-moulding machine of claim 105 or 106 wherein in the random first orientation handles may be leading or trailing relative a direction of movement of preforms along the infeed track towards a preform pick-off position at a lower outer end of the infeed track.

108. The stretch-blow-moulding machine of any one of claims 105 to 107 wherein the friction strip mounted to one of the main support rails is substantially coextensive with lengths of the auger screws; the friction strip intruding into space between the pair of spaced apart main support rails sufficient to engage with the sides of bodies of preforms moved along by the auger screws.

109. The stretch-blow-moulding machine of any one of claims 105 to 108 wherein a section of that guide rail on the same side as the friction strip is discontinuous for a length substantially coextensive with lengths of the auger screws.

110. The stretch-blow-moulding machine of any one of claims 105 to 108 wherein rotation of the preforms while carried along the auger screws rotates all preform handles into a handle trailing position with the handles arrested by contact with that guide rail of the pairs of guide rails opposite to the friction strip; the handles able to rotated through the discontinuous section of the guide rail.

111. The stretch-blow-moulding machine of any one of claims 107 to 109 wherein the auger screws separate successive preforms according to the pitch of the auger screws; the auger screws further providing downward pressure on preforms with oriented handles between the ends of the auger screws and the preform pick-off position.

112. A method of producing stretch-blow-moulded containers with integral handle in a continuously rotating stretch-blow-moulding machine; the containers with integral handle stretch-blow-moulded from separately injection-moulded preforms with integral handle; the preform comprising a neck portion, a body portion and a handle forming a loop of orientable material extending from a first junction point below the neck portion to a second junction point on the body portion; the method of injection-moulding including the steps of:

- Forming a multicavity injection-moulding die;
- In a heated fixed side of the die forming an array of cavities; the cavities formed to correspond to sections of the preforms to a point below the integral handle;
- Providing a corresponding array of opposing half cavities projecting from a face of the opposite moving side of the die; the half cavities shaped to form the preform from the neck portion, body and integral handle to the point below the integral handle;
- Providing cores for forming the internal shape of the preforms; the cores fixed to the moving side of the die and centred on a common axis of the cavities in the fixed heated side of the die and the opposing half cavities.

113. The method of claim 112 wherein in a mould cycle;

- cavities in the heated fixed side of the die and the opposing half cavities at the opposite moving side of the die are injected with orientable polymer material to form the preforms;
- When filled, after a predetermined delay moving the moving side of the die away from the heated fixed side to draw the ends of the preform bodies below the handle out of the cavities in the heated fixed side of the die;
- After a predetermined delay, opening the opposing half cavities to release the neck portion, the integral handle and the body portion of the preform to below the handle portion.

114. The method of claim 113 wherein further in the mould cycle;

- activating a robot to position an array of vacuum suction elements between the heated fixed side of the die and the moving side of the die;
- positioning the array of vacuum suction elements in registration with the array of cavities;
- as the opposing half cavities open apply vacuum pressure to the vacuum elements and activate the robot to drive the vacuum elements to fit over the ends of the preforms;
- retract the robot to draw the preforms from the cores and withdraw the vacuum elements and retained preforms from between the heated fixed side and the moving side of the die;
- rotate the array of vacuum elements into a position in which axes of the preforms are substantially vertical and cut vacuum pressure to allow preforms to fall into a receiving bin.

115. The method of claim 114 wherein each vacuum element is provided with a slot or channel at an open end of the vacuum elements; the slot or channel provided to allow each vacuum element to accommodate at least a portion of the handle of the preform.

116. A continuously rotating, non-symmetric preform feed, stretch-blow-moulding machine in which injection-moulded preforms with integral handles are transferred from a first transfer system to a preheating stage; the transfer of a preform from a gripper of the first transfer system to a preform supporting mandrel achieved in one fluid motion as a vertical axis of the preform is brought into alignment with a vertical axis of the preform supporting

mandrel and the handle of the preform is protected from heat by a heat shield provided on the mandrel, the transfer made while accommodating each of the rotations of a loop rail of the preheating stage, the mandrel and the transfer system as well as movements of the gripper.

117. The machine of claim 116 wherein the handle as injection moulded is protected by the heat shield during the preheating stage; the shape of the handle of a container stretch-blow-moulded from the injection moulded preform being identical to the as injection-moulded shape of the handle of the preform.