Apparatus and Method of Manufacturing Hollow Articles

The apparatus comprises a mandrel (12) and a hollow mould (34) having a first section (50, 52, 58, 60) and a second (36, 38). Internal surfaces of the mould (34) and external surfaces of the mandrel (12) bound an elongate space including a neck portion, a body portion and a shoulder portion which joins said neck and body portions. Surfaces of the first section (50, 52, 58, 60) of the mould (34) and of the mandrel (12) bound the neck and shoulder portions and surfaces of the second section (36, 38) of the mould and of the mandrel (12) bound a cylindrical gap forming the body portion of the space. Mouldable material is fed into the space along a bore (46). The sections can move relatively to one another between a first position in which they are spaced apart and a second position in which they abut. The first section of the mould comprises two thread plates (50, 52) which bound a bore (54) having a thread groove (56) in the cylindrical surface thereof and two mould halves (58, 60) which have surfaces that bound the shoulder portion.
For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.
APPARATUS AND METHOD OF MANUFACTURING HOLLOW ARTICLES

FIELD OF THE INVENTION

This invention relates to the manufacture of hollow articles, specifically, but not exclusively, blown bottles.

BACKGROUND TO THE INVENTION

There are two widely used methods of manufacturing bottles. The first method, usually referred to as injection blow moulding, involves the injection moulding of a preform of the requisite material. The most widely used material is PET. The preform is placed in a blow mould after it has been brought to the correct temperature. Air is then blown into the preform to expand it so that it takes up the shape of the cavity of the blow mould. Prior to expansion the preform can be stretched by a stretch pin. This form is known as stretch blow moulding. In this method, the neck of the preform is not blown. The neck, and the thread which is formed in the neck, retain the same shape and dimensions in the blown bottle as they had at the preform stage.

The second method is known as extrusion blow moulding. In this form a tube of material, usually HDPE, is extruded from a nozzle directly into an open blow mould which usually comprises two mould halves. The mould is then closed onto the tube. Portions of the mould flatten the free end of the tube to form the base of the bottle. Further portions of the mould close around the other end of the tube for the
purpose of forming the neck and thread. Once the mould is closed, the extruded tube, sometimes referred to as a parison, is blown.

If a handle is required, projections on the two mould halves come into cooperating relationship to form a bar across the mould. The material of the tube is flattened by these two projections, a thin film of material remaining between them when the mould is fully closed. This film is subsequently cut away and the bottle is left with a hollow handle and a space between the handle and the body of the bottle.

Injection blow moulding results in a product which has what is known as an engineered neck meaning an accurately dimensioned neck with a smooth inside surface and an acceptable degree of rigidity. These attributes are desirable as they facilitate fitting of an injection moulded closure and this combination of features minimises the possibility of leakage. However, as described above, the procedure has two steps, injection moulding to form the preform and then blow moulding, or stretch blow moulding, to form the body of the bottle. The requisite injection moulding and blow moulding apparatus is expensive and the preforms usually have to be re-heated before blowing so that power consumption is high.

Extrusion blow moulding is advantageous in that it is a one stage procedure. However, it results in the production of a neck the dimensions of which cannot accurately be controlled. Furthermore, the inside of the neck is not generally smooth. If the parison is thick walled, a neck with a smooth inside surface can be
obtained but materials costs increase as does cycle time. The portion of the parison
which becomes the neck is blown outwardly into threading cut into the mould and hence
the threading is usually reproduced on the inside of the neck. Ensuring that a closure
fitted onto the neck seals properly is difficult due to variations in neck size and shape
and due to its lack of rigidity.

A widely used extrusion method of producing tubes with engineered necks
is often referred to as the Ossberger system and is described in, for example, US
Patent 4,806,093. The method is usually applied to the production of tubes with a
threaded neck at one end and a transverse seal in the other.

The diameter of the extruded parison is limited to the diameter of the
moulded neck. Consequently space considerations make it impractical to form a
product having a hollow handle using this method.

BRIEF DESCRIPTION OF THE INVENTION

According to one aspect of the present invention there is provided
apparatus comprising a mandrel and a hollow mould having a first section and a
second section, internal surfaces of the mould and external surfaces of the mandrel
bounding an elongate space including a neck portion, a body portion and a shoulder
portion joining said neck and body portions, surfaces of the first section of the mould
and of the mandrel bounding said neck and shoulder portions of said space and
surfaces of said second section of the mould and of the mandrel bounding a cylindrical
gap forming said body portion of said space, means for feeding mouldable material to said space, and means for moving said sections relatively to one another between a first position in which they are spaced apart and a second position in which they abut, characterised in that said first section of the mould comprises two thread plates which bound a bore having a thread groove in the cylindrical surface thereof and two mould halves which have surfaces that bound said shoulder portion.

According to a further aspect of the present invention there is provided apparatus comprising a mandrel and a hollow mould having a first section and a second section, internal surfaces of the mould and external surfaces of the mandrel bounding an elongate space including a neck portion, a body portion and a shoulder portion joining said neck and body portions, surfaces of the first section of the mould and of the mandrel bounding said neck and shoulder portions of said space and surfaces of said second section of the mould and of the mandrel bounding a cylindrical gap forming said body portion of said space, a mouldable material feed passage leading to said gap, means for moving said sections relatively to one another between a first position in which they are spaced apart and a second position in which they abut, a cylindrical piston, and means for advancing said piston in said gap to urge mouldable material that is in said gap into the void which opens up between said first and second sections of the mould as they move to their first position.

According to another aspect of the present invention there is provided apparatus comprising a mandrel and a hollow mould having a first section and a
second section, internal surfaces of the mould and external surfaces of the mandrel bounding an elongate space including a neck portion, a body portion and a shoulder portion joining said neck and body portions, surfaces of the first section of the mould and of the mandrel bounding said neck and shoulder portions of said space and surfaces of said second section of the mould and of the mandrel bounding a cylindrical gap forming said body portion of said space, means for moving said sections relatively to one another between a first position in which they are spaced apart and a second position in which they abut, a cavity into which said gap opens at the end thereof remote from said shoulder portion, means for feeding mouldable material to said cavity, and means for forcing a stream of mouldable material out of said cavity and into said gap and out of said gap into the void which opens up between said first and second sections of the mould as they move to their first position.

In one form the apparatus comprises a mouldable material feed passage leading to said gap, a cylindrical piston, and means for advancing said piston in said gap to urge mouldable material that is in said gap into the void which opens up between said first and second sections of the mould as they move to their first position.

The mandrel can have a head and a cylindrical body, the external surface of said body and an internal surface of said second mould section defining the body portion of said space.

The mandrel can include a circular end surface, a conical surface flaring
out from said end surface, and an undercut surface which intersects said flared surface at an encircling edge.

Said passage can lead into the part of said cylindrical gap which bounds said parison body portion.

Said apparatus can further include a neck insert which is within said bore of the thread plates. The neck insert can have a passageway therein along which blowing air can be fed.

The apparatus can further include a blow mould comprising two or more separable mould components. The blow mould components can include projections which come into co-operating relationship to form a bar across the mould cavity whilst the mould is in its closed condition.

According to a further aspect of the present invention there is provided a method of producing a blown product which comprises feeding mouldable material into an elongate space including a neck portion, a cylindrical body portion and a shoulder portion joining said neck and body portions to fill said space and form a moulded parison having a body portion, a neck portion and a joining shoulder portion, separating said surfaces bounding said body portion of said space from the surfaces bounding said neck and shoulder portions of said space whilst simultaneously pushing the material that in the part of the space bounding said body portion out of said part of the
space so that said cylindrical body portion of the moulded parison enters the void that is opening up between the surfaces which define said body portion on the one hand and said neck and shoulder portions on the other hand, closing a blow mould around the body portion to form a blow moulding cavity and to grip and close off the end of the body portion remote from the shoulder portion, said blow mould having projections which come into co-operating relationship as the mould is closed thereby to form a bar across the mould cavity, closing the mould onto the parison so that said projections squeeze a portion thereof flat, and blowing air into the moulded parison to expand it into the blow moulding cavity leaving a hollow handle outwardly of the squeezed portion.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the present invention, and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawings in which:

- Figure 1 illustrates apparatus in accordance with the present invention;
- Figures 2 to 11 illustrate the steps in a method of producing a blown bottle; and
- Figures 12 and 13 are side elevations which illustrate bottles that can be produced by the method and apparatus of the present invention.

DETAILED DESCRIPTION OF THE DRAWINGS

Referring firstly to Figure 1, the apparatus illustrated comprises a moulding structure generally designated 10. The moulding structure comprises a
mandrel 12 which has a head 14 and a body 16. The head 14 is bounded by a circular end surface 26, a frusto conical surface 28 and an undercut face 30. The mandrel body 16 is cylindrical and its outer surface 32 intersects the undercut face 30. This is more clearly illustrated in, for example, Figure 2 than in Figure 1.

The moulding structure 10 further includes a hollow mould which is generally designated 34 and comprises at least six parts. Parts 36 and 38 together form a housing 40 for the mandrel 12. Each part 36, 38 is semi-cylindrical in plan view and each has a semi-cylindrical inner face. These semi-cylindrical faces co-operate to form the cylindrical inner surface 42 of the housing 40. There is a cylindrical gap between the surfaces 32 and 42 and a sleeve-like cylindrical piston 44 slides in this gap.

The part 38 is formed with a radial bore 46 at the outer end of which there is a shut-off valve 48. The bore 46 leads into the gap between the surfaces 32 and 42.

The mould 34 further includes two thread plates 50 and 52 which, in the closed condition of the mould, abut to form a bore designated 54 which has grooves 56 in its cylindrical bounding face.

Between the thread plates 50, 52 and the parts 36, 38, there are two mould halves 58 and 60 which together, in the closed condition of the mould, provide a frusto-conical surface 62 which is at the same angle as the surface 28 of the mandrel.
The surface 42 of the housing 40 flares at the end thereof adjacent the mould halves 58, 60 so that its taper approximates the taper of the face 30 of the mandrel.

A neck inset 64 enters the bore 54 from above. The insert 64 is in the form of a plug having a head 66 and a spigot 68. The spigot 68 passes through the bore 54 and enters the space which is bounded externally by the surface 62.

Figure 2 shows the position of the various components immediately prior to opening of the valve 48. The mandrel 12 is raised from the position shown in Figure 1. The gap, designated 70, between the surfaces 32 and 42 communicates with the gap, designated 72, between the surfaces 28 and 62. The neck insert 64 is fully inserted.

The valve 48 is opened and molten synthetic plastics material flows in from a source (not shown) to pack the gap 72 and the part of the gap 70 which is above the piston 44. The material also fills the neck space bounded by the spigot 68 and the cylindrical face which bounds the bore 54. The neck and adjacent flared shoulder part of the parison are thus injection moulded integrally with one another, the parison thus having an engineered neck with integrally moulded thread.

The mouldable material is preferably a random polypropylene co-polymer with a haze value of less than 10%.
The piston 44 is then retracted (Figures 3 and 4) whilst infeed of material continues so that the main body of the parison is moulded in the space 70.

The valve 48 then closes and the thread plates 50, 52 and mould halves 58, 60 move away from parts 36, 38 (Figure 5). Simultaneously the piston 44 moves upwardly pushing the cylindrical part of the parison P out of the gap 70. The piston 44 can move at the same speed as the mould halves 58, 60. However, different speeds can be employed to thin or thicken the parison’s walls depending on the final configuration required.

The next step (Figure 6) comprises retraction of the mandrel 12 so that the circular edge 74 between the surfaces 28 and 30 abuts the parts 36, 38 cutting off the parison P.

Further separation of the parts 36, 38 on the one hand and thread plates 50, 52 and mould halves 58 and 60 on the other hand (see Figure 7) results in separation of the parison P from mould parts 36, 38.

The thread plates 50, 52 remain in their original relative positions (see Figure 8), the parison P hanging from these plates. The halves 58 and 60, however, separate to make space for the two components 76, 78 (Figures 8 and 9) of a blow mould 80 (Figure 9). The halves 58, 60 and the components 76, 78 can move along lines which are at right angles to one another. The blow mould closes as shown in
Figure 9, lower parts of the components 76, 78 gripping the open end of the parison P and squeezing it shut.

Air is then blown in through a passage 80 (Figure 10) in the neck insert 64 to expand the parison P into the mould 80.

The thread plates 50, 52 separate with the components 76, 78 after the bottle B has been blown (see Figure 11) thereby to release it.

The mould parts are then returned to the position of Figure 2 and the cycle re-commences.

The bottles shown in Figures 12 and 13 have engineered necks N with threads T and flared shoulders F. The hollow handle is designated H and the finger opening left by the projections of the blow mould is designated O. It will be noted that the neck in Figure 13 is not symmetrically positioned. This means that the shoulder F is itself unsymmetrical. The openings O are also positioned differentially.

The surfaces 28, 62 can be formed to impart design features to the final product. For example, the surfaces 28, 62 can have matching ribs and grooves thereby to form ribs on the shoulder F.

To form the hollow handle H and finger opening O, projections 82 are
provided within the blow mould. These come into abutting relationship thereby to
squeeze the parison flat as the mould closes.

In a form of the invention which has not been illustrated, the bore 46 leads
to a cavity below the parts 36, 38. The gap between the surfaces 32, 42 opens into this
cavity. The mouldable material thus enters the gap from its lower end instead of at a
point midway along its length.
CLAIMS:

1. Apparatus comprising a mandrel and a hollow mould having a first section and a second section, internal surfaces of the mould and external surfaces of the mandrel bounding an elongate space including a neck portion, a body portion and a shoulder portion joining said neck and body portions, surfaces of the first section of the mould and of the mandrel bounding said neck and shoulder portions of said space and surfaces of said second section of the mould and of the mandrel bounding a cylindrical gap forming said body portion of said space, means for feeding mouldable material to said space, and means for moving said sections relatively to one another between a first position in which they are spaced apart and a second position in which they abut, characterised in that said first section of the mould comprises two thread plates which bound a bore having a thread groove in the cylindrical surface thereof and two mould halves which have surfaces that bound said shoulder portion.

2. Apparatus comprising a mandrel and a hollow mould having a first section and a second section, internal surfaces of the mould and external surfaces of the mandrel bounding an elongate space including a neck portion, a body portion and a shoulder portion joining said neck and body portions, surfaces of the first section of the mould and of the mandrel bounding said neck and shoulder portions of said space and surfaces of said second section of the mould and of the mandrel bounding a cylindrical gap forming said body portion of said space, a mouldable material feed passage leading to said gap, means for moving said sections relatively to one another between a
first position in which they are spaced apart and a second position in which they abut, a
cylindrical piston, and means for advancing said piston in said gap to urge mouldable
material that is in said gap into the void which opens up between said first and second
sections of the mould as they move to their first position.

3. Apparatus comprising a mandrel and a hollow mould having a first section
and a second section, internal surfaces of the mould and external surfaces of the
mandrel bounding an elongate space including a neck portion, a body portion and a
shoulder portion joining said neck and body portions, surfaces of the first section of the
mould and of the mandrel bounding said neck and shoulder portions of said space and
surfaces of said second section of the mould and of the mandrel bounding a cylindrical
gap forming said body portion of said space, means for moving said sections relatively
to one another between a first position in which they are spaced apart and a second
position in which they abut, a cavity into which said gap opens at the end thereof
remote from said shoulder portion, means for feeding mouldable material to said cavity,
and means for forcing a stream of mouldable material out of said cavity and into said
gap and out of said gap into the void which opens up between said first and second
sections of the mould as they move to their first position.

4. Apparatus as claimed in claim 1, 2 or 3 and which comprises a mouldable
material feed passage leading to said gap, a cylindrical piston, and means for
advancing said piston in said gap to urge mouldable material that is in said gap into the
void which opens up between said first and second sections of the mould as they move
to their first position.

5. **Apparatus as claimed in any preceding claim, wherein said mandrel has a head and a cylindrical body, the external surface of said body and an internal surface of said second mould section defining the body portion of said space.**

6. **Apparatus as claimed in claim 5, wherein said mandrel further includes a circular end surface, a conical surface flaring out from said end surface, and an undercut surface which intersects said flared surface at an encircling edge.**

7. **Apparatus as claimed in claim 1 and further comprising a neck insert which is within said bore of the thread plates.**

8. **Apparatus as claimed in claim 7, in which the neck insert has a passageway therein along which blowing air can be fed.**

9. **Apparatus as claimed in any preceding claim and further including a blow mould comprising two or more separable mould components.**

10. **Apparatus as claimed in claim 9, wherein said blow mould components include projections which come into co-operating relationship to form a bar across the mould cavity whilst the mould is in its closed condition.**
11. A method of producing a blown product which comprises feeding mouldable material into an elongate space including a neck portion, a cylindrical body portion and a shoulder portion joining said neck and body portions to fill said space and form a moulded parison having a body portion, a neck portion and a joining shoulder portion, separating said surfaces bounding said body portion of said space from the surfaces bounding said neck and shoulder portions of said space whilst simultaneously pushing the material that in the part of the space bounding said body portion out of said part of the space so that said cylindrical body portion of the moulded parison enters the void that is opening up between the surfaces which define said body portion on the one hand and said neck and shoulder portions on the other hand, closing a blow mould around the body portion to form a blow moulding cavity and to grip and close off the end of the body portion remote from the shoulder portion, said blow mould having projections which come into co-operating relationship as the mould is closed thereby to form a bar across the mould cavity, closing the mould onto the parison so that said projections squeeze a portion thereof flat, and blowing air into the moulded parison to expand it into the blow moulding cavity leaving a hollow handle outwardly of the squeezed portion.

12. A blown product when produced in the apparatus claimed in either of claims 9 and 10.

13. A blown product when made by the method of claim 11.
**INTERNATIONAL SEARCH REPORT**

### A. CLASSIFICATION OF SUBJECT MATTER

| IPC  | B29C49/02 |

According to International Patent Classification (IPC) or to both national classification and IPC

### B. FIELDS SEARCHED

**Minimum documentation searched (classification system followed by classification symbols)**

| IPC  | B29C |

**Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched**

**Electronic data base consulted during the international search (name of data base and, where practical, search terms used)**

EPO-Internal

### C. DOCUMENTS CONSIDERED TO BE RELEVANT

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents:

  - "A" document defining the general state of the art which is not considered to be of particular relevance
  - "E" earlier document but published on or after the international filing date
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  - "P" document published prior to the international filing date but later than the priority date claimed

**Date of the actual completion of the international search**

11 May 2004

**Date of mailing of the international search report**

04/06/2004

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