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(54) **A METHOD OF FORMING A CLOSURE**

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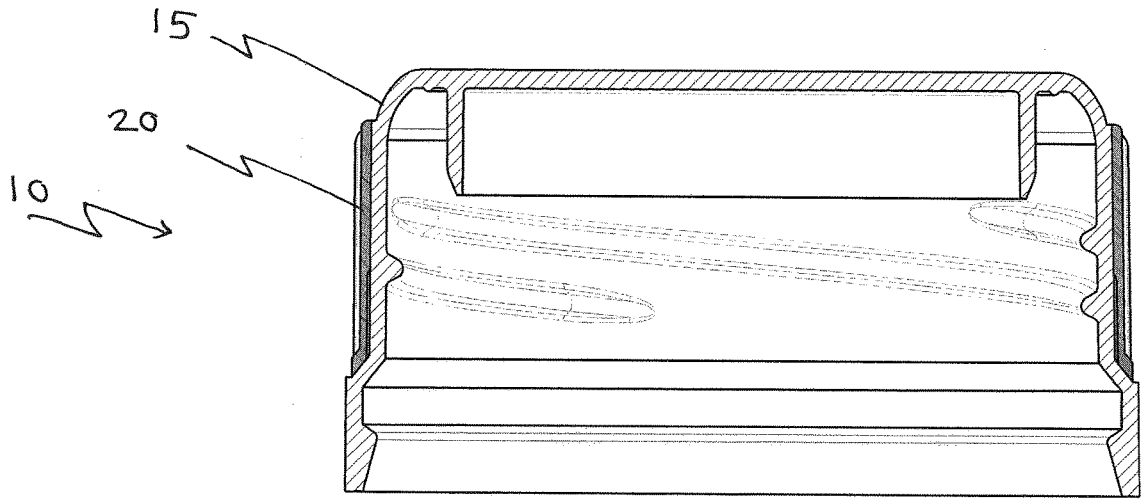
(57) **ABSTRACT**

A method of forming a bi-injected closure, comprising the steps of: forming a cap with a top plate and a depending sidewall, in a first injection moulding phase using a first mould part, the cap formed so as to include one or more external sealing areas; changing the first mould part for a second mould part, the second mould part sealing against the or each sealing area on the cap; and forming an outer ring around the cap sidewall whilst the second mould part is sealed against the sealing area/s in a second moulding phase.



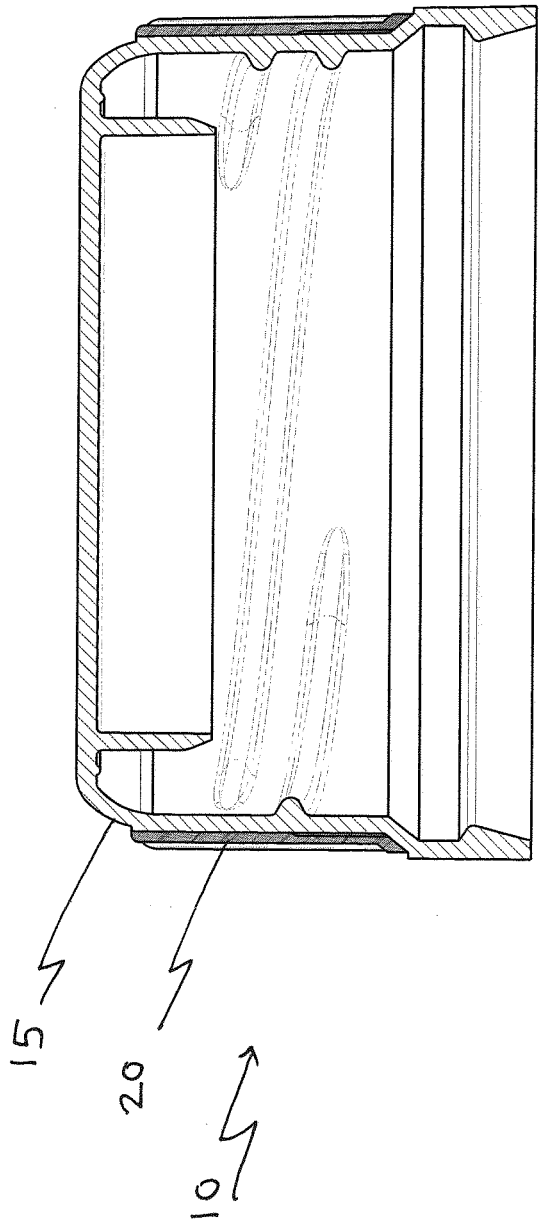


Figure 1

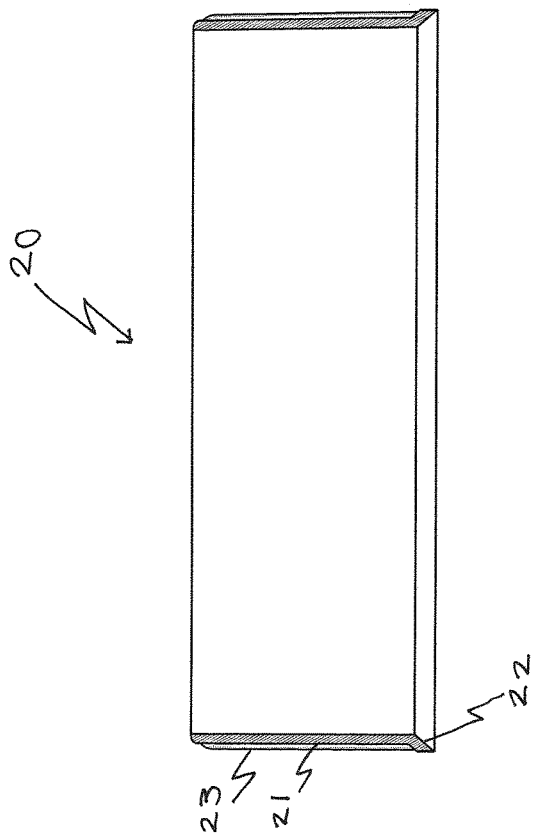


Figure 2B

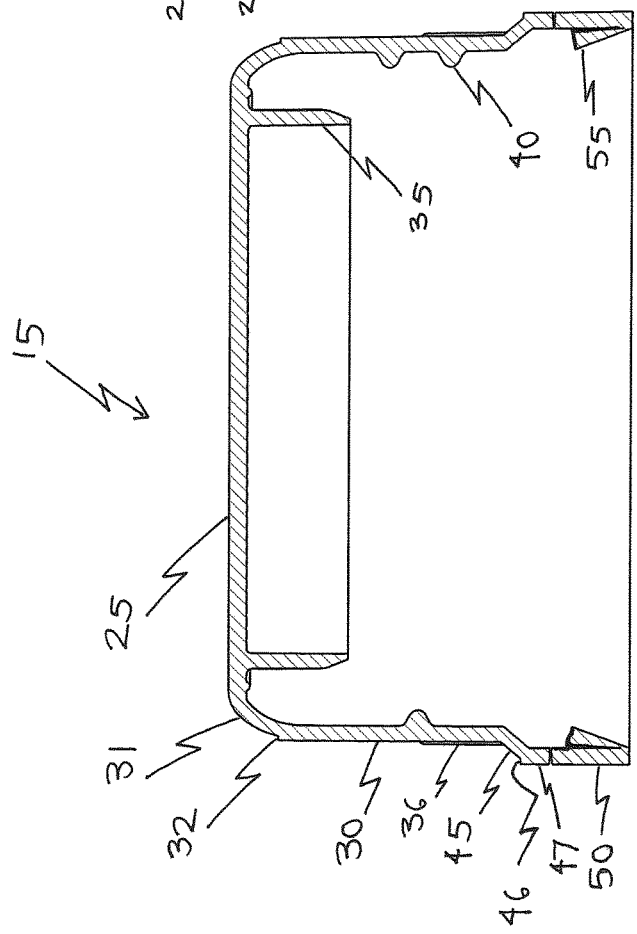


Figure 2A

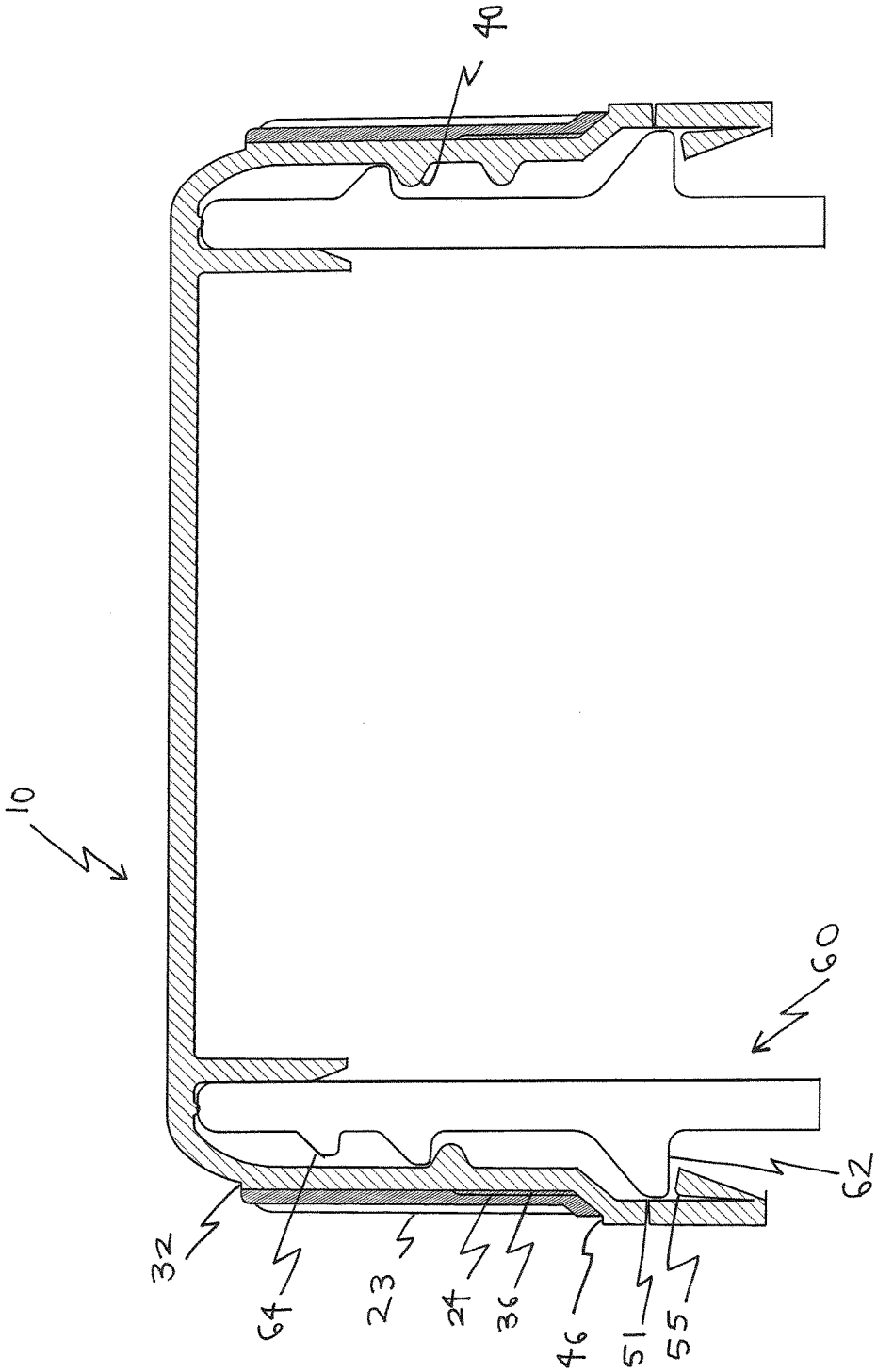


Figure 3

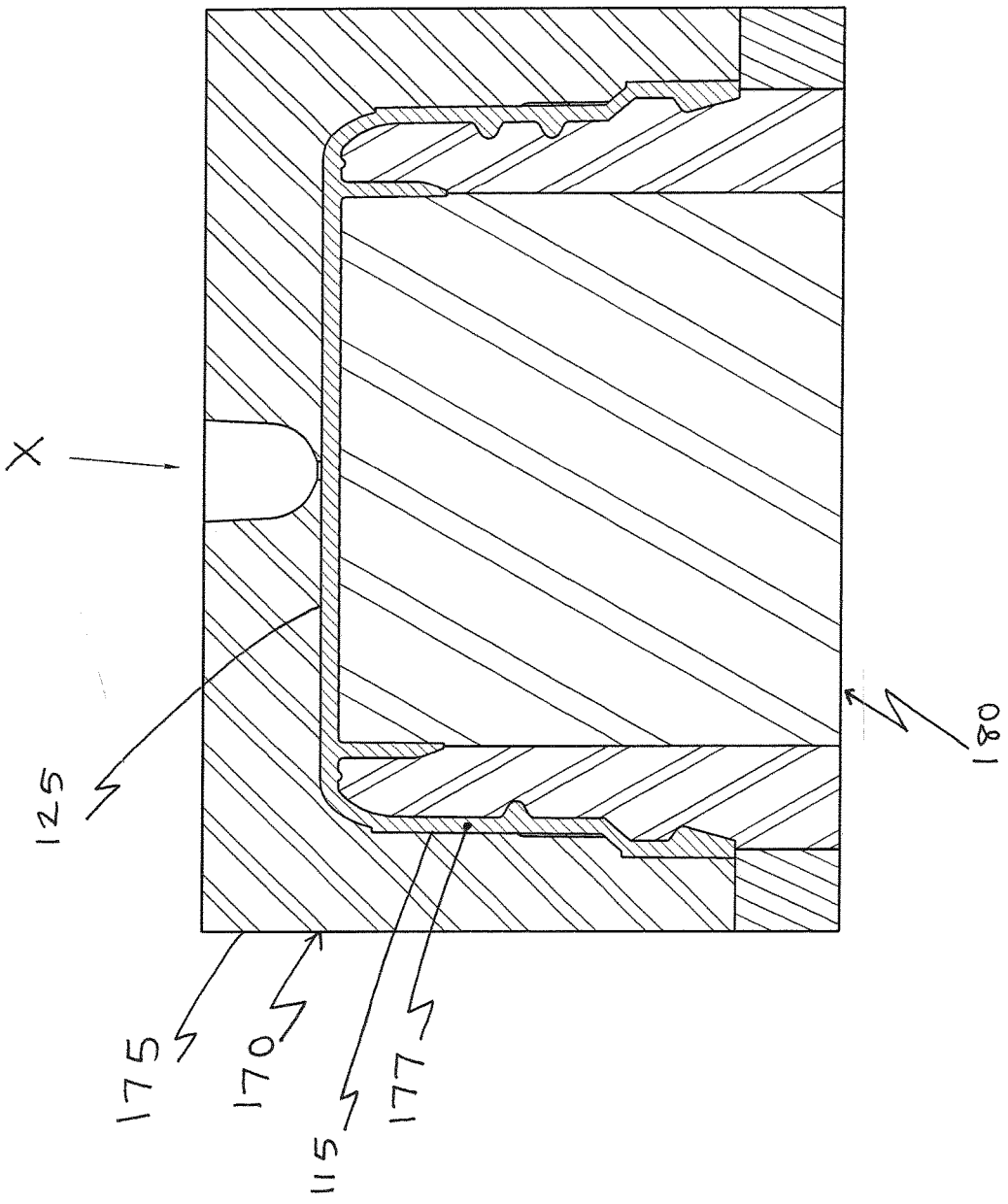


Figure 4

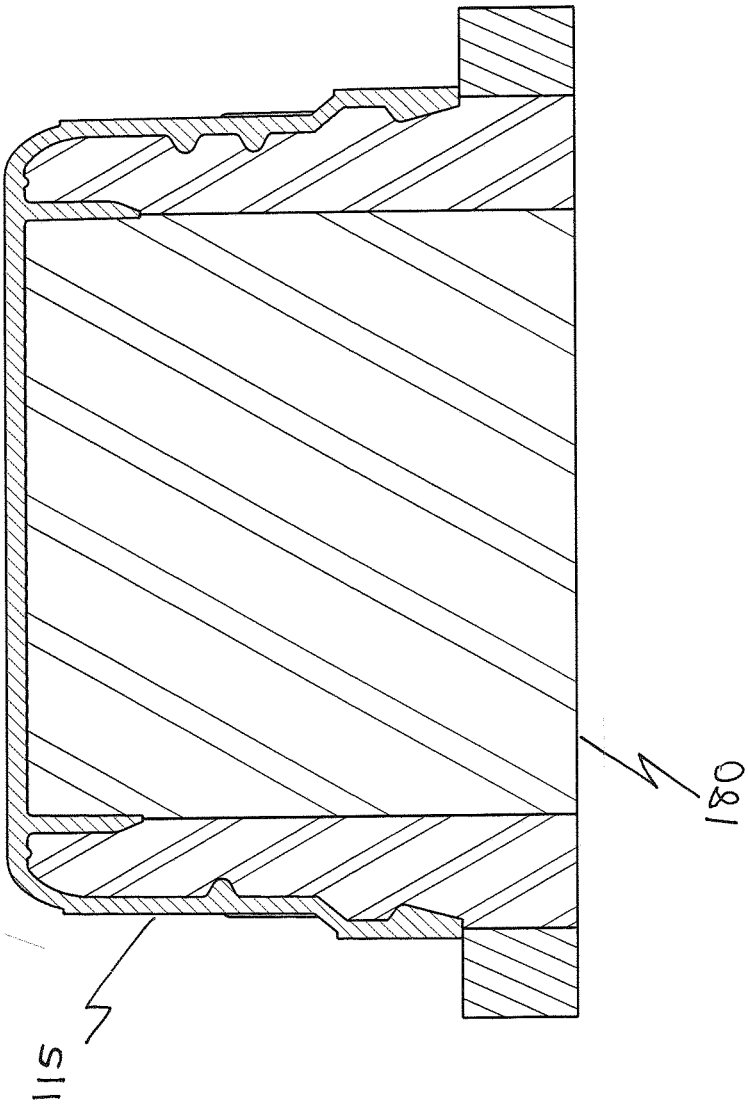


Figure 5

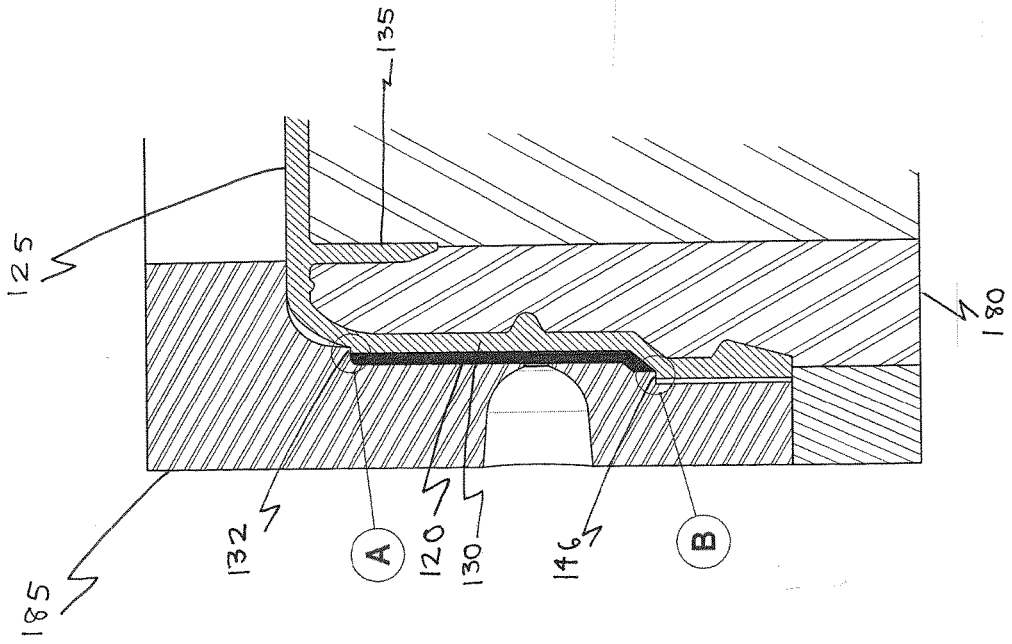


Figure 6B

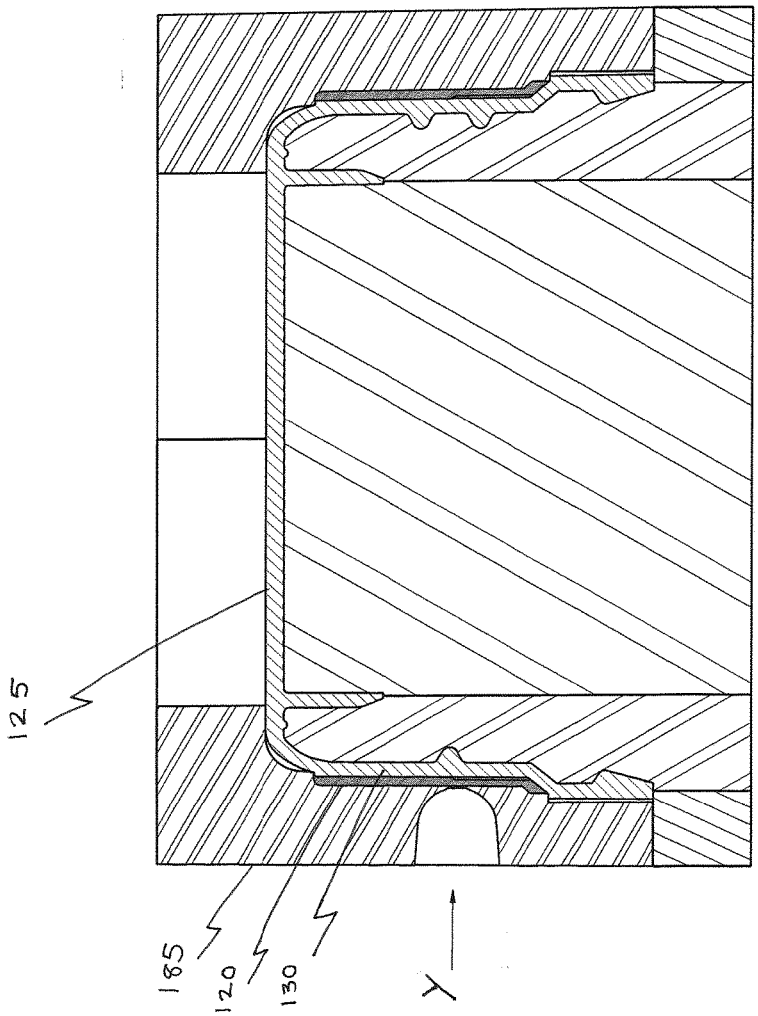


Figure 6A

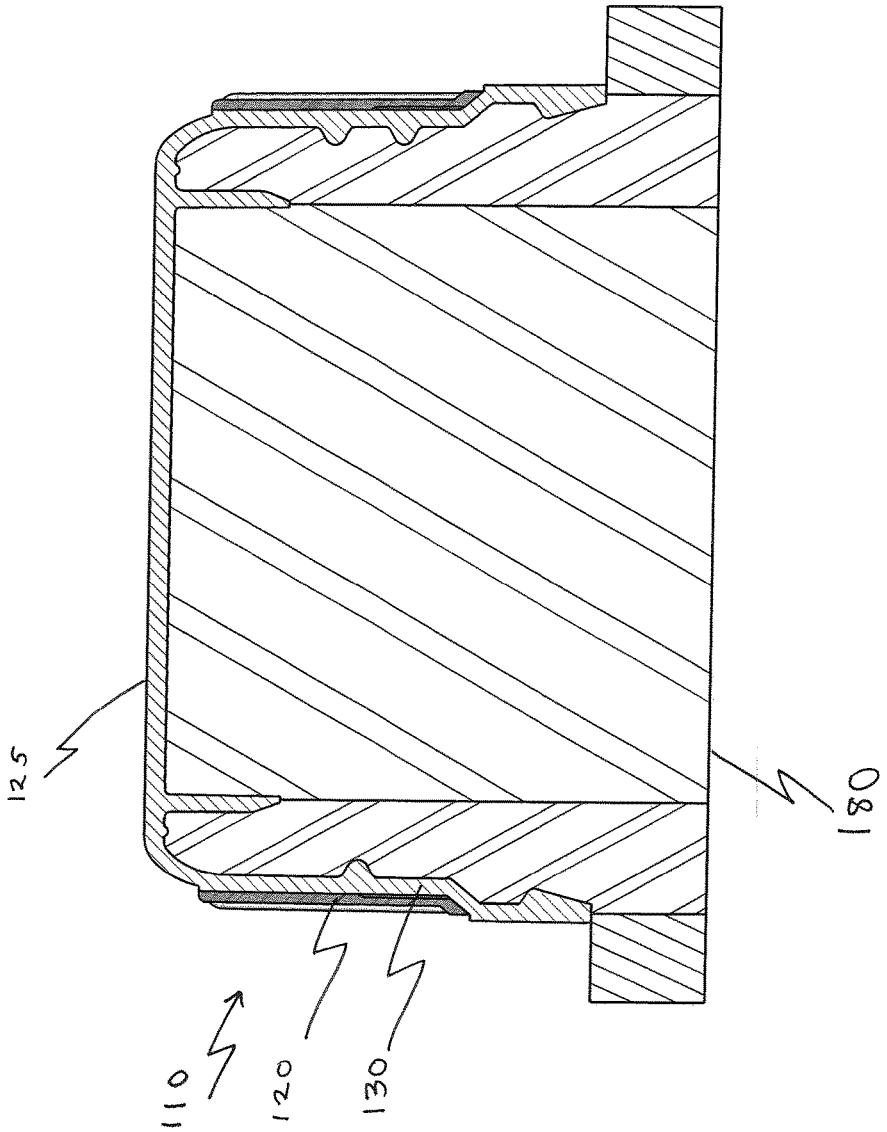


Figure 7

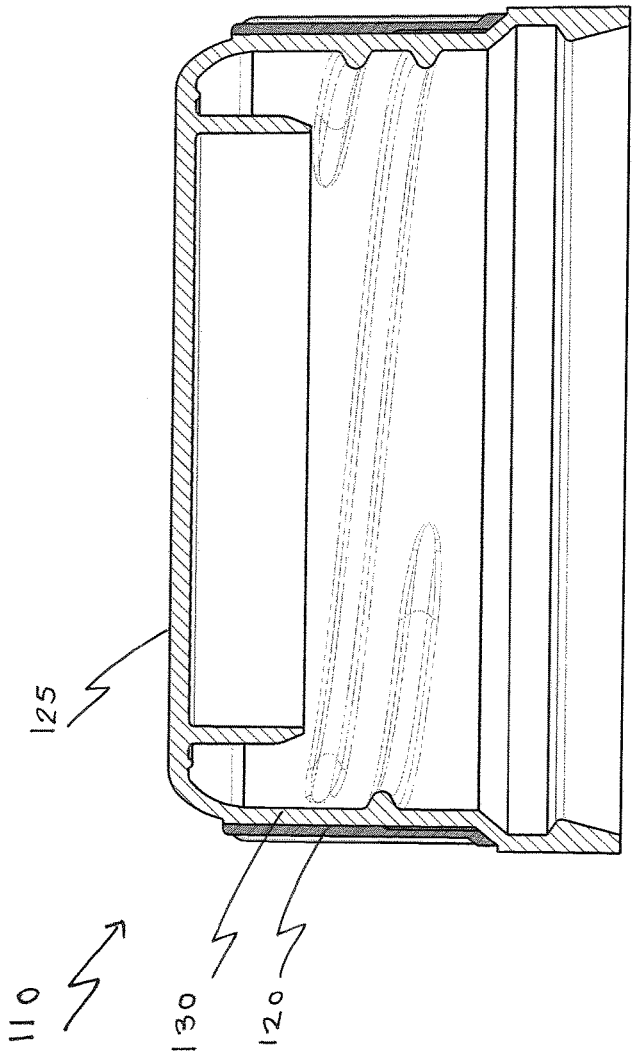


Figure 8

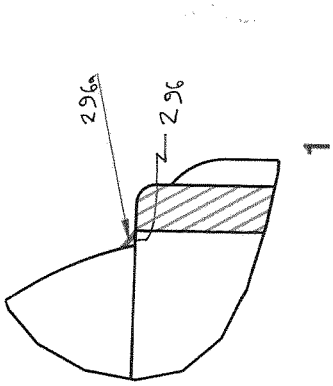


Figure 9A

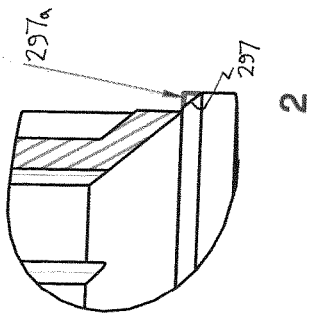


Figure 9B

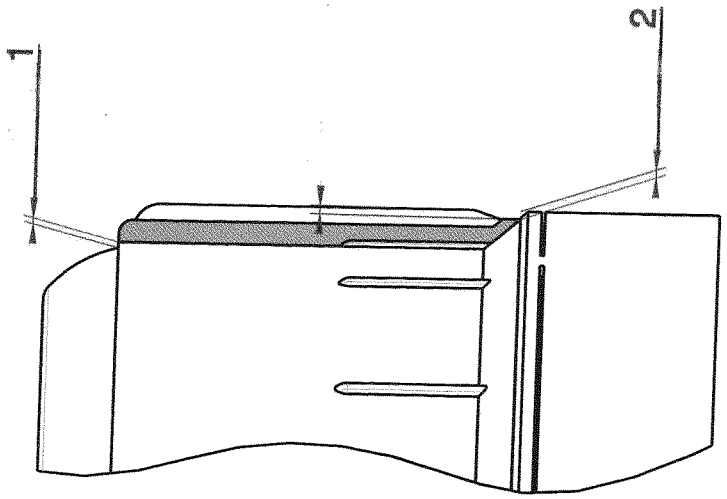


Figure 9

A METHOD OF FORMING A CLOSURE

[0001] The present invention relates generally to a closure and particularly to a method of forming a moulded closure.

[0002] The present invention seeks to provide improvements in or relating to a bi-injection moulding process.

[0003] According to an aspect of the present invention there is provided a method of forming a bi-injected closure, comprising the steps of: forming a cap with a top plate and a depending sidewall in a first injection moulding phase using a first mould part, the cap formed so as to include one or more external sealing areas; changing the first mould part for a second mould part, the second mould part sealing against the or each sealing area on the cap; and forming an outer ring around the cap sidewall whilst the second mould part is sealed against the sealing area/s in a second moulding phase.

[0004] The cap may have a plurality of sealing areas, for example two sealing areas.

[0005] The sealing areas may delimit a cavity for the ring in the second moulding phase.

[0006] One or more sealing areas may be formed on the cap sidewall. For example the sealing areas may flank that portion of the sidewall onto which the ring is formed.

[0007] The sealing area may be generally flat, or an angle, or a chamfer, or a radius.

[0008] The or each sealing area may be a width in the range 0.1 mm to 0.3 mm.

[0009] The closure may be demoulded along the main axis thereof. A natural demoulding may be used.

[0010] In the first moulding phase the material may be injected generally axially (with respect to the cap), for example into the mould cavity region which will form the cap top plate.

[0011] In the second moulding phase the material may be injected generally laterally (with respect to the cap), for example into the mould cavity region which will form the ring.

[0012] Part of the mould may be rotated between the first and second phases. For example the cap, carried on a core mould part, may be rotated. The mould may be rotated approximately 90 degrees.

[0013] The cap sidewall may be formed so as to include one or more anti-rotation ribs on its exterior.

[0014] The ring may be formed so as to include one or more ribs on its exterior.

[0015] The cap may formed from a suitable injection mouldable material, such as polyethylene.

[0016] The ring may be formed from a flexible material; for example a thermoplastic elastomer.

[0017] A further aspect provides a method of forming a bi-injected closure comprising the steps of: injection moulding a cap using a mould including a first superior mould part; opening the mould; providing a second superior mould part; closing the second superior mould part onto the cap; delimiting a cavity into which material is to be injected into the second superior mould part using spaced sealing zones on the cap; and injection moulding an outer ring around the cap.

[0018] According to a further aspect of the present invention there is provided a method of forming a bi-injected closure, comprising the steps of: a first injection moulding phase to form a cap with a top plate and a depending sidewall; and a second injection moulding phase to form a ring around the sidewall, in which in the first phase material is injected generally axially and in the second phase material is injected generally laterally.

[0019] The first and second moulding phases may be performed using a rotary tool and the tool may be rotated after the first phase.

[0020] The first phase injection may be generally axially into the top plate region of the mould cavity. The injection may be generally central into the top plate mould cavity region.

[0021] Corresponding formations may be formed on the outer surface of the sidewall and the inner surface of the ring to promote bonding of the first and second phase materials.

[0022] The first and second phase materials may be generally the same. Alternatively the first and second phase materials may be different.

[0023] The first and/or second phase material may be a polyolefin, such as polyethylene.

[0024] In some embodiments the first phase material may be generally rigid once cured and the second phase material may be generally flexible once cured.

[0025] The injection point for the second phase material into the sidewall cavity region may be: at or towards one end or the region; or spaced from the region ends.

[0026] Once formed in phase **1**, the cap may include one or more support points upon which a changed mould part is supported during the second phase.

[0027] In one embodiment the present invention comprises:

- **[0028]** bi-injection moulding of two parts: e.g. a cap (part **1**) and a ring (part **2**);
- **[0029]** the cap has two support areas;
- **[0030]** the support areas mean that in the second stage of moulding, when the mould change part is closed onto the cap there is a good seal of the metal mould part against the plastic cap;
- **[0031]** the material for the ring is injected into a cavity between the two support areas;
- **[0032]** the cap is demoulded naturally and this allows formation of anti-rotation ribs on the outside of the cap; and
- **[0033]** the ring is demoulded naturally and this allows formation of ribs on the outside of the ring.

[0034] The present invention also provides a method of sequentially moulding a container closure, comprising the steps of: a first injection stage in a mould having inner and outer mould parts to form an inner cap; opening the mould by removing the outer mould part; retaining the inner cap on the inner mould part and rotating them; reclosing the mould with a changed outer mould part; and a second injection stage to form an out ring around the sidewall.

[0035] The present invention also provides a method substantially as shown and/or described herein.

[0036] The present invention also provides a closure formed by a method as described herein.

[0037] The present invention also provides a method of forming a bi-injected closure, comprising the steps of: forming a first part in a first injection moulding phase using a first mould part, the first part formed so as to include one or more external sealing areas; changing the first mould part for a second mould part, the second mould part sealing against the or each sealing area;

[0038] forming a second part onto the first part whilst the second mould part is sealed against the sealing area/s in a second moulding phase.

[0039] The present invention also provides a closure substantially as shown and/or described herein.

[0040] In some embodiment the present invention relates to a mould for the overmoulding of a material on another.

[0041] The shape of the first moulded portion may be equipped with two specific forms to prevent smudging and have a good steel/plastic closure.

[0042] Natural demoulding of the first part may be used to allow anti-rotation ribs between the two parts.

[0043] The workpiece may, for example, be round or oval.

[0044] Different aspects and embodiments of the invention may be used separately or together.

[0045] The present invention is more particularly shown and described, by way of example, with reference to the accompanying drawings, in which:

[0046] FIG. **1** is a section of a closure formed in accordance with the present invention;

[0047] FIG. **2**A is a section of the inner cap part of the closure of FIG. **1**;

[0048] FIG. **2**B is a section of the ring part of the closure of FIG. **1**;

[0049] FIG. **3** is a section of the closure of FIG. **1** shown fitted to a container neck;

[0050] FIGS. **4** to **8** illustrate the steps in a method according to the present invention;

[0051] FIG. **9** shows part of a closure formed in accordance with the present invention; and

[0052] FIGS. **9**A and **9**B show magnified areas **1** and **2** of FIG. **9** respectively.

[0053] Example embodiments are described below in sufficient detail to enable those of ordinary skill in the art to embody and implement the systems and processes herein described. It is important to understand that embodiments can be provided in many alternate forms and should not be construed as limited to the examples set forth herein.

[0054] Accordingly, while embodiments can be modified in various ways and take on various alternative forms, specific embodiments thereof are shown in the drawings and described in detail below as examples. There is no intent to limit to the particular forms disclosed. On the contrary, all modifications, equivalents, and alternatives falling within the scope of the appended claims should be included. Elements of the example embodiments are consistently denoted by the same reference numerals throughout the drawings and detailed description where appropriate.

[0055] The terminology used herein to describe embodiments is not intended to limit the scope. The articles "a," "an," and "the" are singular in that they have a single referent, however the use of the singular form in the present document should not preclude the presence of more than one referent. In other words, elements referred to in the singular can number one or more, unless the context clearly indicates otherwise. It will be further understood that the terms "comprises," "comprising," "includes," and/or "including," when used herein, specify the presence of stated features, items, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, items, steps, operations, elements, components, and/or groups thereof.

[0056] Unless otherwise defined, all terms (including technical and scientific terms) used herein are to be interpreted as is customary in the art. It will be further understood that terms in common usage should also be interpreted as is customary in the relevant art and not in an idealized or overly formal sense unless expressly so defined herein.

[0057] Referring first to FIG. **1** there is shown a closure generally indicated **10**. The closure **10** comprises an inner closure **15** and an outer ring **20**.

[0058] The inner cap **15**, also shown in FIG. **2**A, comprises a generally disc-shape top plate **25** and a generally cylindrical sidewall **30** which depends from the periphery of the top plate **25**.

[0059] An internal annular sealing projection **35** depends from the underside of the top plate **25** and the inner surface of the sidewall **30** is provided with internal screwthread formations **40**. The exterior of the sidewall is provided with a plurality of circumferentially spaced axial anti-rotation ribs **36**

[0060] At the end of the sidewall opposite the top plate **25**, an inclined wall section **45** is provided and extends radially outwardly.

[0061] At the end of the wall section **45** an axial wall section **47** depends and defines a radial, flat step **46**.

[0062] The section **47** merges into an annular tamper-evident band **50** which is provided with an annular bead **55** on its interior surface.

[0063] At the top of the sidewall a curved intermediate wall section **31** extends and merges into the top plate **25**. At the intersection of the wall section **31** and the sidewall a flat radial section **32** is defined.

[0064] The ring **20** is generally annular with a main annular sidewall section **21** which at one end has an inclined terminus **22** shaped to correspond to the sidewall step **45**. The exterior surface of the section **21** is provided with a plurality of axial ribs **23** and on the interior of the ring a plurality of grooves **24** are formed at the end closest to the terminus **21** corresponding to the ribs **36**.

[0065] As shown in FIG. **3**, in use the closure **10** is fitted to a container neck **60** by screwthread engagement between the sidewall threads **40** and corresponding thread **64** on the neck. The inner ceiling skirt **35** fits into the bore of the neck **60** to form a ceil against its interior surface and the bead **55** passes under a neck transfer bead **62** so that upon first opening when the closure is unscrewed the tamper-evident band **50** remains on the neck finish and is released from the sidewall step **45**, for which purpose a plurality of frangible bridges **51** interspersed and defined by slits.

[0066] FIGS. **4** to **8** illustrate a method according to the present invention by which a closure of the type shown in FIGS. **1** to **3** could be manufactured.

[0067] In FIG. **4** a mould generally indicated **170** is shown in a closed position a female or upper mould part **175** is closed onto an inner core **180** to define a mould cavity **177** corresponding to the inner cap **115**. A plastics material, in this embodiment polyethylene, is injected into the mould in an axial direction X, in this embodiment with the gate generally in the centre of what will become the top plate **125**.

[0068] In FIG. **6** the mould has been opened. The newly formed inner cap **115** remains on the core **180** whilst the mould part **175** is withdrawn axially. The mould is then rotated, for example **90** degrees, and a new female mould part **185** is closed onto the inner cap, as shown in FIG. **6**A.

[0069] The cavity into which the second material is injected is delimited by two closure zones A, B. The mould part closes onto the closure in the closure zones; there is direct compression on the inner cap.

[0070] In this position the mould part **185** is partly supported by sealing areas A and B shown in FIG. **6**B. The mould part **185** is supported principally at zones A and B. The metal mould part **185** seals against the cap steps **132**, **146**. The steps **132**, **146** help to delimit the cavity into which material flows to form the ring **120**.

[0071] With the mould in the closed position shown in FIG. **6**A and **6**B the material for the bi-injected ring **120** is now introduced in a lateral direction Y by a lateral nozzle.

[0072] The outer ridges **136** on the cap sidewall are shown and it can be seen that the material of the ring flows around the ridges **136** to form the correspondingly shaped grooves **124** which help to promote bonding between the two materials.

[0073] In FIG. **7** the mould is shown opened, with the mould part **185** withdrawn axially i.e. simple demoulding in the principal axis of the workpiece. The core **180** is then stripped to release the closure as shown in FIG. **8**. The closure **110** is then ejected from the mould ready for use.

[0074] In this embodiment the closure **110** is post-mould processed to introduce slits to define frangible bridges and thus creates the tamper-evident band at the free end of the sidewall.

[0075] FIGS. **9**, **9**A and **9**B show a magnified view of part of a closure **210** formed according to a further embodiment. In this embodiment the inner closure **215** has two support zones: support **1** is a flat radial step **296** located between the top plate and the sidewall, immediately adjacent one end of the ring; support **2** is an angled step **297** immediately adjacent the other end of the ring **220** and just above the point along the sidewall where frangible bridges **295** are formed. In other embodiments, for example, support **1** is an angled step **296***a* and support **2** is a flat step **297***a*, as also shown in the drawings. The zones give a good metal/plastic closure when the mould is closed and the mould part presses onto the supports.

[0076] Although illustrative embodiments of the invention have been disclosed in detail herein, with reference to the accompanying drawings, it is understood that the invention is not limited to the precise embodiments shown and that various changes and modifications can be effected therein by one skilled in the art without departing from the scope of the invention.

1. A method of forming a bi-injected closure, comprising:

forming an inner cap with a top plate and a depending cylindrical sidewall in a first injection moulding phase using a first mould part, the sidewall of the inner cap formed so as to include two external sealing support areas, the sealing support areas comprising radial steps which flank a portion of the sidewall onto which an outer ring is to be formed;

changing the first mould part for a second mould part, the second mould part sealing against the sealing areas on the sidewall of the inner cap so as to delimit a cavity for the outer ring; and

forming the outer ring around the sidewall of the inner cap whilst the second mould part is sealed against the sealing support areas in a second moulding phase, a material for the outer ring being injected between the two sealing support areas.

2-5. (canceled)

6. A method as claimed in claim **1**, in which each of the sealing areas is generally flat or is angled, or is a chamfer, or is a radius.

7. A method as claimed in claim **1**, in which each sealing area has a width in the range of 0.1 mm to 0.3 mm.

8. A method as claimed in claim **1**, in which the closure is demoulded along a main axis thereof after the second moulding phase.

9. A method as claimed in claim **1** in which in the first moulding phase the material is injected generally axially.

10. A method as claimed in claim **1**, in which in the second moulding phase the material is injected generally laterally.

11. A method as claimed in claim **1**, in which the first and second mould parts are portions of a mould and part of the mould is rotated between the first and second moulding phases.

12. A method as claimed in claim **11**, in which the inner cap carried on a core mould part is rotated.

13. A method as claimed in claim **12**, in which the core mould part is rotated approximately 90 degrees.

14. A method as claimed in claim **1**, in which the sidewall of the inner cap is formed so as to include one or more anti-rotation ribs on an exterior of the sidewall.

15. A method as claimed in claim **1**, in which the outer ring is formed so as to include one or more ribs on an exterior of the outer ring.

16. A method as claimed in claim **1**, in which the inner cap is formed from polyethylene.

17. A method as claimed in claim **1**, in which the outer ring is formed from a thermoplastic elastomer material.

18-35. (canceled)

36. A method as claimed in claim **1**, in which at the end of the sidewall of the inner cap and opposite the top plate an inclined wall section is provided and extends radially outwards.

37. A method as claimed in claim **36**, in which at the end of the inclined wall section an axial wall section depends and defines a radial step.

* * * * *