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(54) **CONTAINER WITH INTEGRAL HANDLE, PREFORM AND METHOD OF MANUFACTURE**

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Related U.S. Application Data

(63) Continuation of application No. 09/508,353, filed on Nov. 6, 2000, now Pat. No. 6,896,943, filed as 371 of international application No. PCT/AU98/00738, filed on Sep. 9, 1998.

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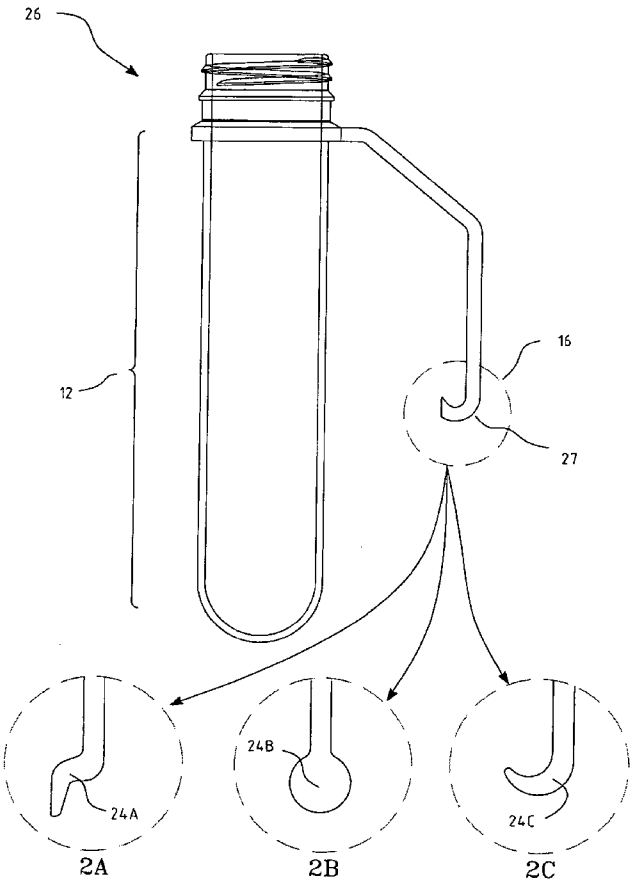
(52) **U.S. Cl.** **428/35.7**; 264/523

(57) **ABSTRACT**

A method of forming a container from bi-axially orientable plastics material and having an integral handle formed from a stem; said method comprising: (a) forming a preform having a neck portion and an expandable portion below the neck portion, said neck portion including a locating ring above the expandable portion and a solid stem of orientable thermoplastics material projecting from or near the neck portion or immediately below it and moulded integrally therewith, and (b) performing a blow moulding operation on said preform to expand the expandable portion to form the body of the container. Also disclosed is a container manufactured from a two stage injection stretch blow moulding process, said container including a graspable handle affixed at at least a first point to said container so as to form an enclosed area between the handle and the container and through which the fingers of a human hand may be passed.



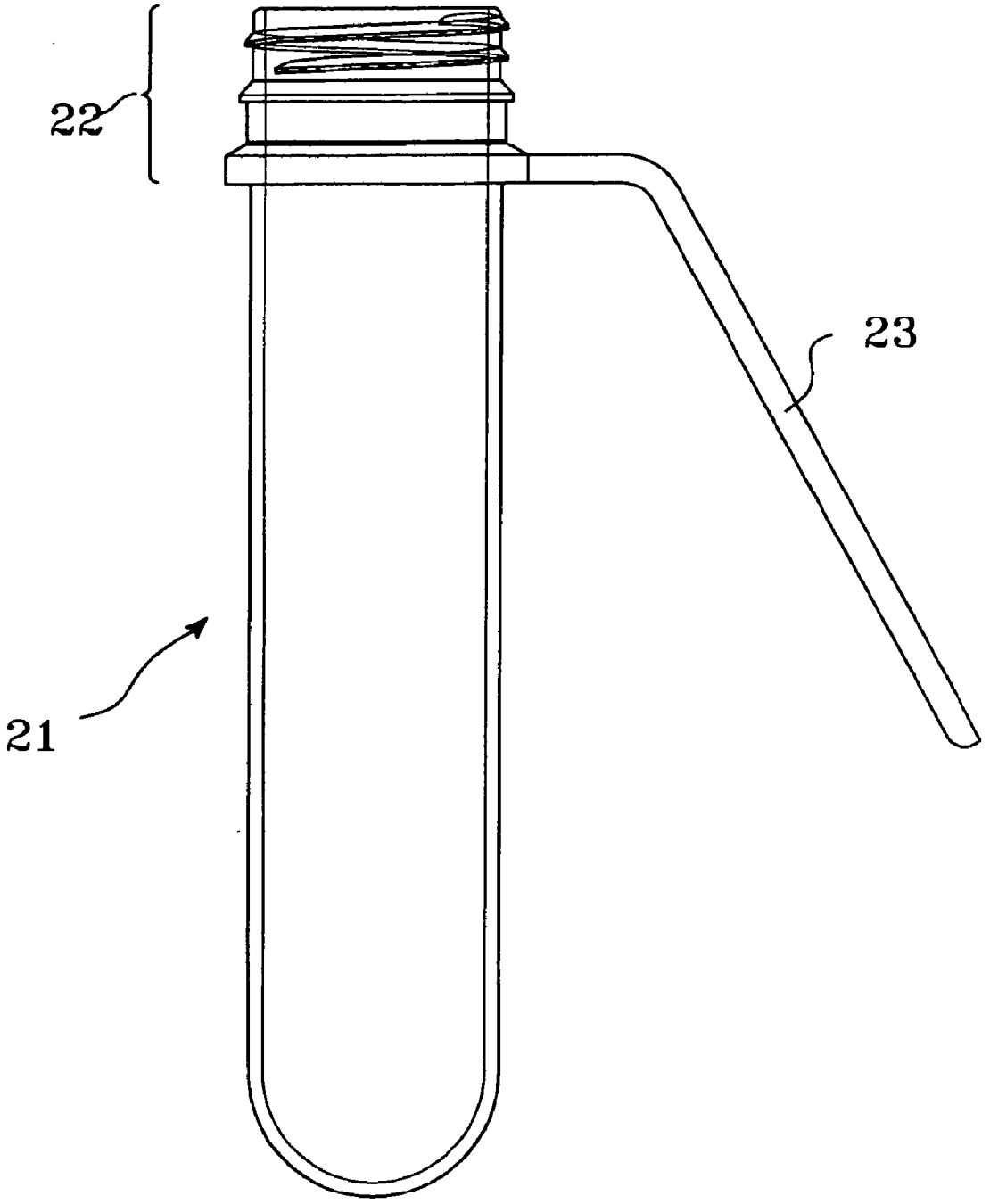


Fig. 1
Prior Art

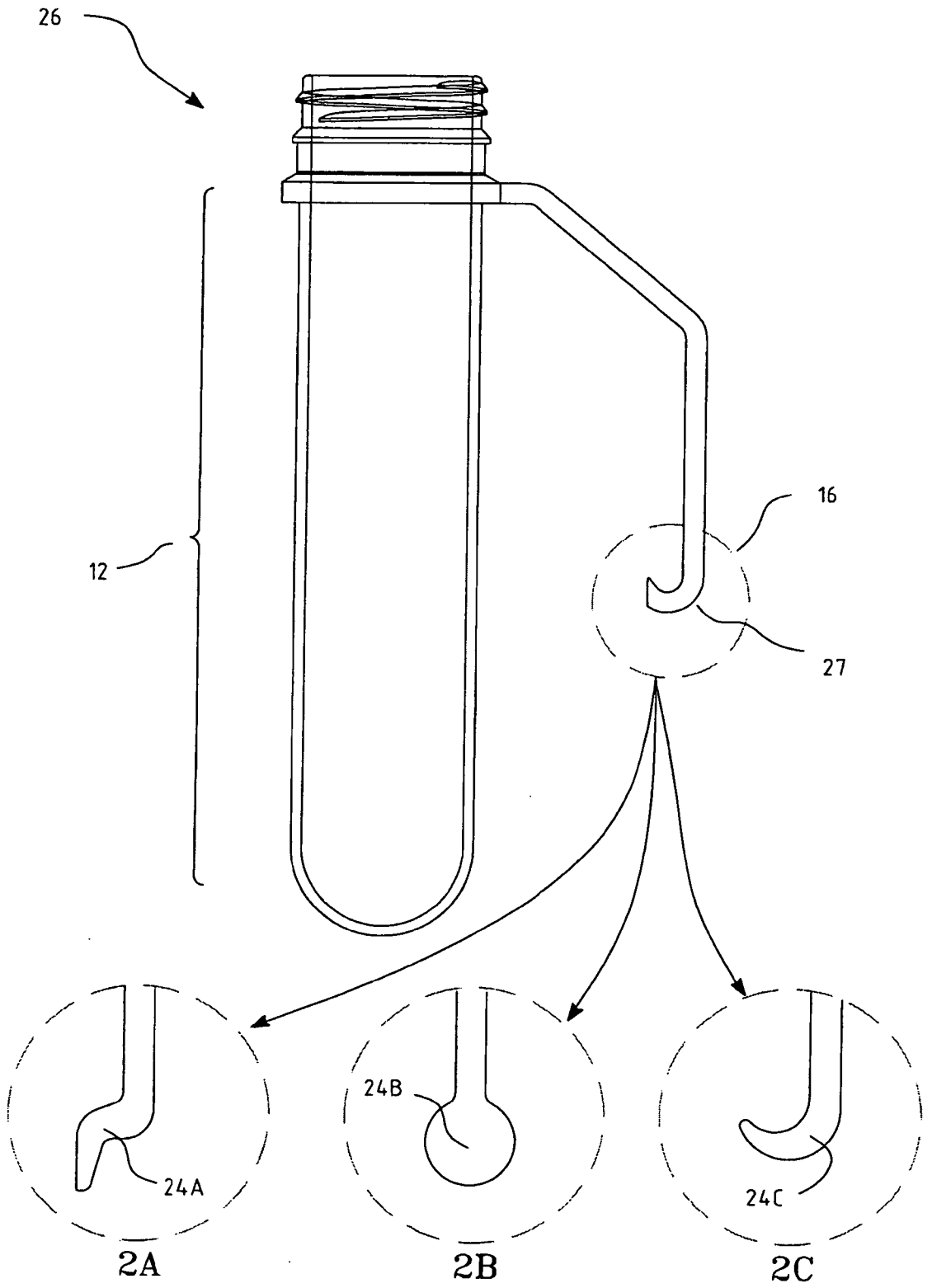


Fig. 2

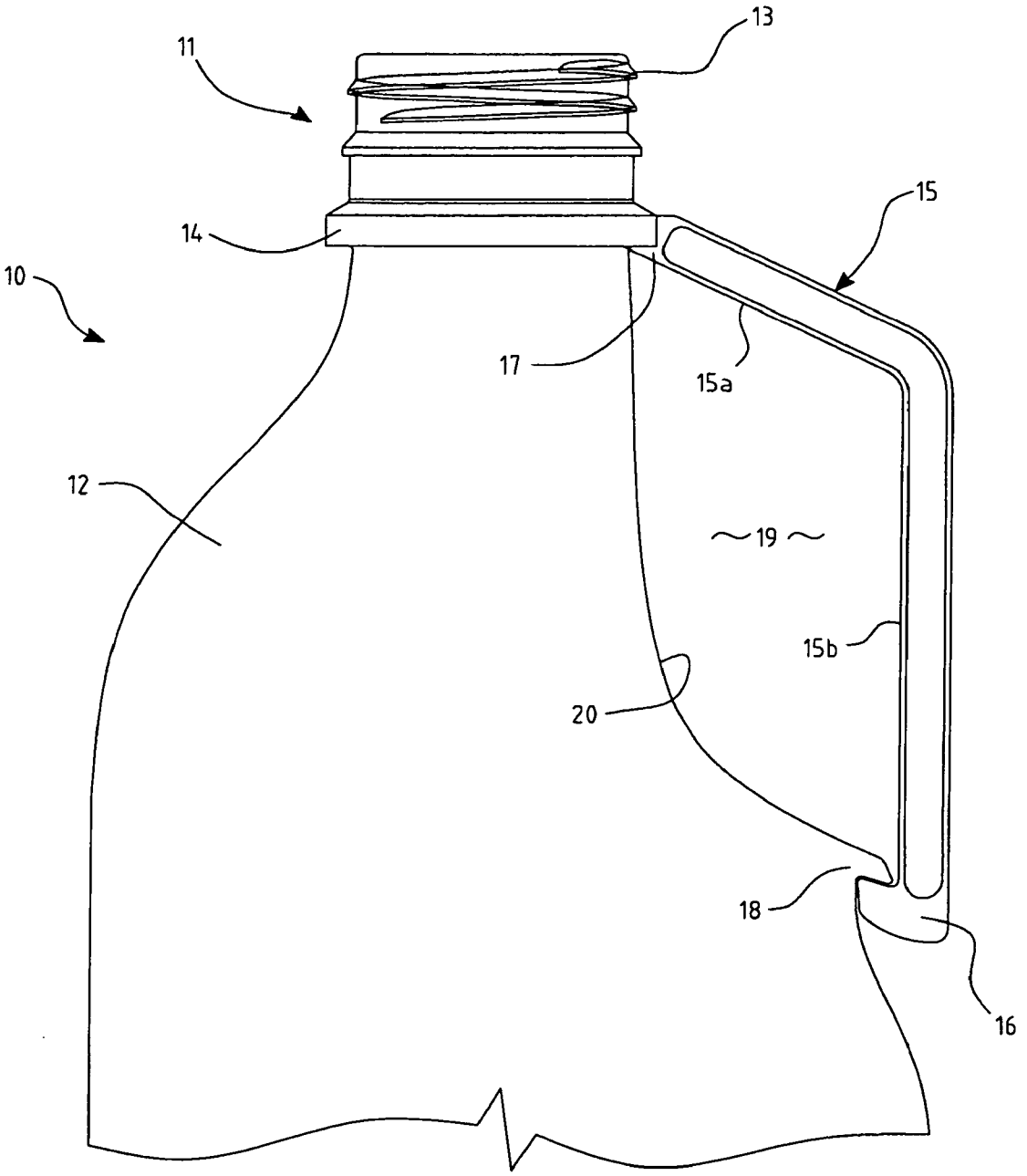


Fig. 3

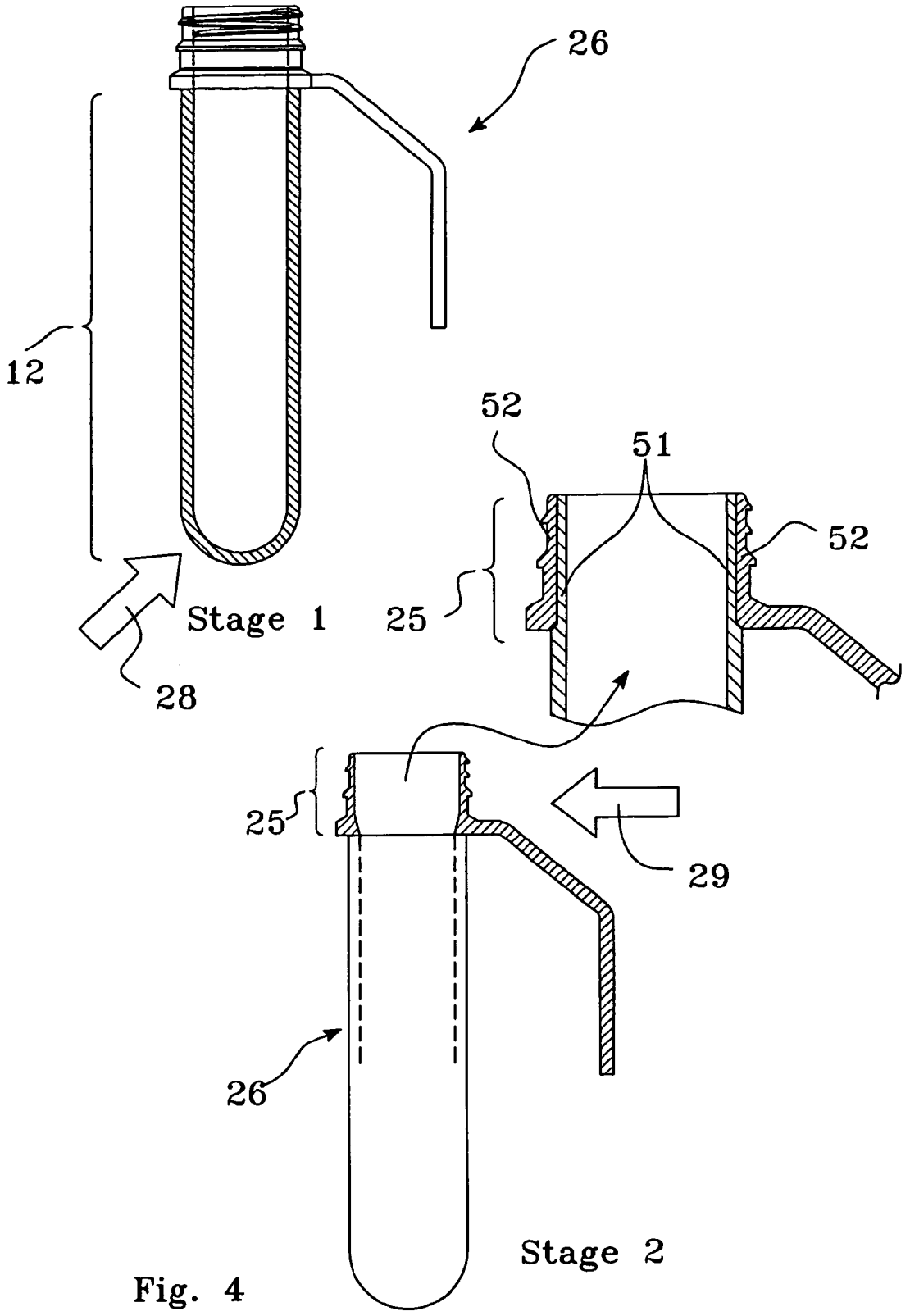


Fig. 4

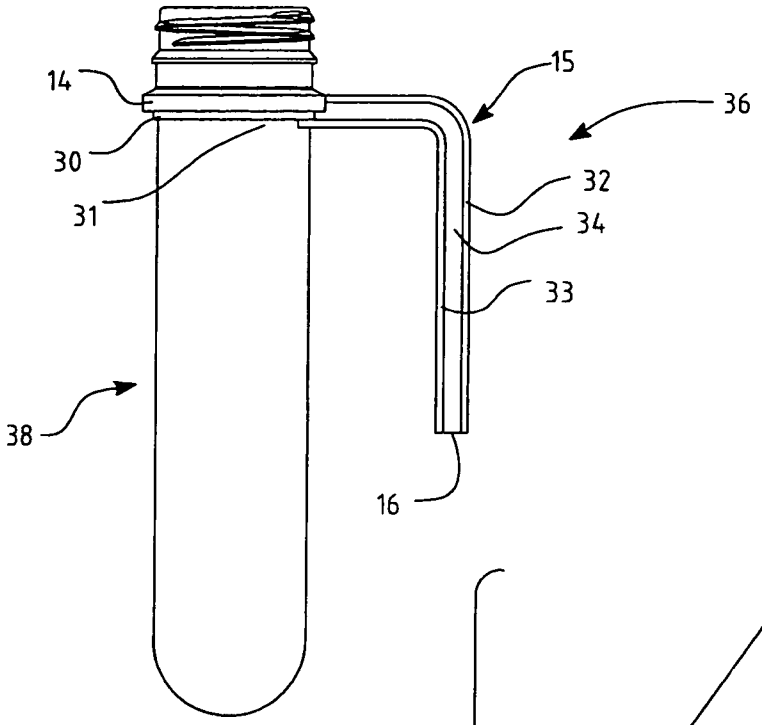


Fig. 5A

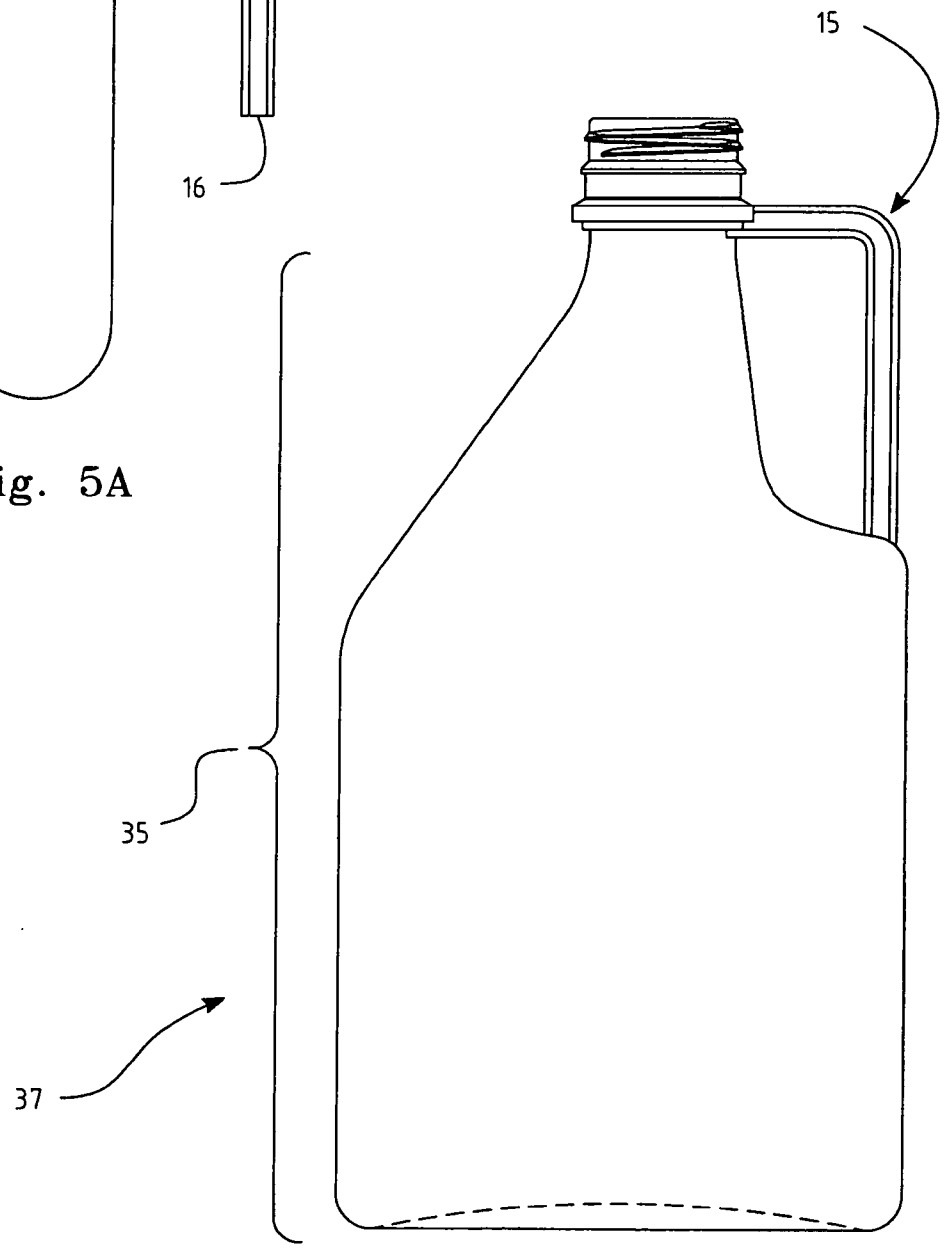


Fig. 5B

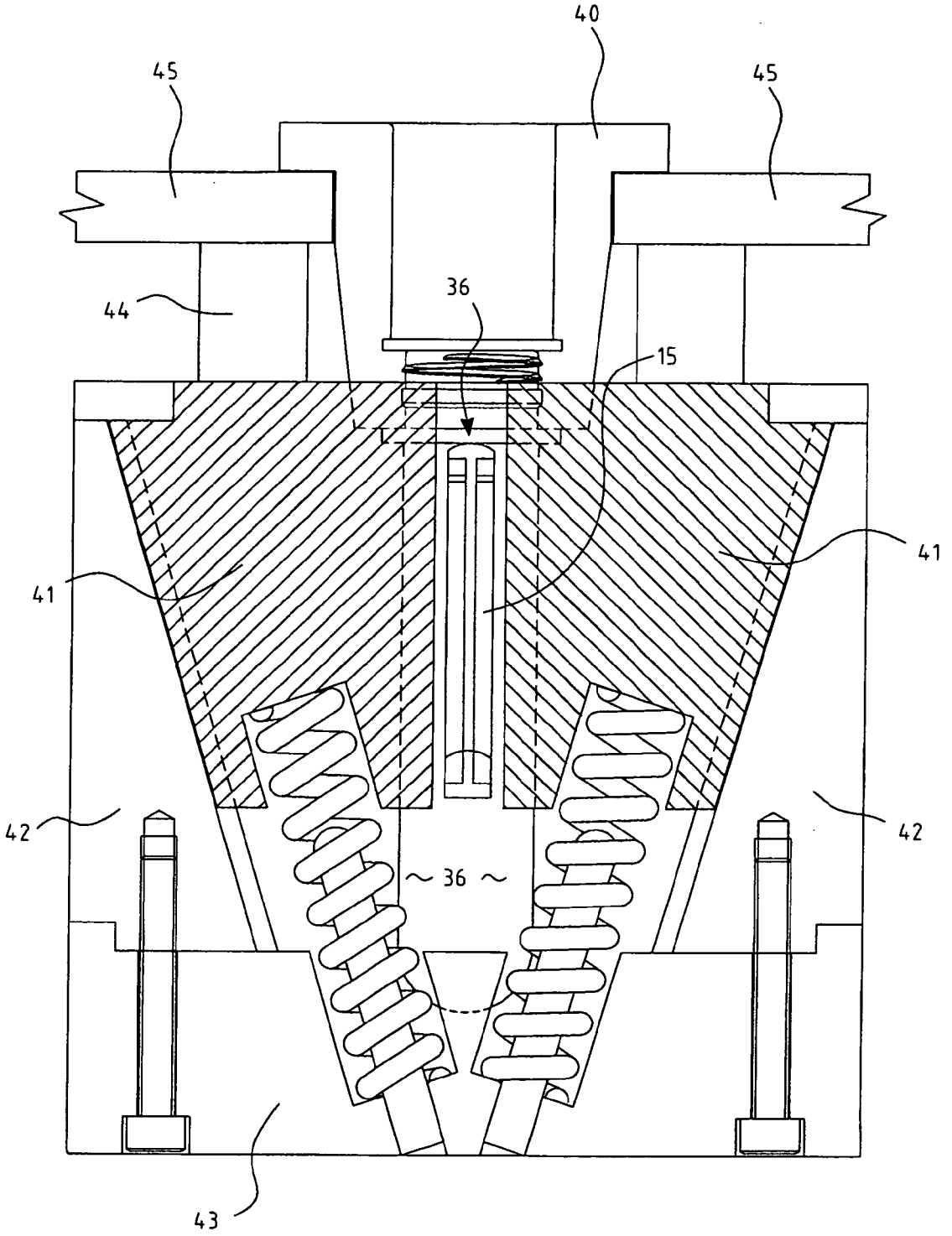
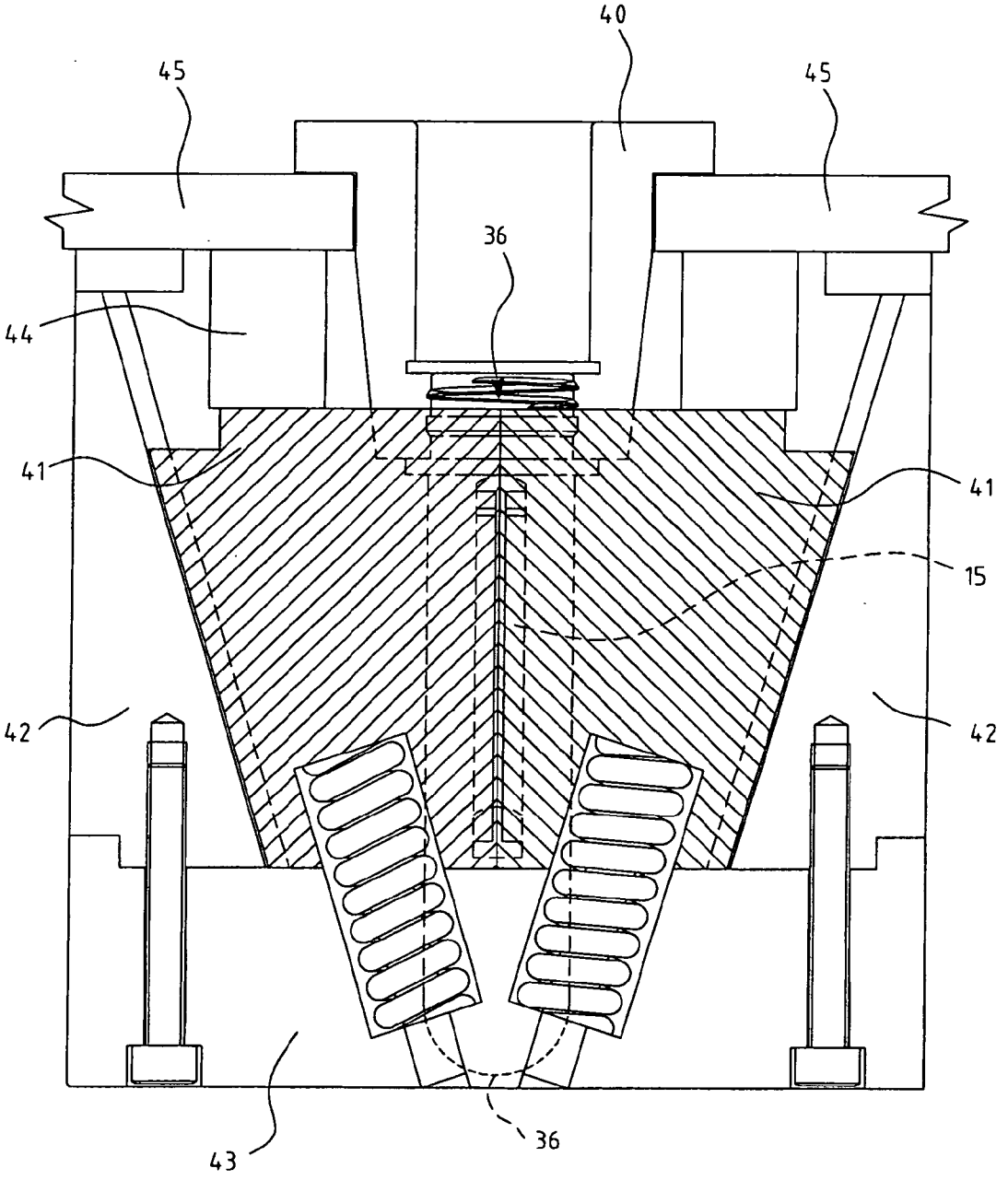


Fig. 6



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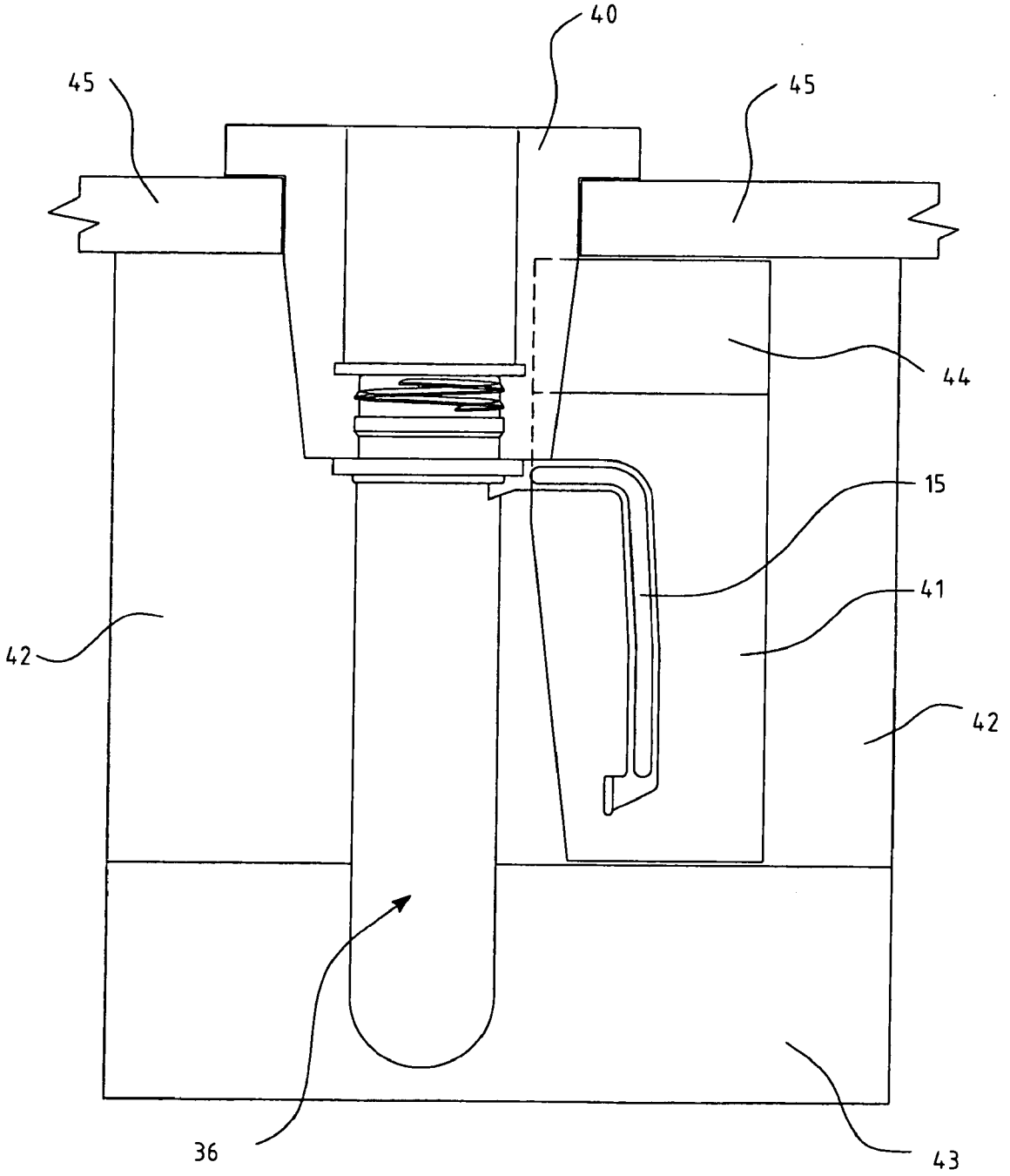

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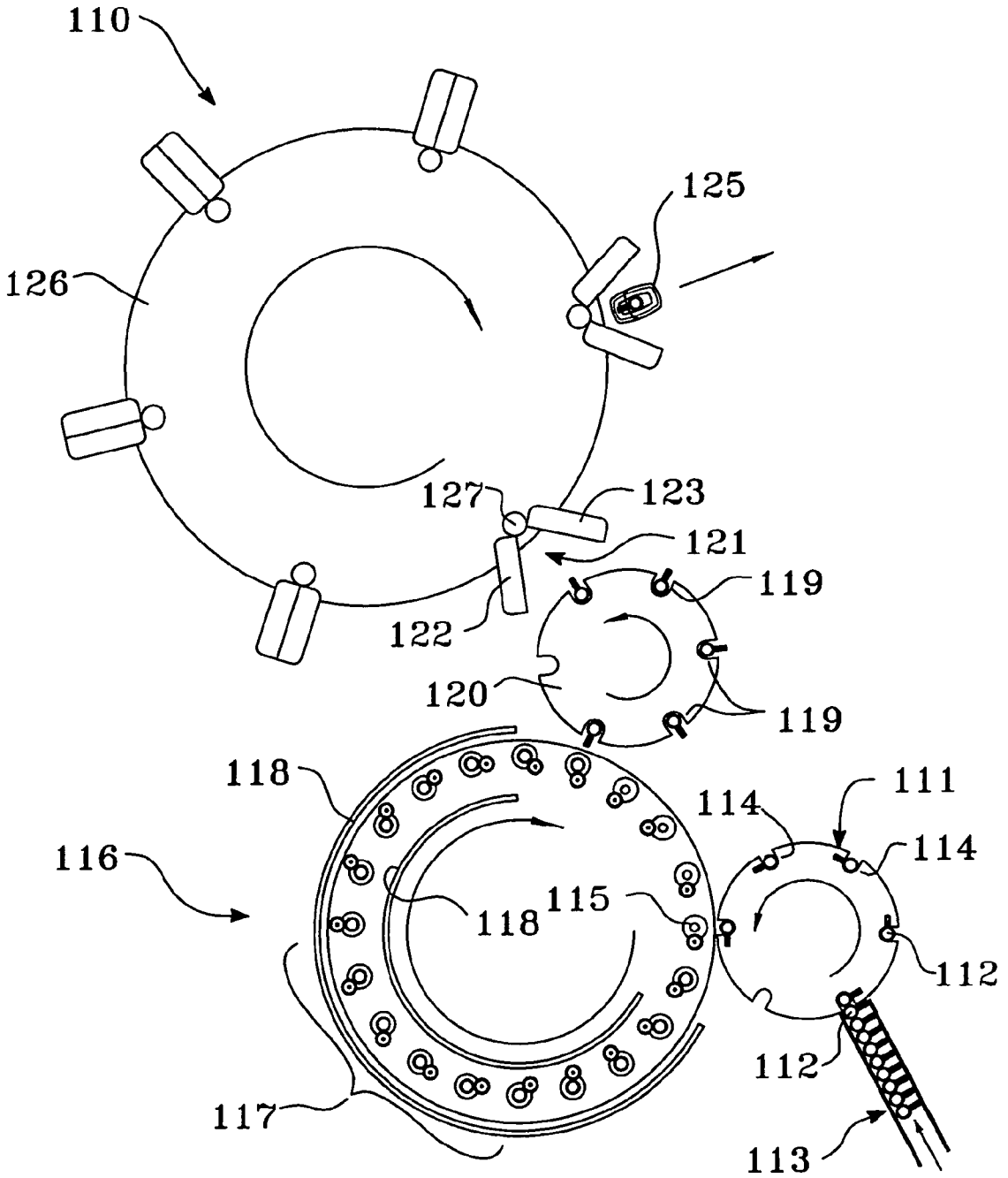
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Fig. 9

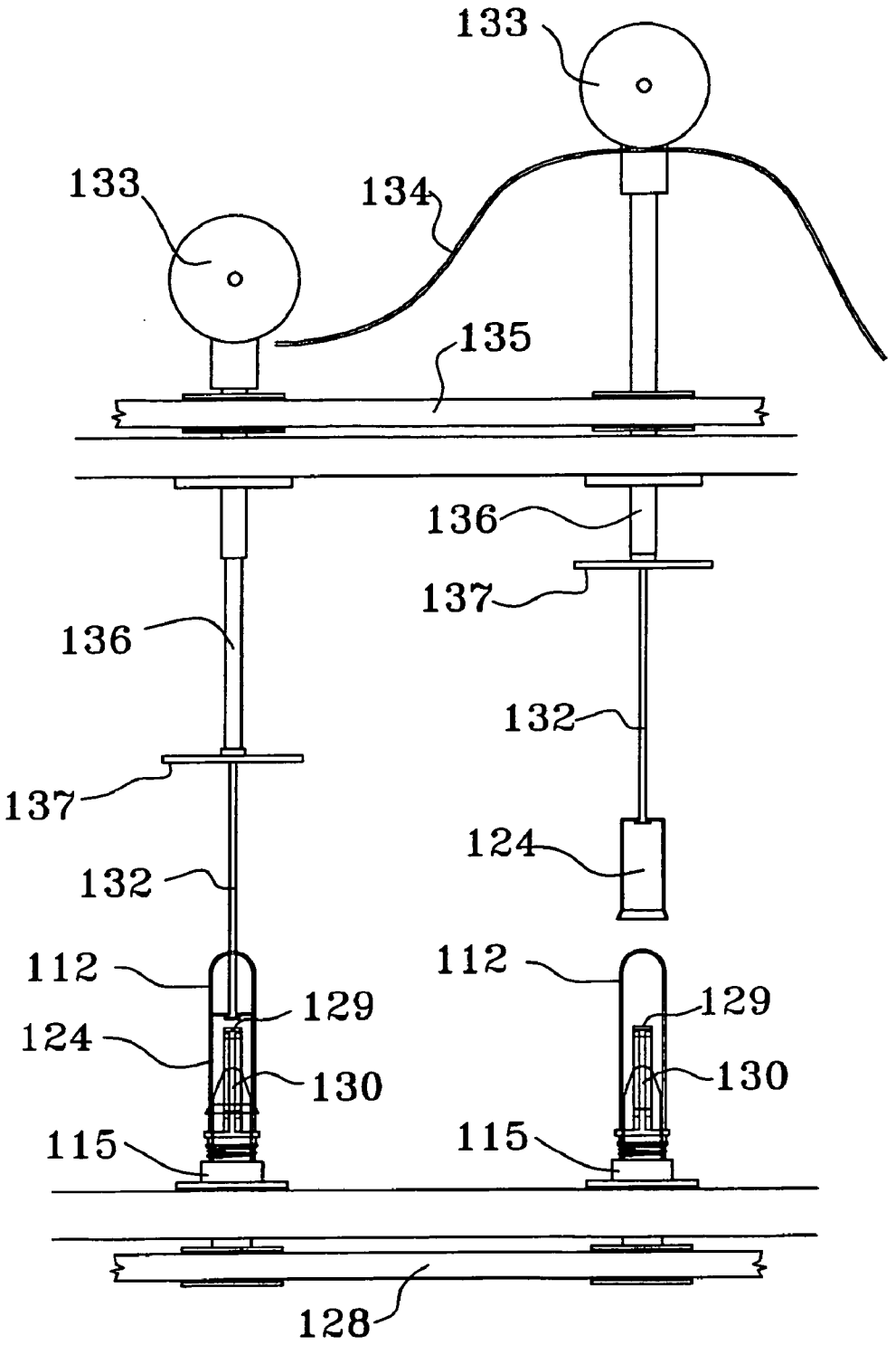
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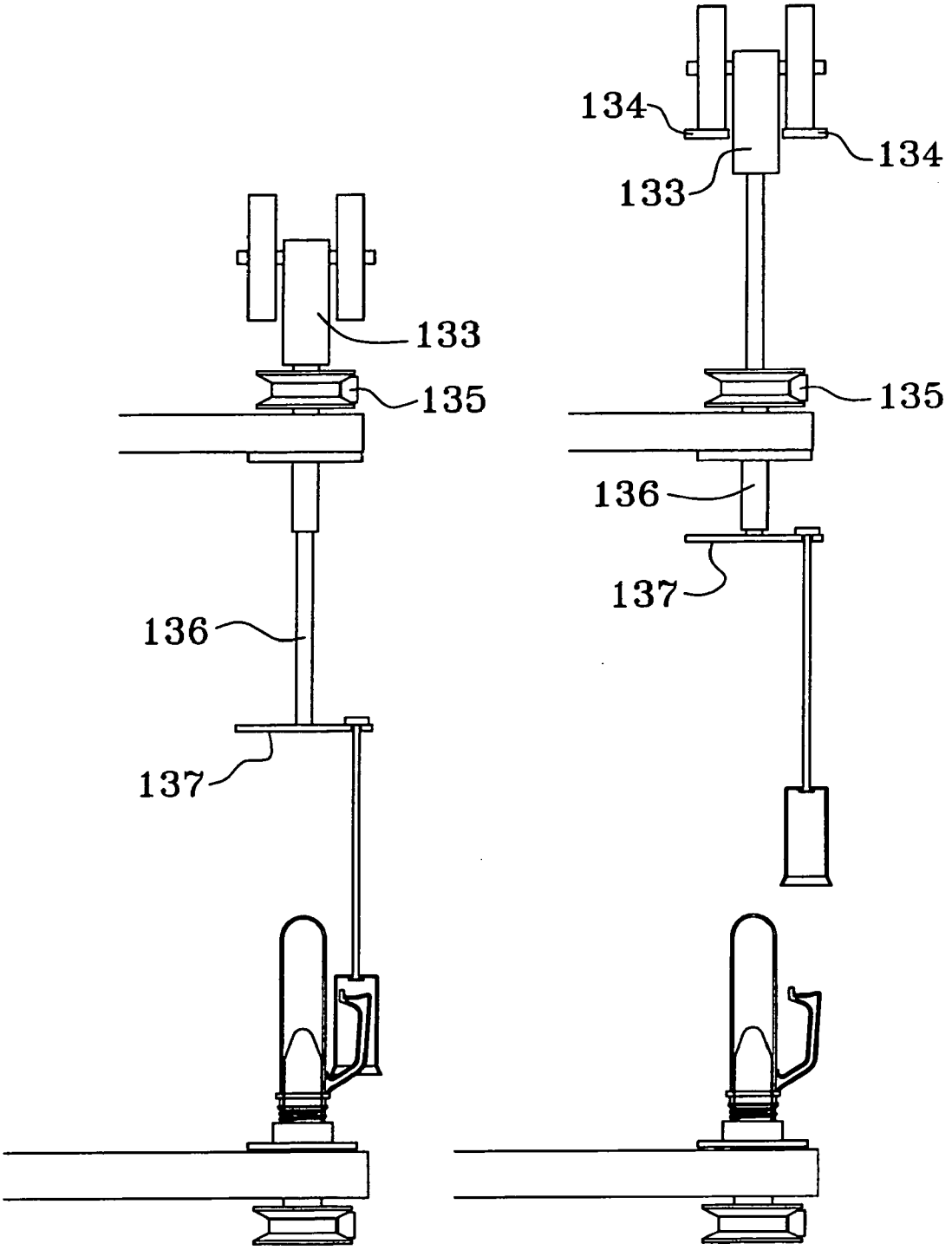
Fig. 10



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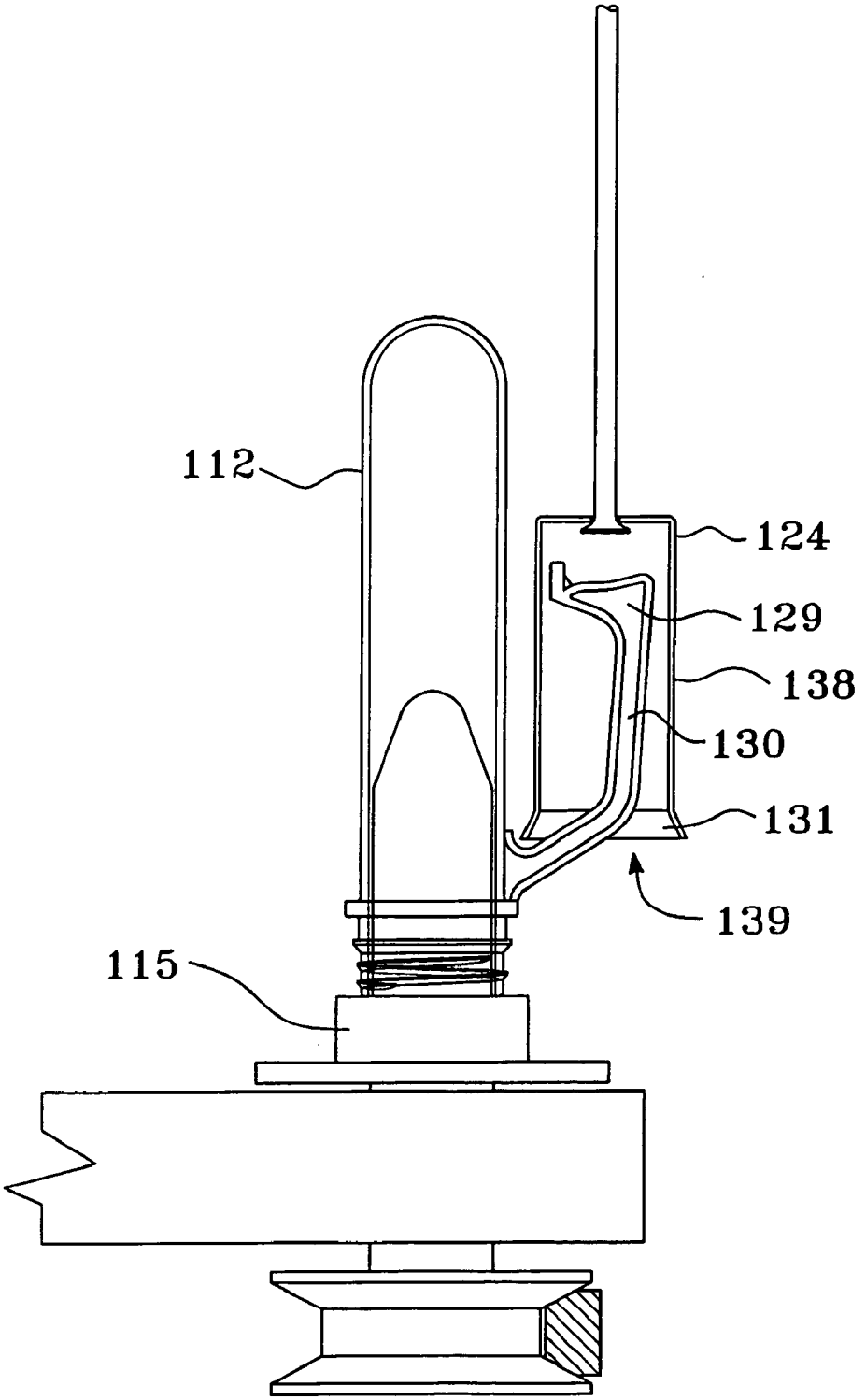
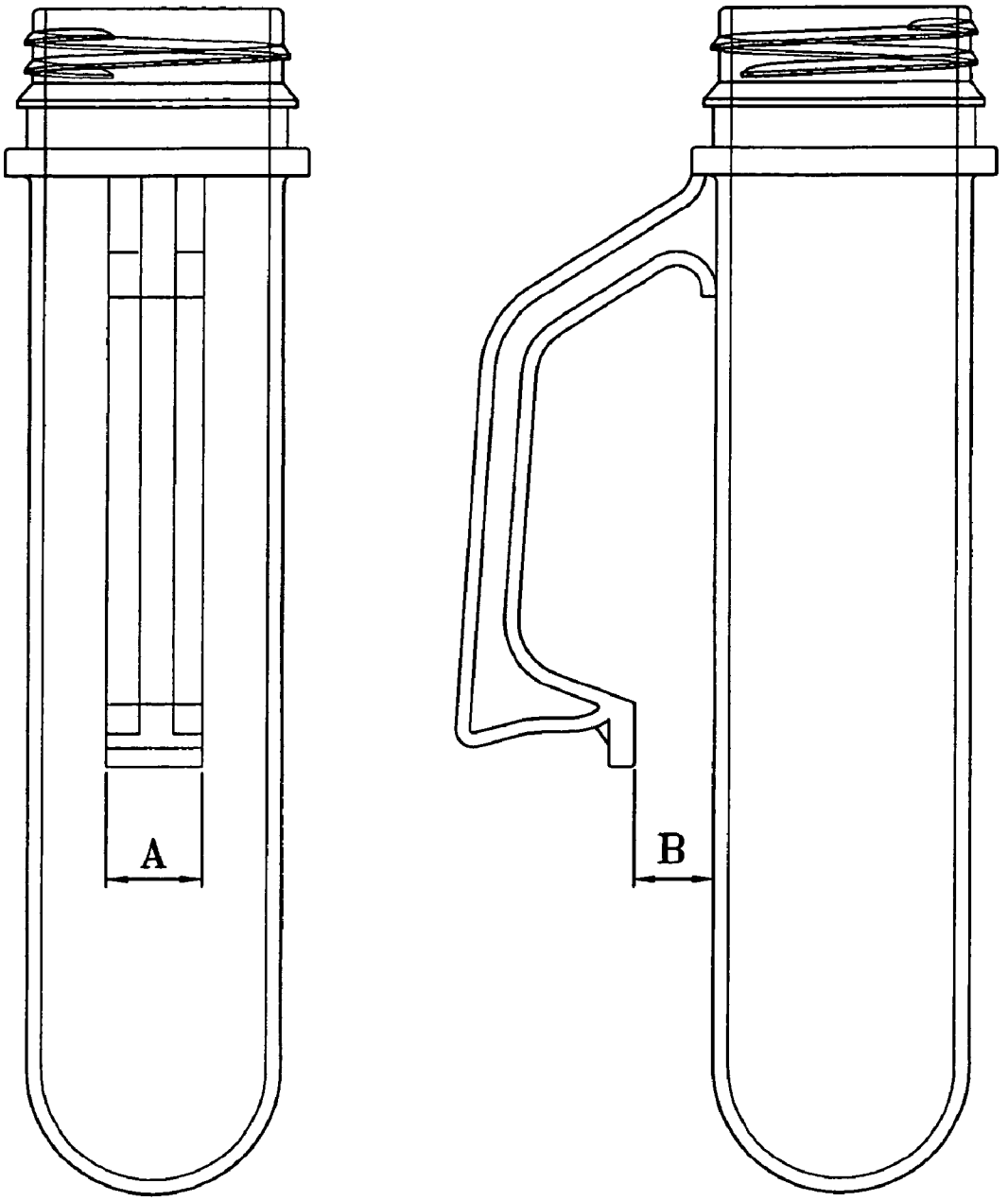


Fig. 12



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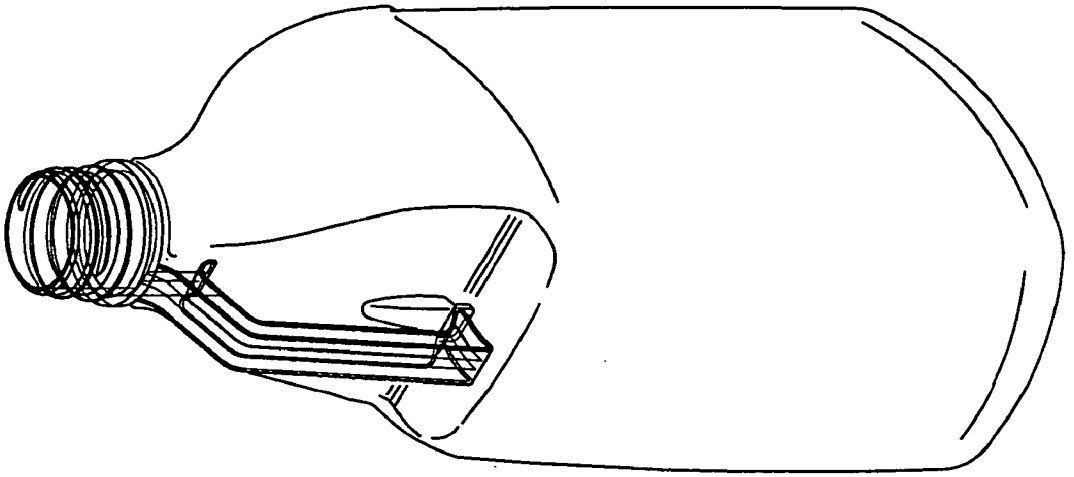


Fig. 15

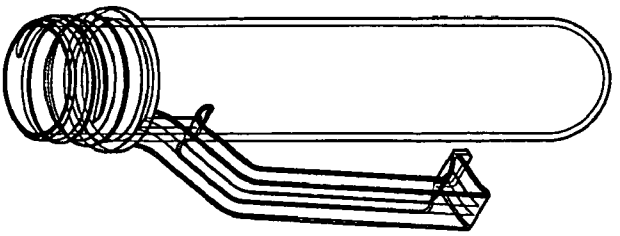
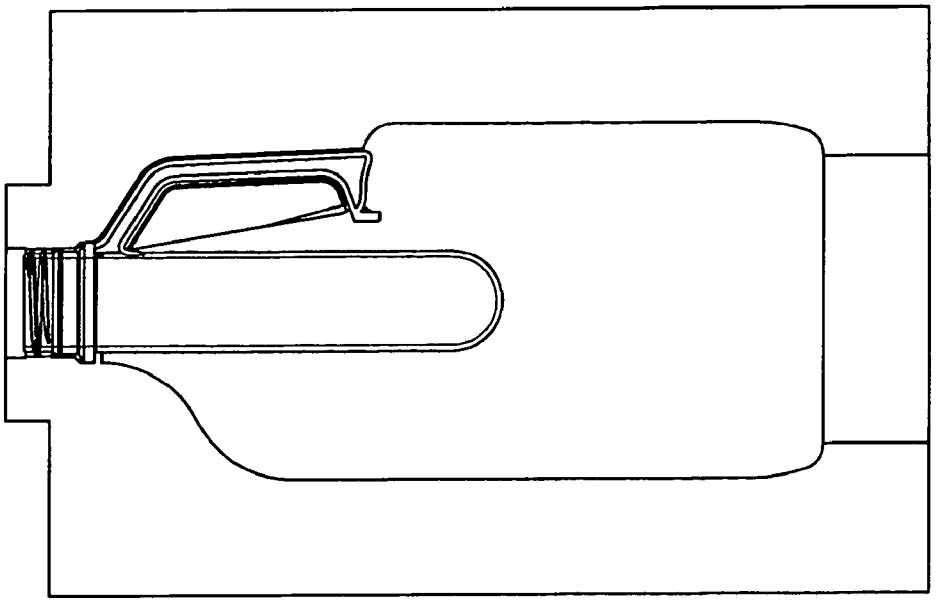


Fig. 14



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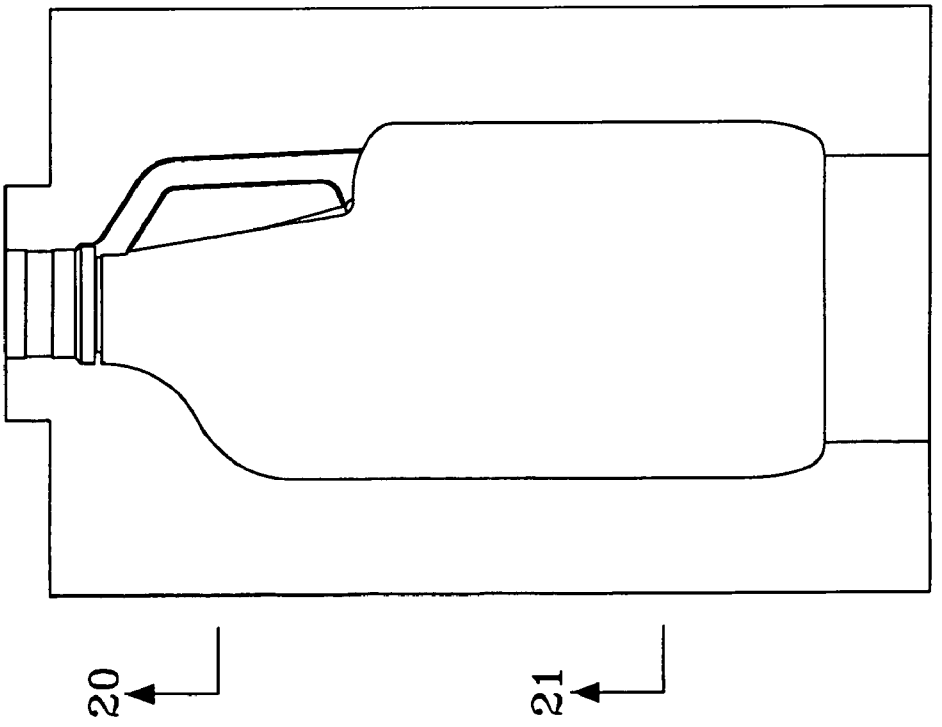

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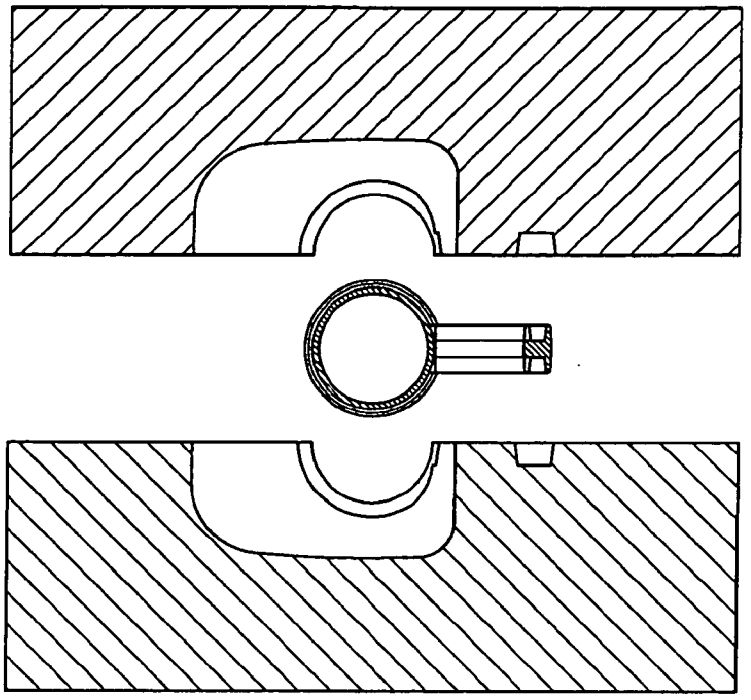

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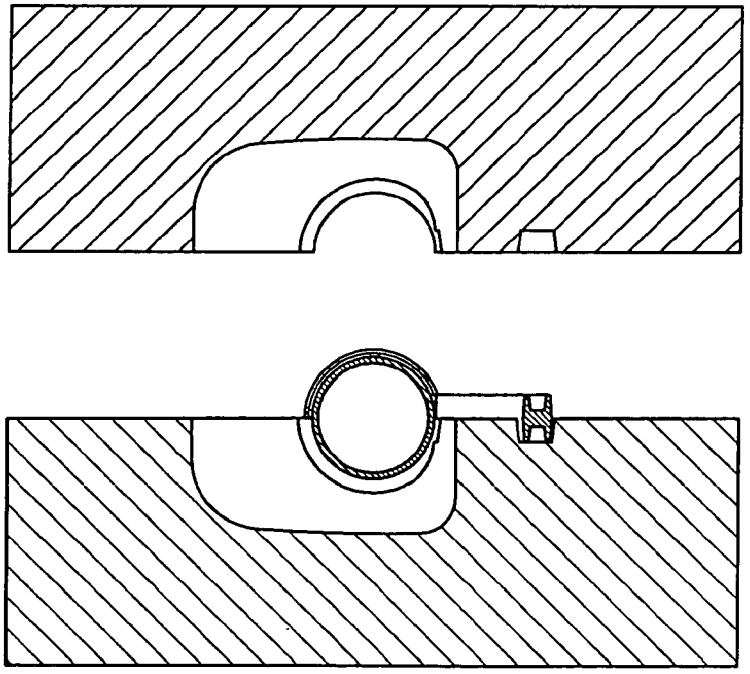

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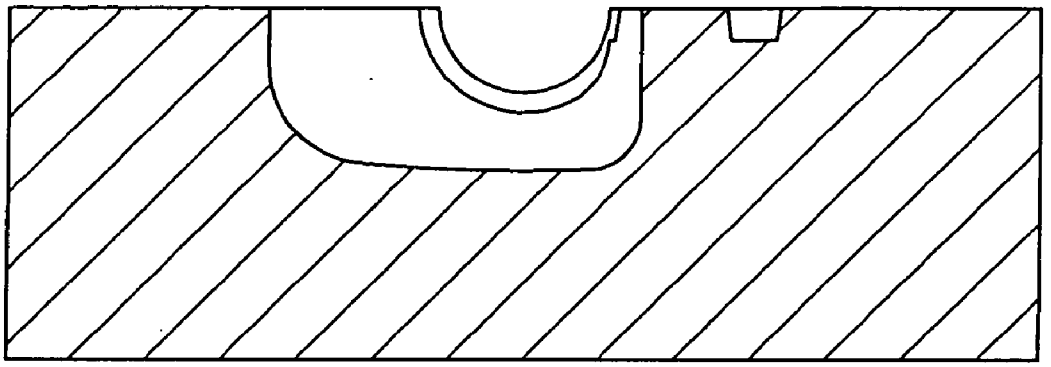

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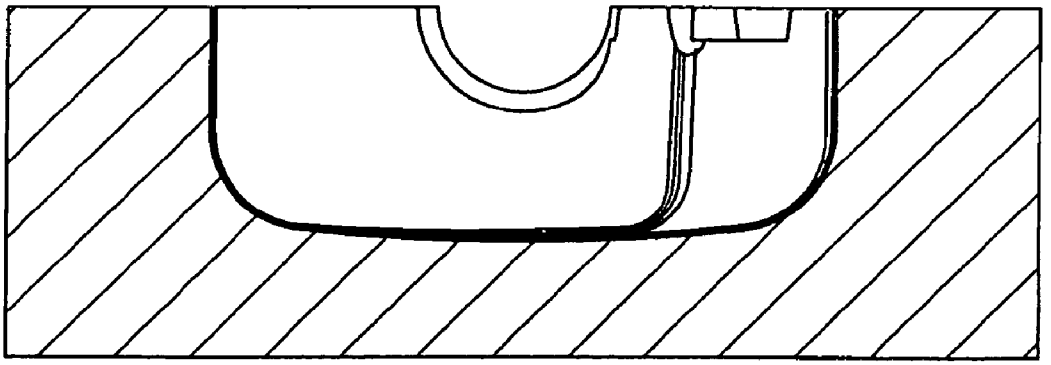

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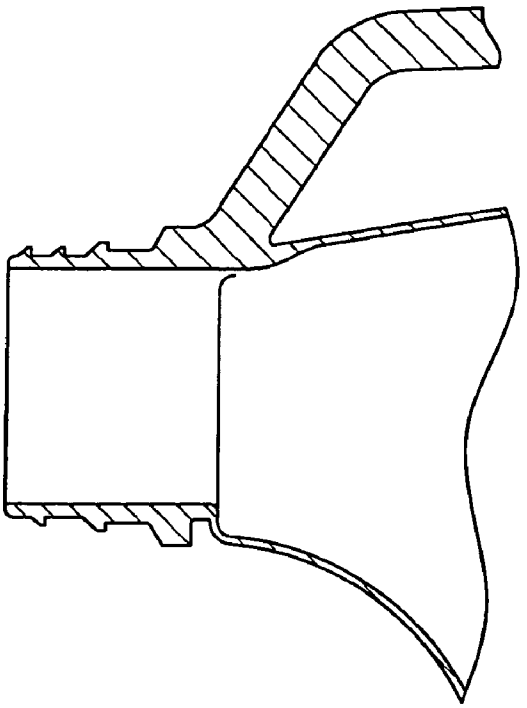

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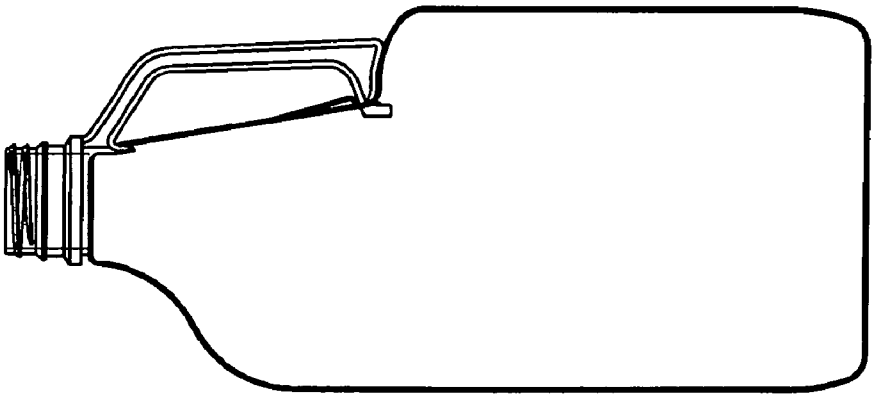

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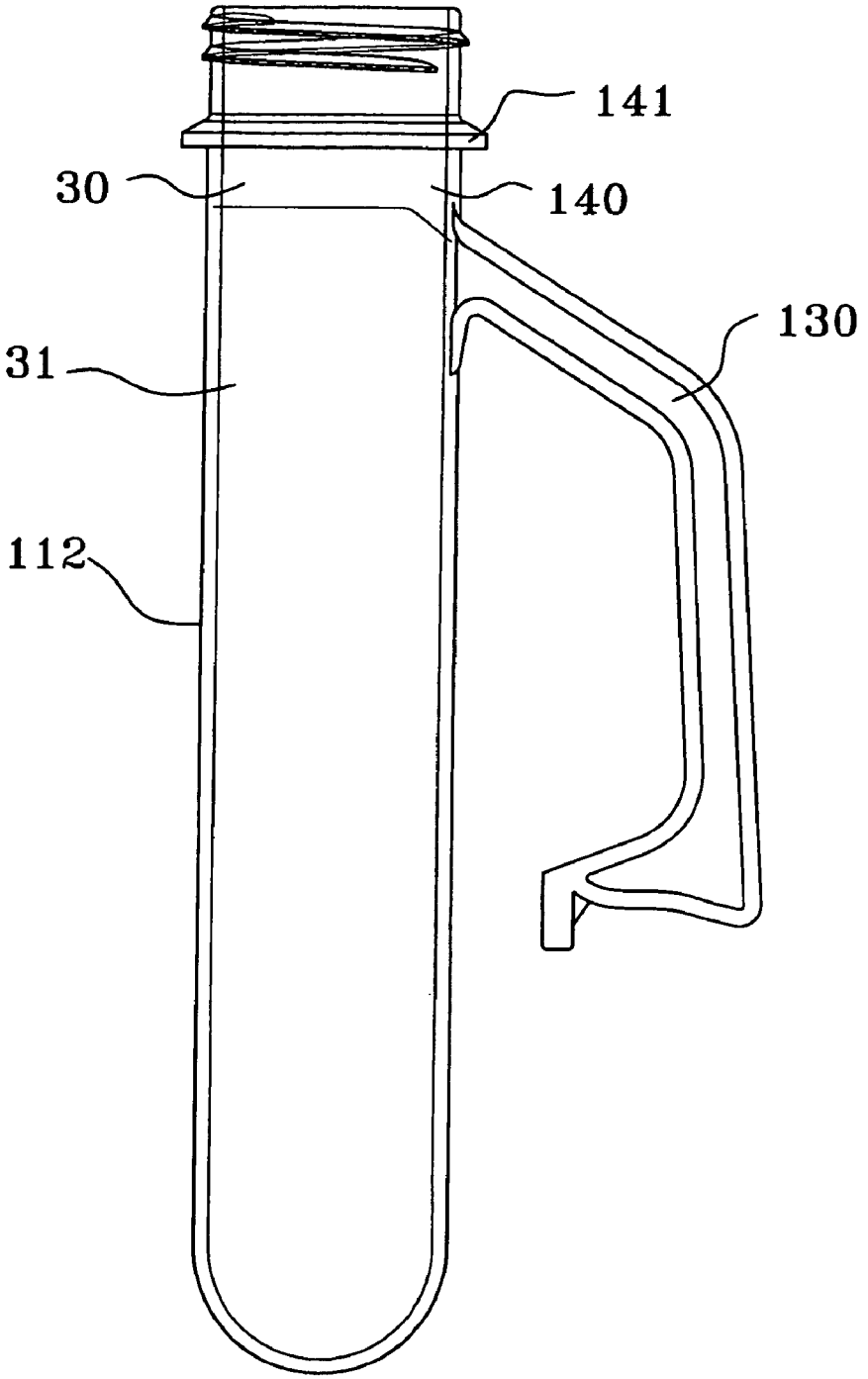

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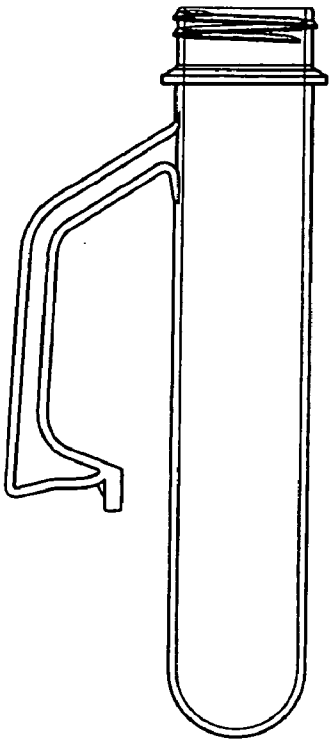

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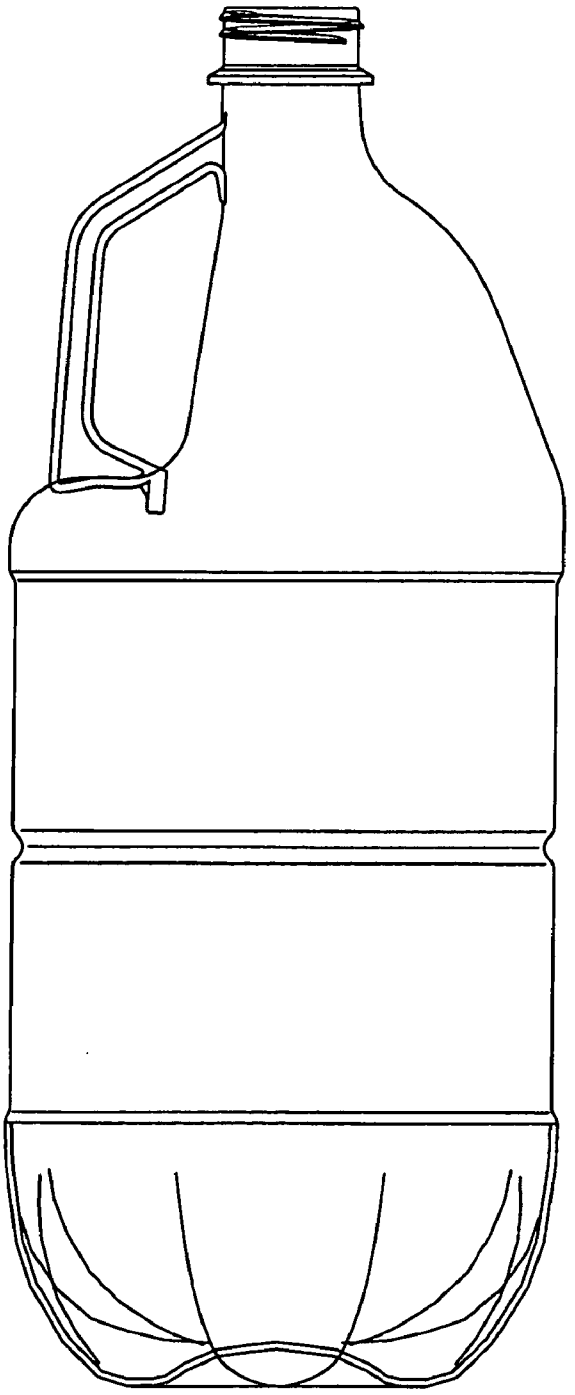

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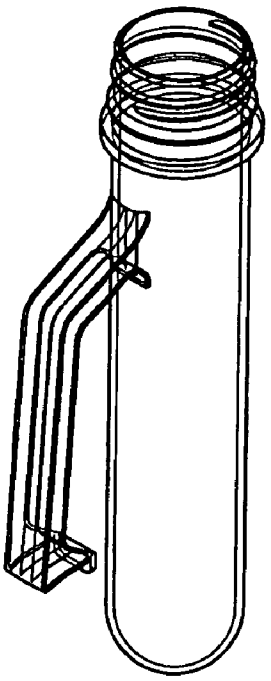

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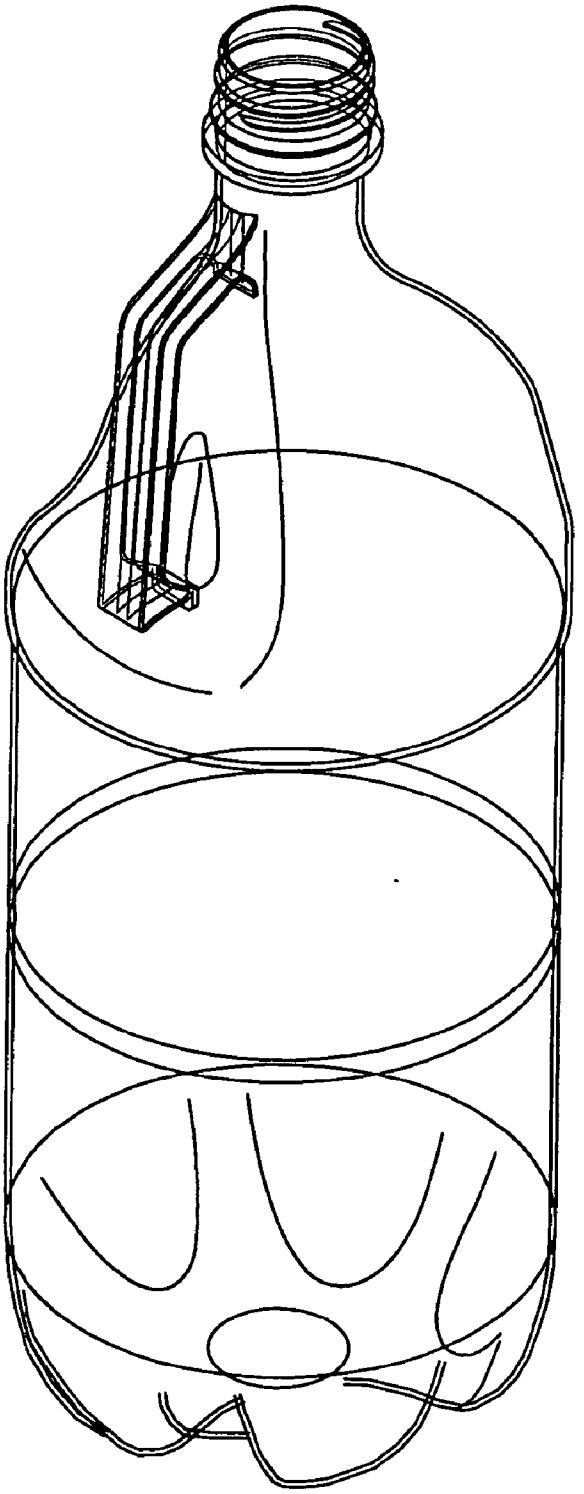

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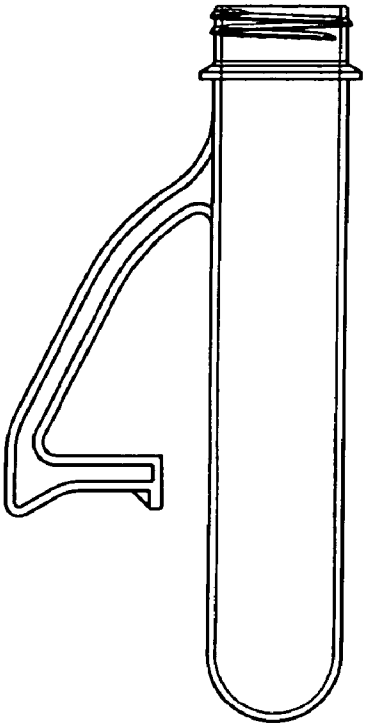

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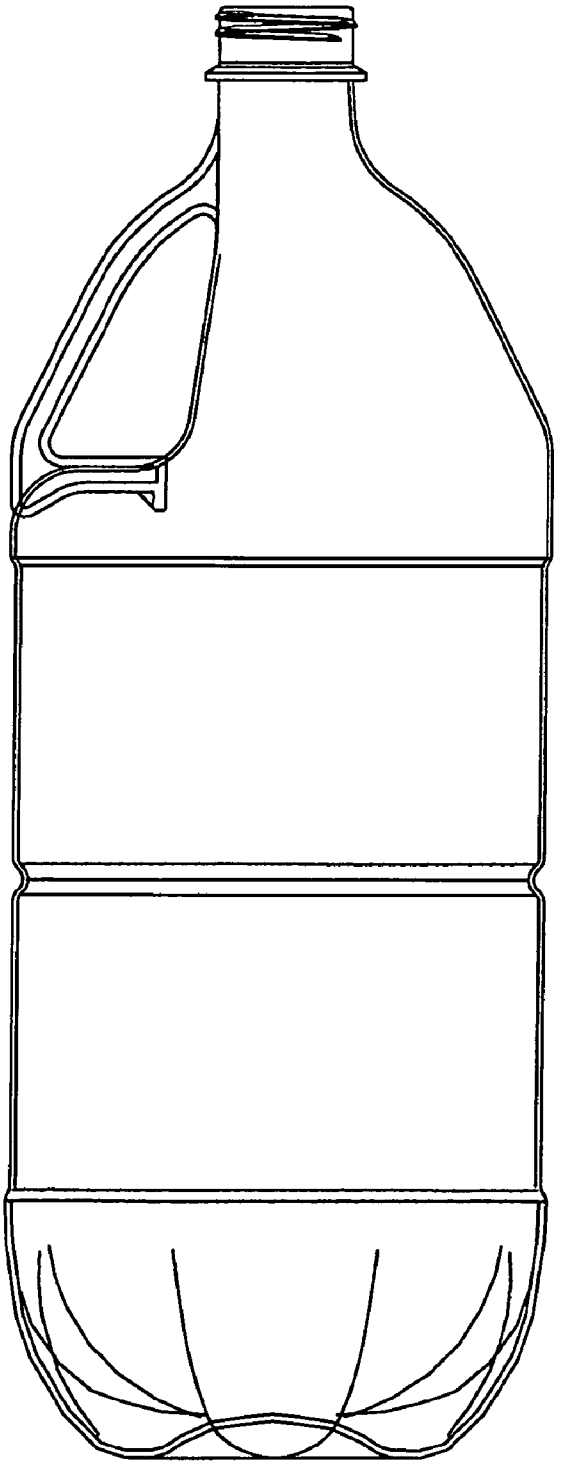

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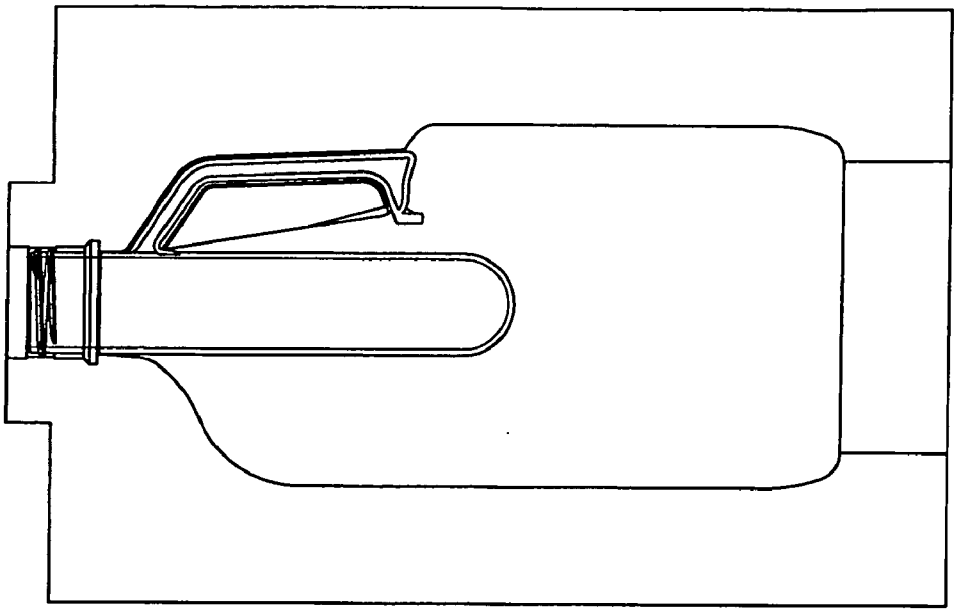

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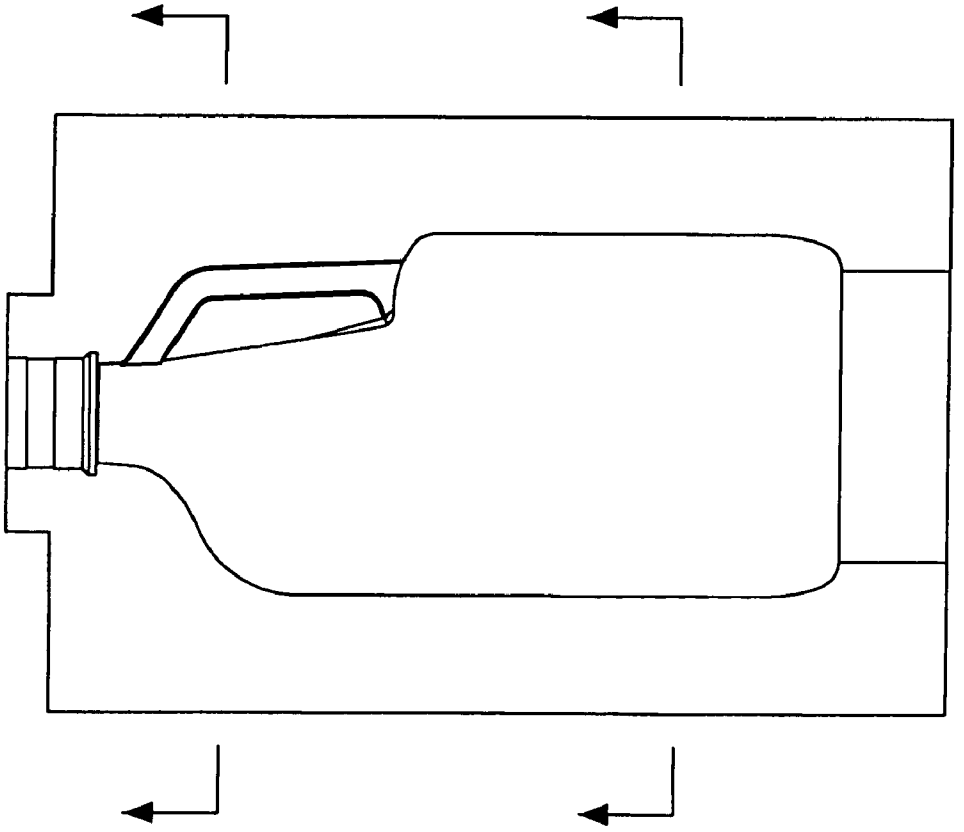

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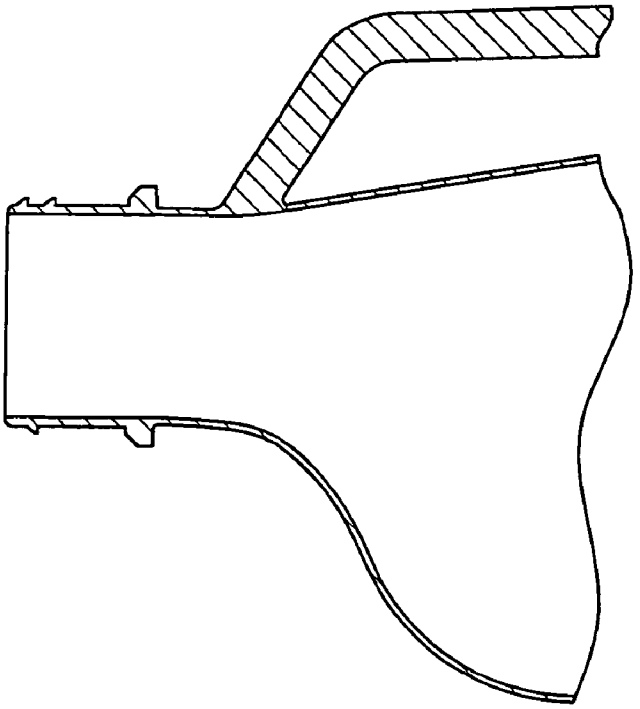

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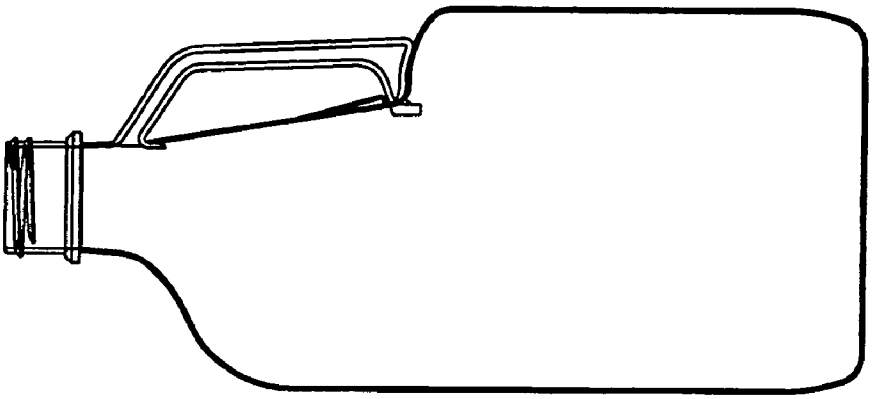

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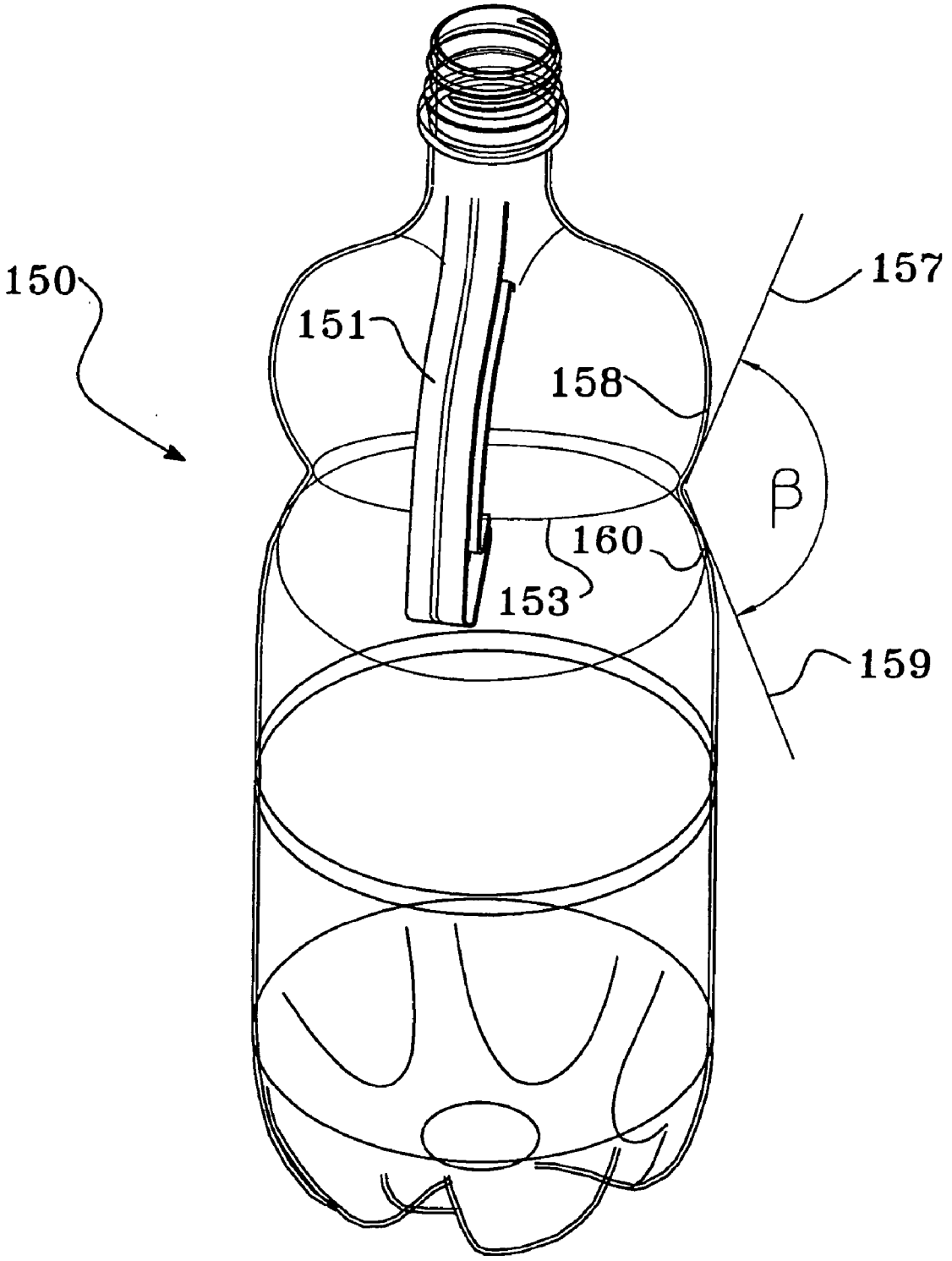

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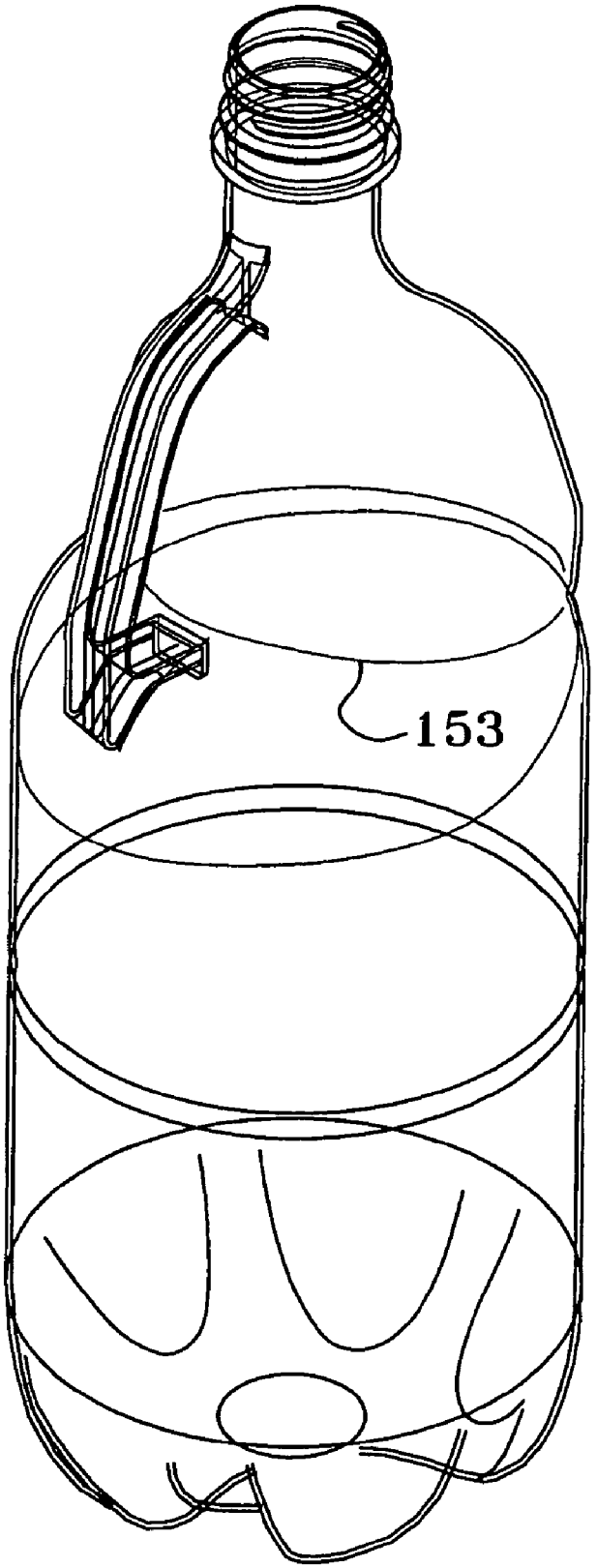

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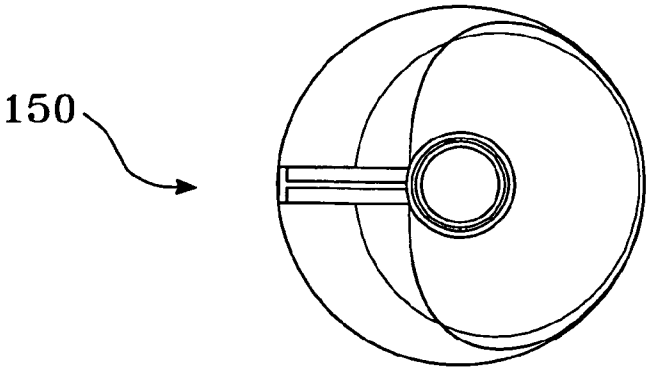

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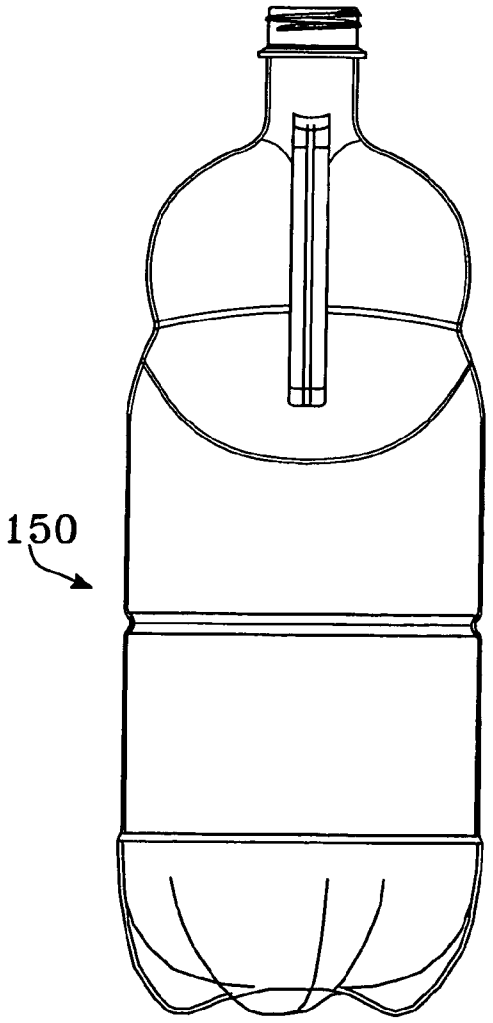

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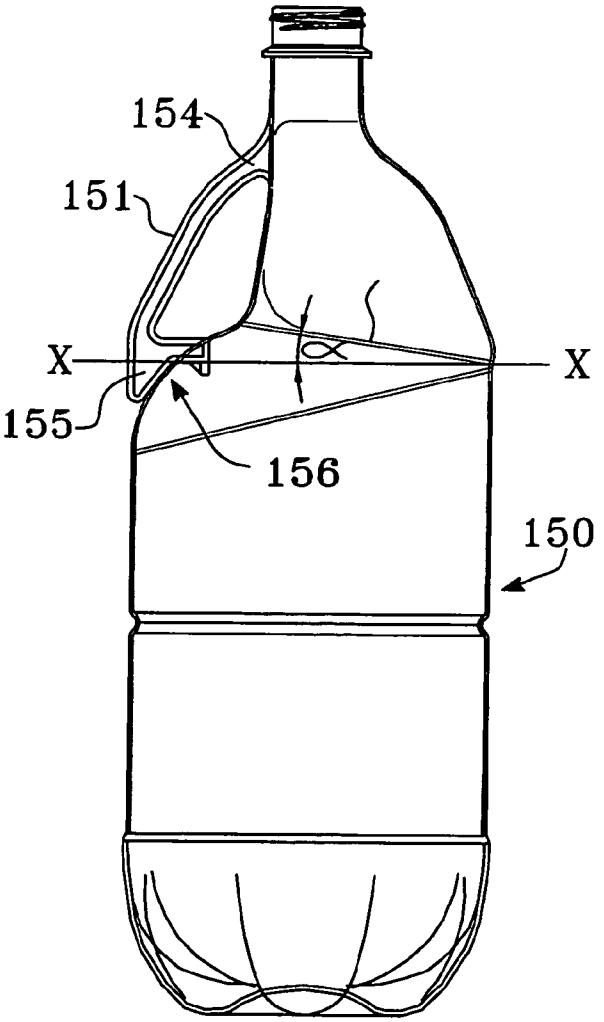

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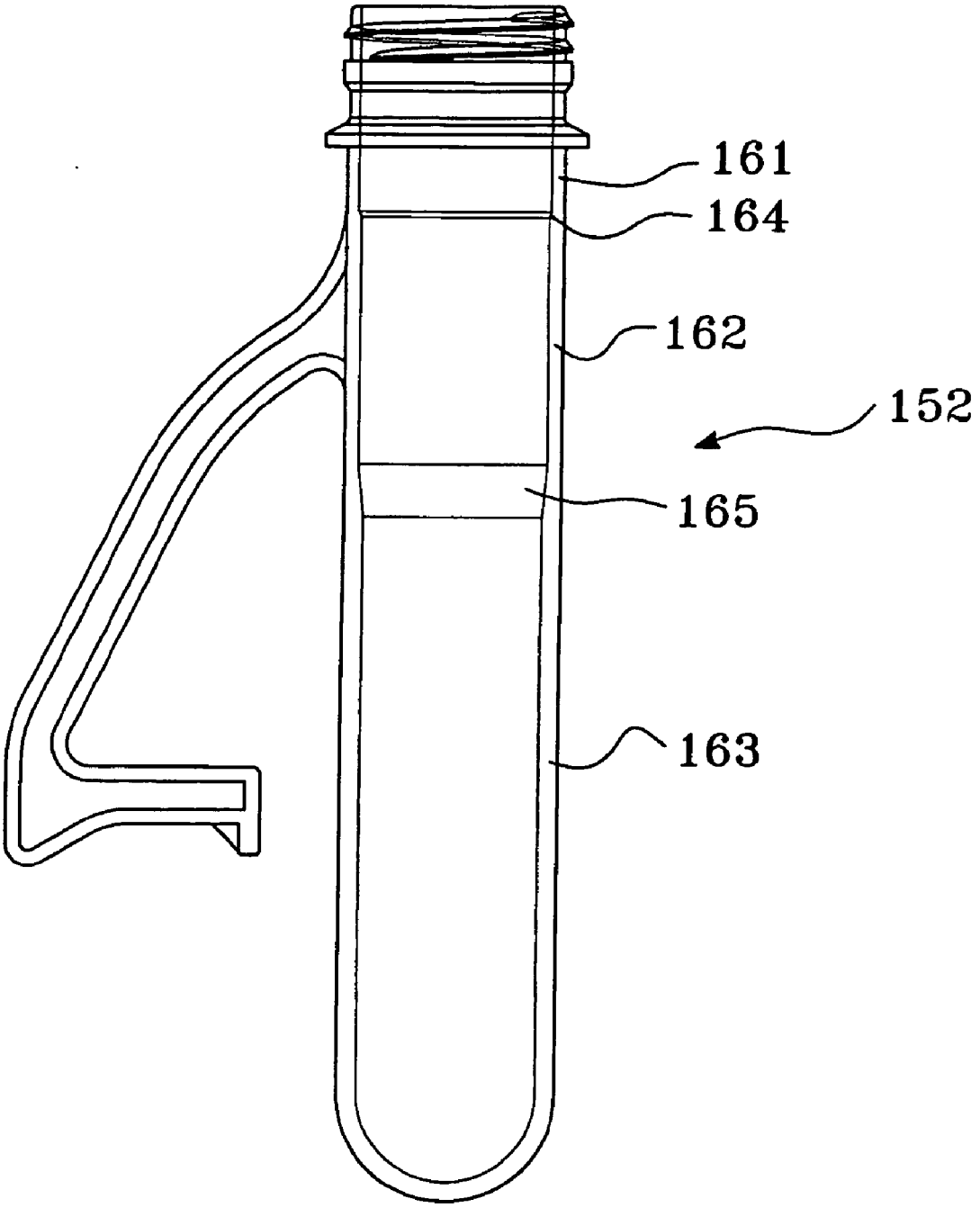

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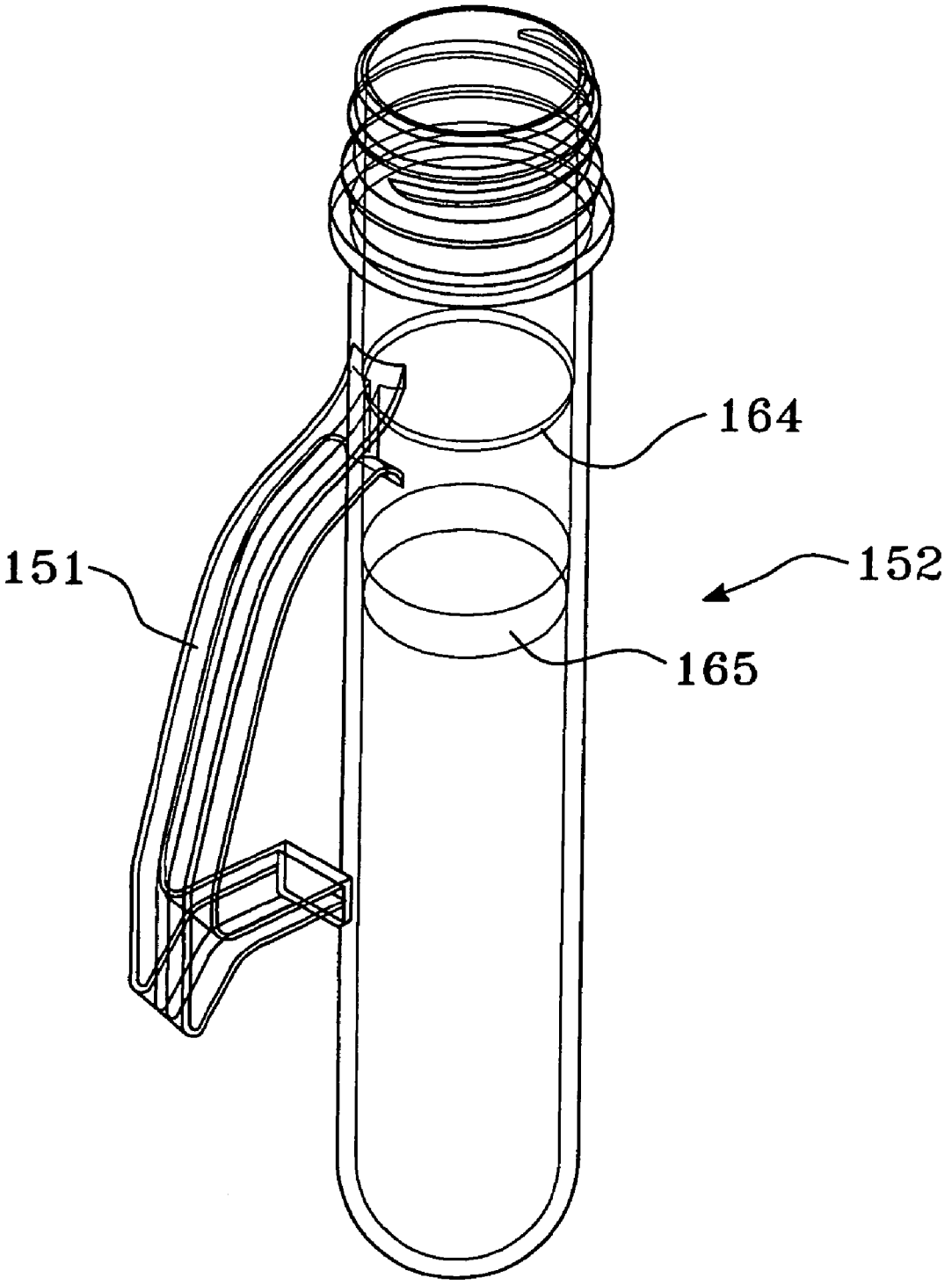

Fig. 41

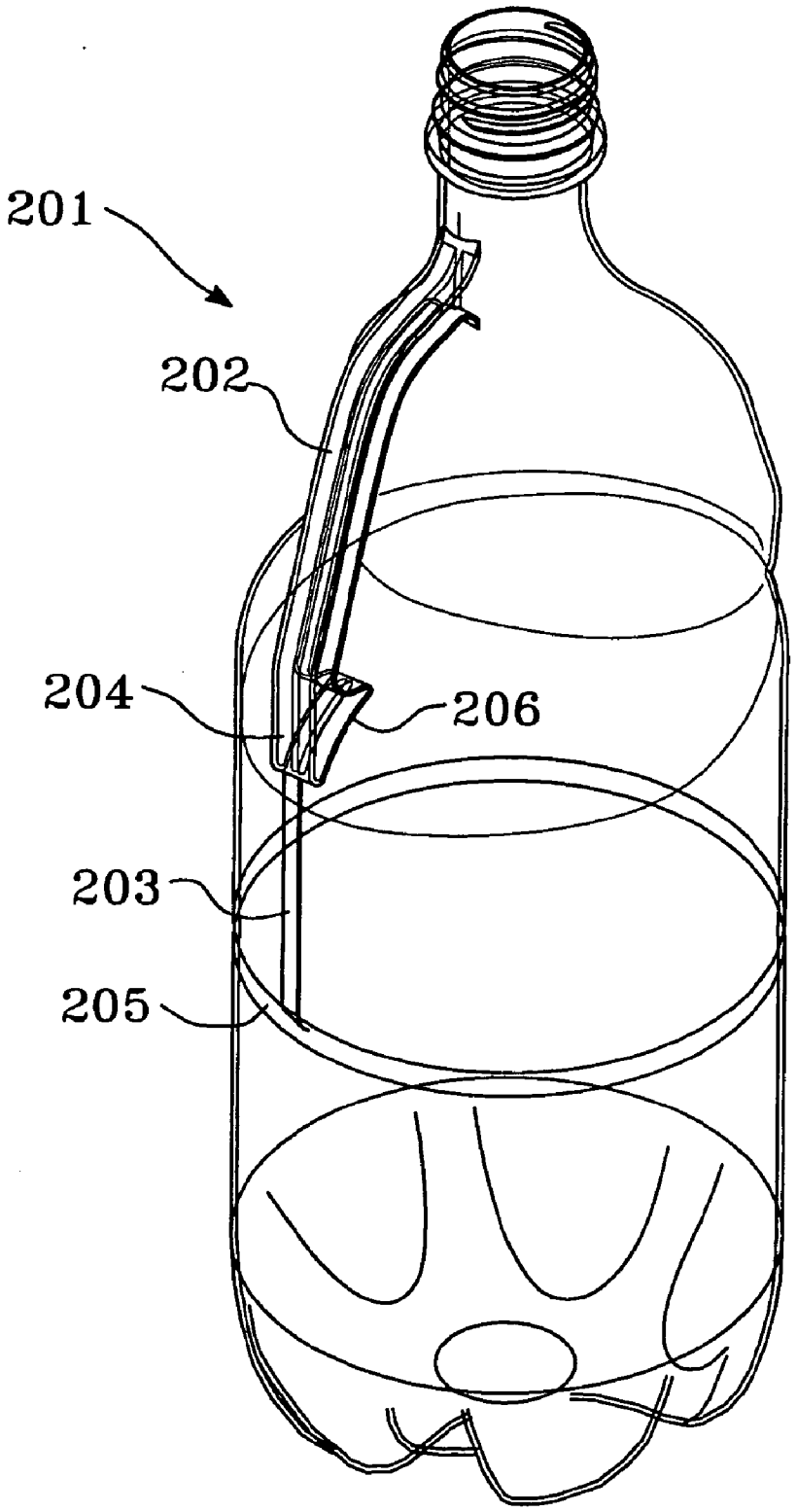

Fig. 42

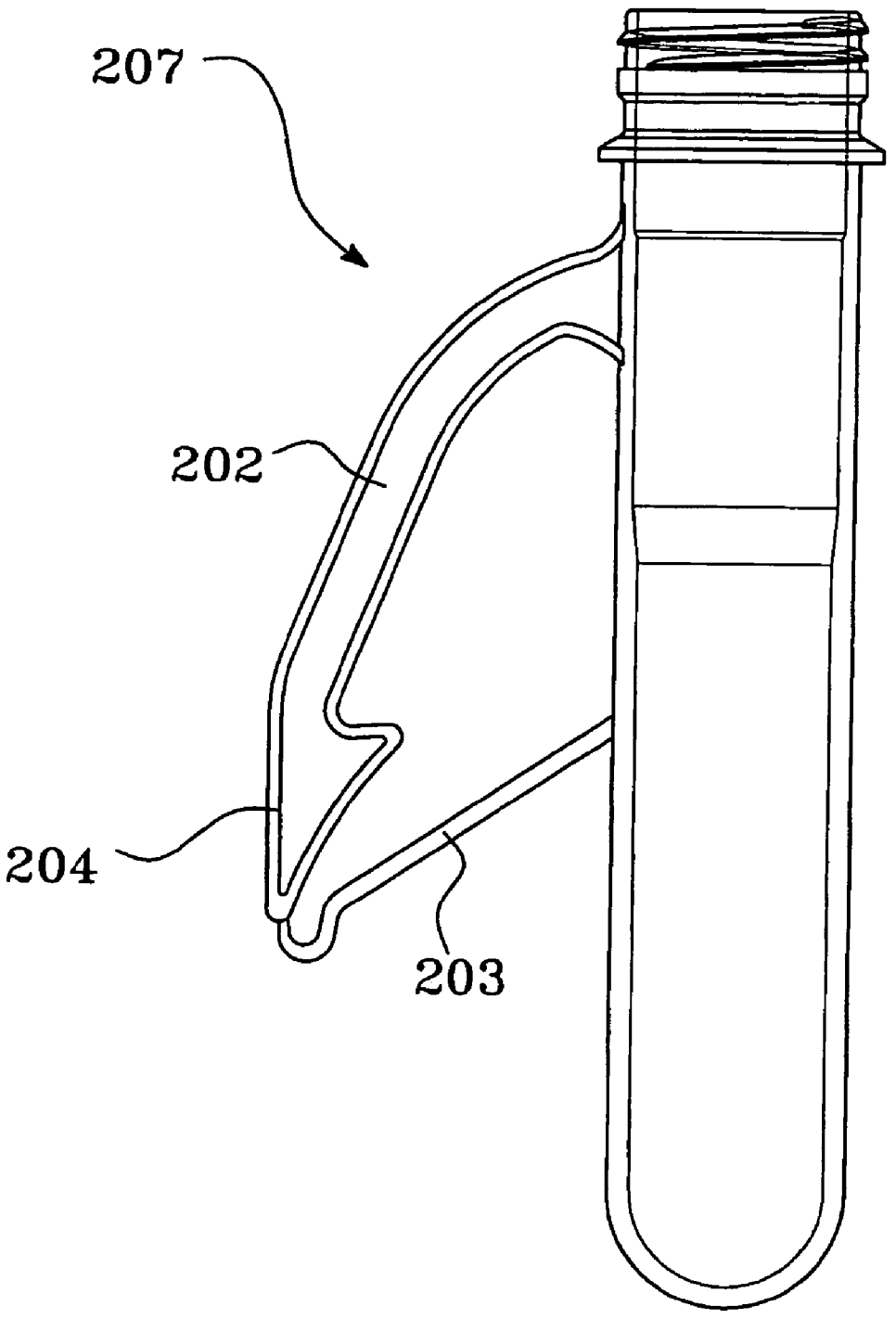

Fig. 43

CONTAINER WITH INTEGRAL HANDLE, PREFORM AND METHOD OF MANUFACTURE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This is a continuation to U.S. application Ser. No. 09/508,353 filed on Mar. 9, 2000 under 35 U.S.C. §371 to PCT/AU98/00738, which claims priority to Australian Application Nos. PO09080, filed Sep. 9, 1997, PP00982, filed Dec. 17, 1997 and PP03441, filed May 8, 1998. The date of receipt of §371 requirements for Ser. No. 09/508,353 is Nov. 6, 2000. The entire disclosures of these preceding applications are incorporated by this reference as though set forth fully herein.

BACKGROUND OF THE INVENTION

[0002] Attempts have been made to incorporate integral handles in PET and like injection blow moulded containers—for example see U.S. Pat. No. 4,629,598 to Thompson, assigned to Tri-Tech Systems International, Inc. The parison from which the handled bottles of U.S. Pat. No. 4,629,598 are produced is illustrated in **FIG. 1**. To date, however, attempts to produce a practical, mass produced version of this arrangement have been unsuccessful. Instead, the best that appears to have been done in commercial practice is an arrangement whereby the blown containers are arranged to accept a clip on or snap on handle in a separate production step after the container itself is formed. See for example WO82/02371 and WO82/02370, both to Thompson.

[0003] Injection-stretch-blow moulding is a process in which the parison is stretched both axially and radially, resulting in biaxial orientation.

[0004] Biaxial orientation provides increased tensile strength (top load), less permeation due to tighter alignment of the molecules, and improved drop impact, clarity, and lightweighting of the container.

[0005] Not all thermoplastics can be oriented. The major thermoplastics used are polyethylene terephthalate (PET), polyacrylonitrile (PAN), polyvinyl chloride (PVC), and polypropylene (PP). PET is by far the largest volume material, followed by PVC, PP, and PAN.

[0006] The amorphous materials, e.g., PET, with a wide range of thermoplasticity are easier to stretch-blow than the partially crystalline types such as PP. Approximate melt and stretch temperatures to yield maximum container properties are:

Material	Melt, Degrees C.	Stretch, Degrees C.
PET	280	107
PVC	180	120
PAN	210	120
PP	240	160

[0007] There are basically two types of processes for stretch-blow moulding: 1) single-stage in which preforms are made and bottles blown on the same machine, and 2) twostage in which preforms are made on one machine and blown later on another machine.

[0008] Single-stage equipment is capable of processing PVC, PET, and PP. Once the parison is formed (either extruded or injection moulded), it passes through conditioning stations which bring it to the proper orientation temperature. The single-stage system allows the process to proceed from raw material to finished product in one machine, but since tooling cannot be easily changed, the process is best suited for dedicated applications and low volumes.

[0009] Oriented PVC containers most commonly are made on single-stage, extrusion-type machines. The parison is extruded on either single- or double-head units. Temperature conditioning, stretching, and thread forming are done in a variety of ways depending on the design of the machine. Many of the processes presently in use are proprietary.

[0010] Many oriented PET containers are produced on single-stage machines. Preforms are first injection moulded, then transferred to a temperature conditioning station, then to the blow moulding operation where the preforms are stretchblown into bottles, and finally to an eject station.

[0011] With the two-stage process, processing parameters for both preform manufacturing and bottle blowing can be optimized. A processor does not have to make compromises for preform design and weight, production rates, and bottle quality as he does on single-stage equipment. He can either make or buy preforms. And if he chooses to make them, he can do so in one or more locations suitable to his market. Both high-output machines and low output machines are available. Two stage extrusion-type machines generally are used to make oriented PP bottles. In a typical process, preforms are re-extruded, cooled, cut to length, reheated, stretched while the neck finish is being trimmed, and ejected. The two-stage process is the lowest-cost method to produce oriented PET containers. The two-stage process, which permits injection moulding of the preform and then shipping to blow moulding locations, has allowed companies to become preform producers and to sell to blow moulding producers. Thus companies that wish to enter the market with oriented PET containers can minimise their capital requirements. Two-stage stretch-blow moulding also is being used for production of oriented PVC containers.

[0012] Preform design and its relationship to the final container remains the most critical factor. The proper stretch ratios in the axial and hoop directions must be met if the container is to properly package its intended product.

Material	Stretch Ratios	Orientation Temp. Deg. F.
PET	16/1	195–240
PVC	7/1	210–240
PAN	9/1	220–260
PP	6/1	260–280

[0013] It is an object of the present invention to produce a practical, readily implementable injection, stretch blow moulded container made from an orientable thermoplastics material incorporating a handle which is formed during and as part of the said injection, stretch blow moulding operation.

BRIEF SUMMARY OF THE INVENTION

[0014] According to one aspect of the invention, there is provided a preform for a container comprised of orientable thermoplastic material and arranged so that the resultant blown container will include a handle or like support structure; said preform comprising a moulded structure having a neck portion and an expandable portion below the neck, said neck including a locating ring above the expandable portion and a solid stem of orientable thermoplastics material projecting from the EMI4.1 and moulded integrally therewith which when the container is formed constitutes the handle.

[0015] Preferably said stem projects from said locating ring and from a temperature transition zone located immediately below said ring.

[0016] According to another aspect of the invention there is provided a method of forming a container having an integral handle; said method comprising:

[0017] (a) forming a preform having a neck portion and an expandable portion below the neck portion, said neck portion including a locating ring above the expandable portion and a solid stem of orientable thermoplastics material projecting from the EMI4.2 and moulded integrally therewith, and

[0018] (b) performing a blow moulding operation on said preform to expand the expandable portion to form the body of the container.

[0019] Preferably said stem projects from said locating ring and from a temperature transition zone located immediately below said ring.

[0020] In a preferred form of the invention, the neck portion and integral handle are subjected to a crystallisation step.

[0021] Preferably, the blow moulding operation includes supporting the stem whilst the preform is blown in a manner whereby at least a portion of the external side of the tube expands to encircle at least a lower portion of the stem so as to form an enclosed grip portion between the external side and the solid stem.

[0022] It is preferred that the enclosed grip portion allows at least two fingers of the adult human hand to pass therethrough.

[0023] In a particularly preferred form of the invention the stem is formed so as to have an I-shaped cross-section at least throughout that portion of the stem where it projects from the external side of said tube. The handle may be curved to provide additional strength.

[0024] In a further broad form of the invention there is provided a parison for an injection stretch blow moulding process, said parison formed by an injection process including two separate points of injection.

[0025] Preferably a first point of injection permits injection of non-recycled PET or like thermoplastics material. Preferably a second point of injection permits injection of PET or like thermoplastics material incorporating at least a portion of recycled material.

[0026] Preferably said first point of injection is for the formation of that part of the parison which will be stretched during a stretch blow moulding operation on the parison. Preferably said second point of injection is for the formation of those parts of said parison which will remain unexpanded or substantially unexpanded in a stretch blow moulding operation on said parison.

[0027] In yet a further broad form of the invention there is provided a container manufactured from a two stage injection stretch blow moulding process, said container including a graspable handle affixed at at least a first point and a second point to said container so as to form an enclosed area between the handle and the bottle and through which the fingers of a human hand may be passed.

[0028] Preferably said first point of connection comprises an integral connection between the handle and the container and is formed in said first step of said two step operation.

[0029] Preferably said second point of connection is formed during said second step of said two step operation.

[0030] Preferably said handle at said second point of interconnection includes a bulbous portion adapted to be at least partially enfolded by a portion of said container as it is blown during said second step of said two step operation whereby a mechanically interlocked connection is formed at said second point of connection of said handle to said container.

[0031] In particular preferred forms said bulbous portion comprises one of an upwardly extending hook, a downwardly extending hook, a bulb or a combination of one or more thereof.

[0032] In a further broad form of the invention there is provided a method of production of an integral handle PET container including the step of shrouding a handle stem portion of a preform during preheating of said preform preparatory to a stretch blow moulding step.

[0033] Preferably the handle stem is fully supported in a mould cavity against movement during the stretch blow moulding operation.

[0034] In a further broad form of the invention there is provided a container comprised of biaxially orientable thermoplastic material manufactured from a two stage injection stretch blow moulding process; said two stage process comprising a first stage in which a preform is manufactured and a second stage in which said preform is reheated and biaxially stretched to form said container; said container including a graspable handle affixed at at least a first point of connection and a second point of connection to said container so as to form an enclosed area between said handle and said container and through which at least two fingers of a human hand can pass; and wherein said first point of connection comprises an integral connection between the handle and the container and is formed in said first stage of said two stage process.

BRIEF DESCRIPTION OF THE DRAWINGS

[0035] Embodiments of the present invention will now be described by way of example, with reference to the accompanying drawings, in which:

[0036] **FIG. 1** is a side view of a prior art parison,

[0037] **FIG. 2** is a side view of a parison incorporating features according to embodiments of the present invention,

[0038] **FIG. 3** is a partial side elevational view of a blow moulded PET container formed from a preform according to one embodiment of the invention;

[0039] **FIG. 4** illustrates the steps of formation of a parison according to another embodiment of the invention.

[0040] **FIG. 5A** is a side view of a preform according to a further embodiment of the invention;

[0041] **FIG. 5B** is a side view of a container formed from the preform of **FIG. 5A**.

[0042] **FIG. 6** is a side view of a die in open position for manufacture of a preform;

[0043] **FIG. 7** is the die of **FIG. 6** in closed position;

[0044] **FIG. 8** is a side view of the die of **FIGS. 6 and 7** showing the stem of the preform located therein,

[0045] **FIG. 9** is a top view of a two stage injection, blow mould machine adapted to receive preforms and biaxially orient them into blown containers according to an embodiment of the invention,

[0046] **FIG. 10** is a side section view of a lifting, lowering and rotating mechanism for handle covers for use with the machine of **FIG. 9**,

[0047] **FIG. 11** is an alternative side section view of the mechanism of **FIG. 10**,

[0048] **FIG. 12** is a side section, close up view of the machine of **FIG. 9** showing a preform with handle cover lowered over the handle portion thereof,

[0049] **FIG. 13A**, B illustrates first and second side section views of a preform adapted for loading into the machine of **FIG. 9**,

[0050] **FIG. 14** is a perspective view of the preform of **FIG. 13**,

[0051] **FIG. 15** is a perspective view of a container blown from the preform of **FIG. 14** on the machine of **FIG. 9**,

[0052] **FIG. 16** is a plan view of a half mould adapted for blowing preforms on the machine of **FIG. 9**,

[0053] **FIG. 17** is a top view of the mould of **FIG. 16** with a preform inserted therein ready for blowing on the machine of **FIG. 9**,

[0054] **FIG. 18** is a bottom view of **FIG. 17** with both half moulds in opposed relationship,

[0055] **FIG. 19** is a further bottom view of **FIG. 17** showing the preform in the position of **FIG. 17**,

[0056] **FIG. 20** is a section view through the half mould of **FIG. 16**,

[0057] **FIG. 21** is a section view through the mould of **FIG. 16**,

[0058] **FIG. 22** is a side view of the container of **FIG. 15** blown in the mould of **FIG. 19** from a preform as illustrated in **FIG. 13** and **14**,

[0059] **FIG. 23** is a detail, side section view of the neck and top handle portion of the container of **FIG. 22**,

[0060] **FIG. 24** is a side view of a preform incorporating an enlarged first non-expanding region according to a further embodiment of the invention,

[0061] **FIG. 25** is an alternative side view of the preform of **FIG. 24**,

[0062] **FIG. 26** is a side view of a container blown from the preform of **FIG. 24** on the machine of **FIG. 9**,

[0063] **FIG. 27** is a perspective view of the preform of **FIG. 24**,

[0064] **FIG. 28** is a perspective view of the container of **FIG. 26**,

[0065] **FIG. 29** is a side view of yet a further alternative embodiment of a preform incorporating a lengthened or enlarged first non-expanding zone and adapted for blowing on the machine of **FIG. 9**,

[0066] **FIG. 30** is a side view of a container blown from the preform of **FIG. 29** on the machine of **FIG. 9**,

[0067] **FIG. 31** is a plan view of a half mould for blowing the preform of **FIG. 24**,

[0068] **FIG. 32** is a plan view of the half mould of **FIG. 31** with the preform of **FIG. 24** inserted therein ready for blowing on the machine of **FIG. 9**,

[0069] **FIG. 33** is a side section view of a container blown in the mould of **FIG. 32** and

[0070] **FIG. 34** is a detail side section view of the neck and top handle portion of the container of **FIG. 33**.

[0071] **FIG. 35** is a first perspective view of a container according to a further embodiment of the invention particularly adapted to resist high internal pressures,

[0072] **FIG. 36** is a second perspective view of the container of **FIG. 35**,

[0073] **FIG. 37** is a first side view of the container of **FIG. 35**,

[0074] **FIG. 38** is a second side view of the container of **FIG. 35**,

[0075] **FIG. 39** is a plan view of the container of **FIG. 35**,

[0076] **FIG. 40** is a side view of a preform from which the container of **FIG. 35** can be blown,

[0077] **FIG. 41** is a perspective view of the preform of **FIG. 40**,

[0078] **FIG. 42** is a perspective view of a container with strap connected handle according to a further embodiment of the invention, and

[0079] **FIG. 43** is a side view of a preform from which the container of **FIG. 42** can be blown.

DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS

[0080] A container **10** according to an embodiment of the invention is shown in **FIG. 3**. It includes a neck **11** and an expanded portion **12**.

[0081] The neck **11** has a threaded portion **13** and a locating ring **14**. Moulded integrally with the ring **14** is a stem **15** having a first portion **15***a* extending outwardly from

the ring **14** and a second portion **15***b* so inclined to the first portion **15***a* that it is nearly parallel to a vertical axis of the container **10**. In this instance, the first portion **15***a* subtends an angle of slightly more than 450 to the wall **20** and the second portion subtends an angle of about 200 to the wall **20**.

[**0082**] The particular shape of the stem **15** is selected so that when formed as a handle it may be grasped by fingers of the human hand.

[**0083**] The stem **15** terminates in a stem end **16** which faces generally downwardly in the general direction of closed end of the container **10**.

[**0084**] In this instance, the stem **15** is of I-shaped cross-section to combat unwanted effects arising at or near junction **17** of stem **15** with the ring **14** following a blowing operation on the preform **10**.

[**0085**] These unwanted effects particularly include stress effects and air inclusions resulting from non-uniform cooling through preform volumes of differing cross-section.

[**0086**] In this embodiment of the invention, the preform is made from PET and is prepared utilizing a heated mould.

[**0087**] In order to produce the container **10**, the parison or preform **26** (see **FIG. 2**) according to an embodiment of the invention can be placed in a blow moulding machine (not shown) and blow moulded according to bi-axial orientation blow moulding techniques with the neck **11** being held in a mould in such a way as not to expand. Initially, the expandable portion of the preform below the neck can be mechanically stretched downwardly to the bottom of the mould and then the bulk of the preform can be blown outwardly by application of compressed air to the extent that a support portion **18** is formed around the stem end **16** such that an enclosed area **19** is formed between wall **20** of the container **10** and the stem **15** in the process of the formation by blow moulding of container **10**.

[**0088**] In a particular preferred form of the invention, the enclosed area **19** is of sufficient cross-sectional area to allow at least two fingers of a human hand to be inserted therethrough and to grasp handle **15** so as to support the container **10**.

[**0089**] The blow moulding operation is carried out in such a way so as to provide a bottle or container having optimum strength by achieving biaxial orientation of the molecules of the preferred PET material as well as improved barrier properties to reduce oxidation.

[**0090**] In accordance with an embodiment of the invention, the neck **11** and handle **15** can be crystallised by over-heating those parts of the preform. The crystallisation of the handle increases its rigidity which assists orientation of the preform and permits the use of less material.

[**0091**] Crystallisation of the neck and handle can be carried out by running hot oil over the neck and handle, applying an open flame or by blowing hot air.

[**0092**] The location of the handle **15** on the ring **14** ensures that there is minimum interference to the blow moulding process applied to the remainder of the preform. Either a one stage or two stage process can be used.

[**0093**] Detailed Description of Further Embodiments

[**0094**] **FIG. 1** illustrates the prior art preform or parison **21** of U.S. Pat. No. 4,629,598. The concept of this prior art disclosure is to form a handle portion **23** from the locating ring of non-expandable portion **22** of the parison **21**.

[**0095**] With reference to **FIG. 2** and with reference to the detailed description of the preferred embodiment this arrangement of **FIG. 1** is modified according to the present invention in a number of respects.

[**0096**] Insets **2**A, **2**B and **2**C show bulbous portions **27** forming part of stem end **16** in the shape, respectively of a downwardly extending hook **24***a*, a bulb **24***b* and an upwardly extending hook **24***c*.

[**0097**] These portions have in common a shape which is adapted to engage mechanically with a blown portion of the container **10** which is adapted to envelop the bulbous portion **27**.

[**0098**] The process by which the second stage blow of the expandable portion **12** of parison **26** is effected so as to envelope the bulbous portion **27** of stem end **16** is a stretch blow, biaxial orientation process.

[**0099**] With reference to **FIG. 4 a** particular method of manufacture of the parison **26** according to another embodiment of the invention is illustrated. It includes a two stage process for the formation of the parison by an injection moulding process. In Stage **1** a first injection mould inlet **28** permits entry of plastics material for the formation of the expanded portion **12** of the parison **26** (expanded in the blow moulding stage of container formation, with reference to **FIG. 3**).

[**0100**] In a second stage of the injection moulding process for the formation of parison **26** a second injection mould inlet **29** permits entry of plastics material for the formation of the non-expandable portion **25** of parison **26**.

[**0101**] The two stage injection arrangement is such that different plastics materials may be injected through first injection mould inlet **28** and second injection mould inlet **29**.

[**0102**] In a particular preferred form the plastics material injected in first injection mould inlet **28** is non-recycled or substantially non-recycled plastics material whilst the plastics material injected into second injection mould inlet **29** is recycled or at least partially recycled plastics material.

[**0103**] This arrangement permits controlled use of proportions of recycled and non-recycled plastics material in order to achieve optimum economics in the construction of parison **26**.

[**0104**] In a modification of this arrangement the Stage **2** step can include the production of two walls in the nonexpandable portion **25** comprising inner wall **51** and outer wall **52**. Inner wall **51** is made from virgin or noncontaminated PET material and acts as an insulation barrier with respect to wall **52** which can be made from recycled material **52**. This dual wall arrangement can be produced by use of a sliding core arrangement as a modification in the die arrangement and process described with reference to **FIGS. 6, 7** and **8** later in this specification.

[**0105**] Of course the Stage **1** and Stage **2** steps of **FIG. 4** can be interchanged in order.

[0106] A parison and resulting container according to a further embodiment of the invention are illustrated in **FIGS. 5A** and B respectively. Like parts are numbered as for previous embodiments.

[0107] In this embodiment the parison **21** includes a locating ring **14** immediately below which is a first non-expanding region **30** and a second non-expanding region **31**. The first non-expanding region **30** may itself be formed so as to be slightly raised or otherwise differentiated from the expandable portion of parison **21**. Second non-expanding region **31** may not be differentiated from the expandable portion of parison **21** but, in use, the blowing operation will be such as to ensure that the second non-expanding region **31** is not expanded in the blowing process.

[0108] In this case the stem **15** includes a first rib **32** integrally moulded with and extending from locating ring **14**. The stem **15** also includes second rib **33** integrally moulded with and extending from second non-expanding region **31**. Stem **15** further includes a rib connector **34** integrally moulded with and extending from first non-expanding region **30** and forming a continuous connection between first rib **32** and second rib **33** throughout the length of stem **15**.

[0109] The parison **36** of **FIG. 5A** is then blown in the manner previously described to form the volume **35** of container **37** illustrated in **FIG. 5B**. The neck portion including stem **15**, ring **14**, first non-expanding region **30** and second nonexpanding region **31** remain unexpanded whilst the expandable portion **36** of parison **36** is biaxially stretched to form the major volume **35** of container **37**. The stem end **16** may include the bulbous portions according to the previously described embodiments for connection to container **37** or, either alternatively or in addition can include the application of an adhesive material whereby a chemical bond is formed between stem end **16** and the wall of container **37** by the use of a chemical intermediary.

[0110] In a modification of the embodiments of **FIG. 5A** and **FIG. 5B** first non-expanding region **30** and second nonexpanding region **31** can form part of a single non-expanding region.

[0111] In yet a further modification second non-expanding region **31** can be located in the temperature transition zone of the container and wherein minor expansion during the blow moulding step may take place.

[0112] In yet a further modification both first non-expanding region **30** and second non-expanding region **31** may be located in the temperature transition zone immediately below the locating ring **14** and, again, minor expansion of these regions may take place during blowing.

[0113] With respect to the last two variations described advantage is taken of the observation that expansion at the temperature transition zone can be limited by appropriate mould design and process control whereby unwanted distortion effects caused by the rigid interconnection of this temperature transition zone **30, 31** via second rib **33** and rib connector **34** to ring **14** (or other non-expanding portion of the neck **11**) can be controlled.

[0114] In use preforms and containers blown therefrom can be manufactured as follows:

[0115] A preform is formed from orientable thermoplastics material, preferably PET or like material in an injection moulding process. Slidable dies are illustrated in **FIGS. 6, 7** and **8** and include a sliding core **40**, sliding blocks **41**, body **42**, base **43**, push block **44** and splits holder **45**. **FIG. 6** illustrates the die in open position, **FIG. 7** illustrates the die in closed position and **FIG. 8** illustrates a side view showing accommodation of the stem **14**.

[0116] The completed preforms in a second and preferably separate step are subsequently passed to a stretch blow mould machine where the preforms are first reheated to the appropriate transition temperature (refer introduction). The non-expandable portion of the preform including locating ring **14** and stem **15** are shielded substantially from the reheat process by appropriate guarding. In most instances there is likely to be a temperature transition zone in the region **30, 31** described with reference to **FIGS. 5A, 5B**.

[0117] The reheated preform is then placed in a mould and biaxially stretched and the expandable portion blown to full size utilising processes known in the art. During this process the preform is supported at neck **14** and may also be supported at stem **15**. Stem **15** does not take part in the blow process although its stem end **16** may be partially enveloped by an external wall of the blown container.

[0118] Detailed Description of Methods of Manufacture Incorporating Modified Two Stage Stretch Blow Moulding Machine

[0119] **FIG. 9** illustrates a modified two stage stretch blow mould machine **110** adapted to stretch blow mould (including biaxial orientation) of the preforms of previous embodiments and preforms of further embodiments to be described below with reference to later figures.

[0120] The machine **110** comprises a first carousel **111** adapted to receive integral handle preforms **112** from inclined chute **113** into apertures **114** spaced around the periphery thereof.

[0121] As first carousel **111** rotates it moves, via apertures **114** the preforms **112** from the chute **113** to a second carousel loading position where the preform **112** is transferred to a spindle **115** mounted near the periphery of second carousel **116**.

[0122] A sector of approximately 2700 of second carousel **116** is arranged as a preheating tunnel **117** where the preforms **112** are progressively heated by a heating bank mounted in opposed relationship to the path of travel of the preforms.

[0123] The suitably preheated preforms **112** are loaded consecutively into apertures **119** of a third carousel **120** which acts as a transfer mechanism to both suitably orient the preforms **112** about their longitudinal axis and present them to a mould cavity **121** comprising first half mould **122** and second half mould **123**.

[0124] It should be noted that during their time in the preheating tunnel **117** the preforms **112** are rotated about their longitudinal axis by spindles **115** and have a handle shroud **124** mounted over the preform stem which subsequently forms a handle for blown container **125**. Details of

the rotation of spindles **115** and the shrouding of the preform stem are discussed more fully with reference to **FIGS. 10, 11** and **12**.

[**0125**] Mould cavities **121** are mounted on the periphery of a fourth carousel **126**. During their travel through approximately a 2700 sector the half moulds **122, 123** rotate to a closed position about their axis **127** and, whilst closed, the preform **112** enclosed therein is blown and biaxially stretched in known manner in order to produce an integral handle, blown container **125**. This container **125** is ejected as illustrated when the half moulds open preparatory to receiving a fresh, preheated preform **112**.

[**0126**] With reference to **FIG. 10** further detail is shown of spindles **115** and handle shrouds **124** and their manner of operation upon and in relation to preforms **112** whilst passing through preheating tunnel **117** on second carousel **116**.

[**0127**] The spindles **15** are rotated by band drive **128** so as to, in one embodiment, rotate the preforms **112** through approximately four full axial rotations during their passage through the preheating tunnel **117**.

[**0128**] Whilst in the preheating tunnel **117** a handle shroud **124** is lowered over the free end **129** of handle stem **130** so as to fully shroud the handle stem **130** as best seen in greater detail in **FIG. 12**.

[**0129**] The shroud **124**, in one preferred form, is cylindrical save for a fluted open mouth **131** best seen in **FIG. 12**. The fluted mouth **131** assists in ensuring maximal shrouding of handle stem **130** and also assists in guiding the shroud **124** onto the free end **129** of stem **130**.

[**0130**] Lifting and lowering of the shroud **124** is effected through a shroud support stem **132** which is suspended from a cam follower **133** adapted to travel on cam **134**.

[**0131**] The stems **132** are themselves rotated by band drive **135** so as to follow the rotation of spindles **115**. As best seen in end view of **FIG. 11** the shroud support stem **132** is offset from the cam follower stem **136** by virtue of being mounted near the periphery of platten **137**.

[**0132**] As cam follower **133** rides up cam **134** it pulls handle shroud **124** up with it by virtue of the connecting link comprising shroud support stem **132**, platen **137** and cam follower stem **136**.

[**0133**] Cam follower stem **136** can comprise a telescoped arrangement allowing relative axial rotation between two component, telescoping parts thereof.

[**0134**] The handle shroud **124** can comprise alternative shapes other than cylindrical, for example an oval cross section is possible although the cylindrical arrangement having a circular cross section is preferred.

[**0135**] The handle shroud **124** is preferably made of insulating material such as a ceramic material and is covered on an exterior surface **138**, in a preferred version, with a heat reflecting material which, ideally, is also light reflecting.

[**0136**] In use the reflective surface **138** causes light and heat emanating from heating bank **118** to be reflected thereof whereby two functions are performed. The first function involves protecting the handle stem **130** from heat. The second function is to reflect heat and light in direction of that portion of the preform closes to the handle stem **130** so that it is evenly heated and tends not to be shadowed by the stem **130**.

[**0137**] In one particular form the handle shrouds **124** can be cooled by an air or nitrogen blast (not shown) directed at them whilst they are lifted clear of the preform **112**. This will assist to prevent radiated and/or convected heat building up within the cavity **139** of the shroud **124**.

[**0138**] **FIGS. 13-23** illustrate details of a preform, mould and container blown therefrom and therein by the machine of **FIG. 9**. With reference to **FIG. 13**, in a preferred version, dimension A is greater than dimension B thereby to discourage tangling of preforms prior to loading into chute **113**.

[**0139**] It will be observed that the top end of the handle is located close to the locating ring in this version. It will also be noted that the stem of the preform which subsequently constitutes the handle of the blown container is fully supported within the half mould during the entire blowing process. In contrast the walls of the container including portions of the container wall peripherally opposite the top end of the handle stem are free to be blown within the constraints of the mould.

[**0140**] With reference to **FIGS. 24-34** a second version of a preform, mould and resulting blown container is illustrated wherein first non-expanding region **30** is relatively long in the axial direction including a portion **140** which extends from locating ring **141** down to and around at least a top portion of the connection of the handle stem **130** thereby forming a join of the top end of handle stem **130** to locating ring **141**. (Best seen in **FIG. 24**).

[**0141**] In this version there is at least partial expansion of wall portions of the preform located peripherally away from the join of the handle stem **130** to the preform **112** (best seen in **FIGS. 32 and 34**). This expansion, relatively, is not as great as the biaxial expansion occurring below the first and second non-expanding regions **30**, **31**. It can, however, be significant in providing strength and resistance to gas permeation in at least second nonexpanding region **31**, if not non-expanding region **30**.

[**0142**] Container Resistant to Internal Pressures

[**0143**] With reference to FIGS. **35** to **39** there is shown a container **150** incorporating an integral handle **151** which is biaxially blown from the preform **152** illustrated in **FIGS. 40 and 41**.

[**0144**] In this instance, as perhaps best seen in **FIG. 36**, the blown container **150** includes a discontinuity region **153**. In this instance the discontinuity region **153** extends the entire circumference of the container **150**.

[**0145**] As best seen in **FIG. 38** the discontinuity region **153** lies in a plane which subtends an acute angle alpha with a horizontal plane XX.

[**0146**] The plane of the discontinuity region **153** is oriented so that where it passes closest to the integral handle **151** it lies between first end **154** and second end **155** of the handle **151**.

[**0147**] In this instance that part of the discontinuity region **153** located furtherest from the handle **151** lies in the plane XX which passes through, or close to, join region **156** where the second end **155** of handle **151** is joined to container **150**.

[0148] The discontinuity region **153** is formed by a substantial change in direction of the wall of the container **150**, perhaps best seen in **FIG. 35** wherein first tangent **157** to upper wall portion **158** intersects with second tangent **159** to lower wall portion **160** of container **150** at an obtuse angle beta, thereby forming a portion of the discontinuity region **153**.

[0149] This discontinuity region **153** imparts additional strength to the container walls, thereby to resist deformation of, particularly from internal pressures which can arise when the container is sealed, as for example when the container contains a carbonated beverage.

[0150] In order to assist in the creation of the discontinuity region **153** the preform **152** from which the container **150** is biaxially blown includes different wall thickness profiles, in this instance in the form of first wall profile **161**, second wall profile **162** and third wall profile **163** separated one from the other by first transition zone **164** and second transition zone **165** as best seen in **FIG. 40**.

[0151] It will be observed that the wall thickness of third wall profile **163** is greater than the wall thickness of second wall profile **162** which, in turn, is greater than the wall thickness of first wall profile **161**.

[0152] The second end **155** of the handle **151** is joined to the container during a biaxial blowing operation by defamation and envelopment about the second end **155**. The second end **155** can include a bulbous portion including a bulbous portion of the types illustrated in **FIG. 2**.

[0153] The preform **152** can be manufactured from PET materials in an injection moulding operation as described earlier in this specification.

[0154] The preform **152** is then blown as a second stage operation in a stretch blow moulding machine so that its walls conform to the inside surfaces of a mould, also as described earlier in this specification.

[0155] Tag Connected Handle

[0156] With reference to **FIG. 42** and **FIG. 43** an alternative version of the container and the preform from which it is constructed are illustrated.

[0157] With reference to **FIG. 42** the container **201** includes an integral handle **202** as previously described and constructed, save that the connection to the lower end of the container **201** is formed as an integral connection by way of a tag **203** which extends from a lower edge **204** of a wide part of the handle **202** down to a mid circumferential portion **205** of container **201** at which point it is integrally connected thereto. The lower edge **204** of the wide part of the handle **202** includes a landing portion **206** which merely rests on the surface of the container **201** at this point rather than being integrally connected thereto or otherwise connected thereto at this point.

[0158] A preform **207** from which the container **201** of **FIG. 42** is blown is illustrated in **FIG. 43**. This preform **207** is constructed substantially in the same manner as that illustrated in **FIG. 40** except that lower edge **204** of handle **202** is integrally connected to the preform **207** by way of tag **203** in the manner illustrated in **FIG. 43**.

[0159] The preform **207** is blown to form the container of **FIG. 42** utilising the process previously described with reference to **FIGS. 10, 11** and **12**. The above describes only some embodiments of the present invention and modifications obvious to those skilled in the art can be made thereto without departing from the scope and spirit of the present invention.

INDUSTRIAL APPLICABILITY

[0160] Embodiments of the invention are applicable to the manufacture of containers made from orientable thermoplastics material and incorporating a handle or like grasping fixture as an integral component of the container.

1-79. (canceled)

80. A preform for a container comprised of orientable plastics material and arranged so that the resultant blown container will include a handle or like support structure; said preform comprising a moulded structure having a neck portion and an expandable portion below the neck, at least one loop or portion of orientable plastics material integrally connected at both a first end and a second end to a respective first location and a separate second location on said preform which when the container is formed constitutes said handle.

81. A method of forming a container having an integral handle; said method comprising:

(a) forming a preform having a neck portion and an expandable portion below the neck portion, said preform having at least one loop of orientable plastics material integrally connected at both a first end and a second end to a respective first location and a separate second location on said preform, and

(b) performing a blow moulding operation on said preform to expand the expandable portion to form the body of the container.

82. The method of claim 81 wherein the neck portion includes a locating ring above the expandable portion.

83. The method of claim 81 wherein said container is formed from said preform in a two stage operation.

84. The method of claim 83 wherein the handle allows at least two fingers of the adult human hand to pass therethrough.

85. The method of claim 81 wherein the loop is formed so as to have an I-shaped cross-section at least throughout that portion of the stem where it projects from the external side of said tube.

86. A parison or preform as claimed in claim 80 for an injection stretch blow moulding process, said parison formed by an injection process including two separate points of injection.

87. The parison of claim 86 wherein a first point of injection permits injection of non-recycled PET or like plastics material.

88. The parison of claim 86 wherein a second point of injection permits injection of PET or like plastics material incorporating at least a portion of recycled material.

89. The parison of claim 86 wherein said first point of injection is for the formation of that part of the parison which will be stretched during a stretch blow moulding operation on the parison.

90. The parison of claim 88 wherein said second point of injection is for the formation of those parts of said parison

which will remain unexpanded or substantially unexpanded in a stretch blow moulding operation on said parison.

91. A container manufactured from a two stage injection stretch blow moulding process, said container including a graspable handle integrally affixed at at least a first point and a second point to said container so as to form an enclosed area between the handle and the container and through which the fingers of a human hand may be passed.

92. The container of claim 91 wherein said first point of connection comprises an integral connection between the handle and the neck portion of the container and is formed in a first stage of said two stage process.

93. The container of claim 92 wherein said second point of connection is located on an expandable portion of said container.

94. The container of claim 92 wherein said second point of interconnection is located on a lower neck portion of said container at a substantially non-expanding part.

95. The container of claim 94 wherein said first and second points of connection are located on a substantially non-expanding part of said container.

96. The container of claims **91** including an elongated substantially non-expanding neck portion to which said loop is affixed.

97. The preform of claim 80 further including a locating ring immediately below which is a first non-expanding region and below which is a second non-expanding region.

98. The preform of claim 80 wherein the first non-expanding region is formed so as to be slightly raised or otherwise differentiated from the expandable portion of said preform.

99. The preform of claim 97 wherein the second non-expanding region is not differentiated from the expandable portion of said preform.

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