



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁵ : B65D 41/04, 1/20, 55/06 B65D 41/34, 41/48, 55/02 B65D 25/16, 1/02	A2	(11) International Publication Number: WO 93/01098 (43) International Publication Date: 21 January 1993 (21.01.93)																																				
(21) International Application Number: PCT/GB92/01255 (22) International Filing Date: 10 July 1992 (10.07.92) (30) Priority data: <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;">9114871.8</td> <td style="width: 40%;">10 July 1991 (10.07.91)</td> <td style="width: 30%;">GB</td> </tr> <tr> <td>9120264.8</td> <td>23 September 1991 (23.09.91)</td> <td>GB</td> </tr> <tr> <td>9122097.0</td> <td>17 October 1991 (17.10.91)</td> <td>GB</td> </tr> <tr> <td>9124872.4</td> <td>22 November 1991 (22.11.91)</td> <td>GB</td> </tr> <tr> <td>796,946</td> <td>22 November 1991 (22.11.91)</td> <td>US</td> </tr> <tr> <td>9125397.1</td> <td>29 November 1991 (29.11.91)</td> <td>GB</td> </tr> <tr> <td>9126242.8</td> <td>11 December 1991 (11.12.91)</td> <td>GB</td> </tr> <tr> <td>9201494.3</td> <td>24 January 1992 (24.01.92)</td> <td>GB</td> </tr> <tr> <td>9209299.8</td> <td>30 April 1992 (30.04.92)</td> <td>GB</td> </tr> <tr> <td>9209374.9</td> <td>30 April 1992 (30.04.92)</td> <td>GB</td> </tr> <tr> <td>9209420.0</td> <td>30 April 1992 (30.04.92)</td> <td>GB</td> </tr> <tr> <td>9210194.8</td> <td>12 May 1992 (12.05.92)</td> <td>GB</td> </tr> </table> (71) Applicant (for all designated States except US): BEESON AND SONS LIMITED [GB/GB]; Hertford House, Denham Way, Rickmansworth, Hertfordshire WD3 2XB (GB).			9114871.8	10 July 1991 (10.07.91)	GB	9120264.8	23 September 1991 (23.09.91)	GB	9122097.0	17 October 1991 (17.10.91)	GB	9124872.4	22 November 1991 (22.11.91)	GB	796,946	22 November 1991 (22.11.91)	US	9125397.1	29 November 1991 (29.11.91)	GB	9126242.8	11 December 1991 (11.12.91)	GB	9201494.3	24 January 1992 (24.01.92)	GB	9209299.8	30 April 1992 (30.04.92)	GB	9209374.9	30 April 1992 (30.04.92)	GB	9209420.0	30 April 1992 (30.04.92)	GB	9210194.8	12 May 1992 (12.05.92)	GB
9114871.8	10 July 1991 (10.07.91)	GB																																				
9120264.8	23 September 1991 (23.09.91)	GB																																				
9122097.0	17 October 1991 (17.10.91)	GB																																				
9124872.4	22 November 1991 (22.11.91)	GB																																				
796,946	22 November 1991 (22.11.91)	US																																				
9125397.1	29 November 1991 (29.11.91)	GB																																				
9126242.8	11 December 1991 (11.12.91)	GB																																				
9201494.3	24 January 1992 (24.01.92)	GB																																				
9209299.8	30 April 1992 (30.04.92)	GB																																				
9209374.9	30 April 1992 (30.04.92)	GB																																				
9209420.0	30 April 1992 (30.04.92)	GB																																				
9210194.8	12 May 1992 (12.05.92)	GB																																				
(72) Inventors; and (75) Inventors/Applicants (for US only) : KING, Roger, Milner [GB/GB]; KING, Witney, Milner [GB/GB]; White End Park Farm, Latimer, Bucks HP5 1UL (GB). (74) Agent: HOWICK, Nicholas, Keith; Carpmaels & Ransford, 43 Bloomsbury Square, London WC1A 2RA (GB). (81) Designated States: AT, AU, BB, BG, BR, CA, CH, CS, DE, DK, ES, FI, GB, HU, JP, KP, KR, LK, LU, MG, MN, MW, NL, NO, PL, RO, RU, SD, SE, US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IT, LU, MC, NL, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, SN, TD, TG). Published <i>Without international search report and to be republished upon receipt of that report.</i>																																						
(54) Title: IMPROVEMENTS RELATING TO A CONTAINER, TO A CONTAINER NECK, TO A CLOSURE THEREFOR, AND TO THE MANUFACTURE THEREOF																																						
(57) Abstract A container closure assembly consisting of a container neck (10) having a radially outer sealing surface (20) and a corresponding container closure (12) with radially inner sealing surface (18) adapted to seal against the container neck sealing surface. Means are provided to secure the closure onto the container neck, said means being separate from the sealing surfaces (18, 20). When the closure is secured to the container neck, a clearance (24) exists between the outer lip surface and the inner closure surface. The container neck is sealed by a foil seal (28).																																						

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	FI	Finland	MI	Mali
AU	Australia	FR	France	MN	Mongolia
BB	Barbados	GA	Gabon	MR	Mauritania
BE	Belgium	GB	United Kingdom	MW	Malawi
BF	Burkina Faso	GN	Guinea	NL	Netherlands
BG	Bulgaria	GR	Greece	NO	Norway
BJ	Benin	HU	Hungary	PL	Poland
BR	Brazil	IE	Ireland	RO	Romania
CA	Canada	IT	Italy	RU	Russian Federation
CF	Central African Republic	JP	Japan	SD	Sudan
CG	Congo	KP	Democratic People's Republic of Korea	SE	Sweden
CH	Switzerland	KR	Republic of Korea	SN	Senegal
CI	Côte d'Ivoire	LI	Liechtenstein	SU	Soviet Union
CM	Cameroon	LK	Sri Lanka	TD	Chad
CS	Czechoslovakia	LU	Luxembourg	TG	Togo
DE	Germany	MC	Monaco	US	United States of America
DK	Denmark	MG	Madagascar		
ES	Spain				

IMPROVEMENTS RELATING TO A CONTAINER,
TO A CONTAINER NECK, TO A CLOSURE THEREFOR,
AND TO THE MANUFACTURE THEREOF

5 CROSS-REFERENCE

This application will refer to our applications Nos. PCT/GB91/850 (now published) and US 07/706891 (filed 29th May 1991), which describe a container closure assembly, and the contents of which are incorporated herein by reference.

10

FIELD OF THE INVENTION

This invention relates to various aspects of a container, also to various aspects of a container neck and aspects of a closure for the neck. In one form the invention is particularly, but not exclusively, directed to a container which is designed to be sealed against the ingress of air, or liquid, or other contaminants when the closure is fitted to the container neck. In another form, the invention is particularly, but not exclusively, directed to a closure which includes a child-resistant feature. In a further form, the invention is particularly, but not exclusively, directed to a closure which includes a tamper-evident feature. In yet a further form the invention relates to the manufacture of containers.

25 In this specification, a so-called "child-resistant" closure (hereinafter referred to as a "relevant child-resistant closure") comprises an inner closure part adapted to be engaged with the neck of a container by rotation in one sense and to be disengaged therefrom by rotation in the other sense; an outer closure part capable of being moved relative to the inner closure part between a predetermined rest position and a displaced position; means to rotate the inner closure part with the outer closure part on rotation of the latter in the said one sense when the outer closure part is in either of its rest position and its displaced position; and means to rotate the inner closure part with the outer closure part on rotation of the latter in the said other sense when the outer closure part is in its displaced

30

35

position, but when the outer closure part is in its rest position only when any torque resisting rotation of the inner closure part is below a predetermined threshold; wherein the outer closure part is capable of adopting its
5 displaced position only when its angular displacement with respect to the inner closure part is within any one of a number of predetermined discrete angular ranges. It will be appreciated that the term "discrete angular ranges" covers the case where the ranges are zero, and the outer closure
10 part can adopt its displaced position only at discrete angles relative to the inner closure part.

BACKGROUND OF THE INVENTION

Prior art relating to sealing container closure
15 assemblies is described in US Patents Nos. 4177906, 3894647, 4273248, 4093096, 4310101, 4493427, 4746016, 4856674, 3861549, 4328905, 4954191, 1850911, 2313161, 2026889, 3767076, 4335824, 4605136, and in Netherlands specification No. 6707565.

20 Prior art relating to child-resistant container closure assemblies is described in US Patents Nos. 3894647, 4213534, 3770153, 3944101, 3831797, 4376497, 39944102, and in PCT application No. WO 90/04546.

Prior art relating to tamper-evident container closure
25 assemblies is described in US Patents Nos. 4147268, 4157144, 4746026, 3944102, 3737064, 4493427.

Additional prior art relating to container closure assemblies is described in US Patents Nos. 4662530, 4669624, 4289248, 3347403, in European specification No. EP-A-0117948
30 and in French specifications Nos. 2572369, 2558443 and 2036272.

SUMMARY OF THE INVENTION

In one aspect the invention relates to a container
35 having one or more features of the invention. In a second aspect, the invention relates to a container neck having one or more features of the invention. In a third aspect, the invention relates to a closure having one or more features

of the invention. In a fourth aspect, the invention relates to a container closure assembly comprising a container neck and a closure in combination, the assembly having one or more features of the invention.

5 The invention is characterised by one or more of the following independent features which may be used independently, or some in combination. The independent features have been devised with the aim of improving over the prior art in certain areas, as exemplified by the
10 following headings (which refer to preferred embodiments and are not to be regarded as limiting the invention):

Automatic Closure with only Quarter Turn

(1) The closure is movable from fully disengaged from
15 the neck to fully closed by turning the closure relative to the neck by less than 360°. Preferably this is about 180° or less, and more preferably about 90° or less. For example, the rotation may be about 45°-50°.

The threads may have three, four or more starts to allow
20 respectively three, four or more start positions of the closure on the container neck.

Engageable catches or catch projections are preferably provided. There may be 2 catch projections on the container neck or container shoulder, and 4 catch projections on the
25 closure. The projections on the closure may be spaced apart angularly by 90°, and those on the neck by 180°. This arrangement can match the preferred quarter turn feature of the closure, allowing the closure to be secured by the catch projections when rotated from any of the four start
30 positions.

(2) The closure and the container neck are provided with screw threads for threadedly securing the closure on the container neck, and co-operating retaining means are
35 provided on the container neck and on the closure for retaining the closure in a predetermined closed position on the neck until a predetermined external release torque is applied to the closure.

The retaining means may comprise one or more inwardly facing projections on the closure for co-operating with one or more outwardly facing projections on the container neck.

The retaining means may produce a detectable "click" effect when the closed position is reached.

At least one of the projections may be profiled to have a circumferential ramp surface over which the other projection can ride relatively easily on the closure means the closed position, and a relatively steep or radial abutment surface against which the other projection bears when the closure is to be unscrewed from the closed position.

(3) The closure and the container neck are provided with screw threads for threadedly securing the closure on the container neck, and the assembly further comprises means for preventing the closure from being overtightened substantially beyond a predetermined closed position, or beyond a predetermined sealed position.

The closure and the container neck may have complementary sealing surfaces for forming a seal when the closure is in its closed position on the container neck. The complementary sealing surfaces may form the means for preventing the closure from being overtightened substantially beyond the predetermined position. The sealing surfaces may extend in a direction at least a component of which is lateral, or radial. With this arrangement, if the closure is overtightened beyond its closed position, the sealing surfaces will bear against each other more strongly, to thereby oppose further tightening of the closure.

An alternative arrangement is to provide one or more stop projections on the container neck at positions circumferentially beyond the projections which define the closed position. Such stop projections may have a radial abutment surface adapted to engage one or more projections on the closure.

(4) The closure and the container neck are provided with screw threads for threadedly securing the closure on the container neck, and sealing means for forming a seal between the closure and the container neck, the assembly further comprising means for positively defining a closed position of the closure on the container neck at which position the closure is adequately seated on the container neck to obtain a seal, whereby overtightening of the closure can be avoided.

10 The assembly may also comprise means for retaining the closure, in use, in the closed position until a predetermined release torque is applied between the closure and the container neck.

15 The means for defining the closed position may produce a detectable "click" effect when the closed position is reached.

(5) The container neck and the closure include screw thread means on at least one of the closure and the container neck for retaining the closure on the container neck, sealing means for forming a seal between the closure and the container neck when the closure is at a sealing position on the container neck, and urging means co-operating between the closure and the container neck when the closure is near the sealing position for urging the closure automatically into the sealing position independently of whether an external closing torque is being applied to the closure, and thereafter for maintaining the closure in the sealing position until a sufficient external release torque is applied to the closure.

20 The urging means may maintain a force on the sealing means when the closure is in its sealing position. This can ensure that the respective sealing surfaces of the sealing means are firmly seated against each other, even though the closure may not be screwed down especially tightly when in the sealing position. The arrangement can thus increase the force experienced by the sealing means, leading to an improved seal, without requiring the closure to be screwed

down very tightly on the container neck.

The urging means may comprise first means on the container neck for co-operating with second means on the closure, at least one of the first and second means including a ramp surface against which the other of the first and second means bears when the closure is near the sealing position, the ramp surface extending in a direction to urge the closure in a direction towards its sealing position.

10 The first and second means may each comprise a respective ramp surface extending in a direction to urge the closure towards its sealing position.

The first means may comprise one or more outwardly facing projections on the container neck, and the second means may comprise one or more inwardly facing projections on the closure.

The or each second means projection maybe mounted on a resilient portion of the closure which portion is capable of deforming to enable that projection to ride over the first means projection when the closure is screwed into, or out of, the sealing position.

The projections may include respective lead-in ramp surfaces which bear against each other, in use, to ease the projections over each other when the closure is being screwed towards its sealing position, before the aforementioned ramp surfaces which apply an urging force begin to bear against each other.

The urging means maybe arranged to apply a rotational urging force to the closure relative to the container neck.

30 Preferably, the closure can be moved between its sealing position and a fully open position by relative rotation through 180° or less, and more preferably through about 90° or less. The rotation may, for example, be about 45°-50°.

The resilience of the material of the closure may be used to supply an urging force. The closure may deform slightly from its circular shape to an oval shape when the first and second means projections engage, and the resilience of the closure tend to urge the closure to return

to its circular shape with a spring action.

(6) The container neck and the closure include screw thread means on at least one of the closure and the container neck for retaining the closure on the container neck, sealing means for forming a seal between the closure and the container neck when the closure is at a sealing position on the container neck, which sealing position is within a predetermined tolerance range of possible sealing positions, and urging means cooperating between the closure and the container neck when the closure is at a position anywhere within the tolerance range of possible sealing positions, for urging the closure into its sealing position independently of whether an external closing torque is being applied to the closure, and thereafter for maintaining the closure in the sealing position until a sufficient external release torque is applied to the closure.

With this aspect of the invention, closure assemblies can be manufactured which achieve an automatic and reliable seal, and which avoid overtightening, without requiring each container neck and each closure to be manufactured to strict tolerances. The container necks and the closures can therefore be made easily, and quite cheaply without prejudicing the reliability of each closure assembly. The invention can also compensate for any wear of the closure or of the container neck, if they are made of materials which will wear in use, e.g. soft plastics material.

The automatic seal thus achieved can achieve liquid-tight, air-tight, and hermetic seals. The seal is also able to withstand knocks to the container, for example, if it is dropped, or pressure within the container, e.g. from carbonated drinks. Thus, such a container closure assembly enables containers to be suitable for all kinds of applications, such as holding foods and drinks by keeping them fresh, carbonated drinks to maintain their "fizz" or spirits and perfumes to prevent evaporation loss.

The invention is especially advantageous in enabling such a seal to be formed automatically each time that the

closure is secured on the neck. This has not been achieved hitherto, especially with a closure that may be securable by rotation through 90° or less without requiring the closure to be screwed down very tightly and with easy-open and child-resistant features, for examples, as described below.

Flange (Tab-Lever) Top

(7) The closure comprises handle means on the closure, the handle means providing a wall or surface arranged to facilitate application or removal of the closure to or from the container neck. The handle means preferably comprise upstanding handle means.

The closure may be a child-resistant closure. In particular it may be a relevant child resistant closure.

The closure may be a quarter-turn closure which can be opened by rotation through about 90° or less, for example, as described above.

The closure may be fitted with a tamper evident ring, for example, such as described in (25) below.

The handle on the closure is particularly suitable for use with a container having a shape to enable the container to be gripped easily, for easy opening. For example, the container may be polygonal (e.g. square) in section.

The handle means may comprise one or more projections such as a flange or flanges. The flange or flanges may project from the closure in a direction parallel to the rotational axis of the closure.

The handle means may in particular comprise a diametric flange upstanding from the upper surface of the closure.

The closure may comprise a substantially flat surface extending adjacent either side of the handle means, the flat surface providing a surface on which a person may push to press axially down on the closure.

In the case of the closure being a relevant child-resistant closure, the handle means may be formed integrally with the outer closure part of the said relevant child resistant closure.

Automatic Air- and Liquid-Tight Seal

(8) The closure has a skirt portion, the inner surface of which is adapted to seal against an outer surface of the container neck.

The inner surface of the closure adapted to seal is preferably a radially inwardly facing surface which is adapted to seal against a radially outwardly facing surface of the container neck. The inner surface may also, or alternatively, be tapered to form a seal with a corresponding tapered portion of the container neck.

In one embodiment, this arrangement can be used with a container neck having a sealing web attached thereto. No contact other than accidental contact need occur between the closure and the lip of the container neck during application or tightening of the closure. The skirt portion of the closure can be made large enough to pass cleanly over the lip of the neck, and only seal with the neck in a region where the neck is radially wider.

The skirt portion of the closure may include an inwardly tapered surface to form an interference fit seal with a tapered portion of the neck. Preferably, the angle of taper is between about 1° and about 45° , more preferably between about 1° and about 25° , and in particular about 4 or 5° .

(9) The closure has a skirt portion, an inner surface of which is adapted to seal against an outer sealing surface of the container neck, and co-operating securing means are provided on the closure and on the container neck for removably retaining the closure on the container neck, the securing means on the container neck being positioned further from the open end of the container neck than the sealing surface of the container neck. The securing means may comprise a screw thread.

(10) The closure includes first sealing means for sealing against an outer surface of the container neck when the closure is in its closed position, and second sealing means for sealing against an inner surface of the container neck when the closure is in its closed position.

The outer surface of the neck against which the first means is adapted to form a seal may be a circumferentially facing outer surface, or it may alternatively be any other surface, such as a top surface, on the outside of the container neck.

The first and second sealing means may form respective seals with the container neck at positions which are substantially directly opposite each other. This can further improve the sealing effect by "wedging" the wall of the container neck between the first and second means of the closure.

The first sealing means may comprise an inner surface of a skirt portion of the closure, which inner surface is adapted to seal against the neck. The outer surface of the neck may include an outwardly tapered portion, and the inner surface of the skirt portion of the closure may be adapted to form an interference fit with the outwardly tapered portion of the neck. The skirt portion of the closure may include an inwardly tapered surface to form a complementary fit with the outwardly tapered portion of the neck.

The angle of taper of the tapered portion of the neck may be between about 1° and 45° , preferably between about 1° and 25° , and in particular about 4 or 5° .

The second sealing means may comprise a plug portion of the closure, which plug portion is shaped to fit inside the container neck, the circumferential surface of the plug portion being adapted to seal against the inner surface of the neck.

The inner surface of the container neck may include an outwardly tapered portion, the circumferential surface of the plug portion being adapted to form an interference fit with the tapered portion of the neck. The plug portion may include an inwardly tapered surface to form a complementary fit with the outwardly tapered inner surface of the neck. The angle of taper may be between about 1° and 45° , preferably between about 1° and 25° , and in particular about 4 or 5° .

The angle of taper of the inner surface of the neck

preferably matches the angle of taper of the outer surface of the neck.

The sealing surfaces of the closure may be formed a V-shaped channel on the inner surface of the closure.

5

Seamless Air- and Liquid-Tight Seal

(11) The container has an opening intended to be sealable by means of a closure releasably retainable over the opening, the container comprising a seamless first
10 portion including a sealing surface extending around the opening, the sealing surface being intended to seal in use against a said closure, and a second portion which may include a seam or seams.

The first portion may have been formed by injection
15 moulding. The second portion may have been formed by blow-moulding.

The container may be formed of plastics material, the first and second portions being integrally formed.

The first portion of the container may comprise
20 generally a neck, or at least the upper portion of a neck, of the container. In particular, the first portion may consist of the portion of the neck from the container opening to the sealing surface. The second portion consists of the remainder of the neck below the sealing surface and
25 the body of the container.

The neck may include means for releasably retaining a closure on the neck to cover the opening. Such means may comprise a screw thread, or snap fit means. The portion of the neck carrying the retaining means maybe blow moulded.

30 The invention also extends to cover a method for forming a container having an opening which is intended to be sealable by means of a closure releasably retainable over the opening, the method comprising forming a seamless first portion of the container by a first process, which first
35 portion includes a sealing surface extending around the opening, the sealing surface being intended to seal in use against a said closure, and forming a second portion of the container by a second process, which second portion may

include a seam or seams.

The first process may comprise injection moulding. The second process may comprise blow moulding. The method may comprise injection moulding the first portion of the container around a hollow floating mandrel, and blow moulding the second portion of the container by blowing gas through the hollow floating mandrel.

The invention also extends to cover means for forming a container as aforesaid by a process of injection moulding and blow moulding, the means comprising a floating mandrel about which a seamless first portion of the container can be injection moulded, the first portion of the container including an opening and a sealing surface extending around the opening, the sealing surface being intended in use to seal against a releasably retainable closure for sealing the opening, and the floating mandrel being hollow to enable gas to be blown through the mandrel for blow-moulding a second portion of the container.

20 Square Section Threads

(12) The closure and the container neck are formed with thread profiles which fully engage to prevent play between the container and the closure, and ensure axial movement of the closure on the container neck. The threads may be of square or rectangular section to provide maximum stability when the threads first engage, and increasingly thereafter.

Such fully engaging threads are advantageous with the engaging projections on the container neck and on the closure, as they enable more leverage to be applied to the closure.

Such threads are also advantageous if the closure is fitted with a tamper-evident ring, as they provide positive axial movement of the closure when rotated to facilitate separation or releasing of the tamper-evident ring. This is particularly advantageous for a quarter-turn closure since the amount of rotation of the closure through which the tamper-evident ring must be released is restricted to about 90°, or even less.

Tamper Proof Peel Off Seal

(13) The container neck has a sealing web adhered thereto, and at least a circumferential portion of an outer edge of the lip of the container neck under the sealing web is cut away. This provides that the part of the sealing web which overlies the cut away edge may be used as a pull away tab for the web. Such an arrangement is particularly useful for webs which are adapted to be peeled off.

10 In one embodiment, the sealing web is at most coextensive with the lip of the container neck. Thus, when the closure is fitted to the neck, the sealing web will not be fouled by the closure.

15 (14) The arrangement of the container neck and the closure is such that when the closure is in its fitted or closed position on the container neck, a clearance exists between the outer surface of the top of the neck and the corresponding inner surface of the closure.

20 With this arrangement, the closure remains entirely clear of the lip of the neck, and therefore of any sealing web which may be provided thereon.

In the case where a sealing web is provided on the container neck, a clearance preferably exists between the closure and the sealing web at all points around the web, so that the closure does not foul the sealing web when the closure is fitted to the container neck.

This clearance may be afforded by providing the outer surface of the lip with a recess. Preferably, the recess includes a substantially outwardly facing surface which is inclined to the longitudinal axis of the container neck so as to form an overhanging rim on the container. Preferably the inclination of the recess surface is between about 1° and about 45°, preferably about 20°.

35

(15) The container neck has a peelable sealing web attached thereto, an edge or edges of the sealing web projecting radially proud of the container neck.

The container neck may have a reduced circumference portion under the sealing web

With this arrangement, at least one edge of the sealing web projects radially over the reduced circumference portion
5 of the neck to provide a tab by which the seal can be peeled off. The entire periphery of the seal may project, so that an annular tab is formed around container neck.

The reduced circumference portion may be formed substantially as a step, or groove, at the open end of the
10 container neck. The size of the step, or groove, will be sufficient to enable a user to grasp the projecting portion of the sealing web so that it can be peeled back.

In one embodiment, the side of the step may be chamfered radially outwardly away from the open end of the container
15 neck.

The closure assembly is preferably such that the closure does not bear down on the sealing web when the closure is fitted to the container neck. This avoids damage or fouling of the sealing web which might otherwise occur resulting in
20 the loss of sealing integrity.

(16) The container neck has a semi-rigid sealing web adhered to the rim of the neck, an edge of the web extending outwardly beyond the rim to facilitate removal of the web
25 in a peel-off manner.

The semi-rigid web may comprise a semi-rigid foil, or a layer of flexible foil with a semi-rigid backing layer.

For mass production using induction welding, the web may comprise a metallic foil on its underside. The web
30 might consist entirely of metallic foil, or it might comprise an upper layer of, for example, paper or card to which the foil is laminated.

The upper surface of the web may carry printed promotional material, and for this the web may comprise an
35 upper layer of card or paper so that the material can be printed easily.

The edge of the sealing web may project beyond the rim around the entire periphery of the rim.

In the case of a circular container neck, the sealing web may comprise a circular disc having a diameter slightly larger than the diameter of the rim of the neck, to provide a 360° projecting edge.

5

(17) The container neck has a relatively rigid sealing web adhered to the rim of the neck, an edge of the web extending beyond the rim to facilitate removal of the web in a "flip-off" manner.

10 The web in rigid form may be constructed as a rigid metallic layer or as a flexible or semi-rigid layer attached to a rigid backing. The lower surface of the web may be metallic so that the web can be secured using induction welding.

15

Coloured Film

(18) The container neck has a sealing web adhered thereto, and means for providing colouring on the rim of the neck visible once the sealing web is removed, whereby an indication on the rim can be given that the sealing web has been removed.

The means for providing the colouring may comprise means for providing a coloured residue on the rim, which is visible once the sealing web has been removed.

The means for providing the coloured residue on the rim may comprise a coloured adhesive used to secure the sealing web to the rim. The adhesive is preferably difficult to scrape or clean off the rim. The adhesive may be applied as a thin layer or film on the rim.

The colouring may, for example, be green.

The colouring preferably contrasts against the colour of the container neck so that it is immediately apparent to a user.

35 Child Resistant System

Preferably this provides easy opening, for example, for elderly or handicapped people, but a reliable child-resistant feature.

(19) The closure is a relevant child-resistant closure, and the container neck and the closure include means for retaining the closure in a closed position on the container neck, the retaining means holding, in use, the closure in the closed position sufficiently strongly for the outer closure part to be rotatable in said other sense relative to the inner closure part when the inner closure part is in said rest position.

10 The retaining means may include one or more inwardly facing projections on the inner closure part for co-operating with one or more outwardly facing projections on the container neck.

At least one of the projections may be profiled to have a circumferential ramp surface over which another projection can ride relatively easily as the closure nears the closed position, and a relatively steep or radial abutment surface against which the other projection bears when the closure is to be unscrewed from the closed position.

20

(20) The closure is a relevant child-resistant closure comprising a plurality of cantilever leaf springs extending obliquely from one part of the closure towards the other part of the closure, each cantilever leaf spring having a cross-section which tapers towards its free end.

The profile at the acute angle between each cantilever leaf spring and the closure part from which said spring extends is radiused.

Additionally or alternatively, the said other part of the closure may have a number of angularly spaced ratchet ramps against which the leaf springs bear to restrict rotation of the outer closure part relative to the inner closure part in the said one sense, but to permit such rotation in said other sense. The number of ratchet ramps may be sixteen.

(21) The closure moves from fully closed to a fully open position by relative rotation through less than 360°,

preferably approximately 90° or less, the closure being a relevant child-resistant closure and the number of said predetermined discrete angular ranges being such that angular displacement of the outer closure member relative to the inner closure member between adjacent positions in which the outer closure member can move to its displaced position is not greater than 45° , and preferably not greater than 25° .

The closure may include means for biasing rotationally the outer closure member relative to the inner closure member away from each angular position of which the outer closure member can move to its displaced position.

The angular displacement may be about 22.5° , in which case, from a normal rest position, the outer closure would move to a position where it could be moved with its displaced position by rotation through 12.25° relative to the inner closure member. This arrangement is provided by the closure having sixteen castellations, in which the maximum turn required for engagement is only one sixteenth, i.e. 22.5° .

In one embodiment, the angular displacement may be about 22.5° , and thereafter the closure can be moved from a fully closed to a fully open position by relative rotation through about 90° or less.

25

(22) The closure is a relevant child-resistant closure comprising means for biasing rotationally the outer closure part relative to the inner closure part away from each angular displacement at which the outer closure part can adopt its displaced position to a respective angular displacement at which the outer closure part cannot adopt its displacement position.

The rotational biasing means may exert a torque which is greater in absolute value than any frictional torque resisting relative rotation of the closure parts.

In the preferred case, at no time can the closure of the invention be left in a condition at which immediate movement of the outer closure part from its rest position to its

displaced position is possible. The outer closure part must first be rotated against some restoring force before such displacement can be effected.

The means to rotate the inner closure part with the
5 outer closure part may comprise a ratchet mechanism which restricts rotation of the outer closure part relative to the inner closure part in the said one sense, but permits such rotation in the said other sense.

The rotational biasing means may comprise the or a
10 ratchet mechanism.

The number of the said discrete angular ranges may be equal to the number of stable positions of the ratchet mechanism.

The number of the said discrete angular ranges may be
15 at least eight, preferably sixteen. This can enable the closure to be removed with a relatively small amount of rotation.

(23) The closure is a relevant child resistant closure,
20 the container and closure having fully engaging thread profiles to prevent play between the container and closure and ensure axial movement of the closure on the container, the closure being movable from a fully opened to a fully closed position by rotation of the inner closure part
25 through about 90° or less, and the container and the closure further comprise retaining means for retaining the closure in the closed position.

The retaining means may comprise one or more projections on the container neck for engaging one or more projections
30 on the closure. The projections may "click" past each other when the closure is rotated into, or out of, its fully closed position.

(24) The closure is a relevant child-resistant closure,
35 the angular positions at which the outer closure member can move to its displaced position are defined by castellations on each of the inner and outer closure members, there being at least eight and preferably sixteen equally angularly

spaced castellations on at least one of the inner and outer closure members, which castellations mate when the outer closure member is depressed, the closure further comprising resiliently biased ratchet means for biasing the inner and outer closure members apart and for restricting rotation of the outer closure member relative to the inner closure member in the said one sense, but permitting such rotation in the other sense when the castellations are not engaged, the ratchet means further biasing the outer closure member in a rotational direction away from the said angular positions at which the outer closure member can move to its displaced position, in use. The closure being movable from a fully open to a fully closed position by relative rotation through about 90° or less, and the container neck and closure further comprising retaining means for holding, in use, the closure in the closed position sufficiently strongly for the outer closure part to be rotatable in said other sense relative to said inner closure part when said inner part is in said rest position.

The retaining means may comprise one or more projections on the container neck for engaging one or more projections on the closure. The projections may "click" past each other when the closure is rotated into, or out of, its fully closed position.

25

(25) The closure is a relevant child-resistant closure, in combination with a tamper-evident ring. The tamper-evident ring may be attached to or associated with the inner closure part. The closure may be removable by relative rotation through 360° or less, preferably 180° or less, or more preferably 90° or less.

Skirt to cover Tamper Proof Ring

(26) The closure has a tamper-evident ring, the ring being initially substantially concealed by the closure when the closure is fitted to the container neck, the arrangement being such that, in use, after the occasion on which the closure is first removed from the container neck, the tamper

evident ring remains substantially visible on the container neck when the closure is replaced on the neck.

The tamper-evident ring may be integrally formed with the closure, or with at least a substantial part of the closure. The ring may be adapted to be retained on the container neck.

The tamper-evident ring may be movably retained on the container neck, and the assembly may further comprise releasable holding means for initially holding the tamper-evident ring in a first position in which it is substantially concealed by the closure, the holding means releasing the tamper-evident ring when the closure is first removed from the container, to allow the ring to move into a second position in which it is not substantially concealed by the closure when the closure is replaced on the container neck.

The holding means may comprise severable connections between the tamper-evident ring and the closure, which connections are completely severed when the closure is first removed from the container neck. The severable connections may be integrally formed with the tamper-evident ring and with the closure.

The tamper-evident ring may be coloured a contrasting colour to the container so that the tamper-evident ring will be clearly visible, and easily discernable at a glance, once the closure has been removed for the first time. For example, the tamper-evident ring may be coloured red as a warning colour.

The portion of the container neck on which the tamper-evident ring sits when in its visible, second position may itself be coloured a colour which contrasts both the rest of the container and the tamper-evident ring. When the tamper-evident ring is in its concealed, first position, this portion of the neck will be visible, and so it may be coloured with a safety colour, such as blue or green, to indicate that the tamper-evident ring arrangement is intact.

The tamper-evident ring may be slidably retained on a portion of the neck, and is retained thereon. This prevents

a person who has maliciously tampered with the container from discarding the tamper-evident ring.

In the second position the tamper-evident ring may be separated from the bottom of the closure by a distance at least equalling the axial width of the tamper-evident ring. With such an arrangement, a user can see quite clearly at a glance that the tamper-evident ring is detached from the closure.

The closure may include a recess, or a clearance, in which the tamper-evident ring is received when in its concealed, first position. The severable connections are preferably made between an inner wall or walls of the recess, and an edge of the tamper-evident ring. The recess may be defined by a skirt portion of the closure, which covers the tamper-evident ring.

The closure may be a child-resistant closure, for example, a relevant child resistant closure. The closure may include features described in (18) - (24) above.. In addition, or alternatively, the closure may comprise upstanding handle means to facilitate the application of a sufficient opening torque to release the tamper-evident ring. For example, the handle means may include the features described in (7) above.

25 Improved Tamper Proof Ring

(27) The closure comprises a tamper evident ring integrally formed with at least a substantial part of the closure, the tamper evident ring being joined by severable connections each of which comprises a relatively wide or thick portion adjacent the closure and narrowing to a thin severable zone at the point where the connection joins the tamper evident ring, so that, in use, the tamper evident ring will, once detached, have a relatively smooth surface.

This can avoid the undesirable projecting "wires" or stubs which remain on the surface of some conventional tamper evident rings when the severable connections are broken.

The severable connections may be made between an upper

surface of the tamper evident ring and a lower or an upper surface of the closure.

The arrangement is particularly advantageous in the case where the closure substantially conceals the tamper evident
5 ring from view when the closure has not yet been removed from the container neck for the first time. With this arrangement, the thick or wide parts of the severable connections remain integrally attached to an inner surface of the closure so that they are hidden.

10 In an alternative form, the closure may be shaped so that it does not conceal all of the tamper evident ring, but it still hides the thick or wide stub parts of the severable connections. For example, the closure may include a skirt portion which substantially conceals the severable
15 connections when intact, and the remaining stubs once broken.

Inner Sleeve

(28) The container is provided with an insert or liner
20 which can be fitted through the neck of the container. The insert reduces the available capacity of the container. The insert is particularly advantageous when used with other independent features as described above.

In one embodiment a container comprises a container portion of a first cross sectional area and a neck of a second cross-sectional area less than the first cross sectional area, and an open tubular liner of less capacity
5 than the container and capable of insertion into the container through the neck whereby the container can be used with the full container capacity or with a reduced capacity of the liner.

This feature enables the same container size to be used
10 for a number of reduced capacities of contents. The embodiment is particularly useful when the container comprises features described hereinbefore for easy-opening of the container for elderly or handicapped people. The exterior shape of the container preferably enables the
15 container to be gripped easily. For example it may be

polygonal in section, e.g. rectangular or square. The size of the container preferably enables it to be held easily by hand. By using the liner of the present embodiment, this container body can be used to contain smaller volume of contents than the full capacity of the container. This might be desirable, for example, for tablets or other medicaments.

Therefore, this feature appreciates that while it might be desirable to use a relatively large container for easy opening, the capacity of such a container may be inappropriate for contents which occupy only a small volume.

Drip Proof Rim

(29) The container has a drip proof rim. This can reduce wastage and spillage of liquid when the container is used to pour liquids. The dripproof rim may comprise an annular recess formed in the outer, e.g. radially outer, surface of the neck adjacent the open end of the neck. The drip proof rim may also be formed by chamferring the rim inwardly away from the open end of the neck to provide an overhanging portion. The rim may include a step profile. A sealing web may be adhered over the rim, preferably with an edge or edges of the web projecting radially outwardly over the rim to provide a peel-off or lift-off tab. The sealing web may, for example, have features described in (13) - (17) above.

Although each of the above (numbered) independent features may be used in isolation, further advantages may be achieved by combining one or more of the features together. The present application envisages all such combinations.

DESCRIPTION OF THE DRAWINGS

Fig. 1 is a section through a first embodiment of a container neck and a threaded closure;

Fig. 2 is a section through a second embodiment, in which the closure is a snap fit onto the container neck;

Fig. 3 is a section through the embodiment of Fig. 2, the lip of which has a chamfered edge;

5 Fig. 4 is a side view of an alternative sealing arrangement for a container neck;

Fig. 5 is a longitudinal sectional view of an outer closure part of a related child-resistant closure;

10

Fig. 6 is an underneath view of the outer closure part of Fig. 5;

Fig. 7 is a plan view of the corresponding inner closure
15 part;

Fig. 8 is an underneath view of the inner closure part of Fig. 7;

20 Fig. 9 is a longitudinal sectional view of the inner closure part of Figs. 7 and 8;

Fig. 10 is a side view of the inner closure part of Figs. 7 to 9;

25

Fig. 11 is a longitudinal sectional view of the assembled closure retained on a container neck;

Fig. 12 is a side view showing the profile of a blade in the
30 form of a leaf spring.

Fig. 13 is a side view illustrating a conventional child-resistant closure;

35 Fig. 14 is a side view of a child-resistant closure (such as the closure of Figs. 5-12);

Fig. 15 is a plan view of the closure of Fig. 14;

Fig. 16 is a side view of another embodiment of a container neck and closure, with a portion of the closure being cut away;

5

Fig. 17 is a view similar to Fig. 16 but showing an alternative embodiment;

Fig. 18 is a similar view to Figs. 16 and 17 but showing a
10 further alternative embodiment;

Fig. 19 is a side view of a container closure assembly with a tamper-evident ring, shown with the closure removed;

15 Fig. 20 is a side view of the container closure assembly of Fig. 19 shown with the closure fitted;

Fig. 21 is a section view showing a detail of the container closure assembly of Fig. 20;

20

Fig. 22 is a sectional view similar to Fig. 21 but showing a modified design of container closure assembly;

Fig. 23 is a side view of a container closure assembly with
25 an alternative form of tamper evident ring;

Fig. 24 is a side view of a closure and container neck with urging means, the closure being shown in section;

30 Fig. 25 is a half sectional underside view of the closure of Fig. 24;

Fig. 26 is a half plan view of the container neck of Fig. 24;

35

Figs. 27 - 29 are diagrammatic illustrations of the urging means as the closure approaches its fully closed position;

Fig. 30 is a sectional view of part of a screw threaded closure assembly with sealing means;

Fig. 31 is a sectional view of a closure assembly similar to
5 that of Fig. 30 but with a snap fit closure;

Fig. 32 is a sectional view of a modified closure assembly to that of Fig. 31;

10 Fig. 33 is a perspective view of the upper half of a container with a seamless sealing surface;

Fig. 34 is a side view of the neck of the container of Fig. 33;

15 Fig. 35 is a diagrammatic representation of a first processing stage for forming the container of Fig. 33;

Fig. 36 is a diagrammatic representation of a second
20 processing stage for forming the container of Fig. 33; and

Fig. 37 is a side view of a container fitted with an optional liner to reduce the container capacity.

25 DESCRIPTIONS OF EMBODIMENTS

Various embodiments illustrating the features of the invention are now described by way of example only, with reference to the accompanying drawings.

30 FIGS. 1-3

The embodiments in Figs. 1-3 relate to sealing a container neck.

Foil sealed containers are used for a variety of different purposes, particular examples being medicine
35 bottles, coffee jars and drinks containers. Commonly, they are used in applications in which the contents of the container are consumed or exhausted over a fixed or well-defined period of time. In such cases, the foil seal

provides that the contents of the container remain uncontaminated, or that they retain their original quality, until the foil seal is broken. A secondary seal, between the container and its complementary closure ensures a degree
5 of protection for the contents of the container which is sufficient to preserve the quality of the contents throughout its consumption or usage period.

It has been common practice for the secondary seal to be provided between the lip of the container neck and the
10 crown of the closure, which has the effect of sandwiching the foil seal between the two. Overtightening of the closure can tear or rupture the delicate foil seal.

Viewed from one aspect, the present embodiments include a container neck, a container closure and a thread for
15 retaining the closure on the container neck, wherein the inner surface of a skirt portion of the closure is adapted to seal against the outer surface of the container neck.

With the above arrangement, the secondary seal remains entirely clear of the lip of the container neck, and
20 therefore of any foil seal or other sealing web which may be provided thereon.

For additional protection of the sealing web, the assembly may be such that, when the closure is engaged with and sealed to the container neck, a clearance exists between
25 the outer surface of the lip of the container neck and the corresponding inner surface of the closure.

In another aspect, the present embodiments include a container neck, a container closure and means for retaining the closure on the container neck, wherein the inner surface
30 of a skirt portion of the closure is adapted to seal against the outer surface of the container neck and, when the closure is engaged with and sealed to the container neck, a clearance exists between the outer surface of the lip of the neck and the corresponding inner surface of the closure.

35 This clearance may be afforded by providing the outer surface of the lip with a recess. Preferably, the recess includes a substantially outwardly facing surface which is inclined to the longitudinal axis of the container neck so

as to form an overhanging rim on the container. Preferably the inclination of the recess surface is between about 1° and about 45°, preferably about 20°.

Preferably, the container neck includes an outwardly tapered portion and the inner surface of the skirt portion of the closure is adapted to form an interference fit with that tapered portion. This will ensure that no contact, other than accidental contact, occurs between the closure and the lip of the container neck, or any sealing web thereon, during application or tightening of the closure. The skirt portion of the closure can be made large enough to pass over the relatively narrow lip of the container neck and only seal with the neck in a region where the tapered portion is wider.

To provide a good seal, the skirt portion of the closure preferably includes an inwardly tapered surface so as to correspond to the tapered neck. Preferably, the angle of taper is between about 1° and about 45°, most preferably about 1° and about 25°, and in particular about 4 or 5°.

In a case where the container neck and closure are of circular section, the means for retaining the closure on the neck preferably includes a thread. Most preferably a thread is provided on the closure and a complementary thread on the container neck.

Alternatively, the skirt portion of the closure may be provided with an inwardly facing deformable projection to engage a complementary outwardly facing projection on the neck. This provides a snap fit closure. Preferably, the projections comprise one or more outstanding beads.

In a further aspect, the present embodiments also include a container neck adapted to receive a complementary closure and having a sealing web sealed thereto, in which at least a circumferential portion of an outer edge of the lip of the container neck is cut away. This provides that the part of the sealing web which overlies the cut away edge may be used as a pull away tab for the web. Such an arrangement is particularly useful for webs which are adapted to be peeled off.

Preferably the sealing web is at most coextensive with the lip of the container neck. Thus, when the closure is applied, the sealing web is not fouled by the closure.

The cut away edge of the lip may be chamfered, and the
5 container neck, with or without the sealing web may form part of a closure assembly according to the invention.

In detail, Fig. 1 illustrates a container closure assembly including a container neck (10) and a container closure (12). The closure (12) is illustrated in its
10 engaged, sealed position on the container neck (10). In this exemplary embodiment both the neck (10) and the closure (12) are of circular section and are provided with complementary threads (14, 16).

The closure consists of a crown portion (120) and a
15 skirt portion (122). The skirt portion (122) includes an inwardly tapered surface (20) and the container neck (10) includes a corresponding outwardly tapered surface (18). A seal (22) exists between the tapered surfaces (18, 20) by virtue of an interference fit between the two.

20 The lip (30) of the container neck (10) is sealed by a sealing web (28) which, in this exemplary embodiment is a foil seal. The neck (10) and closure (12) are constructed of materials common in the art, e.g. glass, plastics, metal etc.

25 As can be seen a clearance (24) exists between the outer surface (26) of the lip (30) and the inner surface of the closure (12). The clearance is of about 1mm and corresponds to a recess (32) in the lip (30). As can be seen, the closure is held away from the edges of the foil seal, to
30 reduce the likelihood of tearing the seal.

Whilst in the embodiment shown in fig. 1 the clearance (24) is afforded by a recess (32) in the lip (30), it will be appreciated by one skilled in the art that such a clearance may be provided by an appropriate profile on the
35 inner surface of the closure (12), or a combination of profiles on the closure (12) and the neck (10).

The recess (32) includes a substantially outwardly facing surface (26) which is inclined to the axis of the

neck (10). This forms a drip-free, overhanging rim.

The diameter of the inside surfaces of the closure threads (16) is greater than that of the sealing web or foil (28). The complementary threads (14, 16) may therefore be
5 engaged without any portion of the closure (12) contacting the sealing web (28). Rotation of the closure (12) advances it axially until its tapered surface (20) interferes with that (18) on the neck (10). No stress is applied to the sealing web (28).

10 The secondary seal (22) between the tapered surfaces (18, 20) has been found in shelf tests to be, for practical purposes, of equal integrity to the foil seal itself. This offers a substantial improvement over the prior art.

A container closure assembly according to this, or any
15 other embodiment of the invention may for example be applied to the container and closure which forms the subject of our international patent application PCT GB91/00850.

Fig. 2 illustrates an assembly similar to that shown in fig. 1, but which includes a snap-fit closure. The closure
20 (12) is, in this embodiment, formed of deformable plastics material. Its skirt portion (122) is provided with an inwardly facing outstanding bead (52) which cooperates with an outstanding projection (50) on the container neck.

Once again, tapered surfaces (18, 20) are provided on
25 the neck and closure to provide an interference seal (22). The outer surface of the container lip (30) is again provided with a recess (32) which is, practically, identical to the recess shown in fig. 1. The inside diameter of the bead (52) is greater than the diameter of the sealing web
30 (28).

As can be seen, the foil is of a larger diameter than is the recessed container lip so as to provide an overhanging edge of foil to facilitate the removal of the foil. Nevertheless, the foil diameter is not so large that
35 the foil makes contact with the inner surface of the cap.

Fig. 3 shows the embodiment of fig. 2 an edge (66) of the lip (30) of which is chamfered. The chamfer results in an inclined surface (62) which creates a space (64) beneath

a peripheral portion (60) of the web (28).

This peripheral portion (60) performs the function of a pull tab on the web (28) and is particularly useful when the web (28) is adapted to be peeled off the container lip (30). Of course, the web (28) is still fully sealed to the horizontal surfaces of the lip (30).

FIG. 4

The embodiment in Fig. 4 also relates to a sealing arrangement for a container neck. In one aspect it relates to an improved sealing web arrangement.

As explained above, seals of this type are commonly used in containers for food, drinks and medicaments to act as a primary seal until the container is opened for the first time and to provide a tamper-proof feature. A typical type of seal comprises a thin flexible web made of a single material such as foil or paper which is adhered, for example, by adhesive or by heat welding, to the rim of the container. Such very thin webs can be difficult or inconvenient to peel because the web has a fairly low resistance to tearing. This can be a particular problem in cases when the bond strength between the web and the rim of the neck is greater than the tearing strength of the web. In such a case, any tabs or projecting edges of the web have to be made fairly substantial in size if they are to be effective, to enable a person to grip the tab or projecting edge properly.

From one aspect, the present embodiments include a sealing arrangement for a container neck, the sealing arrangement comprising a semi-rigid sealing web adhered to the rim of the neck, an edge of the web extending outwardly beyond the rim to facilitate removal of the web in a peel-off manner.

With this arrangement, removal of the web is simplified by the peel-off design of the web, and its semi-rigidity which can prevent over-bending and consequent tearing. The semi-rigid design also requires a smaller projecting area than do, for example, the tabs or projecting edges for the

thin flexible sealing webs of the prior art.

Preferably, the semi-rigid sealing web comprises semi-rigid foil, or a layer of flexible foil with a semi-rigid backing layer.

5 For mass production using induction welding, the web preferably comprises a metallic foil on its underside. The web might consist entirely of metallic foil, or it might comprise an upper layer of, for example, paper or card to which the foil is laminated.

10 The upper surface of the web may carry printed promotional material, and for this it is preferred that the web comprise an upper layer of card or paper so that the material can be printed easily.

Preferably, the edge of the sealing web projects beyond
15 the rim around the entire periphery of the rim.

In the case of a circular container neck, the sealing web preferably comprises a circular disc having a diameter slightly larger than the diameter of the rim of the neck, to provide a 360° projecting edge.

20 By increasing the rigidity of the web, the removal of the web is enhanced by making it more "flip-off" in manner.

Alternatively, viewed from another aspect, the present embodiments include a sealing arrangement for a container neck, the sealing arrangement comprising a relatively rigid
25 sealing web adhered to the rim of the neck, an edge of the web extending outwardly beyond the rim to facilitate removal of the web in a "flip-off" manner.

The web in rigid form may be constructed as a rigid metallic layer or as a flexible or semi-rigid layer attached
30 to a rigid backing. The lower surface of the web is preferably metallic so that the web can be secured using induction welding.

In another aspect, the present embodiments relate to a tamper-proof feature for providing an indication once a
35 flexible or a semi-rigid sealing web has been removed from the container neck rim.

In this third aspect, the present embodiments include a sealing arrangement comprising a container neck with a

rim, a sealing web adhered thereto, and means for providing colouring on the rim of the neck visible once the sealing web is removed, whereby an indication on the rim can be given that the sealing web has been moved.

- 5 The means for providing the colouring may comprise means for providing a coloured residue on the rim, which is visible once the sealing web has been removed.

 The means for providing the coloured residue on the rim may comprise a coloured adhesive used to secure the sealing
10 web to the rim. The adhesive is preferably difficult to scrape or clean off the rim.

 Although the above aspects of the present embodiments can be used independently of each other, a particularly advantageous sealing arrangement is provided by combining
15 the third aspect with either the first or second aspect of these present embodiments.

 Referring to Fig. 4, a container made of plastics material has a container neck 210 which is adapted to receive a closure (not shown). The neck 210 comprises a rim
20 212, a tapered sealing surface 214 which is adapted to form an interference fit seal with a corresponding sealing surface (not shown) within the closure, and a screw threaded portion 216 for threadedly retaining the closure on the neck 210.

25 The neck 210 is sealed by means of a peel-off semi-rigid protective sealing web 218 which is secured to the rim 212 by a thin layer of adhesive 220 (the thickness of which is shown exaggerated in the drawing). The rim 212 is chamfered radially inwardly around its entire circumference under the
30 sealing web, such that the edge 222 of the sealing web projects radially outwardly beyond the rim 212.

 In this exemplary embodiment, the sealing web 218 comprises an upper layer 218a made of paper or card, laminated to a lower layer 218b made of metallic foil, for
35 example aluminum foil. The web is similar to conventional inserts which are welded in place within caps to provide a paper or card sealing surface as part of the cap. However, for this invention, the conventional insert would be turned

upside down so that the metallic foil side is adjacent the container rim. This allows the webs to be sealed to the rims using induction welding techniques.

The chamfering of the rim 212 provides a circumferential
5 recess 225 to enable a person to push on the underside of the web with his thumb, or grasp the projecting edge 222 with finger and thumb in order lift the edge 222 and peel the sealing web 218 back off the rim 212 (as depicted by the arrow 226, and the sealing web 218' shown in phantom). The
10 semi-rigidity and resilient flexibility of this web assist the peeling of the web from the rim as one edge is lifted. The web can be removed in one piece, in a single "peeling" action. The sealing web 18 is thus very simple to remove, without suffering from the problem of tearing as with the
15 thin flexible webs of the prior art.

The adhesive 220 may be coloured a contrasting colour to the container neck 210 and its rim 212. For example the neck 210 may be white, and the adhesive 220 coloured green, or some other alternative, contrasting colour. When the
20 sealing web 218 is removed, part of the adhesive layer 220 will remain as a coloured residue on the surface of rim 12. This serves as a tamper-proof feature evident

It will be appreciated that the coloured adhesive may be replaced by a substantially transparent layer of adhesive
25 which will not give the positive tamper-proof indication. Alternatively, the sealing web 18 could be bonded directly to the rim 12 without using adhesive for example by heat welding.

The semi-rigid web 18 could be replaced by a relatively
30 rigid web which is removed in a flip-off manner. To remove the web, a consumer would then press his thumb against the projecting edge 22 to lift the rigid web up and off the container rim.

As a further alternative, the coloured adhesive may be
35 used with a conventional sealing web, to provide a positive tamper-evident indication by leaving a coloured residue on the rim when the sealing web is removed.

FIGS. 5 - 12

The embodiment illustrated in Figs. 5-12 relates to a relevant child-resistant closure system.

Many known child-resistant closures include a plurality
5 of equidistant ramps on the outer surface of a crown portion of the inner closure part which cooperate with a plurality of equidistant, resilient oblique blades extending inwardly from a crown portion of the outer closure part. When viewed
10 from the centre of the respective closure parts, the ramps have a right triangular section comprising a horizontal base, a vertical left side and a hypotenuse and the blades extend diagonally downward from the left towards a lower right free end.

When the outer closure part is rotated clockwise, i.e.
15 in a right-handed sense, the free ends of the blades abut the vertical faces of the ramps, thereby driving the inner closure part with the outer closure part.

When rotation of the outer closure part is effected in the other, left-handed sense, i.e. anticlockwise, the blades
20 simply trail over the ramps in the manner of a ratchet, the inner closure part being fixed on the container by its closure torque.

Typically, castellations are provided on both inner and outer closure parts which mate when the outer closure part
25 is depressed. The inner closure part is then bound to rotate with the outer closure part. When the outer closure part is released, the blades act as leaf springs to return it to its rest position, in which the castellations are disengaged.

30 Child-resistant closure systems normally rely on the ability of the closure to spring apart, every time, after pressure has been applied, generally at right angles to the plane of the thread. If, even on rare occasions the two parts of the closure do not spring apart and disengage, the
35 child-resistant feature of the closure no longer functions. It is therefore essential that the blades acting as leaf springs have and continue to retain sufficient resilience to exert sufficient pressure to force the two parts of the

closure apart in order that there is disengagement at all times, apart from occasions when direct and sufficient pressure is applied to engage the closure system. The main failure of existing systems to work properly at all times is
5 due to the weakness of the leaf springs which in the past have typically been made of uniform thickness, with a sharp angle on the inside edge where the leaf spring joins the flat face of the underside of the top part of the closure. This design is potentially unsatisfactory as the leaf
10 springs can weaken at the point of joining the flat plane of the underside of the top part of the closure, and the leaves themselves tend to be stiff and as a result do not flex along the length of the spring leaf.

To overcome this problem and to ensure more flexibility
15 and to ensure that the leaf springs retain their resilience and hence the ability to force the two parts of the closure apart, and also to ensure that when being closed the planes of the top and lower part of the closure remain in parallel planes, the present embodiment includes, in one aspect, a
20 relevant child-resistant closure comprising a plurality of cantilever leaf springs extending obliquely from on part of the closure towards the other part of the closure, each cantilever leaf spring having a cross-section which tapers towards its free end, and the profile at the acute angle
25 between each cantilever leaf spring and the closure part from which said spring extends is radiused.

Another problem arises where a closure is primarily intended for use by the elderly, and hence must be easy to open, but which, for safety, must be child-resistant. The
30 number of castellations provided on known child-resistant closures is normally two, three or four, but this can require the closure to be rotated for up to 180° before engagement of the castellations can take place. Engagement after a much smaller rotation is desirable, and according to
35 a further aspect of the present embodiment there is provided a container neck and closure therefor wherein the closure moves from fully closed to a fully open position by relative rotation through less than 360°, preferably approximately

90° or less, the closure being a relevant child-resistant closure and the number of said predetermined discrete angular ranges being such that angular displacement of the outer closure member relative to the inner closure member
5 between adjacent positions in which the outer closure member can move to its displaced position is not greater than 45°, and preferably not greater than 25°.

A preferred angular displacement is 22.5°, in which case, from a normal rest position, the outer closure would
10 move to a position where it could be moved with its displaced position by rotation through 12.25° relative to the inner closure member. This preferred arrangement is provided by the closure having sixteen castellations, in which the maximum turn required for engagement is only one
15 sixteenth, i.e. 22.5°. This is an important feature when used in conjunction with the container and closure of our International Patent Application No. PCT/GB91/00850, where, in the preferred embodiment, the closure can be removed in only a quarter turn, and the addition of the child-resistant
20 feature does not reduce the capacity to open the closure in approximately a quarter turn. This aspect particularly assists and supports ease of opening for the elderly and frail with only a twist of the wrists, without the necessity to let go of the closure of the container, even though being
25 child-resistant.

The number of ramps in known closures varies, but is commonly three, four or six. The number of blades should be greater than two for stability, and should be a factor of the number of ramps.

30 In the past it has been arranged that the discrete angular ranges of angular displacement of the closure parts at which the castellations may engage one another is one in which the free ends of the blades on the outer closure part lie between ramps on the inner closure part.

35 A result of this is that it is perfectly possible for a container on which such a closure is installed to be left with the closure parts so oriented that the castellations may be engaged simply by immediate depression of the outer

closure part. Such a situation can occur where a closure has been installed with the outer closure part depressed, or where an adult has depressed the outer closure part, but then changed his mind about removing the closure.

5 The present embodiment seeks to overcome the above problem and in a further aspect, the present embodiment provides a relevant child-resistant closure comprising means for biasing rotationally the outer closure part relative to the inner closure part from each angular displacement at
10 which the outer closure part can adopt its displaced position to a respect angular displacement at which the outer closure part cannot adopt its displaced position.

Preferably, the rotational biasing means exert a torque which is greater in absolute value than any frictional
15 torque resisting relative rotation of the closure parts.

In the preferred case, at no time can the closure of the invention be left in a condition at which immediate movement of the outer closure part from its rest position to its displaced position is possible. The outer closure part must
20 first be rotated against some restoring force before such displacement can be effected.

In the case where the friction between closure parts is sufficient to resist the restoring torque, enabling the closure to be left in a "primed" condition as it were, an
25 advantage is still obtained. Subsequent handling of the closure or the container to which the closure is attached, such as setting the container down, dropping it, picking it up, casting it into a "medicine box", will in most cases be sufficient to cause the outer closure part to move somewhat
30 relative to the inner closure part. The outer closure part will then come to rest nearer to, if not actually at, the said respective angular displacement.

It is therefore extremely difficult, in normal usage, to leave the closure in a "primed" condition.

35 Preferably, the means to rotate the inner closure part with the outer closure part comprises a ratchet mechanism which restricts rotation of the outer closure part relative to the inner closure part in the said one sense, but permits

such rotation in the said other sense.

Preferably, the rotational biasing means comprises the ratchet mechanism.

Preferably, the number of the said discrete angular
5 ranges is equal to the number of stable positions of the ratchet mechanism. When the features of this embodiment are combined with the arrangement as disclosed in our International Patent Application No. PCT/GB91/00850, it is advantageous for the number of the said discrete angular
10 ranges to be at least eight, preferably sixteen. This preserves the ability of the closure to be removed with a relatively small amount of rotation.

According to a further aspect of this embodiment there is provided a container and closure as claimed in
15 PCT/GB91/00850 or a relevant child-resistant closure, wherein the container neck and the container closure have fully engaging thread profiles to prevent play between the container and the closure and ensure axial movement of the closure on the container. The threads may be of square
20 section, rather than conventional "V" section threads to provide maximum stability when the thread first engage, and increasingly thereafter, whereby in conjunction with the four threads as described in our Patent Application No. PCT/GB91/00850, the square section thread ensures that the
25 closure is pushed, would down to its closed position on a parallel plane, thereby making it easier for the engagement of the child-resistant closure in one simple turn of the wrist. The same applies when opening.

For increased security, it is preferred that one of the
30 closure parts be provided with a tamper-evident ring.

A further aspect of the present embodiment concerns the combination of a child-resistant closure system, together with a tamper-evident ring. A child-resistant closure has not previously been combined readily with a tamper-evident
35 ring, because of the difficulty of opening using conventional child-resistant closure systems. According to this aspect of the present embodiment, there is provided a child-resistant closure in combination with a tamper-evident

ring, and preferably according one or more of the above aspects of this embodiment. Additionally, the closure preferably includes the feature of additional support for the means of opening including an upstanding flange, or side
5 flanges, to assist in applying torque when opening the closure. Preferably, the closure and container neck is as defined in the invention of PCT/GB91/00850, the disclosure of which is incorporated herein by way of reference, giving the advantage that as the retaining force of the closure
10 system is overcome, and the turning of the closure relative to the container neck starts, combined with the angle of the four threads and the quarter turn required to open, whereby the closure is given sufficient rotational acceleration and thrust to shear through the connections between the tamper-
15 evident ring and the closure in such a manner as to overcome easily the resistance necessary for the tamper-evident ring to be separated from the closure even with the incorporation of the child-resistant system.

As can be seen from Figure 5, an outer closure part 310,
20 constructed of moulded plastics (other suitable materials may be used), consists of a crown portion 312 and a skirt portion 314. The crown portion is provided on its outer surface with a diametric handle 316. The particular form of handle shown includes a central opening 318. Towards the
25 lower, free end of the skirt portion 314, there is provided an inwardly extending bead 320, whose purpose is to retain the outer closure part on the inner closure part as will be described below.

Both Figures 5 and 6 illustrate that the inner surface
30 of the crown portion 312 is provided with sixteen equidistant castellations 322 of substantially rectangular form and four equidistant oblique resilient blades 324. The resilient blades 324 extend circumferentially from an upper, left-hand end 326, when viewed from the centre of the
35 closure part, to a lower, right-hand free end 328.

As can be seen from Figures 7 to 10, an inner closure part 350, constructed of moulded plastics (other suitable materials may be used), which includes a crown portion 352

and a skirt portion 354. The inner surface of the skirt portion 354 is provided with coarsely pitched threads 356 of square section 356 and vertical ribs 358, the function and purpose of which are described in detail in our
5 International Patent Application No. PCT/GB91/00850. The top of the skirt portion 354 is provided with a tapered sealing surface, the function and purpose of which are as described above in relation to Figs. 1-4.

Depending from the lower end of the inner closure part
10 skirt portion 354 is a tamper-evident ring 370 which will be described below.

The crown portion 352 is provided around its periphery with sixteen upstanding, substantially rectangular castellations 360. These castellations 360 are adapted to
15 engage the complementary castellations 322 on the outer closure part (see Figure 6) 310. The outer periphery of the skirt portion 354 includes an outstanding ridge 362 below which, when the inner 350 and outer 310 closure parts are assembled, the bead 320 on the outer closure part 310 is
20 retained. A degree of axial movement of the outer closure part 310 with respect to the inner closure part is permitted to engage and disengage the two sets of castellations 360, 322.

Partly shown in Figure 9, but fully in Figure 7, are
25 sixteen equidistant ramps 364, provided on the upper surface of the inner closure part crown portion 352. When viewed from the centre of the closure part, each ramp 364 is of substantially right triangular section having a horizontal base, a vertical left-hand side 366 and a hypotenuse,
30 terminating in a right-hand side 368.

When the outer closure part 310 is installed on the inner closure part 350, and the outer closure part 310 rotated clockwise, the free ends 328 of the resilient blades 324 abut against the vertical side 366 of their respective
35 ramps, thus rotating the inner closure part 350 with the outer closure part 310. However, assuming that the inner closure part 350 is reasonably tightly held in place, e.g. by a closure torque, then rotation of the outer closure part

310 anticlockwise will merely result in the resilient blades 324 trailing over the ramps 364 in the manner of a ratchet mechanism.

5 In order for the inner closure part 350 to be rotated anticlockwise, it is necessary for the outer closure part 310 to be depressed against the action of the resilient blades 324 to allow the complementary castellations 322, 360 to engage.

10 The handle 316 enables the elderly and frail more easily to apply the force required to push down and engage the two parts of the closure, whilst at the same time the handle 316 makes it easy to turn the closure to open it. When closing the same principles and advantages apply. The handle 316 therefore makes the closure much easier to operate, in spite
15 of the child-resistant feature, compared with standard child-resistant closures which many people, not just children find difficult to open.

Alternatively, the handle 316 may be substituted by four side flanges to the outer closure part 310 which again
20 enables easier opening and closing, or a standard cap with ribbed outer edges.

The relative angular displacements at which the complementary castellations 322, 360 may be engaged correspond to positions in which the free ends 328 of the
25 resilient blades 324 have already travelled some distance along and up their respective ramps 364. They therefore correspond to positions of increased potential energy. The resilience of the blades 324 is such that, when the outer closure part 310 is released in such a displacement, the
30 free ends 328 of the blades tend to move back down the sloping surfaces of the ramps 364 to their right hand sides 368. Once this has occurred, the complementary castellations 360, 322 are no longer so oriented as to be immediately engageable with one another.

35 Thus, all the rotationally stable positions of the outer closure part 310 with respect to the inner closure part 350 correspond to orientations of the castellations 322, 360 in which they cannot immediately be engaged only by depression

of the outer closure part 310.

The tamper-evident ring 370 carried by the inner closure part 350 is shown in detail in Figures 8 to 10. Attached to the top of the ring and integral therewith are eight
5 connecting members 372 which taper upwards from a relatively thick lower region into a relatively thin frangible bridge 374 attached to the inner closure part skirt portion 354. On the inside of the tamper-evident ring 370, extending between the connecting member are eight triangular section
10 ring retaining clips 376 which are adapted to engage a circumferential projection on the outer surface of a container neck.

The assembled closure is shown in Figure 11, and specific details of the thread 356 and vertical rib 358 and
15 the seal between closure and container 390 may be found in our two Patent specifications cited herein. As can be seen in Figure 11, the thread is essentially square in section, providing positive and axial alignment of the two closure parts. The container 390 includes an outstanding
20 circumferential projection 392 which is engaged by the ring retaining clips 376. Unscrewing the closure will result in the frangible bridges 374 being stretched and broken.

Figure 12 shows a preferred profile of a blade in the form of a leaf spring 324'.

25 As can be seen, the leaf spring 324' is thicker at its base, becoming progressively thinner towards its free edge 394. The joint of the leaf spring 24' with the remainder of the outer closure part 310 is radiused to provide extra strength. This profile gives sufficient resilience and
30 strength to the leaf spring 324' to ensure that the outer closure part 310 and inner closure part 350 are always separated until axial pressure is applied to counteract the bias of the springs 324'

An important advantage of this embodiment of the
35 invention is that, in conjunction with features of the container and closure described in PCT/GB91/00850, this is the only child-resistant closure which opens in under half a turn, i.e. 180°, and more generally in approximately a

quarter turn i.e. 90° or less, also in conjunction with the container neck as described in relation to Figs. 1-4 it is the only child-resistant closure system which can be used in conjunction with either both a tamper-evident ring and a foil seal whereby the seal of the closure is air and liquid proof after the foil has been removed or broken.

There is also another useful aspect in combining features of the above embodiment with the closure systems of PCT/GB91/00850. Viewed in one aspect this combination provides a container and closure therefor wherein the closure and container includes means for retaining the closure in a closed position on the container neck, the closure being a relevant child-resistant closure and the retaining means holding, in use, the closure in the closed position sufficiently strongly for the outer closure part to be rotatable in said other sense relative to said inner closure part when said inner part is in said rest position. The closure system preferably includes means for ensuring that the closure closes in the same position, every time of closure. This closure system ensures the functioning of the child-resistant closure, whereby when closed, the resistance to opening is sufficiently strong for the child-resistant feature to operate, but is sufficiently weak as to be overcome by the child-resistant system when properly engaged by an adult. The relevant child-resistant closure is preferably as claimed in PCT/GB91/00850. This feature provides the advantage that, upon engagement of the closure system, the closure is held on the container such that the child-resistant closure mechanism operates effectively but that the closure can be released, once the closure outer part is moved to the displaced position, by application of a predictable torque. Conventional spring blades type child-resistant closures are screwed onto a neck thread with more than a 360° turn for closure. In order for all conventional spring blades type child-resistant systems it is essential that they are screwed up very tightly, when being closed, otherwise the child-resistant system does not become operable at all, thus obviating the purpose of the

child-resistant system. The weakness of conventional child-resistant systems is therefore obvious, as arthritic, weak and elderly users are unable to close such containers sufficiently tightly, either to close them properly, or, even if they were closed tightly, perhaps by somebody else, then to open them. This embodiment overcomes the problem of conventional child-resistant closures of tightening the closure sufficiently, in that the closure does not have to be closed tightly in order for the child-resistant system to become operable, and therefore is particularly effective for the arthritic, weak and elderly, as this combination of new closure systems enables the containers, bottles and closures to be opened and closed easily, in approximately a quarter of a turn, with an effective child-resistant system.

FIGS. 13-15

Figs. 13-15 relate to providing handle means on the closure.

Fig. 13 illustrates an example of a conventional type of relevant child resistant closure. The outer part 410 of the closure is generally circular, and includes a flat top wall 412 and a circular side wall 414 depending from the top wall 412. The outer surface of the side wall 414 includes small vertical ribs 416 arranged side by side around the closure, to enable a person to grip the side wall 414 to screw or unscrew the closure on a container neck.

However, this arrangement makes it awkward for a person to press down axially on the closure while at the same time applying a twisting force as required to unscrew the closure. Typically a person has to press his fingers against the top corner of the closure, as illustrated by in phantom at 418 in Fig. 13. To unscrew the closure at the same time the person usually has to grip the side wall 414 quite tightly since only a small upper portion of the sidewall 414 is being gripped. The problem is particularly important for elderly or handicapped people who may find it difficult to press down and grip the closure.

Viewed from one aspect the present embodiment includes

a child resistant closure with handle means on the closure, the handle means providing a wall or surface arranged to facilitate removal of the closure from a container neck.

The closure is preferably a relevant child-resistant closure, although this invention is applicable to other types of child-resistant closure not falling within this definition.

The handle means may comprise handle means upstanding from the closure. The handle means may comprise one or more projections such as a flange or flanges. The flange or flanges may project from the closure in a direction parallel to the rotational axis of the closure.

The handle means may in particular comprise a diametric flange upstanding from the upper surface of the closure.

The closure may comprise a substantially flat surface extending adjacent either side of the handle means, the flat surface providing a surface on which a person may push to press axially down on the closure.

The handle means may be formed integrally with the outer closure part of the said relevant child resistant closure.

The closure may be a "quarter-turn" closure which may be moved between a fully closed position and a fully disengaged open position by relative rotation through about 90° or less.

The closure may include a tamper evident ring. Suitable tamper evident rings are, for example, described above in relation to Figs. 9-11, and below in relation to Figs. 16-22.

In another aspect, the present embodiment also provides a container closure assembly comprising a container neck, and a container closure with handle means as aforesaid.

The closure 420 shown in the accompanying Figs. 14 and 15 includes handle means in the form of an upstanding diametric flange 422 integrally formed with the outer closure part. The portion of the closure adjacent either side of the handle means comprises a generally flat top surface 423 of the closure. The handle greatly facilitates

attachment and removal of the closure on a container neck, without prejudicing the child-resistant feature of the closure.

To screw or unscrew the closure, a person grips the handle with his fingers as shown phantom at 424. The closure is a relevant child resistant closure, and so to unscrew the closure a person must press down axially on the closure at the same time as he applies a twisting torque to unscrew the closure (e.g. in an anticlockwise direction).
10 With the present embodiment, when the closure is to be unscrewed, the person can push down axially on the closure both through the tips of his fingers against the top surface of the closure, and through the gripping of the handle itself. It is thus much easier for a person to apply a
15 twisting force in a clockwise or an anticlockwise direction (as depicted by the arrow 426 in Fig. 15), while at the same time applying an axial downward force (as depicted by the arrow 425 in Fig. 14) to overcome the child resistant feature of the closure. This is particularly advantageous
20 for elderly or handicapped people.

The closure may include a tamper evident ring, for example, as illustrated in Figs. 9-11 above. An alternative design of a tamper evident ring is described in more detail hereinafter in Figs. 16-22. In a later embodiment, the
25 lower portion of the outer closure part conceals the tamper evident ring until the occasion on which the closure is removed from a container neck for the first time, whereupon the ring becomes detached from the closure.

With the handle means of these embodiments a person can
30 readily apply sufficient torque to break the frangible connections to a tamper evident ring and also unscrew the closure, while at the same time pressing down axially on the closure to overcome the child resistant feature. Such an arrangement usable by elderly or handicapped people has not
35 been achieved hitherto.

FIGS. 16-18

The embodiments in Figs. 16-18 relate to further

features of a container closure assembly. The embodiments are particularly, but not exclusively, directed to container necks and closures which are adapted to fit one another by having complementary screw threads. The embodiments are
5 also particularly, but not exclusively, directed to containers which are designed to be sealed against the ingress of air, or liquid, or other contaminants, when the closure is fitted to the container neck.

A problem with conventional containers is that, often,
10 a user will overtighten a closure on the container neck to ensure that a reliable seal is formed. The closure is then difficult to remove later because it is tight. If the closure is considerably overtightened, it may be extremely difficult to remove later, and it may also cause damage by
15 permanently deforming parts of the closure and/or the container neck.

The problem of overtightening can also occur when the closure is a child-resistant closure. Such closures rely on the closure being secured to the container neck with a
20 predetermined degree of tightness, such that a predetermined torque must be applied to unscrew the closure. If the closure is not secured with the necessary degree of tightness, the child-resistant feature will not operate effectively. Therefore, child-resistant closures are often
25 overtightened to ensure that the closure will operate effectively, since otherwise they closure might fail to be child-resistant.

Viewed in a first aspect, the present embodiments include an assembly comprising a container neck and a
30 closure therefor, complementary threads on the container neck and the closure, means for positively defining a closed position of the closure on the container neck, retaining means for holding the closure, in use, in the closed position, the closure being movable between the closed
35 position and an opened position by relative rotation through approximately 90 degrees or less, and the assembly further comprising means for preventing the closure from being overtightened substantially beyond the closed position.

Preferably, the means for defining the closed position produces a detectable "click" effect when the closed position is reached.

Preferably, the retaining means retains the closure, in use, in the closed position until a predetermined release torque is applied between the closure and the container neck.

Such an arrangement is particularly suitable for use with a child-resistant closure such as that described above in relation to Figs. 5-12. The positively defined closed position indicates to a user that no further tightening of the child-resistant closure is required, and the retaining means holds the closure in position until a predetermined amount of torque is applied between the container neck and the closure. For example, should a child attempt to open the closure, the amount of torque that will be transmitted through the child-resistant closure will be less than the torque required to overcome the retaining means. When an adult attempts to open the closure, the adult will press the closure downwardly to engage the torque transmitting castellations in the child-resistant closure to enable adequate torque to be applied to overcome the retaining means. The invention thereby ensures that the child-resistant feature will operate effectively.

The means for defining the closed position and the retaining means may be embodied together as projections on the container neck and on the closure, the projections engaging as the closed position is reached. At least one of the projections may preferably be profiled to have a circumferential ramp surface over which the other projection can ride easily as the closure nears the closed position, and a radially inwardly extending abutment surface against which the other projection bears when the closure is to be unscrewed from the closed position.

Preferably, the closure and the container neck have complementary sealing surfaces for forming a seal when the closure is in its closed position on the container neck. The complementary sealing surfaces may advantageously form

the means for preventing the closure from being overtightened substantially beyond the closed position. The sealing surfaces preferably extend in a direction at least a component of which is lateral, or radial. With this arrangement, if the closure is overtightened beyond its closed position, the sealing surfaces will bear against each other more strongly, to thereby oppose further tightening of the closure.

An alternative arrangement is to provide stop projections on the container neck at positions circumferentially beyond the projections which define the closed position. Preferably, the stop projections have a radial abutment surface adapted to engage the projections on the closure.

Viewed in a second aspect, the present embodiments provide an assembly comprising a container neck and a closure therefor, complementary threads on the container neck and the closure, means for positively defining a closed position of the closure on the container neck, the closure having a skirt portion an inner surface of which is adapted to seal, in use, against an outer surface of the container neck when the closure is screwed into the closed position, the said surfaces forming the seal co-operating to oppose overtightening of the closure substantially beyond the closed position.

Preferably, the assembly also comprises means for retaining the closure in the closed position until a predetermined release torque is applied between the closure and the container neck. The means defining the closed position and the retaining means may be embodied as projections, as described above.

Viewed in a third aspect the present embodiment also includes an assembly comprising a container neck and a closure therefor, complementary threads on the container neck and the closure, means for positively defining a closed position of the closure on the container neck, complementary sealing surfaces on the container neck and the closure for forming a seal when the closure is screwed into the closed

position, the sealing surfaces being inclined relative to the longitudinal axis of the container neck whereby the sealing surfaces co-operate to oppose overtightening of the closure substantially beyond the closed position.

5 Preferably, the assembly also comprises means for retaining the closure in the closed position until a predetermined release torque is applied between the closure and the container neck. The means for defining the closed position and the retaining means may be embodied together as
10 projections, as described above.

Viewed in a fourth aspect, the present embodiments also include an assembly comprising a container neck and a closure therefor, complementary threads on the container neck and the closure, the closure having a skirt portion an
15 inner surface of which is adapted to seal, in use, against an outer surface of the container neck, the assembly further comprising means for positively defining a closed position of the closure on the container neck at which position the skirt portion is adequately seated on the container neck to
20 obtain a seal, whereby, overtightening of the closure on the container neck can be avoided.

Preferably, the assembly also comprises means for retaining the closure, in use, in the closed position until a predetermined release torque is applied between the
25 closure and the container neck.

Preferably, the means for defining the closed position produces a detectable "click" effect when the closed position is reached.

The means for defining the closed position and the
30 retaining means may be embodied together as projections on the container neck and on the closure, the projections engaging as the closed position is reached. At least one of the projections may preferably be profiled to have a circumferential ramp surface over which the other projection
35 can ride easily as the closure nears the closed position, and a radially inwardly extending abutment surface against which the other projection bears when the closure is to be unscrewed from the closed position.

The skirt portion is preferably deformable temporarily to allow the projections to ride over one another when the closure is screwed into or unscrewed from the closed position.

5 The invention according to this aspect is particularly suitable for use with a child-resistant closure as described above in relation to Figs. 5-12. The positively defined closed position indicates to a user that no further tightening of the child-resistant closure is required. The
10 retaining means holds the closure in position until a predetermined amount of torque is applied between the container neck and the closure, thereby ensuring that the child-resistant feature can operate effectively.

In a fifth aspect, the present embodiments include an
15 assembly comprising a container neck and a closure therefor, complementary threads on the container neck and the closure, the closure having a skirt portion an inner surface of which is adapted to seal, in use, against an outer surface of the container neck, the assembly further comprising means for
20 defining an ultimate stop position of the closure on the container neck beyond which stop position the closure cannot be tightened further.

Such an arrangement prevents a user from overtightening the closure to such an extent that the closure cannot be
25 removed later without extreme difficulty. The arrangement may also prevent damage such as permanent deformation of co-operating surfaces of the closure and container neck, which might otherwise occur if the closure is considerably overtightened on the container neck.

30 The means for defining the ultimate stop position is preferably used in combination with the means for defining the closed position, as described above in accordance with the first aspect of the invention.

In one such combination, the ultimate stop position may
35 be defined at substantially the same position as the closed position. With such an arrangement, the closure will always be tightened up to a predetermined closed position.

In an alternative combination, the ultimate stop

position may be defined at a position beyond the closed position. There will thus be defined a range of closure positions to which the closure may be tightened.

The means for defining the ultimate stop position may
5 comprise circumferential stop means for defining a stop position on the circumference or periphery of the container neck. This may co-operate with a projection on the closure to define an ultimate angular orientation of the closure on the container neck beyond which the closure cannot be
10 rotated. The circumferential stop means may comprise a projection having a radially outwardly extending abutment surface to abut a corresponding projection on the inner surface of the closure.

Alternatively, the means for defining the ultimate stop
15 position may comprise axial stop means for defining an axial position beyond which the closure cannot be further tightened. For example, such an axial stop means may comprise a radially flat abutment surface on the container neck, which surface co-operates with a corresponding surface
20 or edge of the closure.

Alternatively, the axial stop means may be embodied in the arrangement of the sealing surfaces of the container neck and closure. For example, the sealing surfaces may be tapered, or inclined at an angle, relative to the
25 longitudinal axis of the container neck and the closure. With such an arrangement, as the closure is tightened beyond the usual sealing position, the sealing surfaces will tend to produce an axial force opposing further tightening of the closure on the container neck. The sealing surfaces may
30 also tend to produce an increasing circumferential frictional force opposing rotation of the closure as the closure is tightened on the container neck.

Viewed in a sixth aspect, the present embodiments include an assembly comprising a container neck and a
35 closure therefor, complementary threads on the container neck and the closure, the closure having a skirt portion an inner surface of which is adapted to seal, in use, against an outer sealing surface of the container neck, the skirt

portion being tapered radially outwardly towards the open end of the closure, the sealing surface of the container neck being tapered radially inwardly towards the open end of the container neck, and the closure being movable from an opened to a closed position by relative rotation through approximately 90° or less.

Preferably, the sealing surfaces are tapered equally so as to be complementary. Preferably the taper is at an angle of between about 1° and about 45°, most preferably between about 1° and about 25°, and in particular about 4 or 5°.

Viewed in a seventh aspect, the present embodiments include an assembly comprising a container neck and a closure therefor, and a tamper evident ring, the ring being initially coupled to the closure by severable connections and being visible between the closure and the container neck to indicate that the closure has not yet been removed by a user, the arrangement being such that, in use, the connections are severed on the occasion that a user first removes the closure, the ring being subsequently movable to a position on the container neck which is clear of the closure when the closure is later replaced, to indicate that the closure has been removed from the container neck at least once.

Such an arrangement can provide a convenient indication of whether the connection between the tamper evident ring and the closure is intact. If the connection is intact, the ring will be supported between the closure and the container neck. This indicates that the container is unopened. Preferably, a portion of the ring will project below the lower edge of the closure so that the ring is plainly visible. The ring may be made in a contrasting colour to the closure and/or the container.

When the closure is removed, the connections will be severed, and the ring can drop down the neck to a position in which it is clear of, and visibly separated from, the closure when the closure is replaced later. This position of the ring indicates that the closure has been removed at least once from the container, and may indicate to a person

purchasing the container that the container has been tampered with.

Viewed in an eighth aspect, the present embodiments include an assembly comprising a container neck and a
5 closure therefor, and a tamper evident ring, the ring being slidable in a longitudinal direction on at least a portion of the container neck and being captive thereon, and the ring being initially coupled to the closure by severable connections which connections are, in use, severed on the
10 first occasion that a user removes the closure from the container neck.

Such an arrangement ensures that the tamper evident ring cannot be removed from the container neck, for example, by a person who has maliciously tampered with the container.
15 The tamper evident ring is thus always present on the container neck to indicate whether or not the closure has previously been opened.

Preferably, when the assembly includes a tamper evident ring, the closure is provided with an upstanding diametric
20 handle. The handle may be in the form of an upstanding flange.

Such a handle has been found to be especially convenient for enabling the closure to be tightened or unscrewed with ease. The handle is especially convenient for use by
25 elderly people who might otherwise have trouble in grasping the sides of the closure sufficiently strongly to tighten or unscrew the closure. The flange is particularly advantageous in enabling an elderly person to apply with ease a sufficient torque to break the severable connections
30 between the tamper evident ring and the closure.

The tamper evident ring may be used in conjunction with a child-resistant closure, such as the design described above in relation to Figures 5 to 12 and/or 13 to 14. The upstanding flange handle would then also provide a
35 convenient way for an elderly person to apply a downward pressure on the closure to engage the castellations, as well as enabling the person to apply sufficient torque to release the closure.

Viewed in a ninth aspect, the present embodiments also include a container neck and a closure therefor, the container neck having a substantially outwardly facing sealing surface near the open end of the container neck, the sealing surface being adapted to co-operate, in use, with a complementary sealing surface of the closure to form a seal, the container neck further comprising a threaded portion for co-operating, in use, with a complementary thread of the closure, the threaded portion of the container neck being further from the open end of the container neck than the sealing surface.

Such an arrangement can seal the contents of the container from any contamination such as dirt which may exist on the threaded portions of the container neck and closure.

Viewed in a tenth aspect, the present embodiments also include a container neck adapted to receive a complementary closure, the outer surface of the container neck adjacent the open end having a reduced circumference compared to the base portion of the container neck, a peelable sealing web being sealed over the open end of the container neck, an edge or edges of the sealing web projecting radially proud of the reduced circumference portion of the container neck.

Such an arrangement is advantageous in facilitating the peeling of the seal. At least one edge of the seal in effect overhangs the reduced circumference portion of the container neck to provide a tab by which the seal can be peeled off. Preferably, the entire periphery of the seal overhangs, so that an annular tab is formed around the reduced circumference portion of the container neck.

The reduced circumference portion may be formed substantially as a step, or groove, at the open end of the container neck. The size of the step, or groove, will be sufficient to enable a user to grasp the overhanging portion of the seal so that it can be peeled back.

In one embodiment, the side of the step may be chamfered radially outwardly away from the open end of the container neck.

Although the various aspects of the embodiments described above may be used independently of one another, a particularly advantageous arrangement is achieved by combining the aspects together.

5 In detail Fig. 16 shows a container having a container neck 510, and a closure 512 for fitting to the neck 510. The closure 512 is preferably a child-resistant closure incorporating the features shown in Figs. 5-12 above. For clarity, the inner and outer closure parts 514 and 516 of
10 the child-resistant closure are shown in Fig. 16, but the remaining detail of the child-resistant closure system is omitted.

The container neck 510 is formed with a base portion 518, a $\frac{1}{4}$ -turn threaded portion 520, an upper sealing surface
15 522 and crown portion 524 at the open end of the container neck, having a reduced circumference. Two diametrically opposed, and axially chamfered, radial projections, or protrusions, 525 are formed on the base portion 518. Each protrusion has a circumferential ramp surface 525a and an
20 inwardly extending radial abutment surface 525b.

A peelable foil sealing web 526 is sealed over the open end of neck such that its edge 528 projects radially proud of the crown portion 524. The crown portion 24 is chamfered radially outwardly away from the open end of the neck 510,
25 to form a recess below the edge 528 of the sealing web 526. The projecting edge 528 forms a tab by which the foil can be grasped by a user's fingers, and peeled off.

The portion of the closure which is adapted to fit on to the container neck 510 (i.e. the inner closure part 514)
30 is profiled to have an upper skirt portion 530, a $\frac{1}{4}$ -turn threaded portion 532 and a lower skirt portion 534. Four inwardly projecting axial ribs 36 are provided on the lower skirt portion.

The detail of the $\frac{1}{4}$ -turn threaded portions 520 and 532
35 of the container neck 10 and closure 12, respectively, and the axial ribs 36 and protrusions 25, are preferably as disclosed in our International application No. PCT/GB91/00850. With this arrangement, the closure 12 is

movable between an opened position in which it is released from the neck, and a closed position in which it is firmly attached to the neck, by rotation through about 90° or less. The threads each have four starts.

5 The detail of the upper skirt portion 530 of the closure 512 and of the sealing surface 22 of the container neck 510, are preferably as described above in relation to Figs. 1-4. With this arrangement, the inner surface of the upper skirt portion 530 is adapted to make a seal against the sealing
10 surface 522 of the neck when the closure 512 is tightened on the neck 510. The upper sealing surface 522 is tapered radially inwardly towards the crown portion 524, and the upper skirt portion 530 is tapered radially outwardly towards the open end of the closure 512. The tapers
15 preferably complement each other, and have a taper angle of about 4 or 5° relative to the longitudinal axis of the container neck and closure.

In use, when the closure 512 is placed over the container neck 510, the inner closure part 514 passes over
20 the edge 528 of the sealing web 526 without applying pressure directly to the sealing web 526. This ensures that the sealing web 526 will not be damaged by the application of the closure 512 to the neck 510.

The closure 512 is rotated by hand in a clockwise
25 direction (as viewed from above the container) through an angle of about 90° or less to screw the closure 512 on to the neck 510. As the closure 512 approaches its closed position, one of the ribs 536 will begin to ride against the ramp surface 525a of each protrusion 525, and the upper
30 skirt portion 530 of the closure 512 will approach sealing contact with the sealing surface 522 of the neck 510. As the closure 512 further approaches the closed position, the lower skirt portion 534 will deform into an oval shape to allow the ribs 536 to ride easily over the ramp surfaces
35 525a of the protrusions 525. As the closure 512 approaches the closed position, the user will be alerted to this by a mild increase in the torque required to rotate the closure as the ribs 536 ride over the protrusions 525.

When the closure reaches its closed position, the ribs 536 will pass the end of the ramp surfaces 525a, and will snap radially inwardly as the lower skirt portion 534 resumes its normal circular shape. In so doing, a "click" sound will be emitted, and a "click" effect will be felt through the material of the closure. This indicates to the user that the closed position has been reached, and that no further tightening of the closure is required.

In the closed position the upper skirt portion 530 of the closure 512 makes sealing contact with the sealing surface 522 of the neck, to form a reliable seal.

The engagement between the sealing surface 522 and the upper skirt portion 530 also serves to prevent the closure 512 from being overtightened substantially beyond the closed position. As the closure is tightened, the tapered sealing surfaces will bear against each other more strongly, producing a force which tends to oppose further axial movement of the closure.

The protrusion 525 also serves as a retaining means to hold the closure 512 in the closed position until a predetermined torque is applied between the inner closure part 514 and the neck 510. If the applied releasing torque is insufficient the ribs 536 will abut the radial abutment surfaces 525b of the protrusions 525, which thereby prevent the closure 512 from being unscrewed. When the applied torque is sufficient, the lower skirt portion 534 of the closure 512 will deform to an oval shape to allow the ribs 536 to pass over the protrusions. As explained above this ensures that the child-resistant feature will operate effectively and reliably.

The container neck 510 is also provided with a tamper-evident ring 544. The ring 544 is slidable on the base portion of the neck 510, but is held captive on the base portion by abutments (not shown). The ring 544 will initially be coupled to the closure by severable connections (shown diagrammatically at 550), which are severed on the first occasion that the closure is removed from the container neck. The detail of the ring is preferably as

described hereinbefore and/or as that described in relation to Figs. 9-11.

The closure is preferably provided with an upstanding diametric flange handle 546. The detail of this is preferably as that described above, and/or as that disclosed in our International application PCT/GB90/00850. Such a handle has been found to be especially convenient for enabling the closure to be tightened or unscrewed with ease. The handle is especially convenient for use by elderly people who might otherwise have trouble in grasping the sides of the closure sufficiently strongly to tighten or unscrew the closure.

Fig. 17 illustrates a modified embodiment very similar to that of Fig. 16. The difference is that the assembly in Fig. 17 also includes a stop means for defining an ultimate stop position of the closure 512 on the neck 510, beyond which position the closure 512 cannot be tightened further, to prevent the closure from being overtightened. In this exemplary embodiment the stop means are provided in the form of circumferential stop means for preventing rotation of the cap beyond a ultimate circumferential position.

The circumferential stop means co-operate with the ribs 536 of the closure 512 to define an angular position beyond which the closure 512 cannot be tightened further. The stop means are in the form of stop protrusions 548 arranged circumferentially beyond the protrusions 525, in a clockwise direction (as viewed from above the container). Each protrusion 548 has a radial abutment surface 548a against which a rib 536 will abut as the closure 512 reaches the ultimate stop position. In the arrangement shown in Fig. 17, each stop protrusion 548 is spaced by a short distance from the corresponding protrusion 525, so that the ultimate stop position is defined as being substantially the same as closed position, and the relevant rib 536 will engage between the adjacent pair of protrusions 525 and 548. The arrangement of the protrusions on the neck is thus similar to that described in PCT/GB91/00850. However, in an alternative embodiment, the stop protrusions 548 may be

spaced further from the protrusions 525 so that a range of closure positions is defined.

Alternatively, the stop means could be provided in the form of axial stop means to prevent further axial movement of the closure beyond an ultimate axial stop position. For example the stop means could be formed partly by an upwardly facing radially flat surface 540 adjacent the base portion of the neck 510. This surface 540 would abut the lower edge, or rim, of the closure if the closure were tightened substantially beyond the normal closed position.

The axial stop means could also partly be formed by the engagement between the upper skirt portion 530 of the closure 512 and the sealing surface 522 of the neck 510. As the closure is tightened beyond the normal closed position, these tapered sealing surfaces will bear against each other more strongly, producing a force which tends to oppose further axial movement of the closure 512.

Although in the embodiment illustrated in Fig.16 the inner closure part 514 projects below the edge of the outer closure part 516, it will be appreciated that in other embodiments the outer closure part may be extended downwardly so as to substantially conceal the edge of the inner closure part. This would avoid the possibility that a child might overcome the child-resistant feature of the closure by turning the exposed portion of the inner closure part 514.

A further embodiment illustrating this is shown in Fig. 18. The embodiment shown in Figure 18 is very similar to the embodiments shown in Figures 16 and 17, and the same reference numerals denote features of the third embodiment which are already described in relation to the first two embodiments.

The base of the container neck 510 is formed with a shoulder 560 and a radially projecting flange 562 which together define a waist portion 564 of the neck on which the tamper-evidence ring 544 is mounted. The ring 44 is slidable axially up and down the waist portion 564, but is captive thereon.

Initially, before the container has been opened for the first time by a user, the closure 512 will be in its closed position on the container neck 510, and the ring 544 will be coupled to the bottom of the closure by severable
5 connections (shown diagrammatically at 550). The ring 544 will be in its uppermost position abutting the flange 562, and the ring 544 will be held in that position by the connections 550 to the closure 512. The lower edge of the
10 tamper-evident ring 544 will project slightly below the level of the edge of the closure 512, so that the tamper-evident ring can be seen. In this position, the ring indicates that the connections 550 to the closure are intact, which means that the closure 512 has not been removed since manufacture.

15 When a user removes the closure 512 for the first time, the severable connections 550 are severed, so that the ring 44 is no longer coupled to the closure 512. The ring 544 will slide downwardly along the waist portion 564 until the ring 544 rests against the shoulder 560. When the closure
20 512 is later replaced on the neck 510, the tamper-evident ring 544 will be clearly seen to be separated axially from the bottom of the closure 512. In this position, the ring 544 indicates that the closure 512 has been removed at least once since manufacture. To a person purchasing the
25 container, this may indicate that the container has been tampered with.

It will be appreciated that this embodiment provides a reliable and convenient indication of whether the connections to the tamper evident ring 544 are intact. Even
30 after the connections 550 have been severed, the tamper-evident ring 544 is not removable from the container neck, and so the ring 544 cannot be discarded by a person who has maliciously tampered with the container.

The diameter of the waist portion 564 at a position
35 adjacent the shoulder 560 may be increased slightly, so that the tamper-evident ring 544 forms a close fit, or a friction fit, with the waist portion at the position adjacent the shoulder 560. With such an arrangement, the

tamper-evident ring will tend to be retained against the shoulder by the friction fit. This can prevent the ring 544 from sliding back up the waist portion 564, even if the container is tipped on its side.

5 Also in Figure 18, the design of the child-resistant closure 512 is modified compared to the arrangement in Figs. 16 and 17. The modification consists of the lower region of the outer closure part 516 being enlarged and formed as an outer skirt 570 to cover the lower skirt portion 534 of the
10 inner closure part 514. With this arrangement the inner closure part 514 is substantially concealed by the outer closure part, and this avoids the possibility that a child might overcome the child-resistant feature of the closure 512 by directly turning the inner closure part 514. An
15 axial clearance 572 is left between the outer closure part 516 and the lower skirt portion 534 of the inner closure part 514, to allow room for the outer closure part 516 to be pressed downwardly when an adult desires to open the container.

20

FIGS. 19-22

The embodiments in Figs. 19-22 relate to other features of a tamper-evident ring. In a first aspect, these embodiments provide an assembly comprising a container neck,
25 a closure adapted to fit the neck, and a tamper-evident ring, the ring being initially substantially concealed by the closure when the closure is fitted to the container neck, the arrangement being such that, in use, after the occasion on which the closure is first removed from the
30 container neck, the tamper-evident ring remains substantially visible on the container neck when the closure is replaced on the neck.

Such an arrangement provides a positive indication once the closure has been removed for the first time. The
35 positive indication is the appearing of the tamper-evident ring itself. The invention appreciates the real essence of a tamper-evident ring, which is, to provide a warning or positive indication if the closure has been removed from the

container at least once. It is not necessary to see the tamper-evident ring if the ring is properly intact.

Before the closure has been opened for the first time the tamper-evident ring, being substantially concealed by the closure, also will not give the closure an unsightly appearance.

Preferably, the tamper-evident ring is movably retained on the container neck, and the assembly further comprises releasable holding means for initially holding the tamper-evident ring in a first position in which it is substantially concealed by the closure, the holding means releasing the tamper-evident ring when the closure is first removed from the container, to allow the ring to move into a second position in which it is not substantially concealed by the closure when the closure is replaced on the container neck.

Preferably, the holding means comprises severable connections between the tamper-evident ring and the closure, which connections are completely severed when the closure is first removed from the container neck. The severable connections may be integrally formed with the tamper-evident ring and with the closure.

The tamper-evident ring may be coloured a contrasting colour to the container so that the tamper-evident ring will be clearly visible, and easily discernable at a glance, once the closure has been removed for the first time. For example, the tamper-evident ring may be coloured red as a warning colour.

The portion of the container neck on which the tamper-evident ring sits when in its visible, second position may itself be coloured a colour which contrasts both the rest of the container and the tamper-evident ring. When the tamper-evident ring is in its concealed, first position, this portion of the neck will be visible, and so it may be coloured with a safety colour, such as blue or green, to indicate that the tamper-evident ring arrangement is intact.

Preferably, the tamper-evident ring is slidably retained on a portion of the neck, and is retained thereon. This

prevents a person who has maliciously tampered with the container from discarding the tamper-evident ring.

Preferably, in the second position the tamper-evident ring is separated from the bottom of the closure by a distance at least equalling the axial width of the tamper-evident ring. With such an arrangement, a user can see quite clearly at a glance that the tamper-evident ring is detached from the closure.

Preferably, the closure includes a recess, or a clearance, in which the tamper-evident ring is received when in its concealed, first position. The severable connections are preferably made between an inner wall or walls of the recess, and an edge of the tamper-evident ring. The recess may be defined by a skirt portion of the closure, which covers the tamper-evident ring.

The closure may be of any suitable type, for example, a screw-on closure, or a snap-fit closure. The closure may be a $\frac{1}{4}$ turn (or less) closure, for example as described in PCT/GB91/00850. The present embodiments are also particularly suitable for use with a child resistant closure, such as that described above in relation to Figs. 1-4 because the tamper-evident ring is will not interfere with the axial or rotational movement of the outer part of the child-resistant closure.

In a second aspect, these embodiments also provide a closure adapted to fit a container neck, the closure comprising a tamper-evident ring and means for substantially concealing the tamper-evident ring from view when in use on a container, until the closure is first removed from the container neck.

Preferably, the concealing means comprises a recess or clearance within the closure in which recess or clearance the tamper-evident ring is substantially received, and holding means for initially holding the tamper-evident ring within the recess or clearance until the closure is removed from the container neck on the first occasion, whereupon the holding means releases the tamper-evident ring so that it will no longer be concealed within the clearance or recess

when the closure is replaced.

The concealing means may be in the form of a skirt portion of the closure which covers the tamper-evident ring.

Preferably, the holding means comprises means for
5 forming severable connections with the tamper-evident ring, which connections are intended to be severed on the first occasion that the closure is removed from the container neck.

In another aspect, these embodiments relate to an
10 improvement in the design of severable connections for tamper evident rings. A problem with some conventional designs is that when the connections are severed, projecting "wires" or stubs remain on the surface of the ring. As well as being unsightly, such stubs may obscure a person from
15 viewing at a glance whether the ring is detached or intact. They might also interfere with the closure when it is replaced on the container neck.

In the third aspect, these embodiments provide a container closure, a tamper evident ring formed integrally
20 with at least a substantial part of the closure and joined thereto by one or more severable connections, one or each severable connection comprising a relatively wide or thick portion adjacent the closure and narrowing to a thin severable zone at the point where the connection joins the
25 tamper evident ring. With such an arrangement, when the tamper evident ring becomes detached, the surface to which the severable connections were made will be relatively smooth, and in particular, there will be no projecting "wires" or stubs caused by the former severable connections.

30 The arrangement is particularly advantageous when the closure is shaped so that it conceals the severable connections to the tamper evident ring. When the severable connections are broken, the "wires" or stubs will remain on the closure and be concealed by the closure. For example,
35 the closure may include a skirt portion which conceals the severable connections.

The arrangement is also particularly advantageous when the closure is designed to substantially conceal the tamper-

evident ring until the closure is removed from a container neck for the first time. With such an arrangement, the "wires" or stubs from the severable connections will remain concealed when the tamper-evident ring becomes detached.

5 In detail the drawings Figs. 19 to 21 show a container 610 with a neck portion 612 which has a lower waist portion 614 and an upper crown portion 616. The waist portion 614 is defined at its lower end by a shoulder 618 which joins the neck 612 to the body of the container, and at its upper
10 end by an abutment flange 620. The flange 620 has an radially inwardly inclined upper surface 620a and a flat lower abutment surface 620b. The waist portion 614 is adapted to receive a tamper-evident ring as described hereinafter.

15 The crown portion 616 of the neck 612 has a foil sealing web 622, and carries screw threads 624 adapted to secure a screw threaded closure 626 to the container 610.

In this exemplary embodiment, the closure 626 is a relevant child-resistant closure, although it will be
20 appreciated that other types of child-resistant or non-child-resistant closures might be used instead.

The closure 626 comprises an outer closure part 628 and an inner closure part 630. The outer part 28 has an upstanding flange handle 632, and a lower skirt-portion 634.
25 The inner part 630 is coupled internally to the outer part 628 through a child-resistant mechanism (not shown), and carries an inner screw thread (not shown) to match the screw threads 624 of the container neck 612.

The closure 626 is fitted with a tamper-evident ring 36
30 in the form of an annular member which is received substantially entirely within the skirt portion 634 of the closure. Attached to the top of the ring 636 and integral therewith are eight connecting members 638 which taper upwards from a relatively thick lower region into a
35 relatively thin frangible bridge 640 attached to the bottom of the inner part 630 of the closure 626. On the radially inner face of the ring 636, extending between the connecting members 638, are eight triangular section ring retaining

clips 642 which are adapted to engage the abutment flange 620 of the container neck 612. Each clip 642 is profiled with a radially inwardly tapered lower ramp surface 642a and a flat upper abutment surface 642b.

5 Once the desired contents have been placed in the container 610, the closure 626 is screwed on in the normal way, to secure the container in a sealed condition ready for sale. As the closure 626 is screwed down for the first time, the ramp surfaces 642a of the ring retaining clips 642
10 bear against the tapered surfaces 620a of the flange 620. The ring 636 deforms sufficiently to allow the ramp surfaces 642a to ride easily over the flange 620. When the closure reaches its fully screwed-down position, the ring 636 will be in the a first position in the neck 612 as illustrated at
15 636a in Fig. 20, fitting immediately under the flange 620.

 In this condition, the tamper-evident ring 636 is substantially concealed from view by the outer part 628 of the closure 626. In this condition, the assembly indicates that the closure 626 has not been removed since it was first
20 fitted on to the container.

 When the closure 626 is unscrewed for the first time, the abutment surfaces 642b of the ring retaining clips 642 bear against the abutment surface 620b of the flange 620 to prevent the ring 636 from being removable from the neck 612
25 with the closure. The frangible bridges 640 act as severable connections which are severed as the closure 626 is unscrewed, so that the ring 636 becomes detached from the closure 626. Once detached, the ring 636 is free to slide axially down the waist portion 614 of the neck 612, until it
30 rests at a second position against the shoulder 618 as denoted at 636b in Fig. 20.

 When the closure is replaced on the neck 612, the lower skirt portion 634 of the closure no longer conceals the tamper-evident ring 636, and the ring remains visible on the
35 neck 612 to indicate that the closure has been removed at least once since it was first fitted.

 In its visible position, the tamper-evident ring 636 is separated from the bottom of the skirt portion 634 of the

closure 626 by at least a distance equalling the axial width of the tamper-evident ring. This enables a user, or potential purchaser, to see clearly at a glance that the tamper-evident ring 636 is detached from the closure 626.

5 The ring 636 is slidable on the waist portion 614 of the neck 612, but is held captive thereon by the shoulder 618 and the abutment flange 620. This ensures that the ring 626 cannot be discarded once it has become detached from the closure 626, and the ring remains on the neck 612 as a
10 permanent indication that the closure 626 has been removed at least once.

 The tamper-evident ring 636 is coloured a contrasting colour to the rest of the container and closure, so that it will be clearly visible on the container neck once it has
15 become detached from the closure.

 It will be appreciated that this embodiment of the invention is suitable for use with a child-resistant closure, because it does not interfere with the axial movement of the outer closure part 628, and the tamper-
20 evident ring 636 will not become detached if a child tries to open the container 610 by rotating the outer closure part 628. However, the principles of the invention are equally applicable for other types of non-child-resistant screw-on or snap-fit closures.

25 Fig. 22 shows a modified embodiment including a non-child-resistant closure. In this embodiment, the inner and outer closure parts described previously are replaced by a single-part closure member 648, which may be a screw-threaded closure or a snap-fit closure. The tamper-evident
30 ring 636 is substantially concealed within a lower skirt portion 650 of the closure, and is severably connected thereto by the thin frangible webs 640 in the same manner as described previously.

 Fig. 23 shows a modified design of tamper evident ring
35 636'. The assembly is similar to that shown in Figs. 19 and 20, and the same reference numerals are used where appropriate. In Fig. 23, the shapes of the severable connections 638' are inverted. The connections taper from

a relatively thick or wide upper region adjacent the inner closure part 630 to a thin severable bridge or zone 640' at the point where the connection joins the tamper-evident ring 636.

5 When the closure is removed from the container neck for the first time, the connections 638' sever at the severable zone 640', leaving the thick portions as "wires" or stubs on the inner surface of the closure. These stubs are concealed by the skirt portion of the outer closure part 628.

10 The tamper evident ring 636 when detached therefore has a relatively smooth upper surface. Small imperfection may occur at the places to which the connections 638' were joined formerly, but no large projecting "wires" or stubs are left on the surface of the tamper evident ring.

15 This modified design of severable connection may be used with any of the embodiment in this application which incorporate a tamper evident ring. It is also of more general application for use with tamper-evident closure assemblies.

20 Although in the preferred embodiment described above the tamper-evident ring is coupled to the closure by severable connections which, in use, are severed by axial forces, in other embodiments, other types of tamper-evident ring may be used. For example, rings which are severed by
25 circumferential twisting forces, or by cutting devices on the neck or closure, may be used.

FIGS. 24-29

The embodiment illustrated in Figs. 24-29 relates to
30 features of a screw threaded closure assembly which provides a seal between the closure and the container neck when the closure is screwed into its fully closed or sealing position.

In one aspect, it relates to an improvement for the
35 closure assembly described above in relation to Figs. 16-18. In the above embodiments radial stop projections have been provided on the neck and on the closure which "click" past each other as the closure reaches its fully closed

position. This indicates to a person that no further tightening is required. To unscrew the closure out of its closed position, a person has to apply a predetermined release torque to "click" the projections back past each
5 other. The projections therefore also serve to prevent the closure from becoming loose accidentally, even though the closure is not screwed down especially tightly.

With such a design, the manufacturing tolerances for the closure and the container neck may be quite critical. The
10 projections should be positioned and dimensioned such that they "click" past one another at precisely the position of the closure on the container neck at which the seal is formed.

Viewed in a first aspect, the present embodiment
15 provides a container closure assembly comprising a container neck, a closure therefor, screw thread means on at least one of the closure and the container neck for retaining the closure on the container neck, sealing means for forming a seal between the closure and the container neck when the
20 closure is at a sealing position on the container neck, and urging means co-operating between the closure and the container neck when the closure is near the sealing position for urging the closure into the sealing position independently of whether an external closing torque is being
25 applied to the closure, and thereafter for maintaining the closure in the sealing position until a sufficient external release torque is applied to the closure.

Such an arrangement can positively retain the closure in its sealing position, without having to be manufactured
30 to the same precision as the prior art.

Preferably, the urging means maintains a force on the sealing means when the closure is in its sealing position. This can ensure that the respective sealing surfaces of the sealing means are firmly seated against each other, even
35 though the closure may not be screwed down especially tightly when in the sealing position. The arrangement can thus increase the force experienced by the sealing means, leading to an improved seal, without requiring the closure

to be screwed down very tightly on the container neck.

Preferably, the urging means comprises first means on the container neck for co-operating with the second means on the closure, at least one of the first and second means including a ramp surface against which the other of the first and second means bears when the closure is near the sealing position, the ramp surface extending in a direction to urge the closure in a direction towards its sealing position.

10 Preferably, the first and second means each comprise a respective ramp surface extending in a direction to urge the closure towards its sealing position.

Preferably, the first means comprises one or more outwardly facing projections on the container neck, and the second means comprises one or more inwardly facing projections on the closure.

Preferably, the or each second means projection is mounted on a resilient portion of the closure which portion is capable of deforming to enable that projection to ride over the first means projection when the closure is screwed into, or out of, the sealing position.

Preferably, the projections include respective lead-in ramp surfaces which bear against each other, in use, to ease the projections over each other when the closure is being screwed towards its sealing position, before the aforementioned ramp surfaces which apply an urging force begin to bear against each other.

Preferably, the urging means is arranged to apply a rotational urging force to the closure relative to the container neck.

Preferably, the closure can be moved between its sealing position and a fully open position by relative rotation through 180° or less, and more preferably through about 90° or less. The rotation may, for example, be about 45°-50°.

35 This embodiment is also important in enabling the closure to be retained securely on the container neck during transportation, or if the container is accidentally dropped. Additionally, the invention can serve to pull automatically

the sealing surfaces of the closure and container neck against each other to achieve a reliable liquid-tight and/or air-tight seal.

5 The sealing surfaces may comprise a tapered rim on the container neck, and a matching tapered surface on the inside of the closure. In the preferred embodiment angle of taper is about 4° or 5° relative to the longitudinal axis of the container, but of course any taper angle might be used.

10 In the preferred embodiment, the resilience of the material of the closure is used to supply an urging force. The closure deforms slightly from its circular shape to an oval shape when the first and second means projections engage, and the resilience of the closure tends to urge the closure to return to its circular shape.

15 In the preferred embodiment, the closure has a handle in the form of an upstanding diametric flange. This enables the closure to be gripped and turned easily, and is especially advantageous for disabled or elderly people.

20 The closure may include tamper evident means and/or child resistant means.

In one embodiment, the container neck and the closure may be manufactured to a certain tolerance such that the fully closed and sealing position of the closure on the container neck will be within a tolerance range of possible
25 closed positions, as defined relative to the position of the urging means. The urging means is then preferably arranged such that the urging means will act on the closure at least whenever the closure is at a position within the tolerance range of possible closed positions, and more preferably when
30 the closure is at a position which is near but outside the tolerance range of possible closed positions.

Viewed in a second aspect related particularly to this, the present embodiment provides a container closure assembly comprising a container neck, a closure therefor, screw
35 thread means on at least one of the closure and the container neck for retaining the closure on the container neck, sealing means for forming a seal between the closure and the container neck when the closure is at a sealing

position on the container neck, which sealing position is within a predetermined tolerance range of possible sealing positions, and urging means cooperating between the closure and the container neck when the closure is at a position
5 anywhere within the tolerance range of possible sealing positions, for urging the closure into its sealing position independently of whether an external closing torque is being applied to the closure, and thereafter for maintaining the closure in the sealing position until a sufficient external
10 release torque is applied to the closure.

With this aspect of the embodiment, closure assemblies can be manufactured which achieve a reliable seal, and which avoid overtightening, without requiring each container neck and each closure to be manufactured to strict tolerances.
15 The container necks and the closures can therefore be made easily, and quite cheaply without prejudicing the reliability of each closure assembly. The invention can also compensate for any wear of the closure or of the container neck, if they are made of materials which will
20 wear in use, e.g. soft plastics material.

In detail, Figs 24-29 show a container closure assembly in the form of a container neck 710 and a container closure 712, both made of plastics material.

The neck 710 is of generally circular section, and
25 includes a screw threaded portion 714 which has a four-start, square section thread. The closure 712 has a complementary threaded portion 716, such that the closure can be screwed into a fully closed sealing position on the neck by relative rotation through about 90° or less. The
30 closure 712 has a handle in the form of an upstanding diametric flange 717.

The neck 710 and the closure 712 also include complementary sealing surfaces 718 and 720, respectively, for forming a liquid-tight and/or airtight seal between the
35 closure and neck when the closure is in its fully closed, sealing position. The sealing surfaces 718 and 720 are tapered at an angle of about 4° relative to the longitudinal axis of the neck 710. In this embodiment, the engagement of

the sealing surfaces 718 and 720 when the closure 712 is screwed on to the neck 710 defines the fully closed position of the closure.

The neck 710 also carries first means in the form of two
5 radially opposite projections 722 which extend in the circumferential direction around portions of the neck 710. Each projection 722 comprises a respective first radial ramp surface 724 forming one side of the projection 722 and a respective second radial ramp surface 726 forming the other
10 side of the projection 722. The first ramp surface 724 has an inclination of about 30° relative to the radial direction of the neck (i.e. about 60° relative to the tangent of the neck surface), and the second ramp surface 726 has a much gentler inclination to serve as a lead-in ramp surface.
15 Each projection 722 also includes a small ridge 725 between the ramp surfaces 724 and 726.

The closure 712 carries second means in the form of four equally angularly spaced projections 728. Each projection 728 comprises a respective first radial ramp surface 730 on
20 one side of the projection, and a respective second radial ramp surface 732 on the opposite side of the projections. The first radial ramp surface 730 has an inclination of about 30° relative to the radial direction of the closure (i.e. about 60° relative to the tangent of the closure
25 surface), and second ramp surface 732 has a gentler lead-in inclination of about 55° relative to the radial direction of the closure (i.e. about 35° relative to the tangent of the closure surface).

Referring especially to Figs. 27-29, the projections 722
30 and 728 are arranged to form urging means which co-operate as the closure 712 nears its fully closed, sealing position to urge the closure 712 into its sealing position independently of whether any external closing torque is being applied to the closure.

35 As the closure 712 initially approaches its sealing position, two of the four projections 728 of the closure 712 will approach the two opposite projections 722 of the neck 710. As the closure 712 is further moved rotationally the

lead-in second ramp surface 732 of the closure 712 will bear against the lead-in second ramp surface 726 of the neck (see Fig. 27). Further rotation of the closure 712 causes the wall of the closure 712 to deform slightly into an oval shape to enable the projections 722 and 728 to ride over each other. When the closure 712 reaches the position depicted in Fig. 28, the resilience of the wall of the closure 712 urges the projection 728 of the closure radially inwardly (as depicted by the arrow 734) so that the first ramp surface 730 of the closure 712 now bears against the first ramp surface 724 of the neck 710, thereby urging the closure 712 in a rotational direction (as depicted by the arrow 736).

The ridge 725 is provided to positively define the point at which the urging effect of the projections 722 and 728 takes over. The ridge 725 also causes a "click" effect which a person can feel through the closure when screwing the closure closed. The "click" effect indicates that the closure is now being urged into its sealing position, and need not be further tightened.

The projections 722 and 728 are arranged such that the fully closed, sealing position of the closure 712 (as defined by the sealing surfaces 718 and 720) will occur while the first ramp surfaces 730, 724 respectively, of the closure 712 and the neck 710 are in contact (as depicted in Fig. 29). This ensures that the closure 712 is urged fully into its sealing position, even if little or no external closing force is applied to the closure at that instant.

When in the fully closed, sealing position, the first ramp surfaces 724 and 730 of the projections 722 and 728, respectively, co-operate to maintain the closure firmly in its sealing position to prevent the closure from becoming loose, even though the closure is not screwed down especially tightly. The closure 712 is retained in this position until a sufficient external opening or release torque is applied to the closure 712 to cause the projections 722 and 728 to ride back over each other, whereafter the closure 712 can be unscrewed from the neck

710.

It will be appreciated that in the fully closed, sealing position, the urging force applied by the projections 722 and 728 urges the sealing surfaces 718 and 720 against each other. Therefore, the arrangement ensures that the sealing surfaces are seated against each other sufficiently firmly to form a reliable seal, even though the closure is not screwed down especially tightly on the neck.

The above effects are especially advantageous in the present embodiment, where the closure is movable between a fully disengaged position and a fully sealing position by relative rotation through 90° or less. The embodiment provides a container which is easily openable and closable even for elderly people, but yet which achieves a firm and reliable seal when closed.

It will also be appreciated that the exact rotational position of the closure 712 when in the fully closed, sealing position is not critical, owing to the configuration of the first ramp surfaces 724 and 730 of the projections 722 and 728, respectively. Therefore, the closure 712 and the container neck 710 can be manufactured to a much less critical tolerance than if the projections had radially flat surfaces instead of ramp surfaces.

The manufacturing tolerances of the closure 712 and the container neck 710 are such that the sealing position of the closure will lie within a predetermined tolerance range of possible sealing positions. The projections 722 and 728 are arranged such that they will co-operate to urge the closure 712 towards its sealing position whenever the closure is at a position anywhere within the predetermined tolerance range of possible sealing positions. In this exemplary embodiment, the projections 722 and 728 are arranged to co-operate to apply the urging force when the closure is at a position near, but just outside, the predetermined tolerance range of possible sealing positions.

Two second means projections 722 on the container neck 710 are adequate to retain the closure 712 in its sealing position. Four first means projections 728 are provided on

the closure 712 since the closure 712 can be placed on the neck 710 in any one of the four start positions defined by the four-start thread. The second means projections 722 are chamfered axially to prevent the first means projections 728 from coming into contact with them until the closure nears its sealing, fully closed position.

It will be appreciated that the closure described above could also be supplemented by child-resistant means to make the closure child-proof, and/or by tamper-evident means to indicate whether the container has been opened since the closure was fitted during manufacture. Suitable child-resistant and tamper evident mechanisms are, for example, described above.

FIGS. 29-31

The embodiments shown in Figs. 30-32 relate to features of a container closure assembly for forming a reliable seal when the closure is fitted to the container neck.

Such closure assemblies are often used in containers for food, drinks, medicines or other perishable or contaminable contents, to preserve the quality of the container contents.

One known arrangement for a sealing closure assembly is for the closure to be provided with an annular sealing wall which fits inside the container neck, and forms a seal against the radially inner surface of the neck when the closure is fitted on the neck.

A problem which may be encountered with conventional closure assemblies, such as that described above, is that with a screw threaded closure, for example, the closure has to be screwed down tightly to ensure that a reliable seal is formed. This means that the closure may be difficult to remove later, and it may also cause damage by deforming the engaging surfaces of the closure and the neck.

Viewed in a first aspect the present embodiments provide a container closure assembly comprising a container neck, a container closure, means for retaining the closure in a closed position on the neck, first sealing means on the closure adapted to seal against an outer surface of the neck

when the closure is in its closed position, and second sealing means on the closure adapted to seal against an inner surface of the neck when the closure is in its closed position.

5 With such an arrangement, the closure when fitted to the container neck forms a seal against both the inner and outer surfaces of the container neck. This sealing arrangement can provide a more reliable seal than a conventional seal, without requiring the closure to be fastened down very
10 tightly on the container neck.

The outer surface of the neck against which the first means is adapted to form a seal may be a circumferentially facing outer surface, or it may alternatively be any other surface, such as a top surface, on the outside of the
15 container neck.

Preferably, the first and second sealing means form respective seals with the container neck at positions which are substantially directly opposite each other. This can further improve the sealing effect by "wedging" the wall of
20 the container neck between the first and second means of the closure.

Preferably, the first sealing means comprises an inner surface of a skirt portion of the closure, which inner surface is adapted to seal against the neck. The outer
25 surface of the neck may include an outwardly tapered portion, and the inner surface of the skirt portion of the closure may be adapted to form an interference fit with the outwardly tapered portion of the neck. The skirt portion of the closure may include an inwardly tapered surface to form
30 a complementary fit with the outwardly tapered portion of the neck.

The angle of taper of the tapered portion of the neck may be between about 1° and 45° , preferably between about 1° and 25° , and in particular about 4° or 5° .

35 The second sealing means preferably comprises a plug portion of the closure, which plug portion is shaped to fit inside the container neck, the circumferential surface of the plug portion being adapted to seal against the inner

surface of the neck.

Preferably the inner surface of the container neck includes an outwardly tapered portion, the circumferential surface of the plug portion being adapted to form an interference fit with the tapered portion of the neck. The plug portion may include an inwardly tapered surface to form a complementary fit with the outwardly tapered inner surface of the neck. The angle of taper may be between about 1° and 45° , preferably between about 1° and 25° , and in particular about 4 or 5° .

The angle of taper of the inner surface of the neck preferably matches the angle of taper of the outer surface of the neck.

In the case where the container neck and the closure are of circular section, the means for retaining the closure in its closed position preferably includes a thread. Most preferably a thread is provided on the closure and a complementary thread on the container neck. As illustrated in one of the detailed embodiments, the threads are preferably of square section to provide a positive fit. The threads are preferably arranged so that the closure can be moved between the closed position and an open position by relative rotation through 180° or less, for example, through 90° . The invention is suitable for such an arrangement because it does not rely on the closure being fastened down especially tightly to achieve a reliable seal. The closure may include features described in PCT/GB91/00850. The closure may be a child-resistant closure, for example as described hereinbefore.

Alternatively, the retaining means might comprise a snap fit connection between the closure and the container neck.

The closure may comprise a handle in the form of an upstanding diametric flange. Such a handle is particularly convenient for use with both a screw threaded fastening closure and a snap-fit fastening closure. The handle enables a person to grip the closure easily by hand to remove, or fasten, the closure.

Viewed in a second aspect, the present embodiments

provide a closure adapted to fit a container neck, the closure comprising first sealing means adapted to seal against an outer surface of the neck when the closure is in a closed position on the neck, and second sealing means
5 adapted to seal against an inner surface of the neck when the closure is in the closed position on the neck.

The first sealing means may comprise an inner surface of a skirt portion of the closure, which inner surface is adapted to seal against the neck. The skirt portion may be
10 tapered inwardly, for example, to compliment an outward taper of the neck.

The second sealing means may comprise a plug portion of the closure, which plug portion is shaped to fit inside the container neck, the circumferential surface of the plug
15 portion being adapted to seal against the inner surface of the neck. The surface of the plug portion may be tapered, inwardly for example, to compliment an inward taper of the inner surface of the neck.

The first and second sealing means are preferably
20 directly opposed so that when the closure is fitted to a container neck, the first and second sealing means form respective seals with the neck at positions which are substantially directly opposite each other.

The closure may further comprise a screw thread, or
25 snap-fit connecting means, for retaining the closure on the neck in the aforementioned closed position. The closure may comprise a handle in the form of an upstanding diametric flange to enable the closure to be gripped easily by hand to remove, or fasten, the closure.

30 Referring to Fig. 30, a container neck 810 is shown with its closure 812 in its closed, sealed position on the neck 810. In this exemplary embodiment, both neck 810 and the closure 812 are of circular section and are provided with complementary screw threads 814, 816, respectively. The
35 threads 814 and 816 are of square section to provide a positive fit. The threads are arranged such that the closure can be moved between the closed position and an open position by relative rotation through about 90° or less.

The upper portion of the neck 810 is tapered outwardly on its outer surface 818, and on its inner surface 820. The angle of taper is about the same on both surfaces 818 and 820, and is approximately 4 or 5°.

5 The closure 812 consists of a crown portion 822, a handle portion 823, a skirt portion 824, and an annular plug portion 826 fitting inside the container neck 810. The handle portion 823 is in the form of an upstanding diametric flange, which enables a person to grip the closure easily to
10 fasten, or remove, the closure. The skirt portion 824 includes first sealing means in the form of a first sealing surface 828 which is adapted to form an interference fit seal against the radially outer surface 818 of the neck 810. The first sealing surface 828 is tapered inwardly to
15 compliment the taper of the outer neck surface 818. The plug portion 826 includes second sealing means in the form of a second sealing surface 830 which is adapted to form a seal against the radially inner surface 820 of the neck 810. The second sealing surface 830 is also tapered inwardly to
20 compliment to taper of the inner neck surface 820.

In this embodiment the first and second sealing surfaces 828 and 830 of the closure form seals against radially opposite faces of the container neck at positions which are substantially directly radially opposed. The upper portion
25 of the neck is "wedged" between the sealing surfaces, which achieves a particularly reliable and effective seal.

It is to be noted, however, that in an alternative embodiment of this invention, the first and second sealing surfaces might not be directly radially opposed. For
30 example, the first sealing surface 828 could instead be arranged below the screw threads 814.

The container neck and the closure are preferably made of material which enables a reliable seal to be formed by the interference fits between the sealing surfaces of the
35 closure and the container neck.

Fig. 31 shows a similar arrangement of sealing surfaces for a snap-fit closure assembly. Where appropriate, the same reference numerals of Fig. 30 are used to denote

corresponding features of Fig. 31. The main difference in Fig. 31 is that the screw threads are replaced by a lip 840 on the container neck 810, and an inwardly facing deformable snap-fit projection 842 on the closure 812 for engaging under the lip 840. The closure 812' is made of a deformable material such as deformable plastics. The arrangement includes the same first and second sealing means as described above to ensure that a reliable seal is made when the closure is fitted to the container neck.

10 Fig. 32 illustrates a modification of the embodiment in Fig. 31. In the modified embodiment, the flange handle is replaced by an annular protrusion 844 which projects radially outwardly near the lower edge 846 of the closure. The wall of the container neck is inclined to provide a
15 clearance 848 under the lower edge 846 of the closure. With this arrangement, to remove the closure from the container neck, a person can grip around the annular protrusion 844, and under the lower edge 846 of the closure, to get a good grip.

20 Although in the detailed embodiments described above, the first and second sealing means comprise sealing surfaces of the closure, in other embodiments sealing elements might be fitted to the closure to form the first and second sealing means. For example, sealing elements made of
25 compressible material, e.g. rubber, could be used.

Although in the detailed embodiments described above, both the inner and outer surfaces of the neck include tapered portions, in alternative embodiments, only one, or possibly neither, of the outer surfaces might be tapered.
30 The sealing surfaces of the closure might still be tapered, or instead one or both of the sealing surfaces might not be tapered. The actual arrangement used can be varied to meet the requirements of the container and closure for a particular application.

35

FIGS. 33-36

The embodiments shown in Figs. 33-36 relate to a sealable container, and to a method and apparatus for

forming such a container. In particular, the invention relates to a container having an opening which is intended to be sealed by a closure releasably retainable over the opening.

5 Such containers are commonly made of plastics material which is blow-moulded, since this is the most cost-efficient method of production. The mould is made in two separable halves to enable the mould parts to be removed easily from the container once it has been formed.

10 On the other hand, the closures for the containers are normally injection moulded, to obtain the necessary shape detail on the inner surfaces of the closures. This interior detail cannot be achieved easily with blow moulding.

 We have appreciated that a problem sometimes exists with
15 such blow-moulded containers, which hinders the formation of a reliable seal when the closure is fitted over the opening. The problem is caused by the formation on the exterior of the container of a seam running along a line corresponding to the join line of the mould halves. The seam results from
20 the imperfect fitting together of the mould halves when the plastics material is blown forcibly against the mould surfaces. The seam commonly comprises a slightly projecting ridge, or a slight step in the surface of the plastics material.

25 The seam hinders the formation of a reliable seal preventing the closure from fitting intimately against the surface of the container immediately either side of the seam. This problem can be particularly important for containers for foods, drinks or medicaments, which should be
30 sealed in a liquid-tight or an air-tight fashion by the closure to prevent the container contents from being contaminated by, for example, dirt or moisture. The problem lies in the production of the container, since the injection moulding process for forming the closure does not cause the
35 production of a seam on the closure.

 Viewed in a first aspect, the present embodiment provides a method for forming a container having an opening which is intended to be sealable by means of a closure

releasably retainable over the opening, the method comprising forming a seamless first portion of the container by a first process, which first portion includes a sealing surface extending around the opening, the sealing surface
5 being intended to seal in use against a said closure, and forming a second portion of the container by a second process, which second portion may include a seam or seams.

With this embodiment, a seamless sealing surface around the opening is formed, which can match the normally seam-
10 free surface on the inner surface of the closure. The seal is thereby improved by using two seam-free sealing surfaces.

The container is preferably formed of plastics material. The first and second portions are preferably integrally formed.

15 The embodiment appreciates that the requirements for forming the first portion of the container generally conflict with the requirements for forming the second portion. For example, blow-moulding is not ideal as the first process (for forming the first portion) as this causes
20 seams as in the prior art. The first process preferably comprises injection moulding as this technique avoids seams being produced.

On the other hand, injection moulding is not ideal as the second process (for forming the second portion of the
25 container) since this requires mould parts to define both the interior and exterior surfaces of the container. In the case of a container having a relatively narrow neck joined to a relatively wide body, a very complicated and expensive injection mould would be required.

30 Preferably the second process comprises blow-moulding as this enables relatively elaborate exterior profiles and shapes to be formed usually with only a two-part mould. The blow-mould could be formed in more parts if desired. The resulting formation of seams on the second portion does not
35 affect the improved sealing characteristics achieved by the seamless first portion of the container.

The first portion of the container may include the opening. The second portion of the container preferably

includes the majority, if not all, of the body of the container.

The first portion of the container may comprise generally a neck, or at least the upper portion of a neck, of the container. In particular, the first portion may consist of the portion of the neck from the container opening to the sealing surface. The second portion consists of the remainder of the neck below the sealing surface and the body of the container.

10 The neck may include means for releasably retaining a closure on the neck to cover the opening. Such means may comprise a screw thread, or snap fit means. In the detailed embodiment, the portion of the neck carrying the retaining means is blow moulded.

15 The method may comprise injection moulding the first portion of the container around a hollow floating mandrel, and blow-moulding the second portion of the container by blowing gas through the hollow floating mandrel.

Viewed in a second aspect, the present embodiment provides a container having an opening intended to be sealable by means of a closure releasably retainable over the opening, the container comprising a seamless first portion including a sealing surface extending around the opening, the sealing surface being intended to seal in use against a said closure, and a second portion which may include a seam or seams.

The first portion may include the opening. The first portion may have been formed by injection moulding. The second portion may have been formed by blow-moulding.

30 The container is preferably formed of plastics material, the first and second portions being integrally formed.

Viewed in a third aspect, the present embodiment provides means for forming a container as aforesaid by a process of injection moulding and blow moulding, the means comprising a floating mandrel about which a seamless first portion of the container can be injection moulded, the first portion of the container including an opening and a sealing surface extending around the opening, the sealing surface

being intended in use to seal against a releasably retainable closure for sealing the opening, and the floating mandrel being hollow to enable gas to be blown through the mandrel for blow-moulding a second portion of the container.

5 In detail Figs. 33 and 34 show a plastics container which comprises a neck 910 integrally joined to a body 912. The neck is of generally circular section, and includes an upper region 910a comprising an opening 914 over which a secondary sealing web (not shown) may be secured, an upper
10 shoulder 915, and a slightly tapered sealing surface 916 extending around the neck below the shoulder 915.

The neck also includes a lower region 910b which includes a screw thread 918, a projecting collar 919 and a waist region 921 under the collar 919 which is adapted to
15 retain a tamper-evident ring (not shown). The neck is intended to receive a closure (not shown) which can be threadedly retained by the screw thread 918. The sealing surface 916 is intended to form an interference fit seal with a corresponding sealing surface (not shown) within the
20 closure. The upper region on 910a of the neck 910 forms a first portion of the container which is of seamless construction, and in particular the sealing surface 916 is seamless. The lower region 910b of the neck 910 includes a seam 920 running axially down two opposite sides of the
25 neck. As described below, the seam 920 is a result of the blow-moulding process used to form the body 912 and the lower region 910b of the neck. In Fig. 33, the position of the seam 920 is also denoted by the broken line visible through the opening 914.

30 The body 912 is of generally rectangular section, and includes the seam 920, running down diagonally opposite corners of the body 912 and across the base of the body (not shown). The lower region 910b of the neck 910 and the body 912 together form a second portion of the container which,
35 in this exemplary embodiment, is produced with a seam 920.

The profile of the container neck is thus very similar to the embodiments described hereinbefore in relation to the tamper-evident ring feature, the square-section thread

feature, the inclined sealing surface feature, and the sealing web feature. The neck is suitable for receiving a closure having features described in PCT/GB91/00850 and/or with a child-resistant feature and/or fitted with a tamper-evident ring.

Referring to Fig. 35, the upper region 910a of the neck 910 of the container is formed by injection moulding plastics material around a hollow floating mandrel 922. (For clarity, the outer mould part used in the injection moulding process is not shown in Fig. 35). The floating mandrel 922 defines the opening 914 of the neck 910. Adjacent the end of the mandrel 922 a "bung" 923 of plastics material is formed extending across the wall of the neck 910. It is from this bung 923 of material that remainder of the neck 910 and the body 912 will be formed.

Referring to Fig. 36, the remainder of the neck 910 and the body 912 of the container are formed by inserting the floating mandrel into the mouth of a blow-mould 924a, 924b and blowing hot air through the centre of the floating mandrel (as depicted by the arrow 926) to blow the material of the bung 923 outwardly against the surfaces of the mould 924a, 924b. The mould is made in two separable halves 924a and 924b to facilitate removal of the mould once the body 912 has been formed.

The seam 920 is formed as a consequence of the imperfect fitting together of the mould halves 924a and 924b which inevitably occurs when the plastics material is blown forcibly against the surfaces of the mould. The seam 920 may be in the form of a slightly projecting ridge corresponding to the join line of the mould halves 924a and 924b, or it may be a slight step in the surface of the plastics material at the join line.

It will be appreciated that with the construction of the container as described in this embodiment, the upper region of the neck 910 and in particular the sealing surface 916 are produced without a seam which might otherwise interfere with the sealability of the container when the closure is screwed onto the neck 910. On the other hand, the remainder

of the container is produced by a process which is more suitable to forming an elaborate external profile.

In the present exemplary embodiment, the closure (not shown) is intended to be attachable to the thread 18 of the neck by limited rotation through about 90° or less, between a fully open and a fully closed position. With such an embodiment, it is important that a reliable seal be formed after the closure has been rotated through only about 90°. The present invention enables perfectly fitting sealing surfaces (916) to be provided to accomplish this despite the limited available movement of the closure.

Although in the preferred embodiment, the container is formed of plastics material, it will be appreciated that the other mouldable materials could be used instead.

In the preferred embodiment as shown in the drawings, the inner surface of the neck 910 diverges away from the opening 914. The floating mandrel 922 has a flared "cone" shape to define such an inner surface of the neck 910. The mandrel can be extracted from the neck 910 through the opening 914 by relying on the expandability and resilience of the plastics material to return the neck 910 to its intended moulded shape.

Fig. 37

In addition to any of the embodiments described above, the container may be provided with an optional insert which can be fitted through the neck of the container. The insert reduces the available capacity of the container. This is useful when the container is required to hold only a relatively small volume of contents, but allows the same container shape to be used for easy opening and other features described above. The container may, for example, be of rectangular section to enable a person to grip the container body easily. Details of an insert are described, for example, in PCT/US91/00850.

The embodiment in Fig. 37 illustrates independently an optional insert or liner for the container.

This embodiment provides a container comprising a container portion of a first cross sectional area and a neck of a second cross-sectional area less than the first cross sectional area, and an open tubular liner of less capacity than the container and capable of insertion into the container through the neck whereby the container can be used with the full container capacity or with a reduced capacity of the liner.

10

This embodiment enables the same container size to be used for a number of reduced capacities of contents. The embodiment is particularly useful when the container comprises features described hereinbefore for easy-opening of the container for elderly or handicapped people. The exterior shape of the container preferably enables the container to be gripped easily. For example it may be polygonal in section, e.g. rectangular or square. The size of the container preferably enables it to be held easily by hand. By using the liner of the present embodiment, this container body can be used to contain smaller volume of contents than the full capacity of the container. This might be desirable, for example, for tablets or other medicaments.

25

Therefore, this embodiment appreciates that while it might be desirable to use a relatively large container for easy opening, the capacity of such a container may be inappropriate for small quantity contents.

30

The liner also does not interfere with features described hereinbefore, such as a removable sealing web, and sealing surfaces of the container and its closure.

35

Preferably, the liner is cylindrical in shape and forms a tight fit or a seal with the inner surface of the container neck. The liner may be open at both ends and extend to the bottom of the container. Alternatively, the

liner may include a base wall. This latter design enables different lengths, or sizes, of liner to be provided which enable different capacities to be achieved using the same container body.

5 The liner is preferably held in place in the container to prevent the liner from coming out accidentally. This may be achieved by a friction fit in the neck. Alternatively, the liner may have a projection such as an annular bead or flange on its outer surface which forms a snap fit into a
10 corresponding recess on the neck, or a snap fit behind a corresponding projection, for example a bead, on the neck.

 The liner is open at its end adjacent the container neck and relies on sealing features of the container and its closure when the container is to be closed. This is
15 particularly advantageous the container and the closure include other features of this invention as described hereinbefore.

 In detail, Fig. 37 illustrates a container 950 having
20 a neck 952 and a body 954. The neck 952 is cylindrical in section and is of smaller cross-section than the body 954 which is of rectangular section. The container neck includes a four-start square section thread 956, a tapered sealing surface 958 and is sealed by a removable sealing web
25 960. The neck also includes stop means projections 962 and a portion 964 adapted to receive a tamper evident ring (not shown). The neck is intended to be sealed by means of a closure (not shown) which may be as illustrated in any of the previous embodiments.

30

 As illustrated in phantom, the container includes a liner or insert in the form of a tubular sleeve 966 which is inserted through the container neck. The liner 966 is cylindrical to seal against the inner surface of the neck.
35 In one form, the liner has a base 968 to provide a container of volume less than the full capacity of the body 954. In this way, the container 10 can be used to contain different volumes, and the sleeve volume can be different, for

example, by making the sleeve in different lengths. In an alternative form, as denoted by the numeral 970, the liner may be open at both ends and extend to the bottom of the body 954 of the container. The liner may be secured in
5 place by co-operating profiles or projections (not shown) on the outer surface of the liner and the inner surface of the neck.

A small annular groove or recess (not shown) may be
10 formed in the outer surface of the rim of the neck 954, almost immediately adjacent the open end of the neck 954 sealed by the sealing web 960, to provide a drip proof rim for the neck. Alternatively, the upstanding portion 972 of the rim of the neck immediately adjacent to its open end may
15 itself form a drip-proof rim. The angle between the portion 972 and the tapered portion of the neck acts to collect any drips. The portion 972 may be modified to be inclined outwardly towards the open end to enhance the drip-proof feature of the rim.

20

It will be appreciated that the present invention in various aspects has been described above merely by way of example, and that modifications may be made within the spirit and scope of the invention. The descriptions of the
25 embodiments are not to be taken as limiting the possible combinations of features of the invention, all such possible combinations being envisaged in this application.

Although various features of the invention may be used independently, particular advantages may be achieved by
30 combining two or more of the features.

CLAIMS

1. A container closure assembly comprising:
 - a container neck having a radially outer sealing surface and a lip with an outer lip surface;
 - a container closure having an inner closure surface, said closure including a skirt portion having a radially inner sealing surface adapted to seal against said radially outer sealing surface of said container neck;
 - means for securing said closure on said container neck, said means for securing being separate from said radially inner sealing surface of said skirt portion and from said radially outer sealing surface of said container neck; and
 - wherein, when said closure is engaged with and sealed to said container neck, a clearance exists between said outer lip surface and said inner closure surface.
2. A container closure assembly comprising:
 - a container neck having a radially outer sealing surface;
 - a container closure including a skirt portion having a radially inner surface adapted to seal against said radially outer sealing surface of said container neck; and
 - a thread for securing said closure on said container neck, said thread being separate from said radially inner sealing surface of said closure and from said radially outer sealing surface of said neck.
3. An assembly according to claim 2, wherein said container neck includes a lip with an outer lip surface and said closure includes an inner closure surface, wherein, when said closure is engaged with and sealed to said container neck, a clearance exists between said outer lip surface and said inner closure surface.
4. An assembly according to claim 1 or 3 in which said lip of said container neck is provided with a recess.
5. An assembly according to claim 4 in which said recess

includes a substantially outwardly facing surface which is tapered inwardly away from the open end of the lip so as to form an overhanging rim.

6. An assembly according to claim 5 in which the container neck has a longitudinal axis and the inclination of the tapered recess surface is about 20 degrees to the longitudinal axis.

7. An assembly according to any preceding claim wherein said container neck is sealed with a sealing web.

8. An assembly according to claim 7 in which said sealing web is a foil seal.

9. An assembly according to any preceding claim in which said container neck includes an outwardly tapered portion and said radially inner surface of said skirt portion of said closure is adapted form an interference fit with that tapered portion.

10. An assembly according to claim 9 in which said skirt portion of said closure includes an inwardly tapered surface so as to correspond to the tapered neck.

11. An assembly according to claim 1 wherein said means for retaining comprise an inwardly facing deformable projection on said skirt portion of said closure, said projection being adapted to engage a complementary outwardly facing projection on the container neck.

12. An assembly according to claim 11 in which at least one of said projections comprises an outstanding bead.

13. A container closure assembly, comprising:
a container neck having a lip;
a sealing web sealed to said lip, at least a portion of an edge of said sealing web projecting radially beyond said

lip to provide a projecting edge to facilitate removal of said sealing web; and

a container closure securable in a closed position on said container neck, the arrangement being such that when said closure is secured to said container neck a clearance exists at all points between said closure and said sealing web.

14. An assembly according to claim 13, wherein at least a circumferential portion of an outer edge of said lip is cut away under said sealing web to provide said projecting edge of said sealing web to facilitate its removal.

15. An assembly according to claim 14 in which said sealing web is at most coextensive with said lip of the neck.

16. An assembly according to claim 13, 14 or 15 wherein said circumferential portion is chamfered.

17. A container closure assembly comprising:

a container neck having a tapered outer sealing surface and a lip with an outer lip surface;

a container closure having an inner closure surface, said closure including a skirt portion having an inner sealing surface adapted to form an interference fit seal with said tapered outer sealing surface of said container neck; and

means for securing said closure on said container neck, wherein, when said closure is engaged with and sealed to said container neck, a clearance exists between said outer lip surface and said inner closure surface.

18. An assembly according to claim 17, in which said skirt portion of said closure includes an inwardly tapered surface to correspond to the tapered neck.

19. An assembly according to claim 39 in which said means for securing said closure on said container neck is separate

from said inner sealing surface of said skirt portion and from said outer sealing surface of said container neck.

20. A container closure assembly comprising:

- a container neck having a tapered outer sealing surface;
- a container closure including a skirt portion having an inner sealing surface adapted to form an interference fit seal with said tapered outer sealing surface of said container neck; and

- a thread for retaining said closure on said container neck.

21. An assembly according to claim 20 in which said skirt portion of said closure includes an inwardly tapered surface to correspond to the tapered neck.

22. An assembly according to claim 20 or 21, in which said thread for retaining said closure on said container neck is separate from said inner sealing surface of said closure and from said outer sealing surface of said neck.

23. A container closure assembly comprising:

- a container neck having a radially outer neck surface and a lip with an outer lip surface;

- a container closure having an inner closure surface, said closure including a skirt portion having a radially inner surface adapted to seal against said radially outer neck surface of said container neck; and

- means for retaining said closure on said container neck, wherein, when said closure is engaged with and sealed to said container neck, a clearance exists between said outer lip surface and said inner closure surface.

24. A container closure assembly comprising:

- a container neck having a radially outer neck surface;
- a container closure including a skirt portion having a radially inner surface adapted to seal against said radially outer neck surface; and

a thread for retaining said closure on said container neck.

25. An assembly according to any of claims 9, 10 and 17 to 22, wherein at least one of the sealing surfaces is tapered at an angle of between about 1° and 45°.

26. An assembly according to claim 25, wherein said at least one of the sealing surfaces is tapered at an angle of between about 1° and 25°.

27. An assembly according to claim 26, when said at least one of the sealing surfaces is tapered at an angle of between about 4° or 5°.

28. A sealing arrangement for a container neck, the sealing arrangement comprising a semi-rigid sealing web adhered to the rim of the neck, an edge of the web extending outwardly beyond the rim to facilitate removal of the web in a peel-off manner.

29. A sealing arrangement for a container neck, the sealing arrangement comprising a relatively rigid sealing web adhered to the rim of the neck, an edge of the web extending outwardly beyond the rim to facilitate removal of the web in a flip-off manner.

30. A sealing arrangement according to claim 28 or 29, wherein the web comprises a metallic foil to facilitate induction welding.

31. A sealing arrangement according to claim 28, 29 or 30 wherein the web comprises an uppermost layer of paper or card.

32. A sealing arrangement according to any of claims 28 to 31, wherein the edge of the sealing web projects beyond the rim around the entire periphery of the rim.

33. A sealing arrangement according to claim 32, wherein the rim is chamfered under the sealing web to provide a recess.

34. A sealing arrangement comprising a container neck with a rim, a sealing web adhered thereto, and means for providing colouring on the rim of the neck visible once the sealing web is removed, whereby an indication of the rim can be given that the sealing web has been removed.

35. A sealing arrangement according to claim 34, wherein the means for providing colouring comprises means for providing a coloured residue on the rim visible once the sealing web has been removed.

36. A sealing arrangement according to claim 35, wherein the means for providing the coloured residue comprises coloured adhesive used for securing the sealing web to the rim.

37. A sealing arrangement according to any of claims 28 to 33, and incorporating the features of any of claims 34 to 36.

38. A container closure assembly comprising a container neck, a container closure, means for securing the closure in a closed position on the neck, first sealing means on the closure adapted to seal against an outer surface of the neck when the closure is in its closed position, and second sealing means on the closure adapted to seal against an inner surface of the neck when the closure is in its closed position.

39. A container closure assembly according to claim 38, wherein the outer surface of the neck against which a seal is made comprises a circumferentially facing outer surface.

40. A container closure assembly according to claim 39, wherein the first and second sealing means from respective

seals with the container neck at positions which are substantially directly opposite each other.

41. A container closure assembly according to claim 38, 39 or 40, wherein the first sealing means comprises an inner sealing surface of a skirt portion of the closure.

42. A container closure assembly according to claim 38, 39, 40 or 41, wherein the second sealing means comprises a plug portion of the closure, which plug portion is shaped to fit inside the container neck, the circumferential surface of the plug portion being adapted to seal against the inner surface of the neck

43. A container closure assembly according to claim 41 or 42, wherein at least one of the first and second sealing means comprises a tapered surface.

44. A container closure assembly according to claim 43, wherein the angle of taper is between about 1° and 45°.

45. A container closure assembly according to claim 44, wherein the angle of taper is between about 1° and 25°.

46. A container closure assembly according to claim 45, the angle of taper is about 4° or 5°.

47. A container closure assembly according to any of claims 43 to 46, wherein a surface of the container neck is tapered to match a tapered sealing surface of the closure.

48. A container closure assembly according to any of claims 43 to 47, wherein the first sealing means and the second sealing means comprise respective surfaces which have tapers of substantially equal absolute angle.

49. A container closure assembly according to any of claims 38 to 48, wherein the closure can be moved between its fully

closed position and a fully open position by rotation through 360° or less.

50. A closure adapted to fit a container neck, the closure comprising first sealing means adapted to seal against an outer surface of the neck when the closure is in a closed position on the neck, and second sealing means adapted to seal against an inner surface of the neck when the closure is in the closed position on the neck.

51. A closure according to claim 50, wherein the first sealing means comprise an inner surface of a skirt portion of the closure.

52. A closure according to claim 48, wherein said surface of the skirt portion is tapered.

53. A closure according to claim 50, 51 or 52, wherein the second sealing means comprises a plug portion of the closure, which plug portion is shaped to fit inside a said container neck, the circumferential surface of the plug portion being adapted to seal against the inner surface of the neck.

54. A closure according to claim 53, wherein the surface of the plug portion is tapered.

55. A relevant child-resistant closure comprising a plurality of cantilever leaf springs extending obliquely from one part of the closure towards the other part of the closure, each cantilever leaf spring having a cross-section which tapers towards its free end, and the profile at the acute angle between each cantilever leaf spring and the closure part from which said spring extends being radiused.

56. A container neck and closure therefor wherein the closure moves from fully closed to a fully open position by relative rotation through less than 360°, the closure being

a relevant child-resistant closure and the number of said predetermined discrete angular ranges being such that angular displacement of the outer closure member relative to the inner closure member between adjacent positions in which the outer closure member can move to its displaced position is not greater than 45° .

57. A container neck and closure therefor as claimed in claim 56, wherein the closure moves from a fully closed to a fully open position by relative rotation of approximately 90° or less.

58. A container neck and closure therefor as claimed in claim 56 or 57, wherein said angular displacement is not greater than 25° .

59. A container neck and closure as claimed in claim 58 wherein said angular displacement is 22.5° .

60. A container neck and closure as claimed in claim 59 including castellations on the inner and outer closure parts, which castellations mate when the outer part is depressed, the closure having sixteen or more said castellations.

61. A relevant child-resistant closure comprising means for biasing rotationally the outer closure part relative to the inner closure part from each angular disposition at which the outer closure part can adopt its displaced position to a respective angular displacement at which the outer closure part cannot adopt its displaced position.

62. A closure as claimed in claim 61 wherein the biasing means exert a torque which is greater in absolute value than any frictional torque resisting relative rotation of the closure parts.

63. A closure as claimed in claim 61 or 62 wherein at no

time can the closure of the invention be left in a condition at which immediate movement of the outer closure part from its rest position to its displaced position is possible.

64. A closure as claimed in claim 61, 62 or 63, wherein the means to rotate the inner closure part with the outer closure part comprises a ratchet mechanism which restricts rotation of the outer closure part relative to the inner closure part in the said one sense, but permits such rotation in the said other sense.

65. A closure as claimed in claim 64 wherein the rotational biasing means comprises the ratchet mechanism.

66. A container and closure wherein the container neck and the container closure have fully engaging thread profiles to prevent play between the container and the closure and ensure axial movement of the closure on the container.

67. A container and closure therefor as claimed in claim 66 wherein the threads are of square or rectangular section, to provide maximum stability when the threads first engage, and increasingly thereafter.

68. A container and closure therefor as claimed in claim 66 or 67, comprising four thread starts.

69. A container and closure therefor wherein the closure and container includes means for retaining the closure in a closed position on the container neck, the closure being a relevant child-resistant closure and the retaining means holding, in use, the closure in the closed position sufficiently strongly for the outer closure part to be rotatable in said other sense relative to said inner closure part when said inner part is in said rest position.

70. A container and closure therefor as claimed in claim 69 including means for ensuring that the closure closes in the

same position, every time of closure.

71. A container and closure therefor as claimed in claim 69 or 70, wherein the retaining means comprise stop elements on one of the container neck and closure, and rib or projection means on the other of the neck and closure, the rib and projection means being engageable with the stop means such that the child-resistant closure mechanism operates effectively but that the closure can be released, once the closure outer part is moved to the displaced position, by application of a predictable torque.

72. A container and closure therefor as defined in claim 69, 70 or 71, further comprising a tamper-evident ring.

73. A container and closure therefor, wherein the closure is a relevant child-resistant closure comprising a tamper-evident ring, the closure being movable from a fully open to a fully closed position on the container neck by relative rotation through 360° or less.

74. A container neck and closure therefor, the closure being a said relevant child-resistant closure, the number of said predetermined discrete angular ranges being such that angular displacement of the outer closure part relative to the inner closure part between adjacent positions in which the outer closure part can move to its displaced position is 45° or less, the closure including means for biasing rotationally the outer closure part relative to the inner closure part away from each angular position at which the outer closure part can move to its displaced position.

75. A container neck and closure according to claim 74, including castellations on the inner and outer closure parts, which castellations define the angular positions at which the outer part can move to its displaced position, and further including ratchet means between the inner and outer closure parts, which ratchet means forms the rotational

biassing means.

76. A container neck and closure, the closure being a said relevant child-resistant closure, the closure having an upstanding diametric handle, the number of said predetermined discrete angular ranges being such that the angular displacement of the outer closure part relative to the inner closure part between adjacent positions in which the outer closure part can move to its displaced position is not greater than about 22.5° , and thereafter the closure can be moved from a fully closed to a fully open position by relative rotation of approximately 90° or less.

77. A container neck and closure, the closure being a said relevant child-resistant closure, the neck and closure having a tamper-evident ring, and the closure having an upstanding diametric handle, in use, to enable a user to better grip the closure to apply a torque to break the tamper-evident ring.

78. A container neck and closure, the closure being a said relevant child-resistant closure, the container and closure having fully engaging thread profiles to prevent play between the container and closure and ensure axial movement of the closure on the container, the closure being movable from a fully opened to a fully closed position by relative rotation of approximately 90° or less, and the container and closure further comprising retaining means for retaining the closure in the closed position.

79. A relevant child-resistant closure, comprising at least two cantilever leaf springs extending obliquely from one of the inner and outer closure parts towards the other of the parts, each said leaf spring having a cross-section which tapers towards its free end, said other part having a number of angularly spaced ratchet ramps against which leaf springs bear to restrict rotation of the outer closure part relative to the inner closure part in the said one sense, but to

permit such rotation in said other sense.

80. A closure according to claim 79, wherein there are sixteen ratchet ramps or more.

81. A container neck and closure therefor, the closure being a said relevant child-resistant closure, wherein the angular positions at which the outer closure part can move to its displaced position are defined by castellations on each of the inner and outer closure parts, there being sixteen or more equally angularly spaced castellations on at least one of the inner and outer closure parts, which castellations mate when the outer closure part is depressed, the closure further comprising resiliently biased ratchet means for biasing the inner and outer closure parts apart and for restricting rotation of the outer closure part relative to the inner closure part in the said one sense, but permitting such rotation in the other sense when said castellations are not engaged, said ratchet means further biasing said outer closure part in a rotational direction away from said angular positions at which the outer closure part can move to its displaced position, in use, said closure being movable from a fully open to a fully closed position by relative rotation of approximately 360° or less, and said container neck and closure further comprising retaining means for holding, in use, the closure in the closed position sufficiently strongly for the outer closure part to be rotatable in said other sense relative to said inner closure part when said inner part is in said rest position.

82. A container neck and closure therefor according to claim 81, wherein the closure is movable from fully open to a fully closed position by relative rotation of approximately 90° or less.

83. A child-resistant closure for a container neck, the closure comprising upstanding handle means to provide a wall or surface arranged to facilitate removal of the closure

from a container neck.

84. A closure according to claim 83, wherein the closure is a relevant child-resistant closure.

85. A closure according to claim 83 or 84, wherein the closure is fitted with a tamper-evident ring.

86. A closure fitted with a tamper-evident ring, the closure comprising upstanding handle means to provide a wall or surface arranged to facilitate application of an opening torque to the closure to separate the tamper-evident ring from the closure.

87. A closure for a container neck, the closure being securable threadedly to a said container neck by relative rotation through about 180° or less, the closure comprising upstanding handle means to provide a wall or surface arranged to facilitate application or removal of the closure to or from the container neck.

88. A closure according to claim 87, wherein the closure is securable to a said neck by relative rotation through about 90° or less.

89. A closure according to any of claims 83 to 88, wherein the handle means comprises one or more flanges.

90. A closure according to claim 89 wherein the one or more flanges projects or project from the closure in a direction parallel to the rotational axis of the closure.

91. A closure according to claim 89, wherein the handle means comprises an upstanding diametric flange.

92. A closure according to any of claims 83 to 91, wherein the closure comprises a substantially flat surface extending adjacent either side of the handle means.

93. A container closure assembly comprising a container neck and a closure therefor, the closure being as claimed in any of claims 83 to 92.

94. An assembly comprising a container neck and a closure therefor, complementary threads on the container neck and the closure, means for positively defining a closed position of the closure on the container neck, retaining means for holding the closure, in use, in the closed position, the closure being movable between the closed position and an opened position by relative rotation through approximately 90 degrees or less, and the assembly further comprising means for preventing the closure from being overtightened substantially beyond the closed position.

95. An assembly according to claim 94, wherein the means for defining the closed position produces a detectable "click" effect when the closed position is reached.

96. An assembly according to claim 94 or 95, wherein the retaining means retains the closure, in use, in the closed position until a predetermined release torque is applied between the closure and the container neck.

97. An assembly according to claim 94, 95 or 96, wherein the closure is a relevant child-resistant closure.

98. An assembly according to claim 94, 95, 96 or 97, wherein the means for defining the closed position and the retaining means together comprise one or more projections on the container neck and on the closure, the projections engaging as the closed position is reached.

99. An assembly according to claim 98, wherein at least one of the projections is profiled to have a circumferential ramp surface over which the other projection can ride easily as the closure means nears the closed position, and an

abutment surface against which the other projection bears when the closure is to be unscrewed from the closed position.

100. An assembly according to any of claims 94 to 99, wherein the container neck and the closure comprise complementary sealing surfaces for forming a seal when the closure is in its closed position on the container neck.

101. An assembly according to claim 100, wherein the complementary sealing surfaces constitute the means for preventing the closure from being overtightened substantially beyond the closed position.

102. An assembly according to claim 98 or 99, wherein the means for preventing the closure from being overtightened substantially beyond the closed position comprise one or more stop projections on the container neck which engage one or more projections on the closure.

103. An assembly comprising a container neck and a closure therefor, complementary threads on the container neck and the closure, means for positively defining a closed position of the closure on the container neck, the closure having a skirt portion an inner surface of which is adapted to seal, in use, against an outer surface of the container neck when the closure is screwed into the closed position, the said surfaces forming the seal co-operating to oppose overtightening of the closure substantially beyond the closed position.

104. An assembly according to claim 103, wherein the assembly also comprises means for retaining the closure in the closed position until a predetermined release torque is applied between the closure and the container neck.

105. An assembly according to claim 103 or 104, wherein the means defining the closed position and the retaining means

together comprise one or more projections on the container neck and on the closure, the projections engaging as the closed position is reached.

106. An assembly comprising a container neck and a closure therefor, complementary threads on the container neck and the closure, means for positively defining a closed position of the closure on the container neck, complementary sealing surfaces on the container neck and the closure for forming a seal when the closure is screwed into the closed position, the sealing surfaces being inclined relative to the longitudinal axis of the container neck whereby the sealing surfaces co-operate to oppose overtightening of the closure substantially beyond the closed position.

107. An assembly comprising a container neck and a closure therefor, complementary threads on the container neck and the closure, the closure having a skirt portion an inner surface of which is adapted to seal, in use, against an outer surface of the container neck, the assembly further comprising means for positively defining a closed position of the closure on the container neck at which position the skirt portion is adequately seated on the container neck to obtain a seal, whereby, overtightening of the closure on the container neck can be avoided.

108. An assembly comprising a container neck and a closure therefor, complementary threads on the container neck and the closure, the closure having a skirt portion an inner surface of which is adapted to seal, in use, against an outer surface of the container neck, the assembly further comprising means for defining an ultimate stop position of the closure on the container neck beyond which stop position the closure cannot be tightened further.

109. An assembly according to any of claims 94 to 108, wherein the closure is movable from a fully open to a fully closed position by relative rotation through 360° or less.

110. An assembly according to claim 109, wherein the relative rotation is 180° or less.
111. An assembly according to claim 110 wherein the relative rotation is 90° or less.
112. An assembly according to any of claims 94 to 111, wherein the closure comprises upstanding handle means.
113. An assembly comprising a container neck and a closure therefor, and a tamper evident ring, the ring being initially coupled to the closure by severable connections and being retained between the closure and the container neck to indicate that the closure has not yet been removed
5 by a user, the closure being removable by rotation through 360° or less, the arrangement being such that, in use, the connections are severed on the occasion that a user first removes the closure, the ring being subsequently movable to a position on the container neck which is clear of the
10 closure when the closure is later replaced, to indicate that the closure has been removed from the container neck at least once.
114. A container closure assembly comprising
15 a container neck;
removable closure means adapted to fit said container neck;
child-resistant means for preventing removal of the closure by a young child;
20 tamper evident ring means; and
means for substantially concealing said tamper evident ring means when said closure means is fitted to said container neck, until the occasion on which said closure means is removed from said container neck for the first
25 time, the arrangement being such that said tamper evident ring means remains substantially visible on said container neck when said closure means is replaced on said container

neck.

115. An assembly according to claim 114, wherein said means for substantially concealing comprises means on said closure means capable of concealing said tamper evident ring means, and first retaining means for retaining said tamper evident ring means concealed by said means capable of concealing, until said closure means is removed for the first time.

10 116. An assembly according to claim 115, further comprising:
second retaining means for movably retaining said tamper evident ring means on said container neck, and wherein said means for retaining comprises releasable holding means for initially holding said tamper evident ring means in a first
15 position in which it is substantially concealed by said means capable of concealing on said closure means, said holding means releasing said tamper evident ring means when said closure means is first removed from said container neck, to allow said tamper evident ring means to move into
20 a second position in which it is not substantially concealed by said means capable of concealing on said closure means when said closure means is replaced on said container neck.

117. An assembly according to claim 116, wherein said
25 releasable holding means comprises severable connections between said tamper evident ring means and said closure means, said severable connections being severed when said closure means is removed from said container neck for the first time.

30

118. An assembly according to claim 117 wherein said child resistant means and said closure means together comprise an inner closure part attachable to said container neck, an outer closure part substantially covering said inner closure
35 part, and a child resistant mechanism coupling said inner and outer closure parts, said severable connection comprising connections joining said tamper evident ring to said inner closure part, and said means capable of

concealing comprising a portion of said outer closure part.

119. An assembly according to claim 116, 117 or 118, wherein said tamper evident ring means when in said second position
5 is separated from said closure means by a distance at least equalling the axial width of said tamper evident ring means.

120. An assembly according to any of claims 114 to 119, wherein said tamper-evident ring means is slidable on a
10 portion of said container neck, and said container neck includes means for retaining said tamper evident ring means on said portion of said container neck.

121. An assembly according to any of claims 114 to 120,
15 wherein said tamper evident ring means is coloured a contrasting colour to the colour of said container neck so that said tamper evident ring means is easily discernable at a glance once said closure means has been removed for the first time.

20 122. An assembly according to claim 115 wherein said means capable of concealing on said closure means comprises a recess, or clearance, in which said tamper evident ring means is received when said tamper evident ring means is
25 substantially concealed by said closure means.

123. An assembly according to claim 122, wherein said closure means comprises a skirt portion, and said recess or clearance in said closure means is defined by said skirt
30 portion.

124. A closure assembly for a container neck, said closure assembly comprising:

closure means adapted to fit said container neck and be
35 removable therefrom;

child-resistant means for preventing removal of the closure by a young child;

tamper evident ring means; and

concealing means for substantially concealing said tamper evident ring means from view when in use on said container neck, until said closure means is first removed from said container neck.

5

125.A closure assembly according to claim 124 wherein said concealing means comprises a recess or clearance within said closure means, said recess or clearance receiving said tamper evident ring means when said tamper evident ring
10 means is substantially concealed from view.

126.A closure assembly according to claim 125 wherein said concealing means further comprises releasable holding means for initially holding said tamper evident ring means in said
15 recess or clearance until said closure means is removed from said container neck on the first occasion whereupon said holding means releases said tamper evident ring means so that it will no longer be concealed within said clearance or recess when said closure means is replaced on said container
20 neck.

127.An assembly according to claim 126, wherein said closure means and said child-resistant means together comprise an inner closure part attachable to said container neck, an
25 outer closure part substantially covering said inner closure part, and a child resistant mechanism coupling said inner and outer closure parts, said releasable holding means comprising severable connections joining said tamper evident ring to said inner closure part, and said recess of
30 clearance being defined by a portion of said outer closure part.

128.A closure assembly according to claim 125, 126 or 127 wherein said closure means comprises a skirt portion, and
35 said recess or clearance in said closure means is defined by said skirt portion.

129.A container closure assembly comprising:

a container neck;

closure means adapted to fit said container neck;

screw thread means for removably attaching said closure means to said container neck by relative rotation

5 therebetween;

tamper evident ring means adapted to be retained on said container neck, said tamper evident ring means being coupled to said closure means by severable connections;

means for substantially concealing said tamper evident ring means when said tamper evident ring means is coupled to said closure means; and

upstanding handle means on said closure for facilitating rotation of said closure by hand, to break said severable connections when said closure means is unscrewed from said container neck for the first time, the arrangement being such that said tamper evident ring means remains substantially visible on said container neck when said closure means is replaced on said container neck.

20 130.A container closure assembly according to claim 129, wherein said tamper evident ring means is slidable on a portion of said container neck, and said container neck includes means for retaining said tamper evident ring means on said portion of said container neck.

25

131.A container closure assembly according to claim 129 or 130, wherein said means for concealing comprises a recess or clearance within said closure means.

30 132.A container closure assembly according to claim 131, wherein said closure means comprises a skirt portion defining said recess or clearance.

133.A container closure assembly comprising:

35 a container neck;

removable closure means adapted to fit said container neck, said closure means including a skirt portion defining a recess or clearance;

tamper evident ring means adapted to be retained on said container neck, said tamper evident ring means being integrally formed with said closure means and joined thereto by severable integral connecting means so that said tamper
5 evident ring means is retained concealed within said recess or clearance until said closure means is removed from the container neck for the first time whereupon said tamper evident ring means becomes severed completely from said closure means, the arrangement being such that said tamper
10 evident ring means remains substantially visible on said container neck when said closure means is replaced on said container neck.

134.A container closure assembly according to claim 133,
15 wherein said tamper evident ring means is slidable on said container neck, the arrangement being such that when said tamper evident ring becomes severed from said closure means, said tamper evident ring means slides into a released position on said container neck in which said tamper evident
20 ring means is not substantially concealed when said closure is replaced on said container neck.

135.A container closure assembly according to claim 134 wherein said tamper evident ring means when in said released
25 position is separated from said closure means by a distance at least equalling the axial width of said tamper evident ring means.

136.A container closure assembly according to claim 133, 134
30 or 135 wherein said tamper evident ring means is coloured a contrasting colour to the colour of said container neck so that said tamper evident ring means is easily discernable at a glance once said closure means has been removed for the first time.

35

137.A container closure assembly comprising:

a container neck;

a closure for said container neck;

screw thread means on at least one of said closure and said container neck for retaining said closure on said container neck;

5 sealing means for forming a seal between said closure and said container neck when said closure is at a sealing position on said container neck; and

urging means co-operating between said closure and said container neck when said closure is near said sealing position for urging said closure into said sealing position
10 independently of whether an external closing torque is being applied to said closure, and thereafter for maintaining said closure in said sealing position until a sufficient external release force is applied to said closure.

15 138. The container closure assembly of Claim 137, wherein said urging means maintains a force on said sealing means when said closure is in said sealing position on said container neck.

20 139. The container closure assembly of Claim 137 or 138, wherein said urging means comprises first means on said container neck for co-operating with second means on said closure, at least one of said first and second means comprising a ramp surface against which the other of said
25 first and second means bears when said closure is near said sealing position, said ramp surface extending in a direction to urge said closure in a direction towards said sealing position.

30 140. The container closure assembly of Claim 139, wherein said first means comprises a respective urging ramp surface, and said second means comprises a respective urging ramp surface, said ramp surfaces extending in a direction to urge said closure towards its sealing position.

35 141. The container closure assembly of Claim 140, wherein said first and second means each further comprise respective lead-in ramp surfaces which bear against each other, in use,

to ease said projections over each other when the closure is being screwed towards said sealing position, before said urging ramp surfaces of said first and second means begin to bear against each other.

5

142. The container closure assembly of Claim 141, wherein at least one of said first and second means further comprises a projecting ridge formation between said respective lead-in ramp surface and urging ramp surface.

10

143. The container closure assembly of Claim 139, 140, 141 or 142, wherein said first means comprises one or more outwardly facing projections on said container neck, and said second means comprises one or more inwardly facing
15 projections on said closure.

144. The container closure assembly of Claim 143, wherein the or each said second means projection is mounted on a resilient portion of said closure, which resilient portion
20 is capable of deforming to enable said second means projection to ride over said first means projection when said closure is screwed into, or out of, said sealing position.

25 145. The container closure assembly of any of claims 137 to 144, wherein said urging means is arranged to apply a rotational urging force to said closure relative to said container neck.

30 146. The container closure assembly of any of claims 137 to 145, wherein said closure can be moved between its sealing position and a fully open position by relative rotation through 180° or less.

35 147. The container closure assembly of any of claims 137 to 146, wherein said sealing position corresponds to a closed position of said closure on said container neck.

148. A container closure assembly comprising:

a container neck;

a closure for said container neck;

5 screw thread means on at least one of said closure and said container neck for retaining said closure on said container neck;

means for forming a seal between said closure and said container neck when said closure is at a sealing position on said container neck which sealing position is within a
10 predetermined tolerance range of possible sealing positions;

urging means co-operating between said closure and said container neck when said closure is positioned anywhere within said tolerance range of possible sealing positions, for urging said closure into said sealing position
15 independently of whether on external closing torque is being applied to said closure, and thereafter for maintaining said closure in said sealing position until a sufficient external release torque is applied to said closure.

20 149. The container closure assembly of Claim 148, wherein said urging means applies a closing force to said closure when said closure is at a position near but just outside said tolerance range of possible sealing positions.

25 150. The container closure assembly of Claim 148 or 149, wherein said sealing position corresponds to a closed position of said closure on said container neck.

151. A container closure assembly comprising:

30 a container neck;

a closure for said container neck;

screw thread means on at least one of said closure and said container neck for retaining said closure on said container neck;

35 first projection means on said neck for co-operating with second projection means on said closure as said closure approaches a closed or a sealing position on said container neck; and

at least one of said projection means comprising a first ramp surface against which the other projection means bears to urge said closure towards said closed or sealing position.

5

152.A container closure assembly according to Claim 151, wherein said at least one of the projection means includes a relatively gentle lead-in ramp surface forming the opposite side of said projection means to said first ramp
10 surface.

153.A container closure assembly according to Claim 152, wherein said at least one of the projection means includes a projecting ridge formation between said ramp surfaces.

15

154.A method for forming a container having an opening which is intended to be sealable by means of a closure releasably retainable over the opening, the method comprising forming a seamless first portion of the container by a first
20 process, which first portion includes a sealing surface extending around the opening, the sealing surface being intended to seal in use against a said closure, and forming a second portion of the container by a second process, which second portion may include a seam or seams.

25

155.A method according to Claim 154, wherein the first process for forming the first portion comprises injection moulding.

30 156.A method according to Claim 154 or 155, wherein the second process for forming the second portion of the container comprises blow moulding.

157.A method according to Claim 154, 155 or 156, wherein the
35 first and second portions are integrally formed.

158.A method according to Claim 154, 155, 156 or 157, wherein the container is formed of plastics material.

159. A method according to any of claims 154 to 158, wherein the first process comprises injection moulding the first portion of the container around a hollow floating mandrel, and the second process comprises blow moulding the second portion of the container by blowing gas through the hollow floating mandrel.

160. A container having an opening intended to be sealable by means of a closure releasably retainable over the opening, the container comprising a seamless first portion including a sealing surface extending around the opening, the sealing surface being intended to seal in use against a third closure, and a second portion which may include a seam or seams.

161. A container according to claim 160, wherein the first portion has been formed by injection moulding.

162. A container according to claim 160 or 161, wherein the second portion has been formed by blow moulding.

163. A container according to claim 160, 161 or 162 wherein the first portion comprises at least the upper portion of a neck of the container.

164. A container according to claim 160, 161, 162 or 163, wherein the second portion comprises at least the majority of the body of the container.

165. Apparatus for forming a container by a process of injection moulding and blow moulding, the apparatus comprising a floating mandrel about which a seamless first portion of the container can be injection moulded, the first portion of the container including an opening and a sealing surface extending around the opening, the sealing surface being intended in use to seal against a releasably retainable closure for sealing the opening, and the floating

mandrel being hollow to enable gas to be blown through the mandrel for blow moulding a second portion of the container.

166. A container closure assembly comprising a container
5 neck, a container closure, a tamper-evident ring on or fitted to the closure, and fully engaging screw thread profiles for threadedly securing the closure to the container neck, the fully engaging screw thread profiles ensuring positive axial movement of the closure to detach
10 the tamper-evident ring when the closure is opened.

167. An assembly according to claim 166, wherein the closure is movable between a fully open and a fully closed position by relative rotation through about 360° or less.

15 168. An assembly according to claim 167, wherein the closure is movable between a fully open and a fully closed position by relative rotation through about 180° or less.

20 169. An assembly according to claim 168, wherein the closure is movable between a fully open and a fully closed position by relative rotation through about 90° or less.

170. An assembly according to claims 166, 167, 168 or 169,
25 wherein the closure comprises upstanding handle means.

171. An assembly according to any of claims 166 to 170, wherein the closure conceals the tamper evident ring until the closure is removed from the container neck for the first
30 time, after which, the closure no longer conceals the tamper evident ring when the closure is replaced on the container neck.

172. A container closure assembly according to any of claims
35 166 to 171, wherein the screw thread profiles are rectangular or square section.

173. A container closure comprising a tamper evident ring

integrally formed with at least a substantial part of the closure, the tamper evident ring being joined by one or more severable connections one or each of which comprises a relatively wide or thick portion adjacent the closure and
5 narrowing to a thin severable zone at the point where the connection joins the tamper evident ring, so that, in use, the tamper evident ring will, once detached, have a relatively smooth surface.

10 174. A container closure according to claim 173, wherein the closure conceals the severable connections when this tamper evident ring is intact with the closure.

175. A container closure according to claims 173 or 174,
15 wherein the closure conceals substantially the tamper evident ring when the tamper extent ring is intact with the closure.

176. A container neck adapted to receive a container closure
20 having a skirt portion, the container neck comprising a drip-free rim, and a sealing surface below the drip-free rim, the sealing surface being adapted to seal against the inner surface of the skirt portion of a said closure when fitted.

25 177. A container neck according to claim 176, wherein the drip-free rim comprises a radially outwardly overhanging portion of the rim.

30 178. A container neck according to claim 177, wherein the drip-free rim comprises a portion of the rim chamfered inwardly away from the open end of the neck.

179. A container neck adapted to receive a container
35 closure, the container neck comprising a drip-free rim having a sealing web adhered thereto, an edge or edges of the sealing web projecting radially proud of the rim to provide a peel-off or lift-off tab.

180. A container neck according to claim 179, wherein the drip-free rim comprises a radially outwardly overhanging portion of the rim.

5

181. A container neck according to claim 180, wherein the drip-free rim comprises a portion of the rim chamfered inwardly away from the open end of the neck.

10 182. A container closure assembly comprising a container neck, a container closure, screw thread means for removably securing the closure to the neck, first sealing means adhered over the container neck, second sealing means co-operating between the closure and the container neck for
15 forming a seal when the closure is in a closed position on the neck, tamper-evident ring means coupled between the closure and the neck, upstanding handle means on the closure, and retaining means co-operating between the closure and the neck when the closure is in its closed
20 position for retaining the closure in the closed position.

183. An assembly according to claim 182, wherein the closure is movable between a fully disengaged open position and its closed position by relative rotation through 360° or less.

25

184. An assembly according to claim 183, wherein the closure is movable between a fully disengaged open position and its closed position by relative rotation through 90° or less.

30 185. An assembly according to any of claims 182 to 184, the closure with handle means as defined in any of claims 83 to 92.

186. An assembly according to any of claims 182 to 185, the
35 closure with retaining means or with urging means, as defined in any of claims 69 to 72, 96, 104 and 137 to 153.

187. An assembly according to any of claims 182 to 186,

wherein the closure comprises a relevant child-resistant closure, as defined in any of claims 55 to 81.

188. An assembly according to any of claims 182 to 187, the
5 assembly with the second sealing means, as defined in any of claims 1 to 12 and 17 to 27.

189. An assembly according to any of claims 182 to 188, the
10 container neck with the first sealing means as defined in any of claims 13 to 16 and 28 to 37.

190. An assembly according to any of claims 182 to 189, the
assembly with the tamper-evident ring as defined in any of
claims 72, 73, 77, 85, 86, 113 to 136, and 173 to 175.

15 191. An assembly according to any of claims 182 to 190,
wherein the screw thread means comprise fully engaging screw
thread profiles, as defined in claim 66, 67 or 68, or in any
of claims 166 to 172.

20 192. An assembly according to any of claims 182 to 191,
wherein the container neck comprises a drip-free rim as
defined in any of claims 176 to 181.

25 193. An assembly according to any of claims 1 to 27, 38 to
49, 56 to 60, 66 to 78, 81 to 82, 93 to 153, 166 to 172, 182
to 192, further comprising an optional insert or liner
insertable through the container neck and having a lesser
capacity than the container, whereby the container can be
30 used with the full container capacity or with a reduced
capacity of the liner.

194. A container including features defined in any of claims
28 to 37, 160 to 164, 176 to 181, further comprising an
35 optional insert or liner insertable through the container
neck and having a lesser capacity than the container,
whereby the container can be used with the full container
capacity or with a reduced capacity of the liner.

195. An assembly according to claim 143, wherein the container neck carries two projections, and the closure carries four projections, the closure being securable to the container neck by means of a screw thread which has four or more starts.

196. An assembly according to any of claims 137 to 153, and 195, wherein the sealing means comprise a tapered sealing surface one of the neck and the closure and a complementary sealing surface on the outer of the neck and the closure.

197. A container closure assembly comprising a container neck and a closure therefor, screw thread means for securing the closure on the neck, respective sealing surfaces on the neck and the closure for forming a seal between the neck and the closure when the closure is in a sealing position on the neck, and means for automatically holding the closure in the sealing position to hold the sealing surfaces in engagement.

198. An assembly according to claim 197, wherein the sealing surfaces provide a liquid-tight seal.

199. An assembly according to claim 197 or 198, wherein the sealing surfaces provide an air-tight seal.

200. An assembly according to claim 197, 198 or 199, wherein the closure is movable between a fully disengaged position and the sealing position by rotation through about 90° or less.

201. A container closure assembly comprising a container neck and a closure therefor, a semi-rigid or a relatively rigid sealing web adhered to the rim of the neck, an edge of the web projecting radially proud of the rim of the neck, the arrangement being such that the closure when fitted to the neck does not interfere with the radially projecting edge of

the neck.

202.A container closure assembly as claimed in claim 201,
wherein the neck comprises a sealing surface for forming a
5 seal with a corresponding surface of the closure when the
closure is fitted to the neck.

1/22

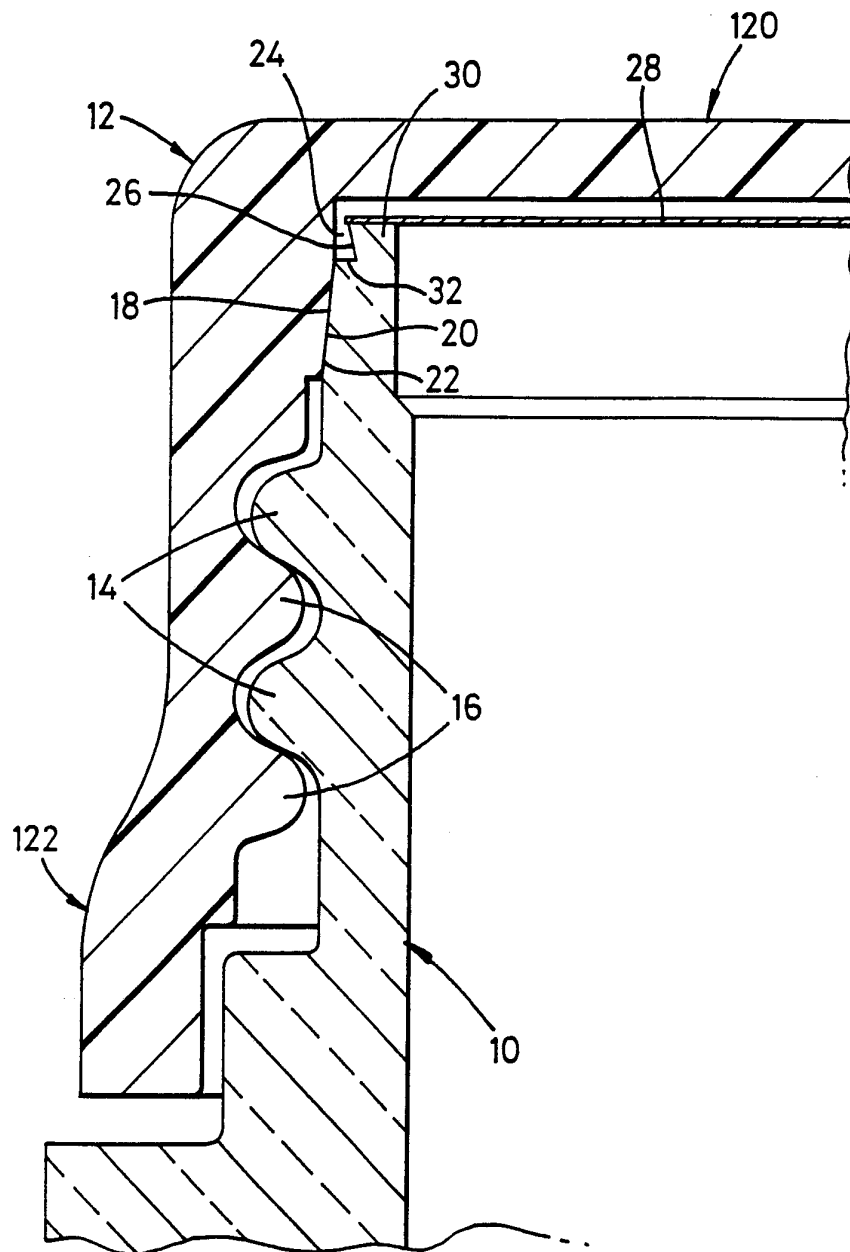


Fig. 1

2/22

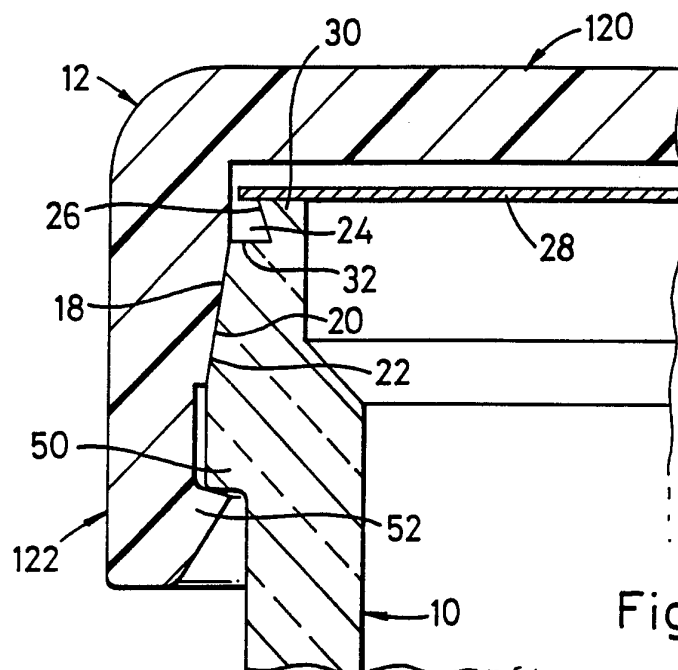


Fig. 2

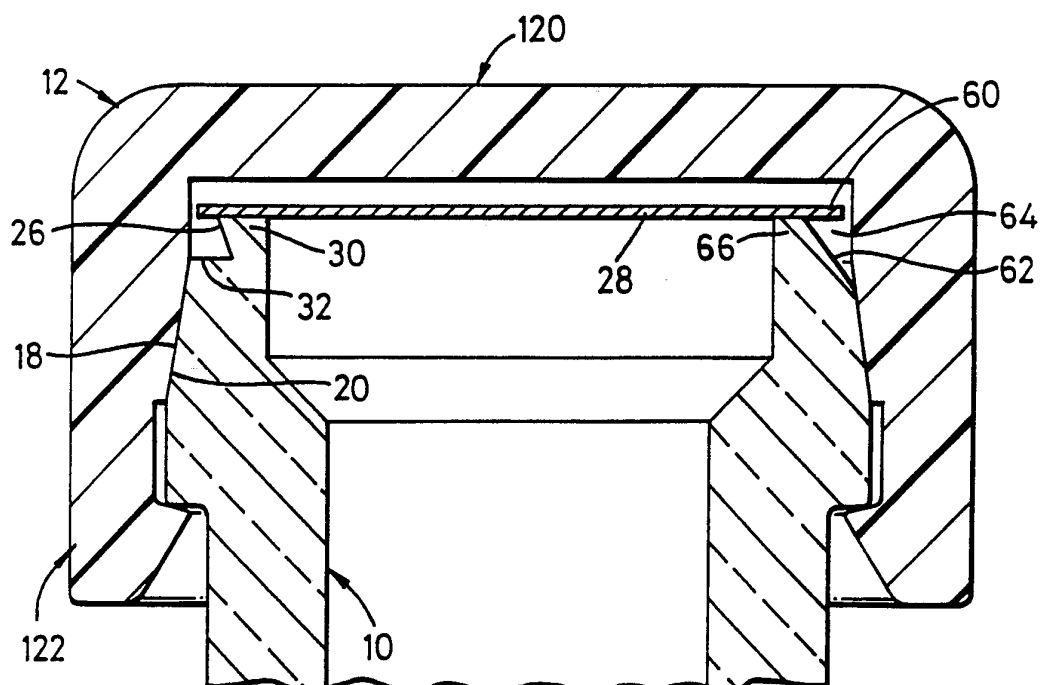


Fig. 3

3/22

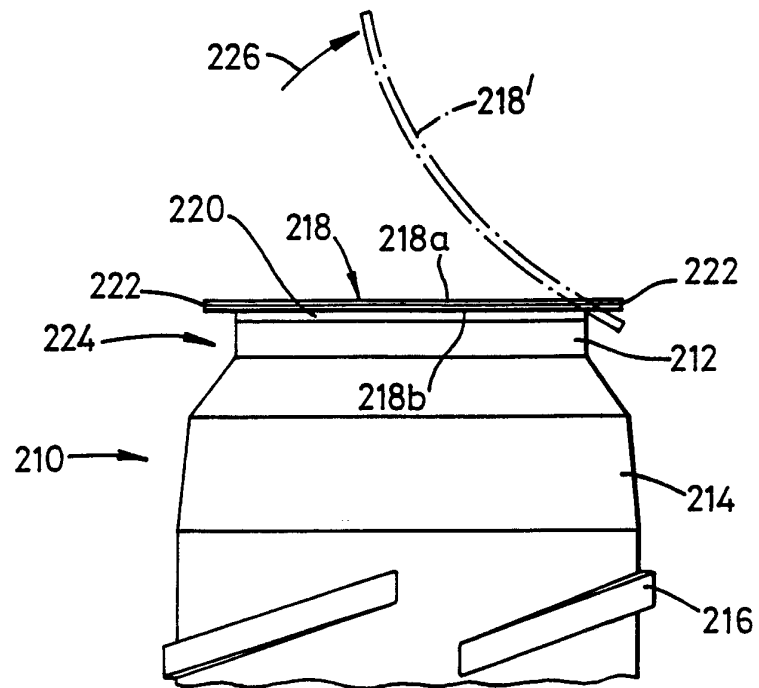
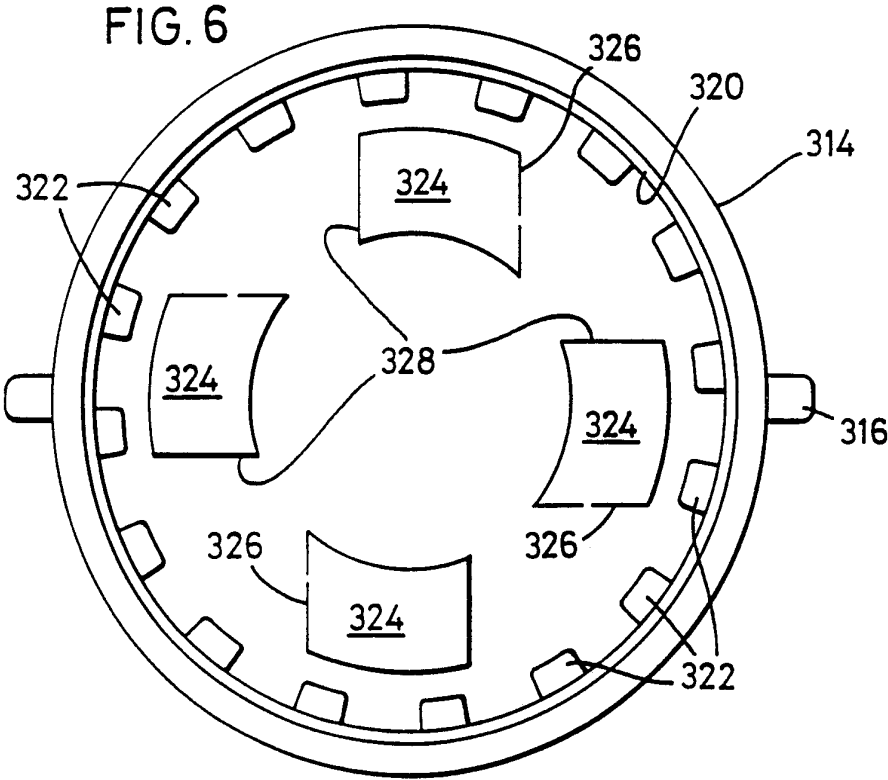
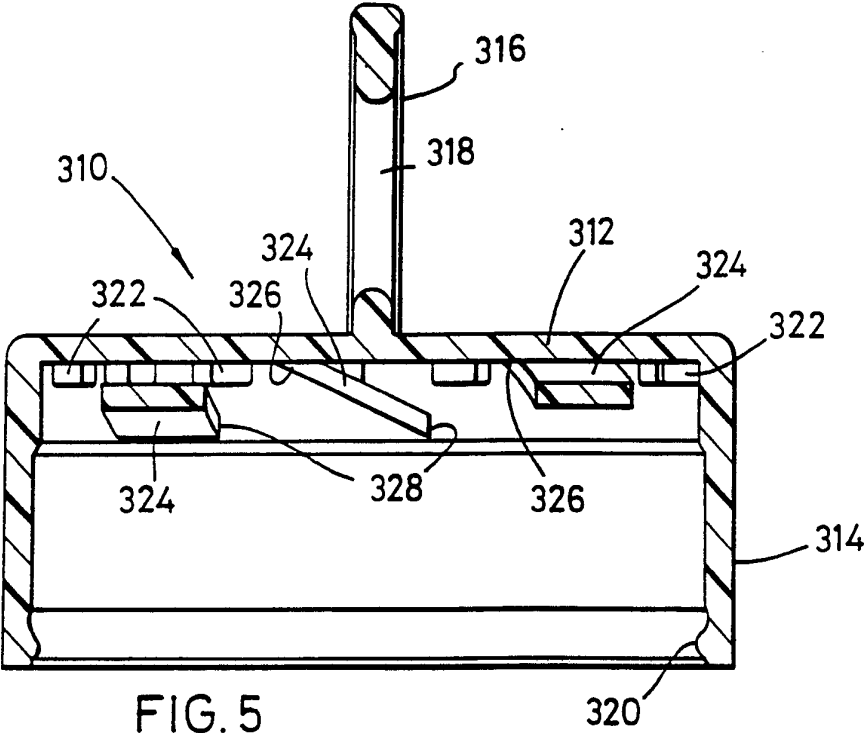


FIG. 4

4/22



5/22

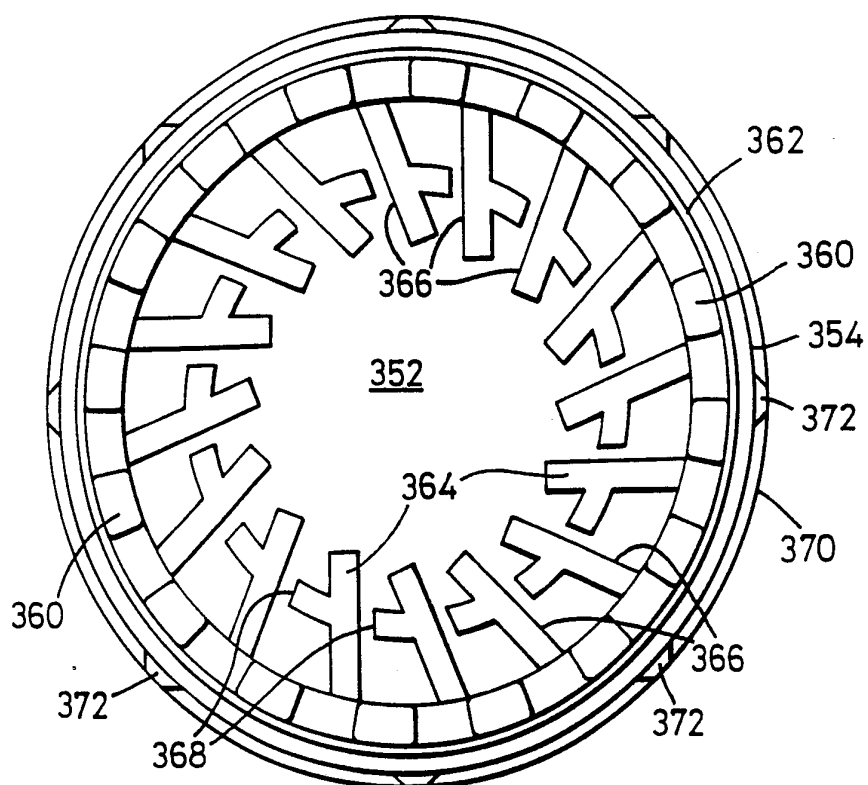


FIG. 7

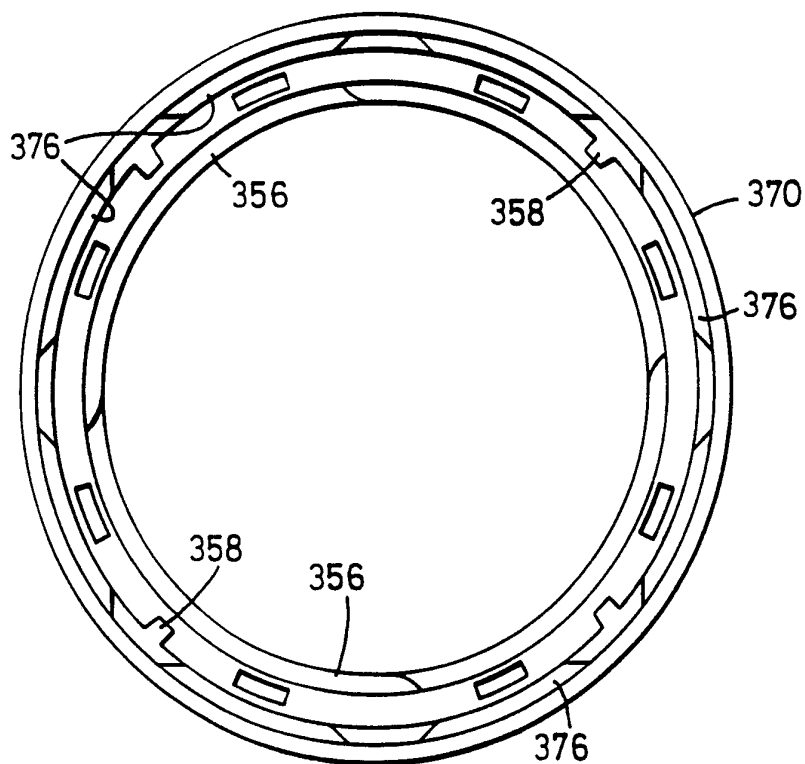


FIG. 8

6/22

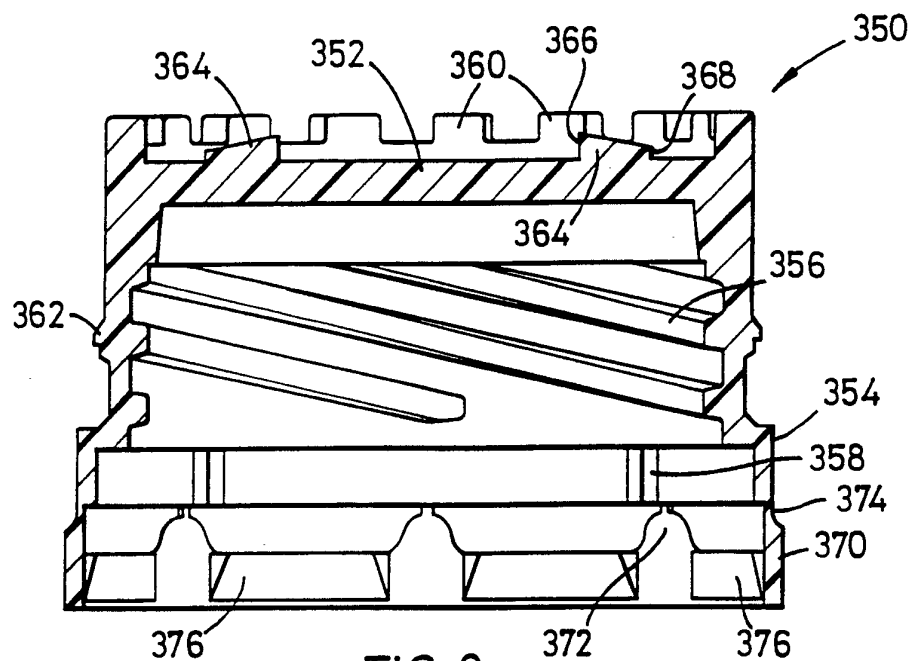


FIG. 9

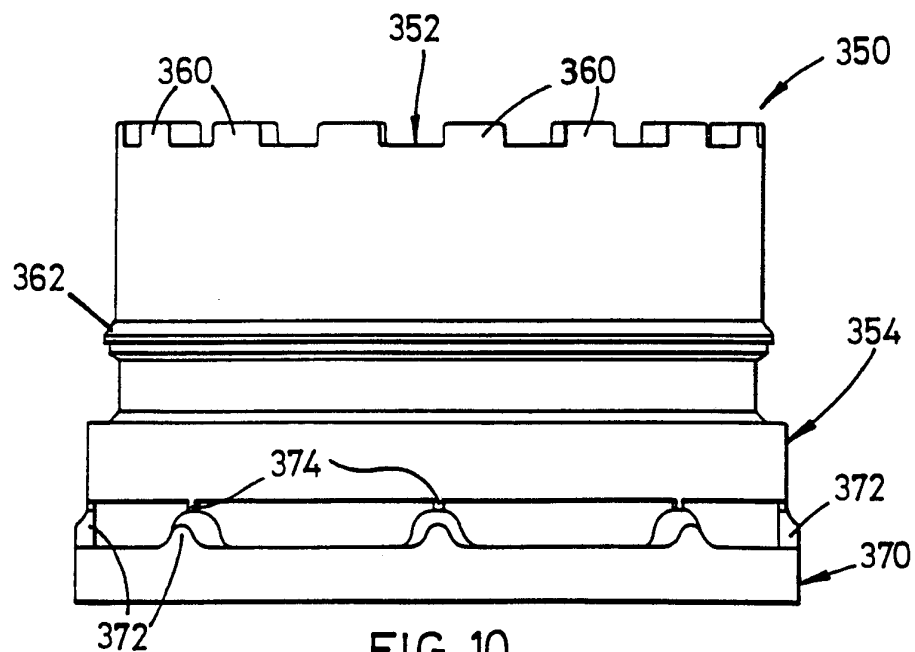


FIG. 10

7/22

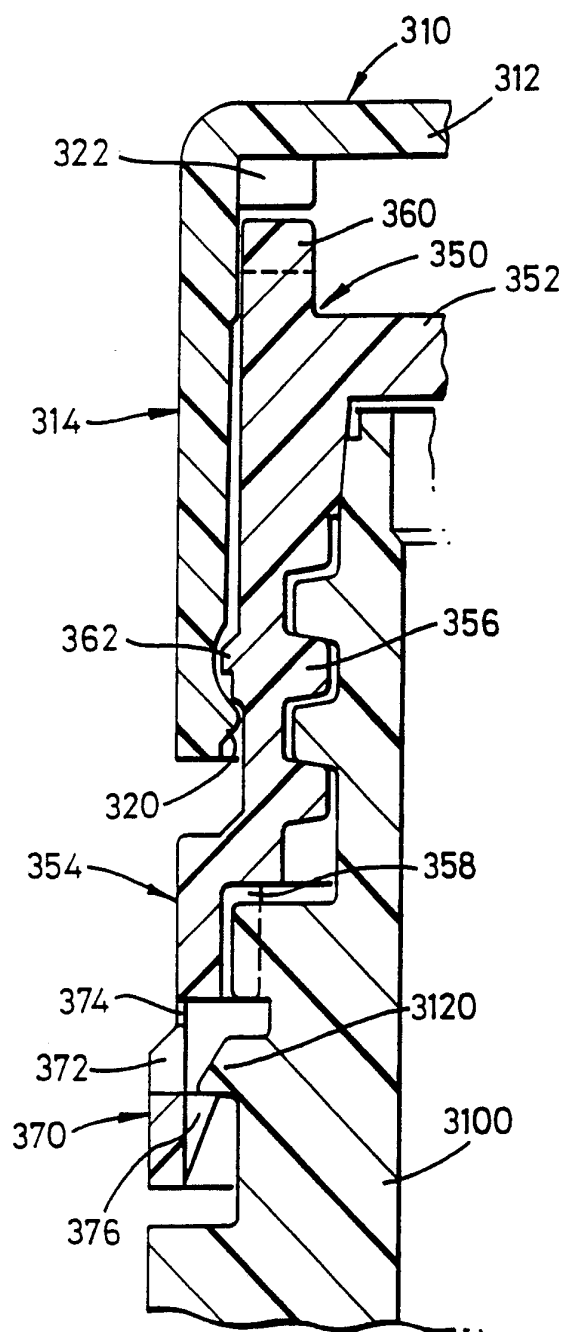


FIG.11

8/22

FIG.12

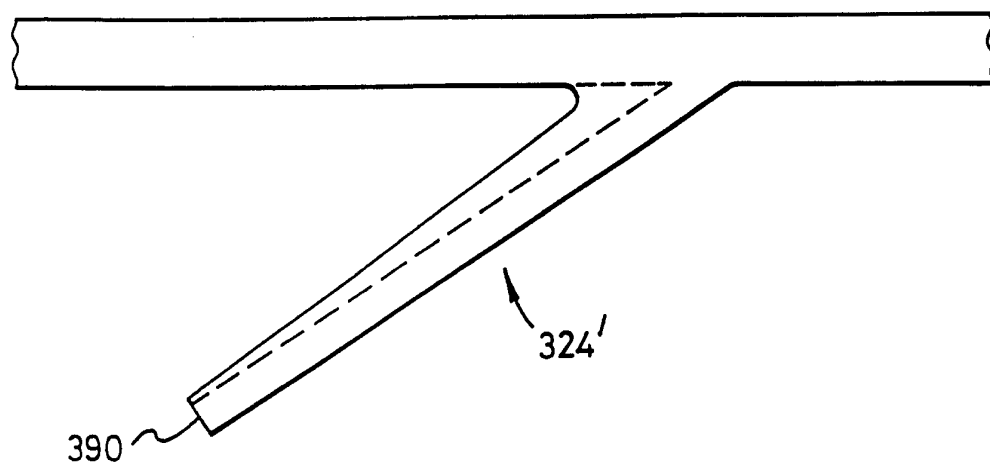


FIG. 13

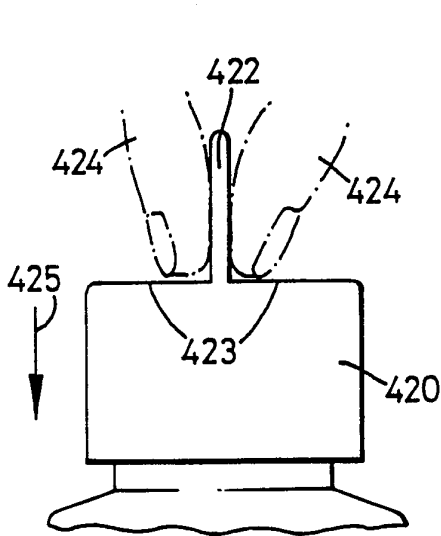
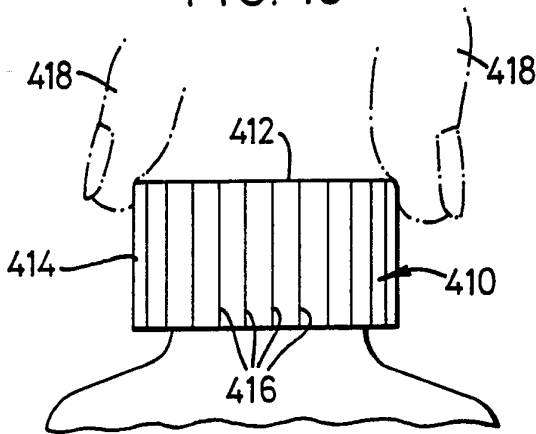


FIG. 14

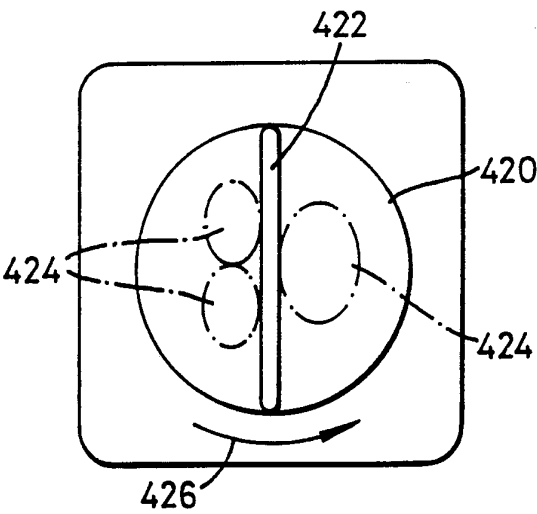


FIG. 15

10/22

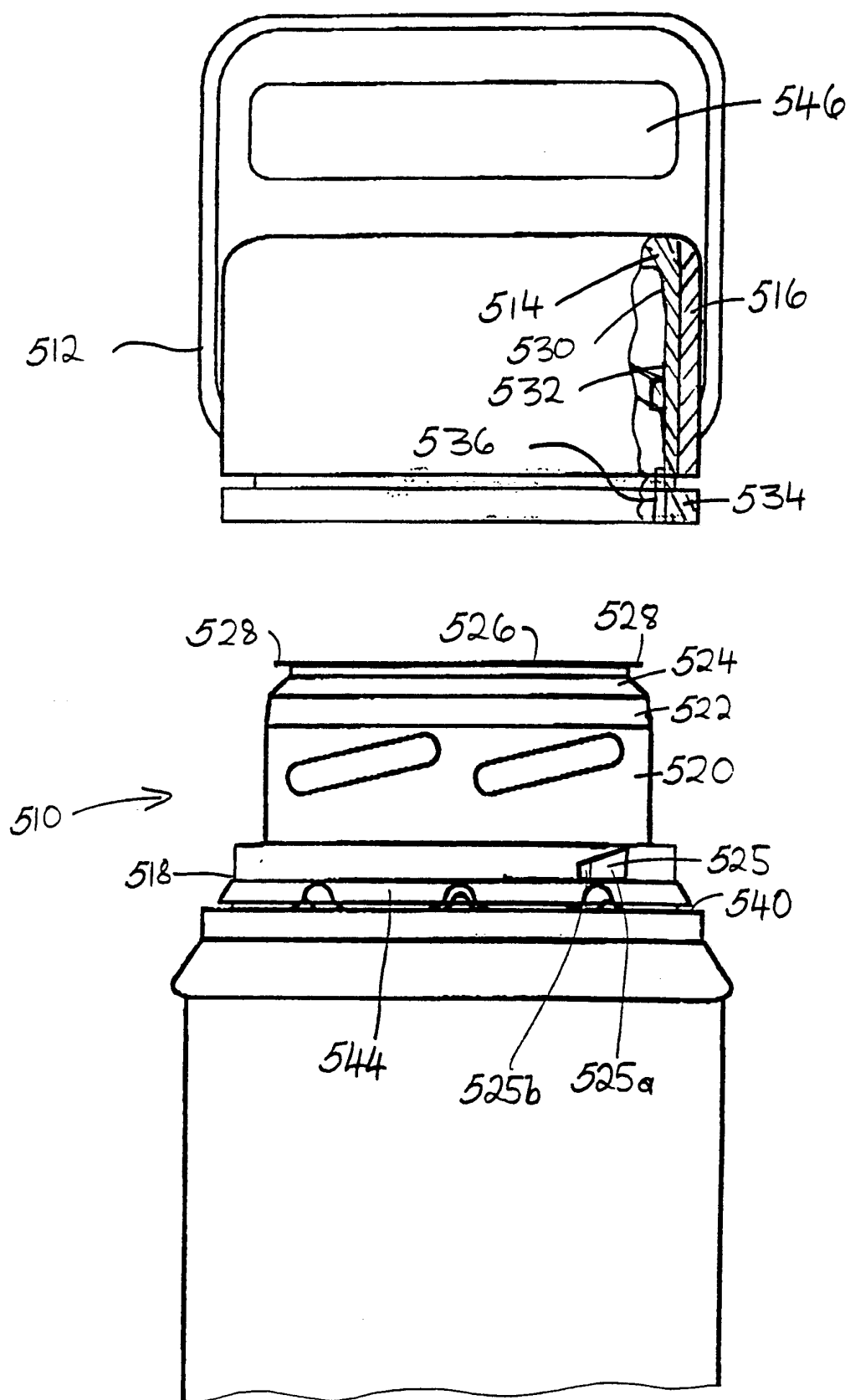


FIG. 16

11/22

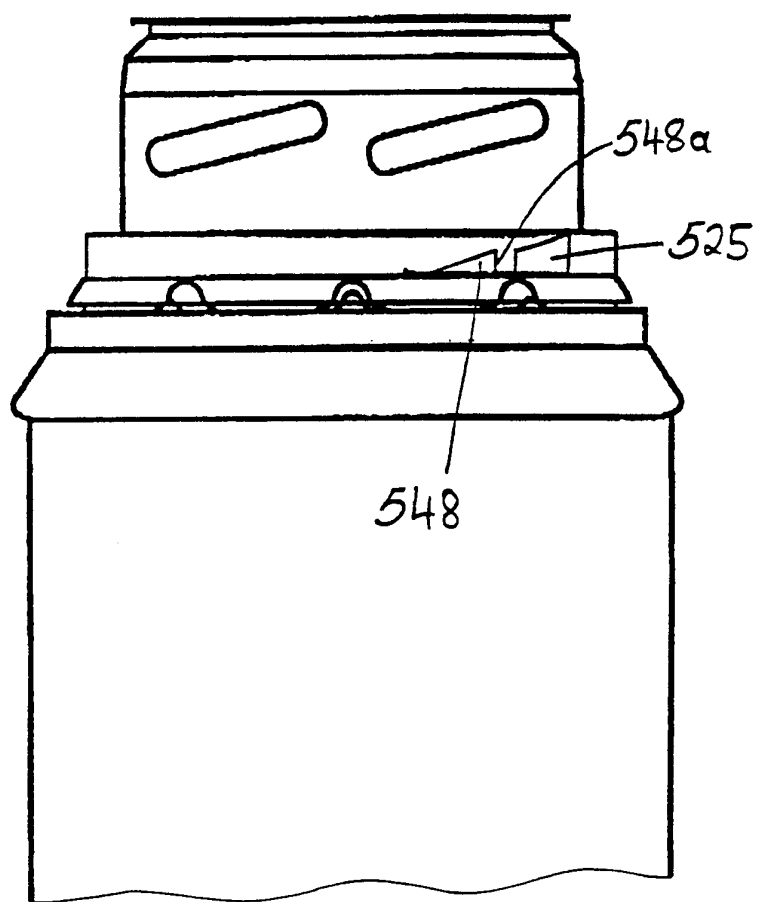
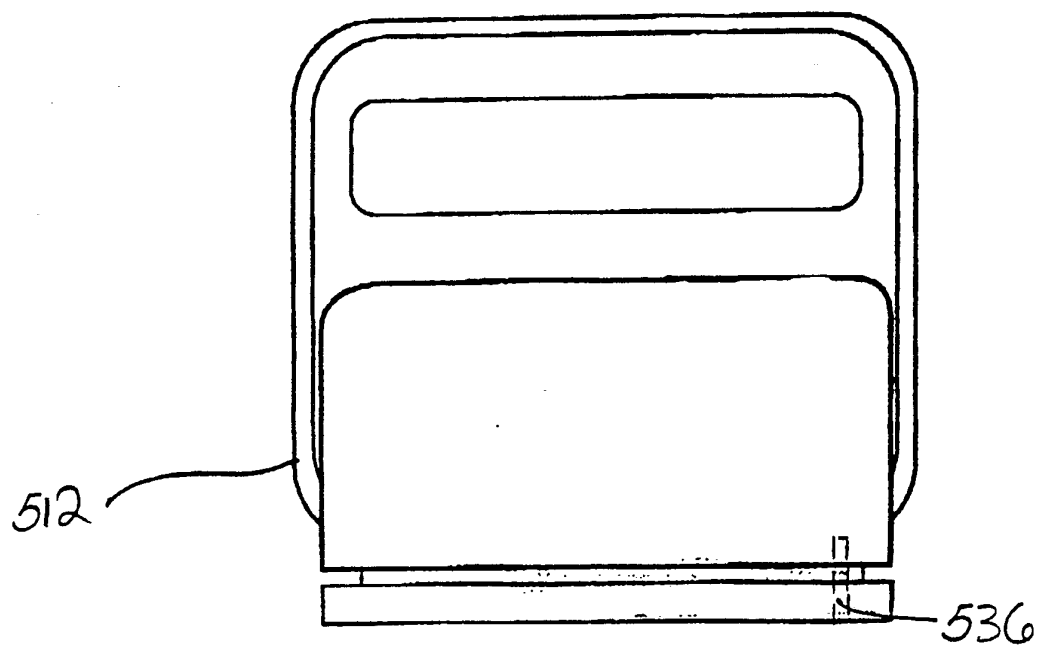


FIG. 17

12/22

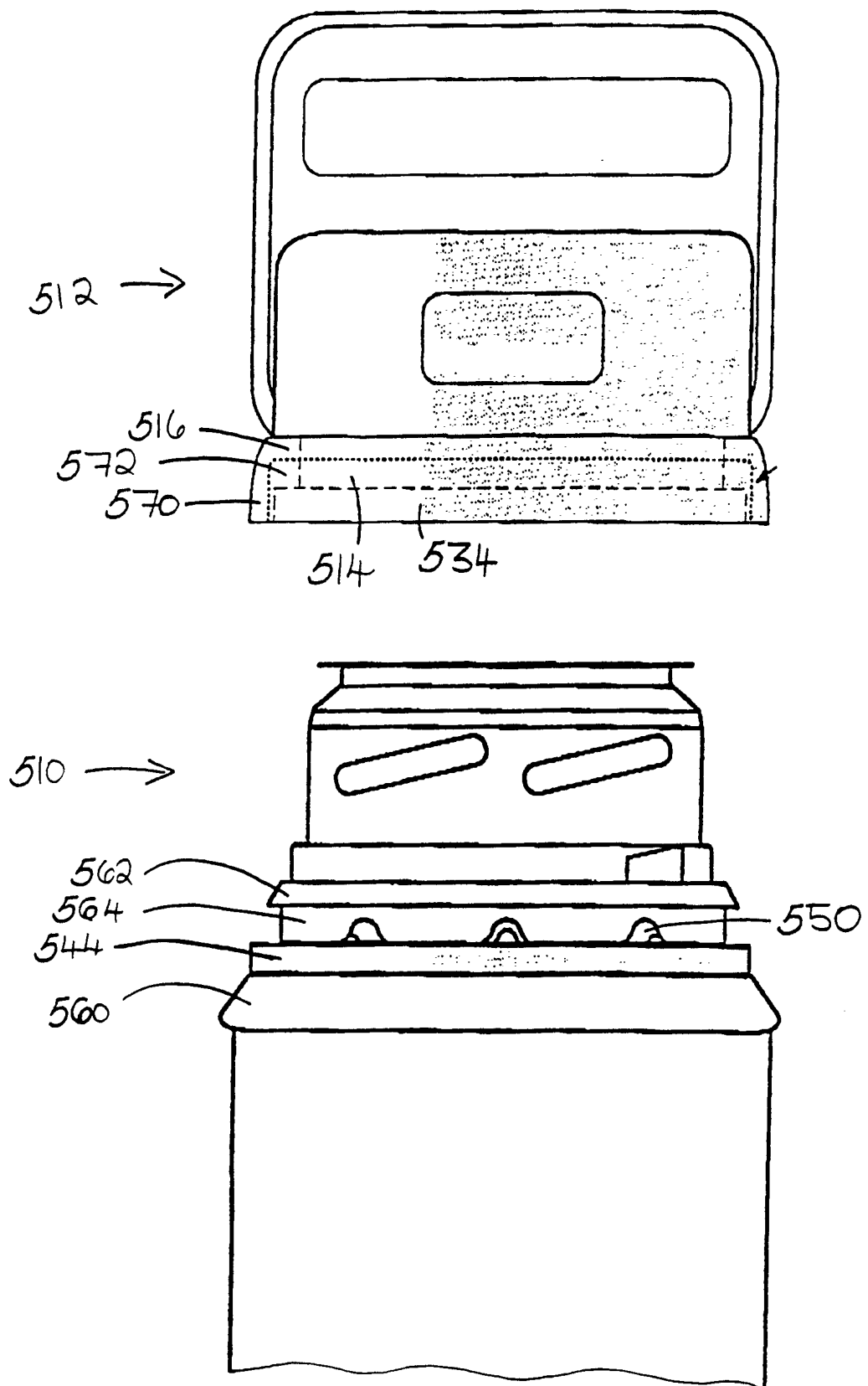
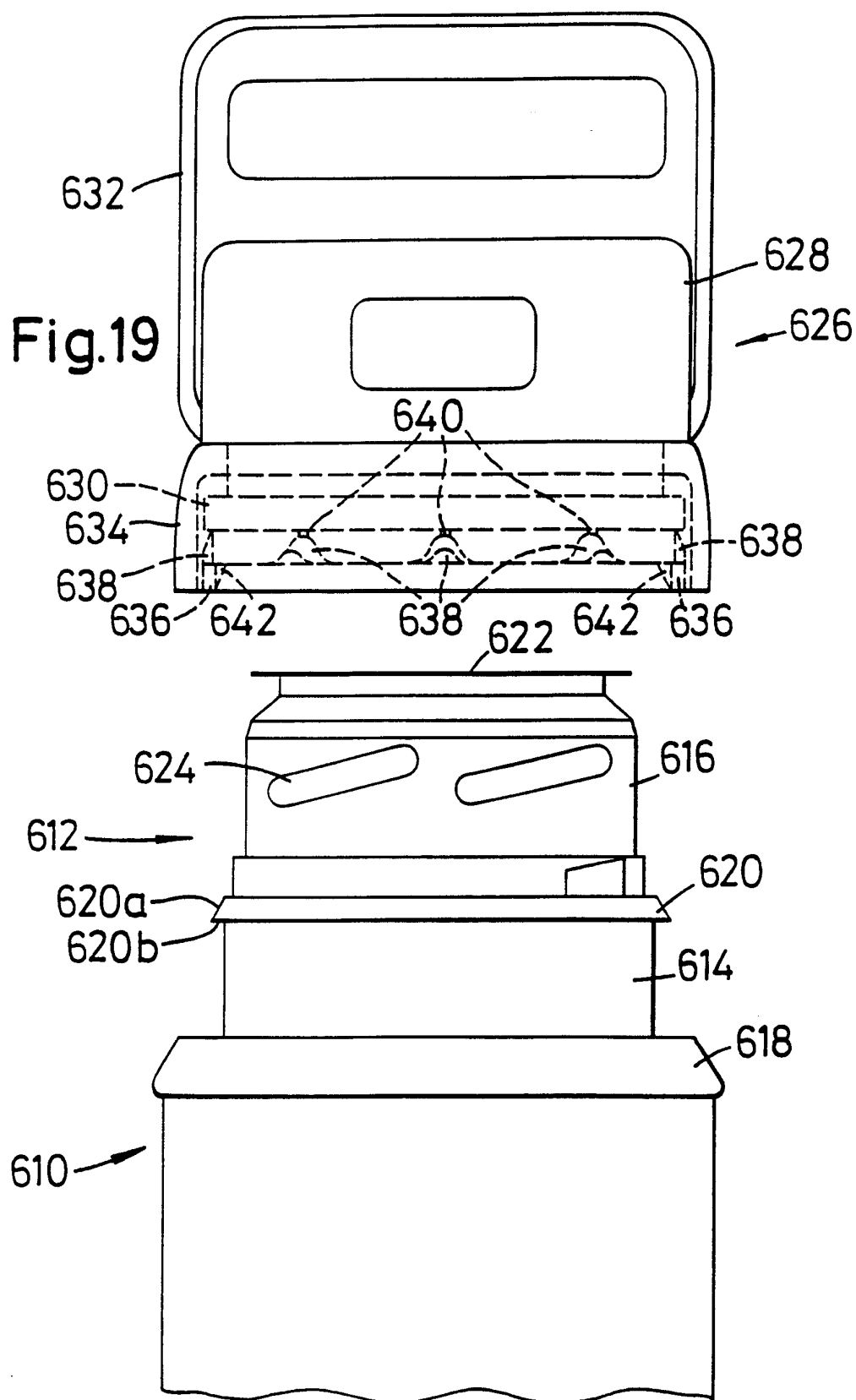


FIG. 18

13/22



14/22

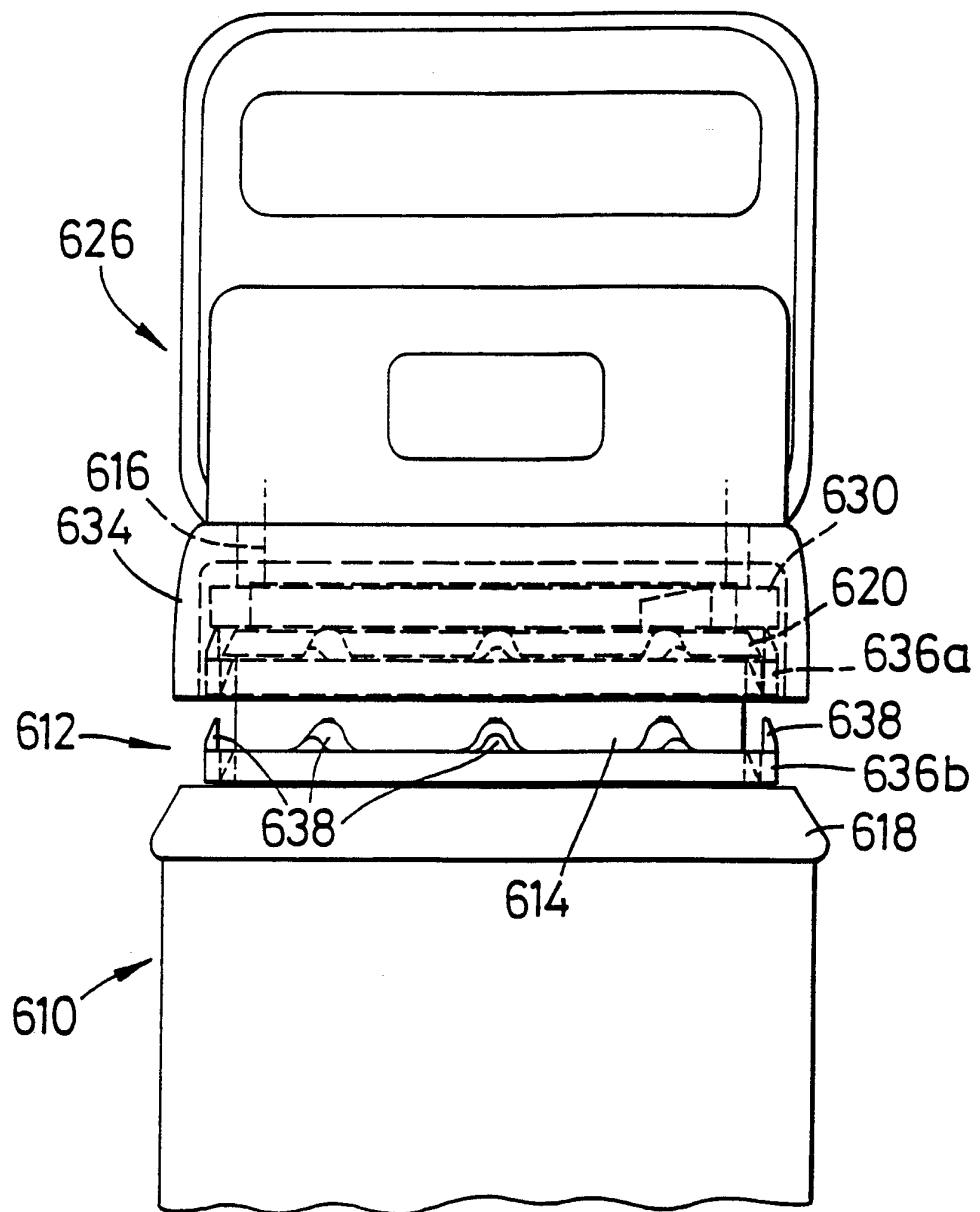


Fig. 20

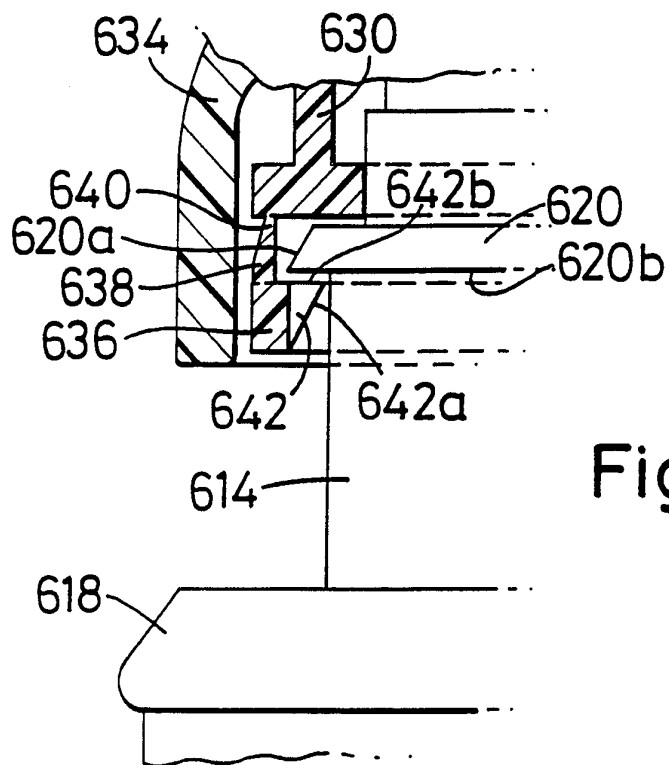


Fig. 21

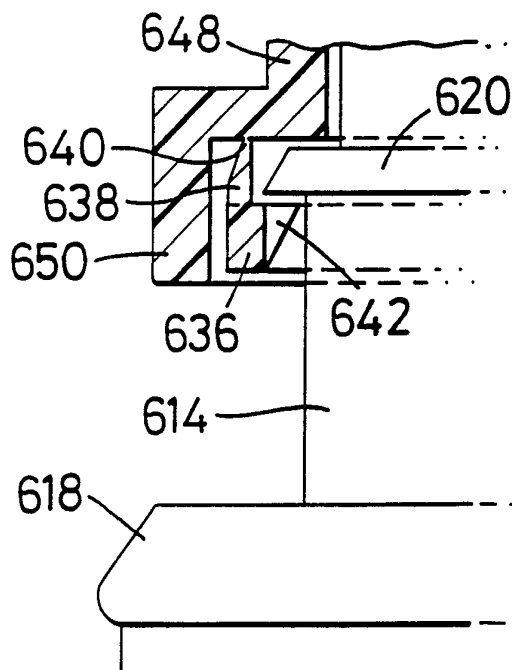
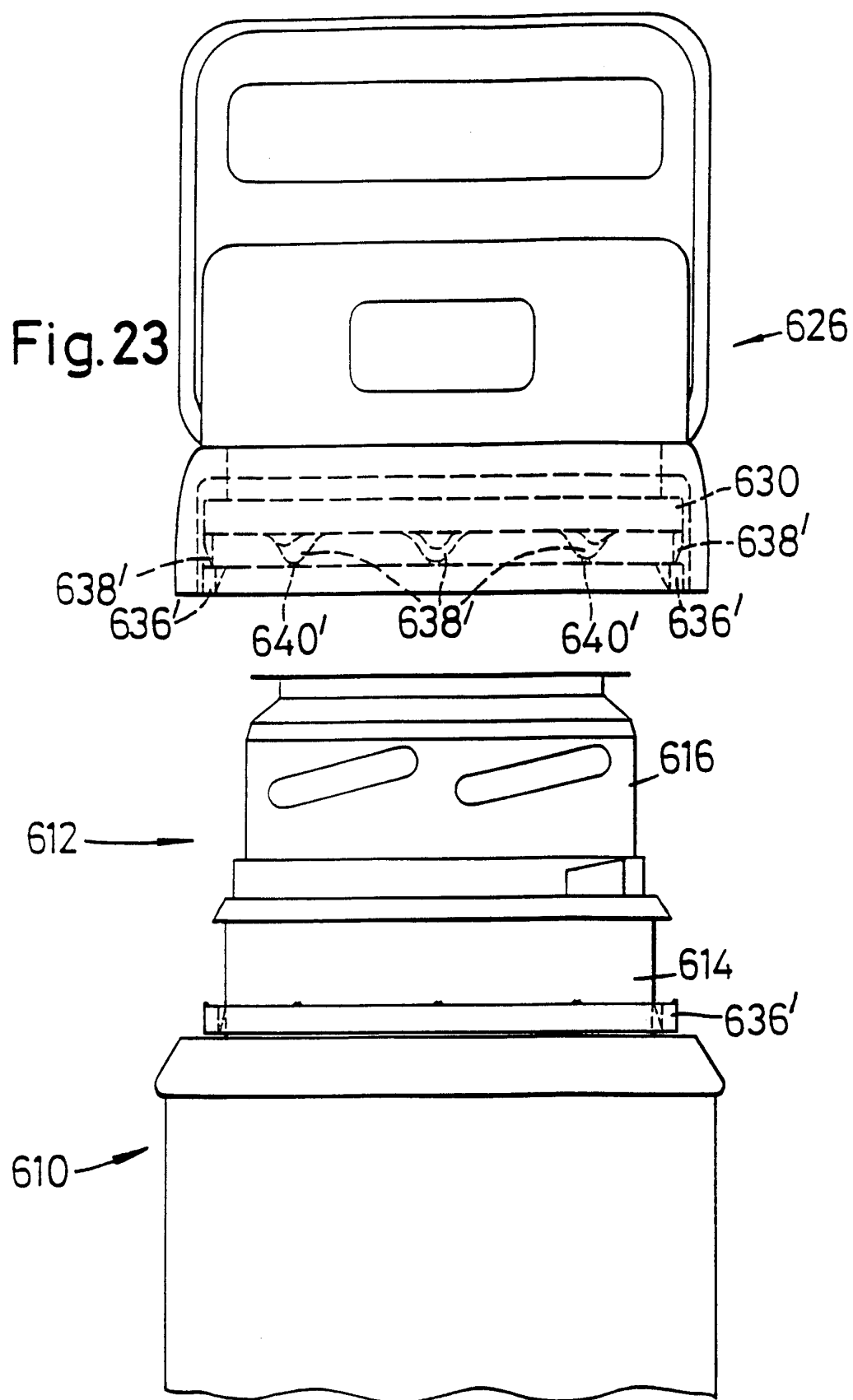


Fig. 22

16/22

Fig.23



17/22

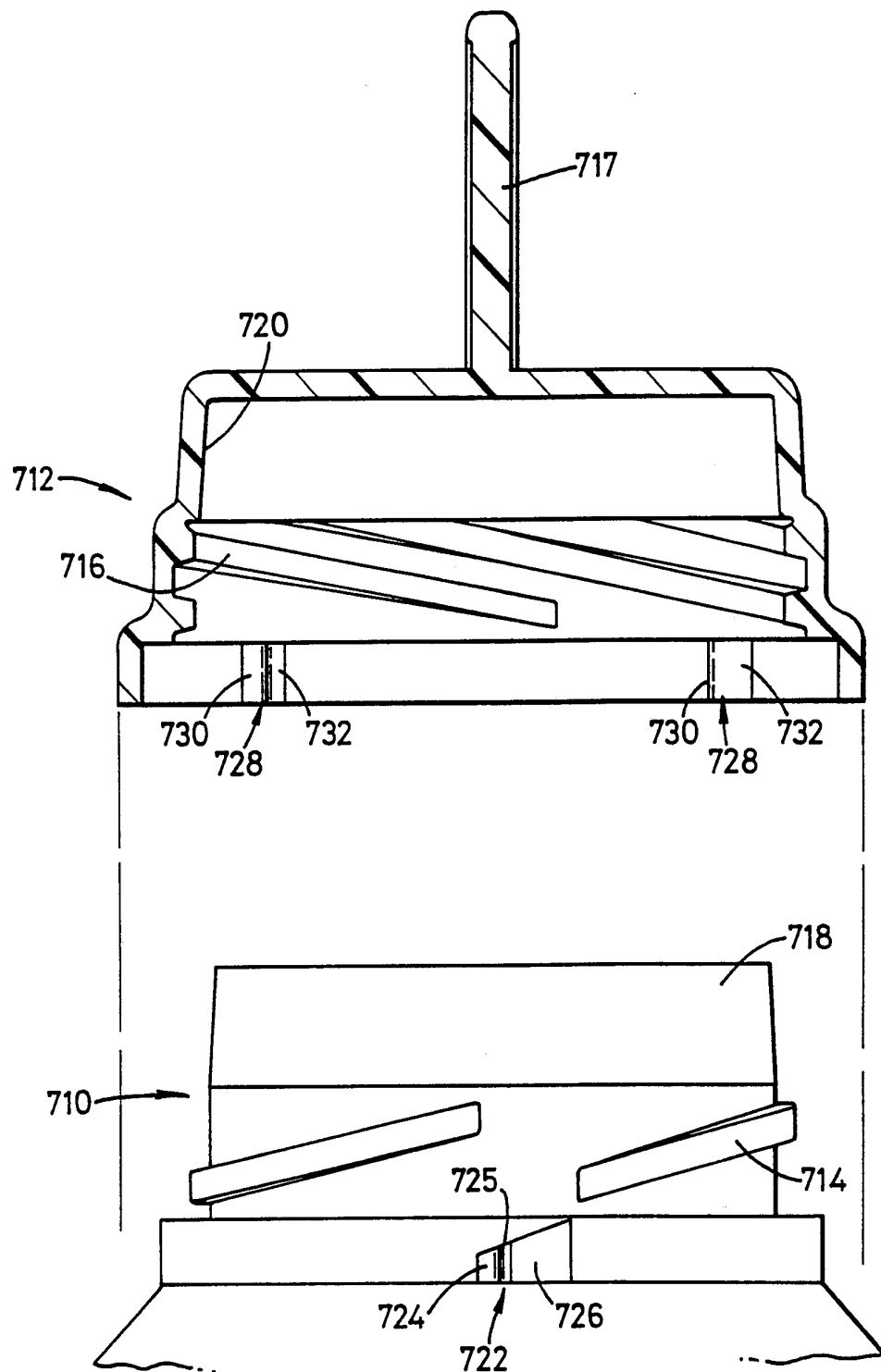


FIG. 24

18/22

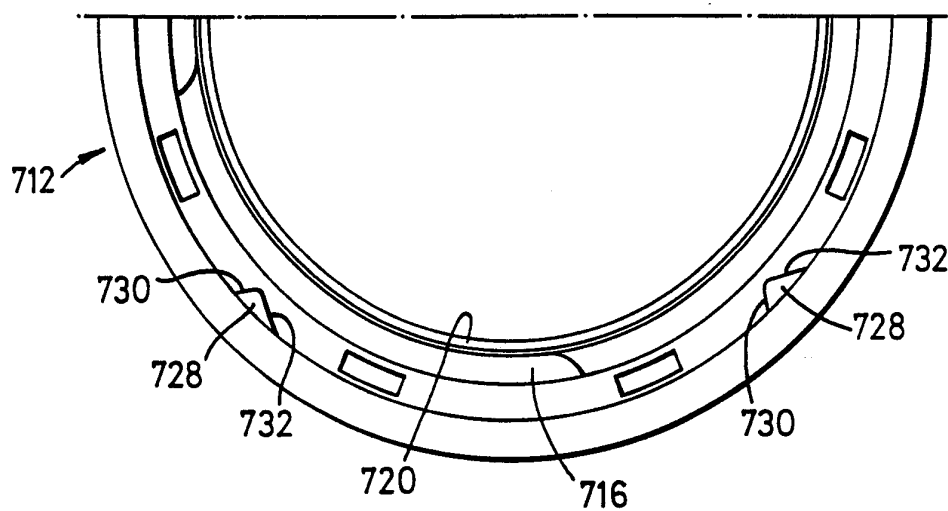


FIG. 25

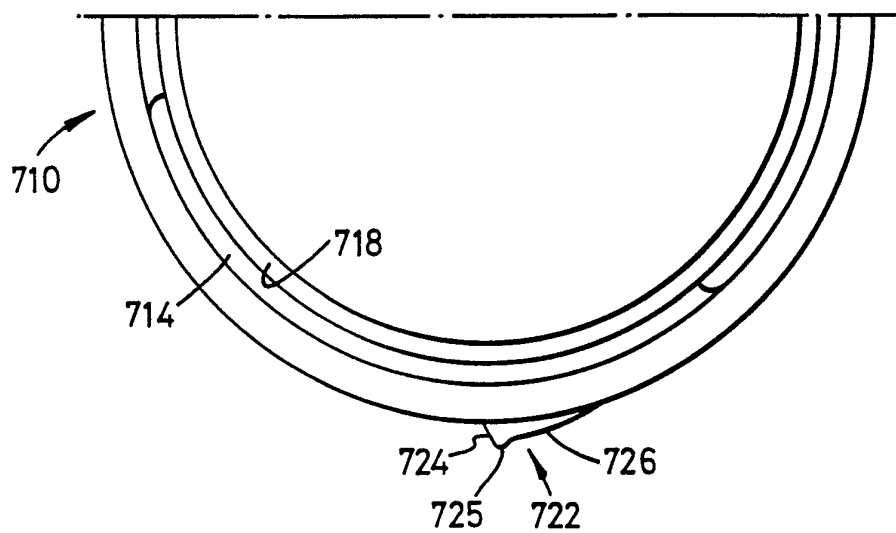
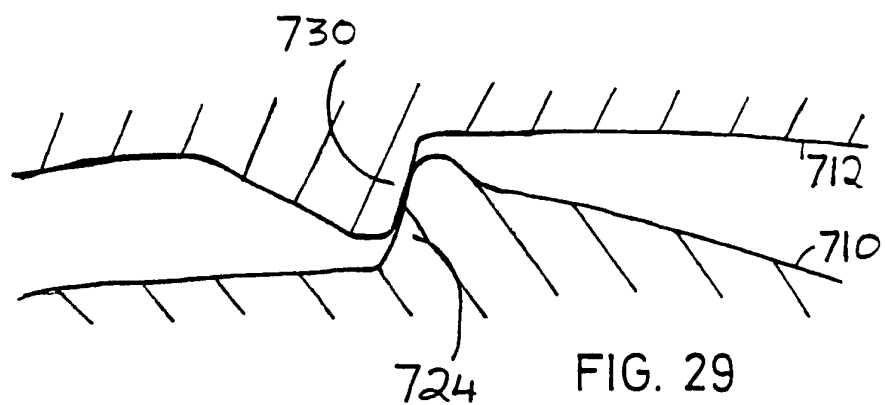
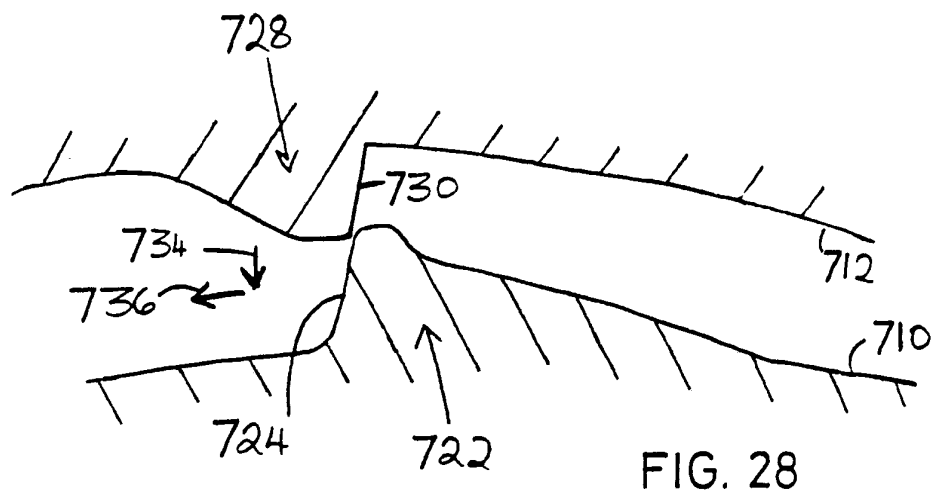
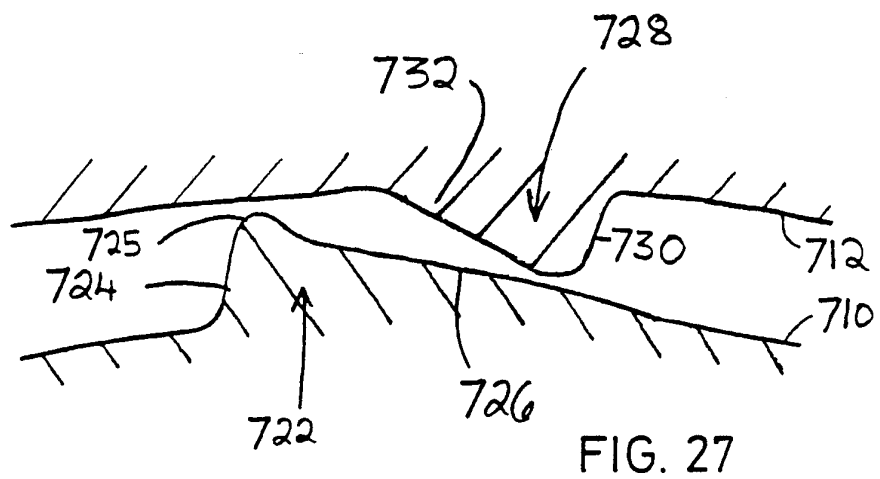


FIG. 26

19/22



20/22

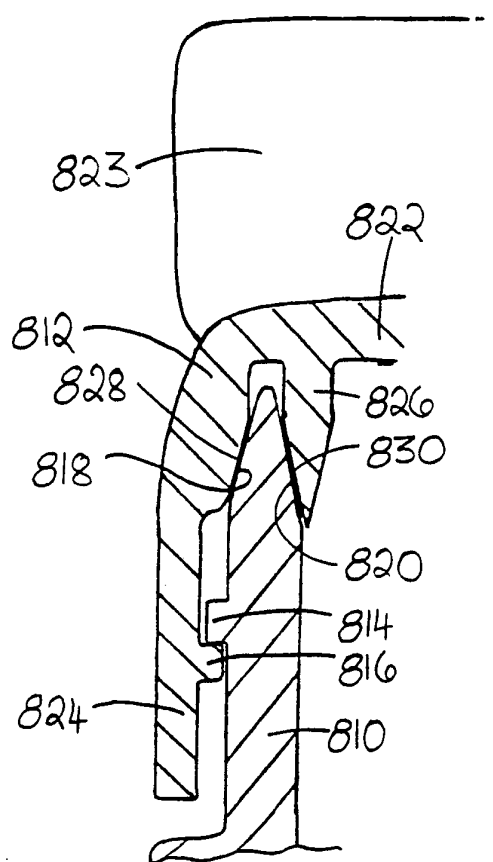


FIG. 30

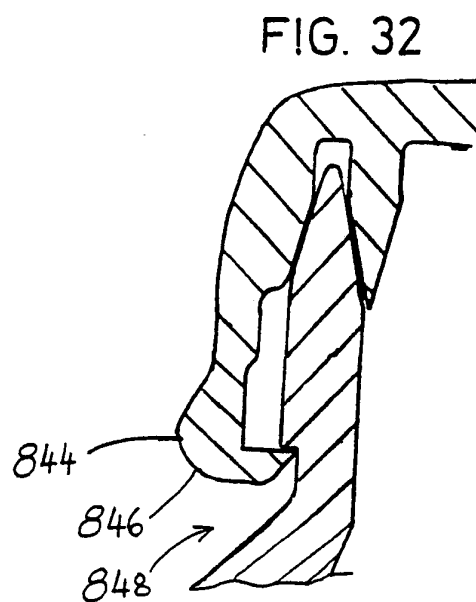


FIG. 32

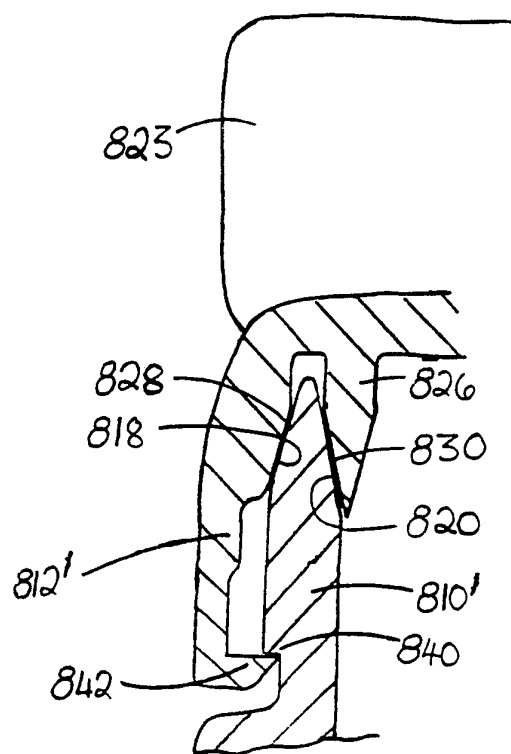


FIG. 31

21/22

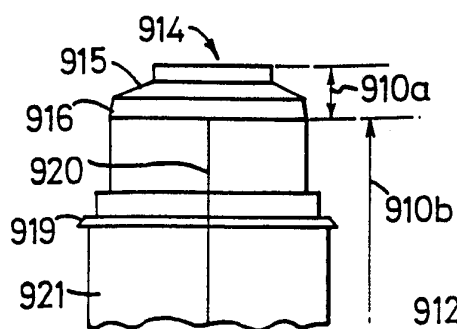


FIG. 34

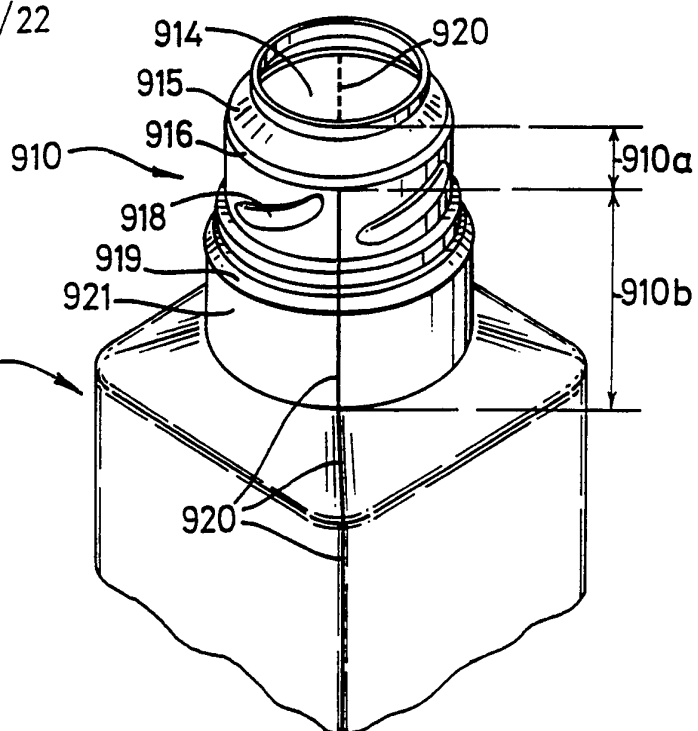


FIG. 33

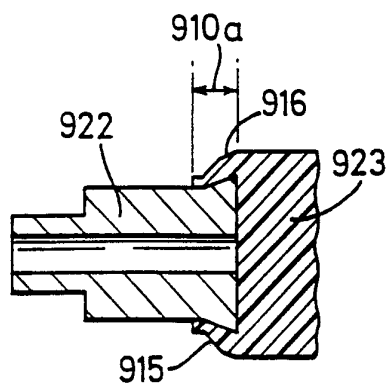


FIG. 35

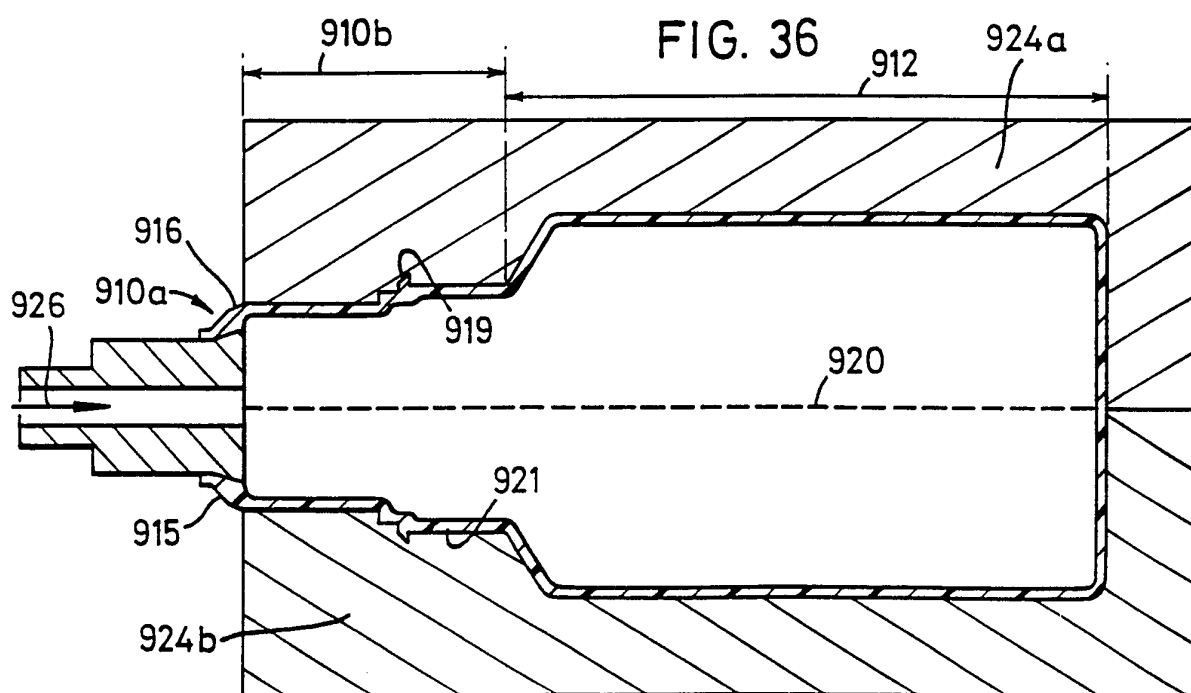


FIG. 36

22/22

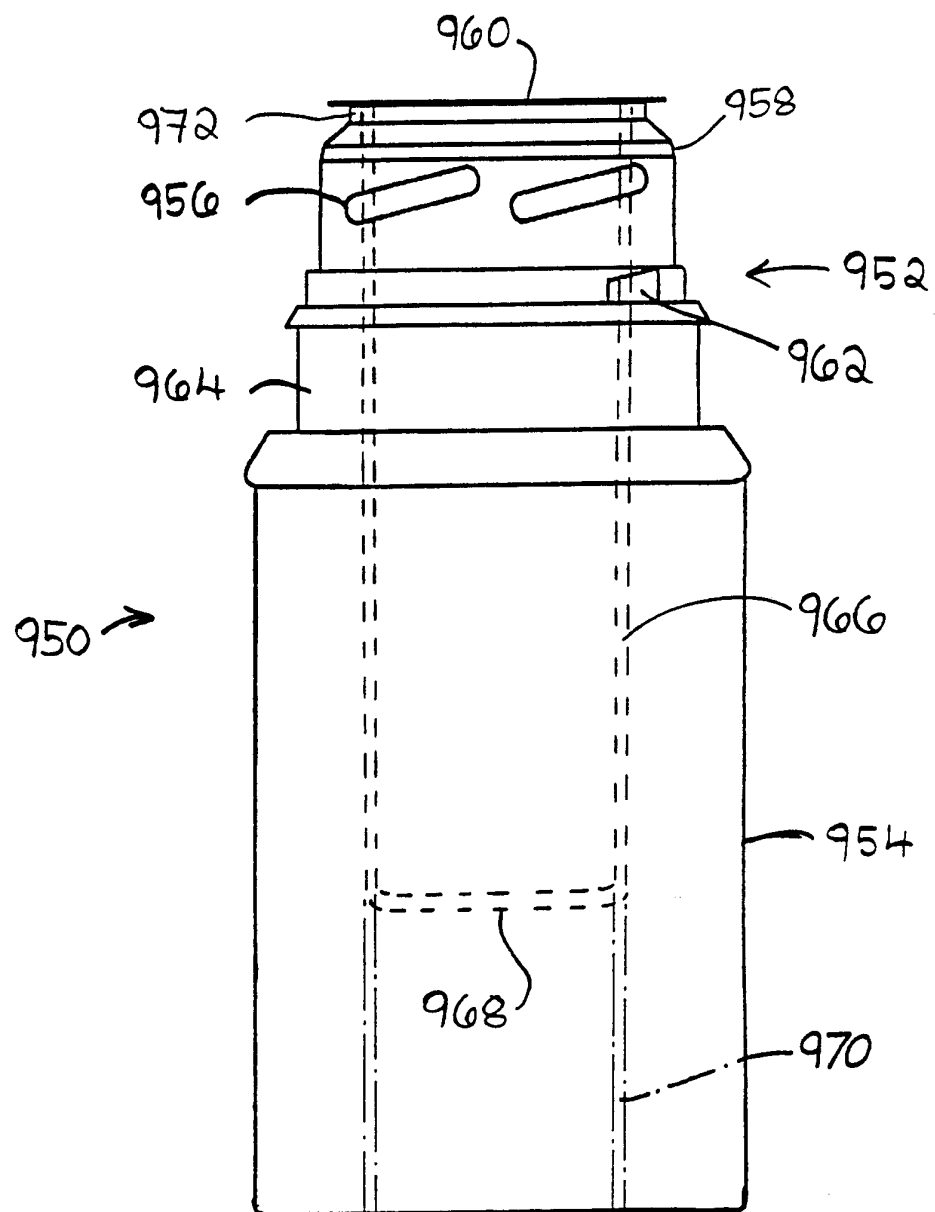


FIG. 37