

TAMPER-EVIDENT CLOSURE AND BEAD ON CONTAINER NECK

FIELD OF THE INVENTION

The present invention relates to closures for containers, and more particularly to tamper-evident closures for containers and including tamper evident dispensing
5 closures and tamper evident child resistant closures together with corresponding container necks .

BACKGROUND TO THE INVENTION

Any discussion of the prior art throughout the specification should in no way be considered as an admission that such prior art is widely known or forms part of
10 common general knowledge in the field.

There exists extensive prior art in relation to the design and manufacture of tamper-evident closures for containers, such as for example US Patents Nos. 4,653,657 (Papavasiliopolous), 4,807,771 (Roy), 5,660,288 (Nyman), 6,551,093 (Taha), 6,640,988 (Taha) and Australian Patent application 43435/85 (patent no
15 550878) the disclosures of which are hereby incorporated into this specification by way of cross-reference.

One problem that exists with prior art tamper-evident closures is the loss of sealing between the closure and container opening prior to the tamper-evidence features operating and insufficient visibility of tamper evidence means.

20 A further problem is that air is often present within sealed containers and at least the oxygen and or moisture contained therein and or contained in air or oxygen which may after sealing permeate into the container may react with and degrade the contents. There exists extensive prior art in relation to means of reducing or limiting the amount of oxygen inside a sealed container. US Patent Nos. 5,202,052,
25 (Zenner) , 5,364,555 (Zenner) , 6,037,022 (Adur) and 5,811,027 (Speer) the disclosures of which are hereby incorporated into this specification by way of cross-reference. The said prior art does not disclose oxygen or moisture reduction in sealed container using means associated with the closures disclosed herein.

It is an object of the present invention to overcome or ameliorate at least one
30 of the disadvantages of the prior art, or to provide a useful alternative.

SUMMARY OF THE INVENTION

One aspect of the present invention deals especially with the need for a proper relationship between sealing means and tamper-evidence means such that the tamper-evidence means operates prior to the seal being breached. This avoids the possibility
5 apparent with many so-called tamper-evident closures whereby by malicious tampering or inappropriate application torque and/or relaxation of the closure causing the seal between closure and container neck to be breached without the tamper-evidence means operating and allowing the contents to be degraded by action of atmosphere or the malicious introduction of contaminants.

10 A further aspect of the present invention provides a tamper-evident closure for a container with tamper-evident means and means of dispensing one or more additives into the container and a tamper-proof cover to protect additive dispensing means.

A further aspect of the present invention provides a tamper-evident closure for a container with tamper-evident means and a dispensing means for dispensing the
15 contents of the container in a controlled or limited manner, and a re-usable tamper evident cover for said dispensing means.

A further aspect of the present invention provides a tamper evident closure having a means of extracting at least oxygen and or moisture from at least the air trapped inside a container sealed with a tamper evident closure.

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BRIEF DESCRIPTION OF DRAWINGS

Preferred embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Fig. 1 is a cross-sectional elevation of a tamper-evident closure according to a
25 preferred embodiment of the present invention;

Fig. 2 is a cross sectional elevation of a preferred embodiment of a container neck;

Fig. 2A is a perspective elevation of portion of a preferred embodiment of a container neck 50 ;

30 Fig. 2B shows the area 'D' in Fig. 2 circled in dotted lines and showing 3 alternate preferred embodiments of a container neck ;

Fig. 2C shows the area 'D' in Fig. 2 circled in dotted lines and showing 3 alternate preferred embodiments of a container neck;

Fig. 3 shows a tamper evident closure 100 similar to the tamper evident closure shown in Fig. 1 and having an alternate preferred arrangement of tamper
5 evident engagement tabs 122 ;

Fig. 3A shows a tamper evident closure 100 similar to the tamper evident closure shown in Fig. 3 and having an alternate preferred arrangement of tamper evident engagement tabs 122 ;

Fig. 4 . Is a cross sectional elevation of area 'W' circled with interrupted line
10 (referring to Fig. 3) which has improved sealing arrangements for a closure ;

Fig. 4A Is a cross sectional elevation of area 'W' circled with interrupted line (referring to Fig. 3) which shows further embodiments of improved sealing arrangements for a closure;

Fig. 4B Is a cross sectional elevation of area 'W' circled with interrupted line
15 (referring to Fig. 3) which shows further embodiments of improved sealing arrangements for a closure

Fig. 5 is an enlarged cross sectional view of view of a closure and container neck in preferred embodiment according to an aspect of the present invention;

Fig. 6 is an enlarged cross sectional view of view of a closure and container
20 neck in preferred embodiment according to an aspect of the present invention;

Fig. 7 is a plan view of tamper evident engagement tabs of a closure as viewed from below in normal orientation in a preferred embodiment according to an aspect of the present invention;

Fig. 8 is a sectional plan of container neck 50 view from direction 'KK' taken
25 through (referring to Fig. 2A) dotted line 'H' 'H' in a preferred embodiment according to an aspect of the present invention;

Fig. 9 is a sectional plan of a container neck 50 view from direction 'KK' and taken through (referring to Fig. 2A) dotted line 'J' 'J' according to a further aspect of the present invention;

Fig. 10 is a dispensing closure 100 and tamper evident sealing cover cap 200
30 according to a further aspect of the present invention;

Fig. 11 is an enlarged sectional view of areas 'A' and 'B' of Fig. 10;

Fig. 12 is a cross sectional elevation of a dispensing closure according to a further aspect of the present invention ;

Fig. 13 is a an enlarged cross sectional elevation view of the main elements contained in the circled section 'D' in fig. 3 showing the sealing elements of sealing cover 200 in closure proximity to but not sealingly engaged with dispensing closure 100 according to a further aspect of the present invention.;

Fig. 14 is a cross sectional elevation of a dispensing closure 100 with a tamper evident sealing cover 200 in sealing engagement and with the closure threadingly engaged on the open end of a container neck 600. The general arrangement of these elements are similar to that shown in Fig. 10 but this embodiment contains at least one means of controlling or shutting off the dispensing flow of product according to a further aspect of the present invention;

Fig. 15 is a sectional view of that portion of dispensing closure 100 circled and marked 'G' in Fig. 14 according to a further aspect of the present invention;

Fig. 16 is a plan sectional view from below cut through the line 'F' 'F' and viewed in direction 'Q' of that portion of dispensing closure shown in Fig. 15 showing further means of dispensing flow control according to a further aspect of the present invention;

Fig. 17 is a plan view of (referring to Fig. 14) disc 700 having slits 705 showing further means of dispensing flow control according to a further aspect of the present invention;

Fig. 18 is a plan sectional view from below of that portion of dispensing closure 100 above the dotted line E in Fig. 12 according to a further aspect of the present invention;

Fig. 19 is a plan view from above lead in surface 128 of dispensing closure 100 (referring to Fig. 13) according to a further aspect of the present invention;

Fig. 20 is an enlargement of a view similar to the view in Fig. 13 and showing a further aspect of the present invention;

Fig. 21 is an enlarged view of sealing assembly 300 as viewed from direction 'Q' according to a further aspect of the present invention;

Fig. 22 is showing an alternate arrangement of enlarged sectional view of the area 'D' and adjacent area shown in Fig. 12 according to a further aspect of the present invention;

Fig. 23 is a cross sectional view through the axis of a closure 100 according to a further aspect of the present invention;

Fig. 24 a cross sectional view through the axis of a closure 100 having:
annular or interrupted annular clip means 105 according to a further aspect of the present invention;

Fig. 25 is a cross sectional elevation of closure 100 in Fig. 24 according to a further aspect of the present invention;

Fig. 26 is a cross sectional plan view of said moulded structure 120 in closure 100 in Fig. 23 according to a further aspect of the present invention;

Fig. 27 is a similar view to that shown in Fig. 26 showing some alternate shapes of walls 121 according to a further aspect of the present invention;

Fig. 28 is a cross sectional elevation through the axis of a closure and container neck according to a further aspect of the present invention;

Fig. 29 is a plan view from above lead in surface 128 of dispensing closure 100 (referring to Fig. 13) according to a further aspect of the present invention;

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DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Fig. 1 illustrates a closure 100. Typically, the closure is a one-piece construction moulded from thermoplastic. The closure 100 includes:

a top wall 102 and connected thereto a downwardly extending skirt 104 having a helically threaded section 106 located on the internal face 108 of the said skirt. Said helically threaded section ideally has more than 1 full turn of thread excluding lead in and washout and preferably two full turns of helical thread which is advantageous on closures for containers of carbonated products under high pressures. Said helical thread is adapted to engage with the corresponding helically threaded section on the external surface of the neck of a container. Said top wall 102 may be shaped in an arc in the area closer to the axis of the closure than annular sealing member 130 and the with the lowest point of the said arc located below the depicted top wall 102 and said arc being at the axis of the closure and thereby forming a partially dome shaped top wall 102 projecting into the closure and said dome shape is more resistant to deformation especially in closures for use on containers of carbonated contents.

annular sealing member

Depending from lower surface 112 of the skirt 104 is tamper-evident means consisting of tamper band 110 which is connected to a said lower surface 112 by a frangible section 114 formed by a series of circumferentially spaced ribs 116 separated by slots 118 which slots may be of different length thereby allowing tamper band 110 to deform more easily adjacent to larger slots when said closure 100 is ejected from a mould and said tamper-evident band 110 has an annular wall 120 from which extends more than one discretely spaced tabs 122. The tabs 122 are connected to the lower surface of the annular wall 120 by means of a hinged section 125.

Initially, the tabs 122 extend radially inwardly at an obtuse angle with respect to the annular wall 120 to facilitate removal from the mould and are depicted in this position in Fig. 1. Subsequent to the moulding of the closure, the tabs 122 are moved to a perpendicular or acute angle with respect to the annular wall 120 prior to application onto a corresponding container.

Said sealing member 130 has sealing contact point 132 which when said closure 100 is fully applied to a corresponding container neck said sealing contact point 132 sealingly engages (referring to Fig. 2) an inner surface 60 of said corresponding container neck 50 and the relative positions of said sealing contact point 132 surface

and (referring to Fig. 5) and free edges 124A of tamper band tabs 122 and the clearance distance between free edges 124A and lower engagement surface 57 on the neck of a corresponding container tamper bead 55 and the distance representing stretching deformation of frangible ribs 116 is such that upon removal rotation and axial movement of said closure 100 free edges 124A of tamper band tabs 122 engage lower engagement surface 57 of said container tamper bead 55 causing frangible ribs 116 to be severed before loss of seal between sealing contact point 132 and inner surface 60 of said corresponding container neck 50.

Fig. 2 is a sectional view of a portion of a container neck 50 and said neck being of a type suitable to accept a closure of the type shown in Fig. 1 said closure having one or more of the sealing means and engagement means as shown Figs 4, 4A, 5, 6 and 7 and providing advantages in the co-operation between a closure tamper evidence means and corresponding container neck. Said container neck having:

- top of neck sealing surface 68 ;and
- inside annular sealing surface 60 ;and
- radius or sloped or curved sealing surface 68A connecting said top of neck sealing surface 68 to outside annular sealing surface 69 ; and
- said outside annular sealing surface 69 located adjacent to said sealing surface 68A and extending downwards away from said sealing surface 68A for the distance necessary to provide a proper seal between container neck and corresponding closure said annular sealing surfaces 68, 68A and 69 are typically formed without mould parting lines and annular sealing surfaces 68A and 69 are together typically at least 1.0mm in vertical height at least on containers used for carbonated contents but including other products and said annular sealing surface 69 may be increased in height as necessary to provide extended vertical height of sealing surface to facilitate extended sealing engagement for closures of the type shown in Fig. 1 to enable frangible ribs 116 to be severed before loss of seal between closure and container ;and
- helical thread 61 ; and
- tamper bead 55 which has

a lower engagement surface 57 to engage co-operatively with engagement surface 124 on closure 100 (Fig. 3.) and neck wall surface 58 which joins engagement surface 57 and preferably immediately or at least within 1.0mm of said joining point said neck wall surface 58 commences to slope or curve towards the axis of the container neck at an angle averaging along the whole surface until it returns at least to parallel to the axis of the container neck said angle being greater than 1 degree and less than 70 degrees and preferably about 20 degrees.

- 10 Fig. 2A is perspective elevation of a portion of a container neck 50 being of a type suitable to accept closures of the type shown in Fig. 1 and in Fig. 3 said closures having one or more of the sealing means and engagement means and tamper band means as shown Figs 4, 4A, 5, 6 and 7 and providing advantages as to co-operation between a container neck and corresponding closure tamper evidence means. Said neck 50 having similar features as listed in Fig. 2. above and additionally having beneath tamper bead 55 more than one engagement means 80 having: engagement faces 78 which referring to the normal position of said container neck are oriented in a horizontal plane at least radially and preferably at less than 90 degrees angle to the normal direction of removal engagement of tamper evident engagement tabs 122 in Fig. 3 and said engagement faces 78 are also oriented vertically with the axis of the said container neck and said engagement faces 78 co-operating upon removal rotation of a corresponding closure to engage with corresponding free edges 122Q (referring to Fig. 3) of tabs 122 on tamper band 110 so as to restrain rotational movement of said tamper band 110 and sever frangible ribs 116 thereby giving clear evidence of opening immediately upon removal rotation ;and

- joining edges 79A which are formed by the abutment said engagement faces 78 with ramped and/or sloped and/or curved surface 79. Said joining edges 79A may be linear and/or curved but referring to the entire length of said joining edge 79A shall have an average angle of greater than 1 degree and preferably at least 15 degrees towards the axis of the said closure ;and

ramped surface 79 which allows free edges 124A of tamper band tabs 122 (referring to Fig.2) to pass over said engagement means 80 and said ramped surfaces 79 having a shape in a vertical direction considering the normal orientation of the said closure and indicated by the joining edges 79A sloping downwards and inwards towards the axis of the closure such that when tamper band 110 is severed from the body of closure the sloped surface following slope 79A of ramped surface 79 will promote the said tamper band 110 to move downwards away from tamper bead 55 of container neck 50 thereby ensuring the creation of a visible gap between tamper band and closure body as is described also in the description to Fig. 5 and Fig. 6 .

Fig. 2B shows the area 'D' in Fig. 2 circled in dotted lines and showing 3 alternate embodiments of the present invention showing surfaces 78 and 79 as revealed by joining edge 79A. In each of these embodiments engagement face 78 and ramped and/or sloped and/or curved surface 79 remains in the orientation to the axis of and radially to the said neck and the normal position of the said neck described in Fig. 2 A

Embodiment 1 has joining edge 79A1 as a sloped curved shape with a convex curve viewed from 'AA' and

Embodiment 2 has joining edge 79A2 as a linear sloped surface and

Embodiment 3 has joining edge 79A3 as a sloped curved shape with a concave curve viewed from 'AA' and

In yet another embodiment 4 curved wall 58 between each engagement means 80 continues as indicated by dotted line 58A intersecting the upper surface of tamper bead 55 at edge 56 and creating an extension to engagement face 78 represented by hatched area 78A . Said curved wall 58 may have a compound curve having a varying radius at various points

In yet another embodiment said wall 58 may be a linear surface not curved.

In yet another embodiment 5 the upper outer edge of engagement faces 78 may abut the lower surface 57 of said tamper bead 55 at a point radially inwards towards the axis of the said container neck for example at joining point 82 and leaving at least
5 adjacent to engagement means 80 a portion of tamper bead lower surface 57 adjoining tamper bead upper surface 55A to engage at least with closures relying on contact between closure tamper evidence means and said lower surface 57 to promote separation of tamper evidence means from the body of said closures and for example (referring to Fig. 2C) the joining point of said outer edges of said engagement faces 78
10 with said lower surface 57 being represented by line 79A5 abutting said tamper bead lower surface 57 at said joining point 82 and the width of said portion of tamper bead lower surface 57 being represented for example by the distance between dotted lines 'X' and 'Y'

15 In yet another embodiment 6 the
In yet another embodiment (not shown) which relies on engagement faces 78A which may of course be made larger by varying the radius and positioning of curved or sloped wall 58 and whereby the tamper bead 55 at least between engagement means 80 is much reduced or absent thus saving in material required to manufacture such a
20 container neck.

Fig. 2C shows the area 'D' in Fig. 2 circled in dotted lines and showing yet another embodiment of the present invention wherein the joining surface 79A4 is a combination of curved surface 79A41 and linear surface 79A42. Such combination of
25 surfaces may of course include variations other than that shown

Fig. 3 shows a tamper evident closure 100 similar to the tamper evident closure shown in Fig. 1 and having an alternate and preferred arrangement of tamper evident engagement tabs 122 having free edges 124A aligned radially or at an acute angle to
30 the axis of the said closure and a first engagement surface 124 to engage with a co-operating surface 57 (referring to Fig. 2) on a corresponding container and said tabs shaped to provide a second engagement surface here shown as a notch or gap 122R in

one or more said tabs. Said notch 122R having free edges 122P and 122Q and said free edge 122Q being disposed so that upon application to a container neck such as those disclosed at Fig. 2A, 2B, 2C, Fig. 8 and Fig. 9 said engagement tabs 122 lie between engagement faces 78 (referring to Fig. 2A, 2B, 2C and Fig. 8) and engagement faces 122Q are disposed in close proximity to said engagement faces 78 on the neck of a corresponding container so that upon removal rotation of less than 25 degrees and preferably 15 degrees said tamper band engagement faces 122Q and said closure engagement faces 78 engage whereby the tamper band 110 is restrained from rotating with the rest of the closure and frangible ribs 116 are severed thereby separating the said tamper band 110 from the body of closure 100 and one or more of said frangible ribs 116 as may be formed in moulding the said closure may after moulding be severed by a secondary process so as to reduce the number of said frangible ribs and thus reduce the force necessary to sever the remaining said frangible ribs 116. In another embodiment (not shown) frangible slots 118 are formed not during moulding but in a secondary process of slitting by known means after moulding at which time ribs 116 are formed in the required size and number. Other shapes of said engagement tabs 122 (not shown) may also be formed which will achieve the same purpose of providing one or more engagement surfaces to engage co-operatively with corresponding engagement surfaces on a container neck to restrain either axial and/or rotational movement of a closure tamper band so as to promote the severing of said frangible ribs to separate the said tamper band from the said closure body..

Fig. 3A shows a tamper evident closure 100 similar to the tamper evident closure shown in Fig. 3 and having :

25 joining elements 122T which join at least 2 adjacent engagement tabs 122 and assist in retaining said tabs 122 in (referring to Fig. 6) operating position 'C' and; one or more spacing elements 110E which (referring to Fig. 6) serve to keep at least one of said tabs 122 adjacent to said spacing element 110E in operating position 'C' by preventing said tab 122 from being folded back against annular wall 120 of tamper band 110

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Fig 4. Is a cross sectional elevation of area 'W' circled with interrupted line (referring to Fig. 3) which has improved sealing arrangements for a closure 100 having a top annular wall or disc 102 and annular inner or bore-seal 130 and bore sealing surface 132 which seals against inside neck surface of a corresponding container (not shown) and

5 sealing surface 145 which seals against the top neck surface of a corresponding container. Said sealing surface 145 may have one or more projections which as well as sealing will raise the annular seal 140 closer to the top of a corresponding container neck and

10 skirt wall 104 depending from said top disc and at least one helical thread means 106 to engage with corresponding thread means on a container neck and annular seal 140 having

15 lower surface 140A which is located so that when the closure is fully applied to a corresponding container said lower surface 140A is preferably above but at least in close proximity to the lower extremity of an the annular sealing surface formed on the upper portion of the outside surface of a corresponding container neck where an outside annular sealing surface is generally formed without mould parting lines and which outside annular sealing surface is typically at least 1.0mm in vertical height at

20 least on containers used for carbonated contents but including other products and lower wall joining point 140B which is preferably formed as a radius of less than 3.5mm and preferably 0.5mm and

25 wall 140C which may be linear or formed as a radius or compound curve but in any case having on average and angle to the axis of the closure of between 85 degrees and 5 degrees and preferably 45 degrees and the angle formed by the dotted lines 'J' and 'L' where dotted line 'L' representing the orientation of at least the major portion of said wall 140C and dotted line 'J' representing the orientation of at least the major

30 portion of said lower surface 140A and where dotted line 'J' is disposed approximately at 90 degrees to the axis of the closure and the angle formed by the

intersection of dotted lines 'J' and 'L' is therefore between 95 degrees and 175 degrees and preferably 135 degrees and

upper wall joining point 140D which is preferably formed as a radius and if as a radius
5 less than 3.5 mm radius but otherwise may be linear by extending walls 140D and 140E and the various features of annular seal 140 which is located at a point sufficiently lower than top sealing surface 145 which when closure is fully applied to a container said sealing surface 145 abuts top of neck sealing surface 68 of container neck 50 (referring to fig. 2) such that said annular seal 140 remains in
10 sealing engagement with annular sealing surface 69 (referring to Fig. 2) on a corresponding container neck 50 even in the event that the said closure 100 backs off from a fully applied position on said container neck thereby reducing losses experienced with top or wedge seal closures backing off and allowing leakage from or into said container. However, preferred container neck embodiments referred to at
15 2A, 2B, and 2C are designed to at least restrict back off and

vertical distance between dotted lines 'K' and 'M' is less than the vertical height of an the annular sealing surface 69 (referring to Fig. 2) formed on the upper portion of the outside surface of a corresponding container neck 50 where an outside annular
20 sealing surface is generally formed without mould parting lines and which outside annular sealing surface is typically at least 1.0mm in vertical height at least on containers used for carbonated contents but including other products and

vertical distance between dotted lines 'M' and 'J' is greater than 0.2mm and less than
25 about 3.0mm and preferably 0.5mm and

vertical distance between dotted lines 'K' and 'J' is preferably such that the sum of said vertical distance between dotted lines 'K' and 'J' + the vertical height of any sealing projections depending from sealing surface 145 is less than the vertical height
30 of the annular sealing surface formed on the upper portion of the outside surface of a corresponding container neck. Said outside annular sealing surface is typically formed without mould parting lines and which outside annular sealing surface is typically at

least 1.0mm in vertical height at least on containers used for carbonated contents but including other products.

Fig. 4A . Is another embodiment of cross sectional elevation of area 'W' circled with
5 interrupted line (referring to Fig. 3) which has improved sealing arrangements
whereby a closure is in sealing contact at least on both the inside or the upper inside
portion of a container neck and the outside or upper outside portion of a container
neck. for a closure 100 having a
top wall or disc 102 and
10 annular inner or bore-seal 130 and bore sealing surface 132 which seals against inside
neck surface of a corresponding container (not shown) and
surface 145 which in the absence of projections 146 may slope or curve downwards to
a level sealing surface 145A (not shown) parallel to the tips of projections 146 and
said sealing surface 145A seals against the top neck surface of a corresponding
15 container thereby preserving the relative position of annular seal 140 in respect of
(referring to Fig 2.) outside sealing surfaces 68A and 69 of neck 50. Said surface 145
may have one or more sealing projections 146 which as well as sealing against the top
neck surface of a corresponding container will preserve the relative position of annular
seal 140 in respect of (referring to Fig 2.) outside sealing surfaces 68A and 69 of neck
20 50and
lower top wall surface 147 which is disposed at approximately 90 degrees to the axis
of the closure said lower top wall surface 147 located at a vertical distance from
dotted line J1 or the extension thereof which is greater than the vertical distance from
dotted line J1 or the extension thereto to sealing surfaces 146 or 145A such that the
25 distance between annular seal 140 and the lower top wall surface 147 is increased
allowing a larger radius on the surface 148 joining said lower top wall surface 147 and
upper wall 140G and allowing the angle between said upper wall 140G and lower
surface 140A to be greater than is possible in prior art closures where the lower
surface of top wall 102 typically abuts the upper surface of the container neck and
30 thereby assisting in ejection of annular seal 140 from a mould and allowing more
space into which annular seal 140 can deform towards said surface 147 upon
application of the closure to a container and

skirt wall 104 depending from said top disc and
at least one continuous or segmented helical thread means 106 to engage with
corresponding thread means on a container neck and
annular seal 140 having

- 5 lower surface 140A disposed or oriented to the axis of the closure as indicated by the
dotted line J1 being at more than 45 degrees and less than 135 degrees and preferably
90 degrees to the axis of the closure and said lower surface 140A adapted so that when
the closure is fully applied to a corresponding container said lower surface 140A is
preferably above the lower extremity of an the annular sealing surface formed on the
10 upper portion of the outside surface of a corresponding container neck where on said
container neck an outside annular sealing surface is generally formed without mould
parting lines and which outside annular sealing surface is typically up to 1.0mm in
vertical height at least on containers used for carbonated contents but including other
products neck arrangements and

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curved surface 140F which may be linear or formed as a radius or compound curve
and if as a radius less than 1.0 mm radius and preferably 0.1 mm radius and

- 20 upper wall 140G which may be linear or curved and having a surface disposed or
oriented in relation to the axis of the closure as indicated by the dotted line J2
whereby the angle formed by the at the intersection of the dotted lines J1 and J2 is less
than 75 degrees and preferably approximately 20 degrees
- 25 said annular seal 140 is located at a point sufficiently lower than top sealing surface
145 which when closure is fully applied to a container said sealing surface 145 abuts
top of neck sealing surface 68 of container neck 50 (referring to fig. 2) such that
said annular seal 140 remains in sealing engagement with annular sealing surface 69
(referring to Fig. 2) on a corresponding container neck 50 even in the event that the
30 said closure 100 backs off from a fully applied position on said container neck thereby
reducing losses experienced with top or wedge seal closures backing off and allowing

leakage of product from or contaminants into said container and said annular seal 140 having relationships including said 140F being located (referring to Fig. 2):
on a diameter less than the diameter of container neck outside annular sealing surface 69; and

- 5 preferably on a diameter equal to the diameter of the distal edge of top of neck sealing surface 68. However, preferred embodiments referred to at 2A, 2B, and 2C are designed to at least restrict back off and

- vertical distance between dotted lines 'J1' and 'J3' where 'J3' should taken to be at
10 the closure fully applied to container position at which stage sealing projections 146 are compressed, is less than the vertical height of an the annular sealing surface 69 (referring to Fig. 2) formed on the upper portion of the outside surface of a corresponding container neck 50 where an outside annular sealing surface is generally formed without mould parting lines and which outside annular sealing surface is
15 typically at least 1.0mm in vertical height at least on containers used for carbonated contents but including other products and neck arrangements.

- Fig. 4B . Is another embodiment of the closure 100 and closure sealing means shown
20 in Fig. 4A. . In this embodiment;
annular seal 140 extends partially from skirt wall 104 and partially from lower top wall surface 147 or in the alternative (not shown) said annular seal 140 extends from lower top wall surface 147 and;
surface 146A is arranged to make contact with (referring to Fig.2) top of neck
25 sealing surface 68 and said surface 146A is separate from annular seal 140 and ;
said lower top wall surface 147 being spaced apart from sealing surface 146A as for example shown by the space between dotted lines J4 and J4A thereby creating space 148 into which annular seal 140 may deform into upon application of said closure to a container neck.

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Fig. 5 discloses a section through a the closure 100 of the type shown in Fig.1 and co-operating container neck 50 showing the position of the tamper evidence band 110

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after removal of the closure from the container and subsequent replacement of the closure to re-seal the container. The operation of removal has after bringing into engagement surfaces 124 on the tabs 122 on tamper band 110 and lower surface 57 of tamper bead 55 on said container neck 50 and by movement of the closure 100 in direction 'Y' whilst tamper band 110 is prevented from such movement in direction 'Y' by said engagement between said engagement surfaces 124 and said lower surface 57 and which movement in direction 'Y' therefore causes frangible ribs 116 to separate from lower surface 112 of skirt 104 thereby opening a visible gap which may be as large as desired to provide good visual evidence of separation between tamper
10 said band 110 and said lower surface 112.

Upon separation of tamper band 110 from skirt 104 tabs 122 which are exerting a pressure in direction 'X' against surface 58 of container neck 50 by the tendency of said tabs 122 urged by the tendency of the joining members 123 (shown in fig 7.) and the natural tendency of a moulded plastic part to return towards its as
15 moulded position and or to return to a neutral position from a compressed or stretched position said stretched position of said joining members 123 corresponding to position 'C' in Fig.6 and said tabs 122 are therefore urged downwards by the sloping surface 58 of container neck 50 so that by selection of an appropriate arced or sloped shape for said surface 58 an easily discerned visual gap becomes apparent between closure
20 body and tamper evidence band and said visual gap is formed contemporaneously with removal of the closure such that a person opening a container can see the operation of the tamper evidence means rather than rely on the feel or sound of ribs 116 separating as is the case with prior art tamper bands. The slope of surface 58 and the action of the tabs also makes difficult or impossible to replace the tamper band
25 into close proximity to simulate an un-opened container. Said sloping surface 58 is formed such that the preferable initial slope represented by the dotted line 'F1' is between 1 degree and 70 degrees and preferably about 20 degrees relative to dotted line 'G1' ('G1' being parallel to the axis of the closure) and when said sloping surface 58 is formed as a radius then such radius is preferably greater than 1.0 mm and
30 less than 20.0 mm. Said sloping surface 58 may be a compound slope having a varying radius at various points.

Sealing members 130 and 140 and sealing surface 145 are shown in sealing engagement with the corresponding sealing surfaces on container neck 50

Fig. 6 is a cross sectional elevation of closure 100 and a co-operating container neck 50 showing:
various approximate positions of tabs 122 including Position 'A' being the as moulded position and position 'B' being the corresponding neutral position when said tabs 122 are folded towards the operating position prior to sorting and application to a container and when at said neutral point 'B' said tabs 122 are at an acute angle to annular wall 120 said neutral point 'B' is also defined as being the point at which the angle formed by dotted lines 'D' and 'E' (dotted line 'E' being parallel to the axis of closure 100) is equal to the angle formed by dotted lines 'E' and 'F' and said neutral position 'B' is the point at which gaps 122c have parallel sides and flap joining members 123 are in a neutral position being neither under tension or compression save for the said force exerted by the propensity of deformed hinge plastic material to return towards an as moulded position.. Position 'C' is the position of tabs 122 when fully applied to container and prior to commencement of removal. Position 'A' is the as moulded position of said tabs 122; and annular neck projection 51 which reduces the clearance gap between tabs 122 and container neck 50 and thereby assisting in prevention of tampering with tabs 122 in operating position 'C'.

Fig. 7 illustrates a means of overcoming the tendency of tabs 122 of closure 100 shown in fig.1 to return towards the as moulded position and provide another benefit by urging tabs 122 to grip more tightly onto a container neck. The view is divided by dotted line into half 'A' and half 'B' and shows the arrangement of tabs 122 viewed from beneath 2 different closures in normal orientation. Said tabs 122 are joined in pairs by a small joining member 123. Said tabs 122 in closure half 'A' are in the as moulded position with adjacent sides of said tabs forming parallel sided gaps 122C and said gaps 122C between unjoined tabs having an arcuate end formed by the annular surface of wall 120 adjacent hinge 125 (shown in referring to Fig.1) and an open end and said gaps 122C between joined tabs become a closed gap with 2 parallel

sides an arcuate end formed by the annular surface of wall 120 adjacent hinge 125 and a fourth side formed by one edge of joining member 123 which may be arcuate or linear.

Said tabs 122 in a separate closure half 'B' are shown in a position at 90 degrees to the axis of the closure and at this point the gaps 122C at edges of said tabs 122 adjacent engagement faces 124 would be narrower because engagement faces 124 are now located on a smaller diameter than the position shown in half 'A' thereby causing joining members 123 to be compressed and some of this compression will be relieved by the free edges of each pair of joined tabs deforming radially as indicated by arrows 'J' which will cause the wall 120 (shown in fig. 1) to deform (said deformation not shown) between points 'K' and 'L'. Upon further folding of said tabs into the said closure 100 (refer to Fig. 6 position 'B') the said joining members 123 will return to an uncompressed state when the engagement ends 124 are located on a diameter equal to the diameter shown for tabs 122 in Half 'A' (this diameter being the referred to in Fig. 6. as diameter 'B') and said tabs 122 having reached said position 'B' (referring to Fig. 6) will tend to remain in this neutral position because the force exerted by the tendency of the hinge 125 to return to an as moulded position will not overcome the resistance to compression in said joining members 123. Upon application of closure to a container tabs 122 will be urged into position by the neck of the container such that the engagement ends 124 will locate on a larger diameter than the said diameter 'B' and joining members 123 will be placed under tension again causing deformation of at least wall 120 between points 'K' and 'L' and urging the said tabs 122 to exert a force against the neck surface 58 of container neck 50 greater than that force exerted by the arrangement of tabs 122 referred to in Fig.3 thereby reducing the possibility that tabs 122 (shown in Fig. 5) may be urged past lower surface 57 of tamper bead 55 on container neck 50 upon removal of closure from container neck failing to break frangible ribs 116 tamper band 110 thereby defeating the tamper evidence means. Tabs 122 when in position shown in half 'A' corresponding to position 'B' in Fig.6 are subject to a residual force exerted to urge the said tabs 122 to return towards the as moulded position 'A' (as moulded position 'A' in Fig. 6) this force results from the propensity of a moulded plastic part when deformed from its as moulded position to return towards the as moulded position.

Fig. 8 is a sectional plan of container neck 50 view from direction 'KK' taken through (referring to Fig. 2A) dotted line 'H' 'H' and said dotted line 'H' 'H' passing through the joining of engagement means 80 and the lower surface 57 of tamper bead 55 and showing by arrow 'Q' the direction of removal rotation of a closure and also showing by arrow 'O' the direction of application' rotation of a closure which may be affixed to said container neck 50 and said container neck having:

top sealing surface 68 ; and

engagement means 80 located on the lower surface of tamper bead 55 (shown with dotted line) and having:

engagement surfaces 78 which are radially oriented to the axis of the container neck or in another embodiment aligned at an acute angle for example shown by dotted line 'R' ;and

ramped surface 79 which may be linear or curved and upon application rotation of a corresponding closure such as shown in Fig. 3 allows free edges 124A of tabs 122 of tamper band 110 to easily pass over said ramped surfaces79; and joining edges 79A at the join between said ramped surfaces 79 and engagement surfaces 78..

Fig. 9 is a sectional plan of container neck 50 view from direction 'KK' and taken through (referring to Fig. 2A) dotted line 'J' 'J' passing through the joining of the neck and tamper bead 55 and showing by arrow 'Q' the direction of removal rotation and also showing by arrow 'O' the direction of application rotation of a closure which may be affixed to said container neck 50. This shows the arrangement described at embodiment 4 in the description to Fig. 2B and said container neck having

top sealing surface 68 ; and

engagement means 80 located on the lower surface of tamper bead 55 and having: engagement surfaces 78 and 78A which are radially oriented at 90 degrees to the axis of the container neck and vertically oriented to the axis of the neck ;and

ramped surface 79 which may be linear or curved and which upon application rotation of a corresponding closure such as shown in Fig. 3 allows free edges 124A of tabs 122 of tamper band 110 to easily pass over said ramped surfaces79 and said closure when

fully applied to said container neck the said free edges 124A of tabs 122 will lie in a position to engage at least with engagement faces 78A upon removal rotation of said closure. Said closure 100 being so designed that upon full application the said engagement faces 124A will lie in close proximity to said engagement faces 78A; and
5 joining edges 79A at the join between said ramped surface 79 ;and engagement surfaces 78, 78A ;and
edge point 56 corresponding to edge point 56 in Fig. 2B. and
neck surface intersection point 59 being at the lower end of curved section 58 (referring to Fig. 2B)

10 Fig.10 discloses a dispensing closure 100 and tamper evident sealing cover cap 200. Typically, the closure is a one-piece moulded construction .
The dispensing closure 100 includes
a dispensing portion 102 having annular and/or frusto-conical wall 110 having one or more thread and/or annular projection or clip means 116 to co-operate with
15 corresponding thread and/or annular clip means 215 on said cover cap to secure and/or resecure said cover cap to said dispensing closure after initial removal and
having annular projection 115 which co-operates with a corresponding
projection 205 on said cover cap tamper band 220 such that upon removal of the said
cover cap the frangible connections 210 between tamper band and lower portion of
20 cover cap wall 212 are severed allowing tamper band 220 to drop away from said
lower portion of cover cap wall 212
and connected thereto
a downwardly extending skirt 104
having a helically threaded section 106 located on the internal face 108 of the said
25 skirt which is adapted to engage with the corresponding helically threaded section on
the external surface of the neck of a container .

Tamper evidence may also be present on or in the dispensing closure body such as by means of foil induction removably welded to the mouth of a container or by a closure
30 tamper band frangibly connected to the lower portion of (referring to Fig 1.) wall 104 .
the dispensing closure 100. Said closure and closure tamper band is of the type and

may be manufactured as disclosed in US Patent 6,640,988 and 6,491,175 which are by reference incorporated herein.

The tamper evident sealing cover cap 200 includes

- 5 Top wall 202 and depending therefrom annular sealing projection 225 which co-operates with annular sealing feature 120 at the orifice of the said dispensing closure to provide a seal to retain the contents of the container and annular side wall 212 and thread or annular clip means 215 and frangible connections 210 and tamper band 220 having annular or interrupted annular projection 205

10

Fig. 11. is an enlarged sectional view of areas 'A' and 'B' of Fig. 10. Enlarged section 'A' shows

- 15 Annular or interrupted annular projection 118 on closure 100 which co-operates with one or more of projections 218 on annular side wall 212 of sealing cover 200 when the said sealing cover is applied or re-applied to the said closure to provide a retention means to retain the said sealing cover in a fully engaged position on the said dispensing closure. Said retention means being such that it can be easily disengaged
- 20 during normal removal and re-application of the said sealing cover from or to the said dispensing closure

- inner wall 208 of cover cap tamper band 220 is angled such that the said wall adjacent to frangible connections 210 is further from the axis of the cover cap than the said
- 25 wall 208 at the end adjacent to projection 205. The said angle 'C' of wall 208 to the axis of the closure is more than 1 degree and less than 90 degrees and preferably 15 degrees. This arrangement allows or promotes the said tamper band 220 to move downwards after separation from frangible connections 210 opening up a visible gap between the lower extremity of said annular side wall 212 of sealing cover 200 so that
- 30 a person viewing the said sealing cover can easily discern that the said sealing cover has been opened

In another embodiment of the present invention (not shown) there is a distinct clearance gap between said wall 208 and projection 115 on the dispensing closure body and projection 205 extends further from the axis of the cover cap. The wall 208 then has a smaller angle to or is parallel to the axis of the closure. This arrangement
5 allows the said tamper band 220 to move downwards after separation from frangible connections 210 opening up a visible gap between the lower extremity of said annular side wall 212 of sealing cover 200 so that a person viewing the said sealing cover can easily discern that the said sealing cover has been opened

10

In yet another embodiment of the present invention (not shown) there is interference between said wall 208 and projection 115 on the dispensing closure body such that upon severing of the frangible connections 210 tamper band 220 is forced downwards by the co-operating angled surfaces of wall 208 and projection 115 opening up a
15 visible gap between the lower extremity of said annular side wall 212 of sealing cover 200 so that a person viewing the said sealing cover can easily discern that the said sealing cover has been opened.

In yet another embodiment or additional feature of the present invention wall 121 of
20 dispensing closure may have an angle 'D' in respect of the axis of the cover cap which ensures clearance between projection 205 on tamper band 220 and said wall 121 as said tamper band fall or is driven downwards after severing of the said frangible connections opening up a visible gap between the lower extremity of said annular side wall 212 of sealing cover 200 so that a person viewing the said sealing cover can
25 easily discern that the said sealing cover has been opened.. The said angle 'D' of wall 121 to the axis of the closure is more than 1 degree and less than 45 degrees and preferably 10 degrees.

Section 'B' shows

30 the tamper band 220 having dropped into annular channel 119 after frangible connections 210 are severed and by the gap between the lower portion of cover cap

wall 212 and tamper band 220 provide clear evidence that the cover cap has been removed.

- 5 Fig. 12. is a cross sectional elevation of a dispensing closure 100 with a tamper evident sealing cover 200 in sealing engagement and with the closure threadingly engaged on the open end of a container neck 600. The general arrangement of these elements are similar to that shown in Fig. 1 but changes to and adjacent to the dispensing orifice have been made in the area circled with a dotted line and marked as
- 10 'D' and more fully described in Fig. 13.

Fig. 13 is a an enlarged cross sectional elevation view of the main elements contained in the circled section 'D' in fig. 3 showing the sealing elements of sealing cover 200 in closure proximity to but not sealingly engaged with dispensing closure 100.

- 15 Dispensing closure 100 having
frusto-conical wall 110 having a
wall with lead in surface 128 which co-operates with outside surface 225A of to assist
in directing annular sealing projection 225 into sealing engagement with said
dispensing closure 100;
- 20 annular or frusto conical sealing surface 120 and
inner surface 110A and connected thereto
disc 105 having
in at least one and preferably 3 locations disc supports 105C are formed between
outside wall 105A of said disc 105 and surface 110A of said wall 110 and
- 25 upper surface 105B may be angled below horizontal in the normal position such that
any contents which remain undispensed on said upper surface 105B with in the area
adjacent to dispensing orifice 125 will be urged under gravity to return to the
container when the container and dispensing closure is in the normal position,.
- 30 Sealing cover 200 has outside surface 225A of annular sealing projection 225 which
as it is moved towards and enters into sealing abutment with annular sealing feature
120 of dispensing closure 100 acts to push any product remaining attached to at least

portion of lead in surface 128 and said annular sealing wall 120 at least towards the upper surfaces of disc 105 and or into the container through orifice 125 or the said product being sealed from atmosphere by the said sealing cover is prevented from drying out and caking or forming a crust and the said product is therefore able to be re-dispensed at the next use.

Said orifice 125 may be of any suitable shape or combination of shapes including circular and/or rectangular and/or ellipsoid and/ or curved or irregular. This arrangement allows the provision of dispensing closures with various dispensing orifice shapes and sizes but which can all be sealed with a common sealing overcap.

10 The arrangement of the said orifice 125 includes the concept shown at Fig. 16 whereby at least part of disc 105 being thin and having at least one and preferably 8 fine slits radially spaced outwards so that the segments formed between the radially spaced slits may flex and displaced more easily so that products which may flow too freely through a larger orifice will be restrained to flow less freely through the small

15 central orifice and said slits but if a larger flow is desired and the container is able to be squeezed to apply pressure to dispense product then the segments formed between the radially spaced slits may flex outwards under said pressure and cause at least the central orifice and adjacent portion of said radially spaced slits to expand and allow product to flow more freely.

20

Fig. 14 . is yet another embodiment of the present invention showing a cross sectional elevation of a dispensing closure 100 with a tamper evident sealing cover 200 in sealing engagement and with the closure threadingly engaged on the open end of a container neck 600. The general arrangement of these elements are similar to that

25 shown in Fig. 10 but this embodiment contains at least one means of controlling or shutting off the dispensing flow of product by increasing or decreasing the pressure applied when squeezing the flexible container to dispense product. The first of said means of controlling or shutting off the flow is shown in the area circled with a dotted

30 line and marked as 'G' and this is described in detail in Fig. 15.

The second of said means of controlling or shutting off the flow is an annular disc of any suitable material such as foamed plastic flexible liner 700 is inserted into the

closure and upon application of the closure is compressed to form a seal between closure and container neck. Said annular disc of foamed plastic flexible liner 700 has one or more shaped cuts or slits 705 which upon a user squeezing or compressing walls of the container and causing an increase in internal pressure and promoting part
5 of the said annular disc of foamed plastic flexible liner 700 at the free edges of slits 705 and especially at intersection point 706 to deform outward thereby creating an opening to allow product to be dispensed. Upon cessation of squeezing a reduction occurs in the internal pressure allowing the deformed portion of said annular disc of foamed plastic flexible liner 700 to return under the influence of the propensity of
10 deformed plastic to tend to return to its original state upon removal of the deforming stress and also the influence of an increase in the volume of the container as it returns to its pre compressed state lowers internal pressure relative such that the pressure is greater on the outside surface of the outwardly deformed part of the said annular disc of foamed plastic flexible liner 700 whereby the said deformed part of the said annular
15 disc of foamed plastic flexible liner 700 is urged to return to its original undeformed position or shape. Said shaped slits cuts 705 forming free edges are preferably in the form of 2 or more intersecting slits as shown in Fig. 16

Fig. 15. is a sectional view of that portion of dispensing closure 100 circled and
20 marked 'G' in Fig. 14. The arrangement of sealing cover 200 and dispensing closure 100 is similar to that shown in Fig. 13 but orifice 125 is absent and instead part of disc 105 is formed as a thin flexible membrane 126 said membrane preferably having a progressively thinner wall section and having the thinnest wall section at the centre , Said membrane may be also be formed with radial slits or have said radial slits added
25 after moulding as shown in Fig. 16 . Said membrane 126 may be formed of the same material comprising dispensing closure 100 or be formed from another more suitable material by injection of said other more suitable material into a mould arrangement (not shown) that allows moulding of one art in one material and then the moulding of the rest of the part from another material of another material. Said membrane may be
30 of any suitable shape or arrangement including a concave or convex shape including a combination curved and linear shapes as shown in Fig.9.

Fig. 16. is a plan sectional view from below cut through the line 'F' 'F' and viewed in direction 'Q' of that portion of dispensing closure shown in Fig. 15 and having wall 110 with inner surface 110A connected to membrane disc 126 and membrane disc supports 105C. Membrane disc 126 has slits 126A which intersect at point 126B and
5 which arrangement operates such that upon a user squeezing or compressing walls of the container and causing an increase in internal pressure and promoting part of the said membrane disc 126 at the free edges of slits 126A and especially at intersection point 126B to deform outward thereby creating an opening to allow product to be dispensed. Upon cessation of squeezing a reduction occurs in the internal pressure
10 allowing the deformed portion of said membrane disc 126 to return under the influence of the propensity of deformed plastic to tend to return to its original state upon removal of the deforming stress and also the influence of an increase in the volume of the container as it returns to its pre compressed state lowers internal pressure relative such that the pressure is greater on the outside surface of the
15 outwardly deformed part of the said membrane disc 126 whereby the said deformed part of the said membrane disc 126 is urged to return to its original undeformed position or shape thereby shutting of or at least substantially reducing flow of product from the dispensing orifice.

20 Fig. 17 is a plan view of (referring to Fig. 14) disc 700 having slits 705. Preferably there are at least 2 slits creating free edges 705 intersecting at point 706.

Fig. 18. is a plan sectional view from below of that portion of dispensing closure 100 above the dotted line E in Fig. 12. and showing wall 110 with inner surface 110A
25 connected to disc 105 and disc supports 105C. Disc 105 has orifice 125. Said orifice 125 or (referring to Fig. 15) membrane disc 126 may be easily varied in shape and dimension by the use of interchangeable inserts in the plastic injection mould assembly (not shown) to enable a variety of dispensing closure to be produced with orifice arrangements suitable for controlled dispensing of a wide range of products of
30 different viscosities and containing particulate matter of various sizes

Fig. 19. is a plan view from above lead in surface 128 of dispensing closure 100 (referring to Fig. 13), and showing wall 110 connected to lead in surface 128 connected to sealing surface 120 connected to disc 105 which has orifice 125.

5

Fig. 20 is another enlargement of a view similar to the view in Fig. 13 and showing yet another embodiment of the present invention in which (referring to Fig. 13) disc 105 with orifice 125 has been replaced with a snap-in sealing orifice assembly having at least one portion similar to that shown in US Patent 6,786,363 which is by reference
10 incorporated in this application. Said sealing orifice assembly 300 consisting of annular body 305 having depending skirt wall 307 which has any known retention means such as clip/projections 318 and 319
said projection 318 co-operates with closure wall recess 130A and projection 130 to retain said assembly in place within closure 100 and provide a sealing means to
15 prevent the contents of a container escaping between said assembly 300 and closure 100 and having annular recess 309 to receive a corresponding projection of annular valve insert 310 which is preferably made of a flexible material such as silicon rubber and having at least one slit 312 (referring to Fig. 21.) which is normally closed but when a corresponding container (not shown) is squeezed the internal pressure
20 increase causes the centre of said annular valve insert to move forward in direction 'Q' and this movement together with the increased internal pressure caused by squeezing the container urges slit 312 to open at least partially and sufficiently to allow fluid product to be dispensed through said open slits 312 in said annular valve insert 310 and
25 valve retention disc 315 which lockingly engages with retention means 319 to retain annular valve insert in position with said projecting portion of said annular valve insert located in recess 109

Fig. 21 shows an enlarged view of sealing assembly 300 as viewed from direction 'Q' and showing annular body 305 and clip/projection 318 and annular valve insert 310
30 having slits 312 said annular valve insert having a concave shape in the normal position being orifice closed and when contents of a corresponding container is placed

under pressure said annular valve insert changes shape and assumes a reverse shape being convex and the free edges of said slits especially at an intersection of said slits 312 are then forced open thereby allowing product to be dispensed through an opening formed by the said forcing apart of the walls of the said slits 312.

5

Fig. 22 shows yet another embodiment of the present invention showing an alternate arrangement of enlarged sectional view of the area 'D' and adjacent area shown in Fig. 12. which has sealing cover 200 in sealing engagement with dispensing closure 100. This view shows invention whereby the sealing orifice assembly 300 (referring to Fig. 20) is replaced with a shaped annular valve insert 310 formed of a flexible and resilient material such a silicon rubber which is retained in place by annular retention projection 142 from closure wall 110. Said retention projection 142 is formed such that point 142A is further from closure wall 110 than point 142B. Annular valve insert 310 is formed so that it follows the shape between closure wall 110 and retention projection 142. Said annular valve insert may advantageously may be shaped to have curved walls being concave when viewed from outside the container and convex or a combination of convex and linear shapes as shown by linear or flat section 328 and having at least one slit 312 (referring to Fig. 21.) which is normally closed but when a corresponding container (not shown) is squeezed the internal pressure increase causes the centre of said annular valve insert to move forward in direction 'Q' and this movement together with the increased internal pressure caused by squeezing the container urges slits 312 to open at least partially and sufficiently to allow fluid product to be dispensed through said open slits 312 in said annular valve insert 310. Said linear or flat section 328 in combination with the convex and concave shapes of forms movable diaphragm 327 which contains said slits 312. Said combination of shapes and slits forming said movable diaphragm is arranged so as to promote the return to a normal slits closed position cutting of the flow of product upon cessation of squeezing the container to dispense product.

Should additional retention means be required additional projections or annular ring projection 143 may be formed on inner wall 110A . The position of said projections 143 may be as shown to allow (not shown) an annular disc to be inserted past said projections so that said annular disc is held in position firmly compressing and

30

holding wall 325 of annular valve insert 310 in position. Said annular disc would have an orifice of diameter at least equivalent to the concave section of annular valve insert 310 so as to allow passage of product to be dispensed. Said projections or annular ring projection 143 may be of different shape and size and also be located to abut and hold
5 in position wall 325 of annular valve insert 310.

In yet another embodiment sealing cover 200 may be absent.

Fig. 23 shows a cross sectional view through the axis of a closure 100 having:
a top wall 102 and depending therefrom;

- 10 an integrally moulded structure 120 consisting of one or more thin walled annular structures 121 separated by gaps 124. The walls of said thin walled annular structures have a large surface area and contain an oxygen scavenging or moisture scavenging or scavenger of taint causing contaminant material, said scavenging material including
15 their derivatives whether organic or synthetically produced.

Fig. 24 shows a cross sectional view through the axis of a closure 100 having:
annular or interrupted annular clip means 105 which act to retain within the closure for example a receptacle insert 126 containing for example an oxygen scavenging
20 material in the form of granules or powder or liquid. Said receptacle may have a sealing cover (not shown) so as to retain said oxygen scavenger material .
Materials or blends of materials have been used to reduce or limit the adverse affect of oxygen or moisture or other contaminants that may spoil or contaminate the contents of a container including food contents or otherwise disaffect its flavour or shelf life of
25 food products in containers.

Methods have been devised for reducing the amount of oxygen which is transported through the container or is contained in the unfilled head space in a container.

- U.S. Pat. Nos. 5,202,052 and 5,364,555 describe polymeric material carriers containing oxygen scavenging material whereby the oxygen scavenging material is
30 activated by contact with water or water vapor. However these materials may be activated prematurely from atmospheric moisture and oxygen surrounding the material prior to use and thus lose effectiveness.

US Patent 6037022 which is by reference incorporated herein discloses a polymer blend especially well-suited for coating paperboard substrates used in food packaging. US Patent 5,811,027 which is also by reference included herein discloses a An improved method of initiating oxygen scavenging by compositions which comprise

5 compounding oxidizable organic compounds and transition metal catalysts to form a composition suitable for forming into films or articles for packaging of oxygen sensitive products is disclosed. The method requires the addition of small amounts of a base to the oxygen scavenging composition as it is being compounded to improve the initiation properties and subjecting the film or article formed from the composition

10 to actinic or electron beam radiation.

Limiting adverse affects of oxygen on the contents of a container may for example be by means of a container closure having affixed to the underside of the top wall a disc or other shaped item consisting of an oxygen scavenging material combined with a polymeric material or alternatively affixing to the underside of the top wall of the said

15 container closure a receptacle containing an oxygen scavenging material or oxygen scavenging material blended with one or more substances to enhance effectiveness of or initiate operation of the oxygen scavenging and said receptacle having a sealing means which retains the said oxygen scavenging material within the receptacle and separate from the contents of the container but said sealing means permitting the

20 passage of at least oxygen and/or carbon dioxide and/or moisture containing or having an acidic nature into the receptacle from the container and/or out of the receptacle into the container. The space inside the diameter of the walls of the plug or bore-seal may also be utilised as a receptacle which may be sealed by known sealing means.

25 More particularly the said closure may be of a type that incorporates one or more of the following annular sealing means such as a wedge-seal or ring-seal respectively sealingly engaging on the top inside edge/ top surface of the container neck opening or a plug-seal or bore-seal sealingly engaging the inner surface of the container neck or an outer neck ring seal sealingly engaging the upper outside surface of the container

30 neck and in such closures the said disc or other shaped item is affixed to the underside of the top wall of the closure inside the diameter of the said annular seals.

The means of affixing the said disc or other shaped item is for example but not limited to by means of adhesive material such as a hot melt glue or by retaining the said disc or other shaped item into a moulded co-operating retention means on the closure by means of an interference fit between the said retention means and the said disc or
5 other shaped item. Advantageously the shape of and the means of affixing the said disc or other shaped item may enhance the total surface area exposed to the contents of the container and/or the air in the unfilled headspace above the level of the filled product in the container so as to enhance the oxygen scavenging or absorbing process by exposing a greater surface area of the said polymeric material containing oxygen
10 scavenging material.

Alternatively the closure itself may be moulded from a polymer containing scavenging material thus avoiding the need for other manufacturing operations to create a disc or receptacle containing scavenger material and/or a disc/receptacle assembly.
15 Advantageously quantities of the closures and/or said disc or other shaped item consisting of an oxygen scavenging material combined with a polymeric material may when the oxygen scavenging material is active or may become active through exposure to ambient atmosphere be stored in packaging which excludes atmosphere and said packaging is only opened at about the time the closure is required to be
20 affixed to the filled container.

The said oxygen scavenging material combined with a polymeric material for example may consist of a polymer such as low density polyethylene (LDPE), ethylene-vinyl alcohol copolymer (EVOH) or any other polymeric material and, mixed therein, from about 0.1% to about 80% by weight of a scavenger material such as
25 an acid-activatable oxygen scavenger such as ferrous carbonate. The oxygen scavenger becomes activated when the polymeric material containing the oxygen scavenger is contacted with an acid-containing liquid or foodstuff or an oxygen scavenging composition comprising an oxidizable organic compound, a transition metal catalyst, optionally a polymeric diluent, and a basic substance and to a
30 method which comprises compounding the basic substance with the remaining components of the composition prior to exposing the composition to radiation, e.g.

actinic or an electron beam. Said radiation including UVA and/ or UVB promotes the activation of the oxygen scavenger.

Fig. 25 shows a cross sectional elevation of closure 100 which is similar to that shown in Fig. 24 but absent receptacle insert 126.

Fig. 26 is a cross sectional plan view of said moulded structure 120 in closure 100 in Fig. 1 taken at dotted line AA and looking in direction X and showing annular walls 121 separated by gaps 124

Fig. 27 is a similar view to that shown in Fig. 26 showing some alternate shapes of walls 121 which serve to increase surface area of said walls thereby allowing more interaction between the contents of a container or the atmosphere in the head space of a container and scavenging material contained within said walls.

Fig. 28 is a cross sectional elevation through the axis of a closure and container neck.

The closure 100 having a top wall 101 and depending therefrom

an annular sealing ring 141 which is also connected to the skirt 105 and which seals against the top and or outside of an annular container neck 200 an annular bore-seal 140 which seals on the inside wall of said container neck 200 an annular or interrupted annular retention means 151 to retain a disc or other shaped object 160 consisting of a polymeric material or a polymeric material containing and acid activated oxygen absorbing material a depending skirt 105 . The skirt having

on its inner wall 106 segmented or continuous helical threads 107 which co-operate with corresponding threads on a container neck (200 in Fig.2) to secure the closure to the container. Advantageously the helical thread has at in excess of 1.625 turns of thread engagement and preferably 2 full turns of thread engagement (not shown) with the said container to ensure that the annular bore seal remains in correct orientation to the neck of the container when the said container is under substantial pressure such as for carbonated contents and

depending from said skirt are frangible bridges 110 connecting tamper evidence means 115 to the said skirt. Advantageously the said bridges must be constructed to as to resist the forces involved when folding the flaps 120 from the as

moulded position into an operating position. Thickening the said frangible bridges to resist stress of the folding process is one solution but it has the undesirable effect of making the bridges less frangible and therefore requiring excessive force to cause operation of the tamper evidence means. A more advantageous solution is to design the frangible bridges having a taper in excess of 1 degree and preferably 5 degrees or greater and tapering from the smallest cross sectional area which is immediately adjacent the lower edge of the skirt 105A and increasing according to the taper angle in cross section progressively to the largest cross sectional area which is in the area connecting to the tamper evidence means 115. Preferably the cross sectional shape is in the form approximating a semi-circular shape or at least a shape with radii between adjoining flat sides which sides are disposed to the adjoining sides at an angle exceeding 90 degrees when referring to the side disposed closest to and approximately parallel or tangent to the outside of the closure and the 2 adjoining sides. Upon commencement of the ejection movement of the bridges from the mould the shape of the bridges tends to urge the said bridges from the mould in a more effective manner than would otherwise be the case with bridges of constant cross section.

Depending from frangible bridges 110 is tamper evidence means 115 with wall 112 and hinge portion 116 which is connected to flaps 120 (shown in an as moulded position) which when folded inwards so that inner walls 122 are in close proximity to the inner surface 113 of wall 112 the free ends 125 are in position to engage with a tamper bead on a container neck 205 (Fig. 2) thus upon removal rotation causing stress on the frangible bridges severing the said bridges and tamper band 115 from the body of the closure. Advantageously the mould which produces the said closure is constructed so as to retain in position the lower edge (105A in Fig. 2.) and at least the immediately adjacent outside surface (105B in Fig. 2.) of the said skirt wall 105 so as to prevent the lateral movement of this portion of the closure during stripping of the closure from the mould. Lateral movement of this area will place stress on the said frangible bridges which may fracture either on ejection from the mould or later after cooling. Alternatively the said bridges must be increased in dimension so as to resist said stress. Making the said bridges thicker to resist stress of the ejection process is one solution but this has the undesirable effect of making the bridges less frangible

and therefore require more force to cause operation of the tamper evidence means. It is important for this type of tamper evidence means using discrete flaps to engage the tamper bead on the container that a minimal force is used to sever the said frangible bridges so as to reduce the possibility of the flaps being so deformed by the force required to sever the bridges that the said flaps 120 roll-over and slip past the said tamper bead 205 on the container neck.

Fig. 29 is a partial sectional elevation of a tamper evident closure 100 and some of the mould elements required to produce said closure. Single piece tamper evident closures of a similar type to said closure 100 are shown in Figs 1, 3, 3A, 4, 4A, 4B, 5, 6, 23, 24, 25 and 28 and the moulds to produce said closures are disclosed in PCT application AU2004/001035, US Patents 6,551,093, 6,626,310 and 6,640,988 the subject matter of which is by reference hereby incorporated herein.

The moulds to produce said tamper evident closures are expensive and although there are standard neck diameter and thread configurations there are many variations of sealing arrangements required on container necks to meet sealing requirements of different products and container/ closure combinations.

It is expensive to make a closure mould for each sealing configuration of closure and container neck and it is an object of the present invention remove the need to construct a new mould for each different sealing configuration required for the same thread configuration and instead to replace a small portion of the mould.

Typically, the said closure is a one-piece construction moulded from thermoplastic and includes:

- a top wall 102 and connected thereto a downwardly extending skirt 104 having a helically threaded section 106 located on the internal face 108 of the said skirt said helically threaded section 106 adapted to engage with the corresponding helically threaded section on the external surface of the neck of a container;
- annular seal 140 and;
- annular sealing member 130 and;
- sealing surface 145 which seals against the top neck surface of a corresponding container. Said sealing surface 145 may have one or more projections and;
- depending from lower surface 112 of the skirt 104 is tamper-evident means consisting of tamper band 110 which is connected to a said lower surface 112 by a frangible

section 114 and said tamper-evident band 110 has an annular wall 120 from which extends more than one discretely spaced tabs 122. The tabs 122 are connected to the lower surface of the annular wall 120 by means of a hinged section 125. Initially, the tabs 122 extend radially inwardly at an obtuse angle with respect to the annular wall 120 to facilitate removal from the mould and said tabs are depicted in this position. The mould to produce said closure 100 includes:

mould element 800 which forms the inner surface of closure 100 including threads 106 and the lower portion of annular seal 140 and;

mould element 880 which forms the upper surface of annular seal 140 and sealing surface 145 and the outer surface including the sealing surface of sealing member 130 and;

interlocking threaded section 890 whereby mould elements 800 and 880 are preferably threadingly engaged or engaged and retained together by known means whereby said mould element 880 may be removed preferably when the mould is normally fully open and replaced with different mould element 880s to produce a closures having different sealing arrangements to annular seals 140 and 130.

The various aspects of the present invention described above may be combined with any one or more of the following:

- (i) Various child resistant features, such as is disclosed in Australian patent 43435/85 (550878) the disclosures of which are hereby incorporated in this application and one of said features may be of the type whereby it is necessary to exert downward force either on the top of the closure or on the top of an over-cap which fits over the top of the closure, such that the downward force overcomes resistance thereby allowing engagement means between the over-cap and the closure to enable removal rotation of the closure to operate the tamper-evident feature and remove the closure from the neck of the container.
- (ii) child-resistant tamper-evident closures, including a "squeeze dropper" type dispensing closure.
- (iii) Dispensing closures for liquids, such as oils.

- (iv) Dispensing closures for particulate matters, such as granular powders and the like.
- (v) The moulding of the closure from more than one type of material. For example, it would assist recycling if the closure tamper-evident band was moulded in the same material as the container. In another example a different colour or type of material may be used to mould the tamper band promoting visual difference between closure body and tamper band or physical performance of the tamper band.
- (vi) Various dispensing means such as, but not limited to, a perforated or partially perforated closure with flip top cover, a flexible membrane with cruciform or other pattern slits or openings to thereby permit the dispensing of container contents or a pump action dispenser or a push/pull valve closing/opening feature.
- (vii) A closure applied by axial rather than rotational motion and closures with more than one thread means.
- (viii) A closure with a cooperating ratchet or engagement means between the tamper-evident band and features on the neck of the container such that cooperation between the said engagement means or any of them upon removal rotation of the threaded closure tends to promote severing of the frangible ribs connecting the tamper-evident band to the skirt of the closure. Said engagement means having ramped surfaces which cooperate during application of said closure to said container neck to reduce rotational force on the tamper-evident band during application reducing the possibility of severing the frangible ribs connecting the tamper-evident band to the skirt of the closure.
- (ix) Various means of employing an additional foil seal to ensure freshness of the contents of a container and which may include a means to pierce the foil.
- (x) Closures made of metal or plastic materials, or a combination of metal and plastic materials as may be useful in hot fill or retorted or vacuum seal packages.
- (xi) Containers made of plastic, metal and glass materials.

Although the various aspects of this invention have been described with reference to specific examples it will be appreciated by those skilled in the art that the invention may be embodied in many other forms.

CLAIMS

1. A container and a closure for connection to said container, said closure including:

an upper wall;

5 a skirt formed integrally with and extending downwardly from said upper wall, said skirt adapted to engage with a neck portion of the container to secure the closure to the container;

a tamper-evident band frangibly connected to said skirt and having at least one tab which when the closure is fully applied to said container neck said tab is oriented
10 inwardly and upwardly said tab having a free end which upon removal rotation of said closure said free end of said tab engages with a corresponding tamper bead on a corresponding container neck to sever said frangible connections;

the neck of the container including a tamper bead adapted to engage with tabs on said tamper-evident band to facilitate separation of the band from the skirt of the
15 closure ;

an inwardly and downwardly sloping neck surface beneath said tamper bead , said neck surface, said inwardly and downwardly sloping surface urging said separated tamper-evident band downwards away from said skirt .

2. The container and closure for connection to said container as claimed in claim
20 1, wherein said closure further includes a sealing means depending from said upper wall, said sealing means adapted to seal against the neck of the container.

3. The container enclosure as claimed in claim 1, wherein said projections include one or more ramped surfaces which engage with engagement surfaces on said tabs of said tamper-evident band to facilitate the breaking of the band from the skirt of
25 the closure.