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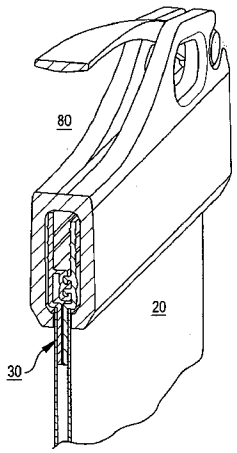
(54) Title: SEALABLE CLOSURE SYSTEMS AND PARTS THEREOF

FIG. 15



(57) Abstract: Flexible, re-sealable containers and systems for retaining solids, liquids, gasses or combinations thereof. Containers and related system embodiments include, in combination or in the alternative, polyethylene and polyurethane laminated panels; linear interlocking closure elements having a pair of opposed sealing members; a removable slider that include structure for accommodating varying thickness sealable closures, for progressively engaging opposing interlock portions of the sealing members of the closure, for engaging portions of a container adjacent to the closure to resist unintended separation thereof and/or engaging portions of the sealing members to provide a means for resisting tensioned separation of the slider from the container, for incorporating permanent or removable handle(s) to facilitate transportation, mounting, attaching or adapting of the container, and/or for selectively modifying the sealing pressure applied to the sealable closures during closure operations; and/or novel high strength apertures/handles that are integral with a flexible container.

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SEALABLE CLOSURE SYSTEMS AND PARTS THEREOF

The invention is directed to flexible, re-sealable containers and systems for retaining solids, liquids, gasses or combinations thereof. Embodiments of the invention comprise, in combination or in the alternative, novel laminated panels; novel sealable closures comprising a pair of opposed sealing members; a novel removable slider that include structure for accommodating varying thickness sealable closures, for progressively engaging opposing interlock portions of the sealing members of the closure, for engaging portions of a container adjacent to the closure to resist unintended separation thereof and/or engaging portions of the sealing members to provide a means for resisting tensioned separation of the slider from the container, for incorporating permanent or removable handle(s) to facilitate transportation, mounting, attaching or adapting of the container, and/or for selectively modifying the sealing pressure applied to the sealable closures during closure operations; and/or novel high strength apertures/handles that are integral with a flexible container.

For purposes of this patent, the terms "area", "boundary", "part", "portion", "surface", "zone", and their synonyms, equivalents and plural forms, as may be used herein and by way of example, are intended to provide descriptive references or landmarks with respect to the object being described. These and similar or equivalent terms are not intended, nor should be inferred, to delimit or define *per se* elements of the referenced object, unless specifically stated as such or facially clear from the several drawings and/or the context in which the term(s) is/are used.

With the foregoing in mind, embodiments of the invention directed to novel laminated panels have at least one panel of the flexible container comprising a laminate of at least two sheets or films (as used herein, "sheet" and "film" are used interchangeably and are intended to denote a material having a large surface area and relatively small sectional thickness, such as the type typically used in the polymeric flexible container arts) wherein the first sheet comprises polyethylene ("PE") and the second sheet comprises polyurethane ("PU"). In embodiments wherein the polyurethane sheet is bonded to the polyethylene sheet, the bonding can be accomplished by adhesives, thermal adhesion, co-

extrusion, or the use of proprietary tie layer(s) between the two polymers. In selected embodiments incorporating this feature, the PE sheet is usually exposed to an interior of the container and the PU sheet is exposed to an exterior of the container, or may be an intermediary ply if incorporated into a three or more ply laminate.

A non-exhaustive summary of the advantages of embodiments incorporating the polyethylene and polyurethane laminated panels is detailed in the following table:

Property	(PE/nylon)	(PE/PU)
Fatigue-related cracking	-----	Better
Fatigue-related pin holes	-----	Better
Fatigue-related delaminations	-----	Better
Ink adhesion	Marginal	Permanent
Resistance to ink solvents	High	Moderate
Noise (crackling sound)	Significant	None
Flexibility	Stiffer	More compliant
Transparency	Slight opacity	Clear
Uniaxial tensile strength	Slightly better	-----
Biaxial (burst) strength	-----	Better
Strain-related whitening	Severe	None
UV resistance	Good	Good (with inhibitors)
Puncture resistance	Better	-----
Tear-out of punched holes	Better	-----
Freeze tolerance	Good	Good
Tolerance to boiling water	Good	Good
Coefficient of friction	Low	High

Embodiments of the invention directed to novel flexible containers having a two part closure system comprise a pair of opposed sealing members that provide means for functionally accommodating high EVA content panels as well as means for accepting a slider as described in more detail below. The sealing members comprise interlock portions that when in registered opposition and compressed, form a gas, fluid and solid-tight seal but may be separated through manual displacement, such as by a "grip and peel" action as is known in the art, *e.g.*, ZIP-LOK® flexible containers. Each sealing member comprises a grip portion, an interlock portion and a flange or panel portion, the latter of which is bonded to a panel of the container or forms a part thereof.

Two part closure system and commonly found in conventional flexible containers of the type described above are often formed from a film composition comprising linear low density polyethylene ("LLDPE") and ethylene vinyl acetate ("EVA"), with the nature of the interlock portion of such closure systems being driven by the mechanical properties of the film. EVA is used to provide flexibility and softness to the closure while LLDPE is used to provide strength and reliability to the closure when sealed. While increasing the content of EVA in a closure system would enhance its usability, existing closure systems would fail during use with a higher than conventional proportion of EVA. However, by using a novel removable slider during use of containers incorporating increased EVA content, EVA content can exceed 30% of the closure composition by weight. While a preferable composition for such closures is 50% EVA by weight, concentrations of EVA in excess of 50% are possible and in some cases desired.

Use of a removable slider according to the invention is a preferred means for accommodating an increased EVA content of the sealing members, although modification to the prior art EVA content of conventional sealing members is not necessary for the use or operation of the slider described herein. Removable slider embodiments according to the invention provide means for restricting separation of the interlock region of the sealing members, preferably by restricting divergence of the flange or panel portion thereof. This is preferably accomplished by restricting separation of the flange/panel portion at or proximate to the interlock portion, as described in more detail below. However, any means for restricting displacement between interlock portions of the closure system is considered within the bounds of the invention.

In certain slider embodiments of the invention, an elongate slot defined by a lower wall of the slider has a lateral width equal to or greater than two times the sectional thickness of the flange/panel portion of a sealing member, but less than the combined sectional thickness of mated sealing members at their interlock portions. The slider further comprises a throat, and preferably longitudinally extending cavity, defined by the slider body, wherein both the throat and the slot are accessible from an end of the slider. Upon introduction of a closed sealing member pair into the throat and slot, a physical restraint to the separation of

flange/panel portions prior to the interlocking regions is provided by the lower wall defining the slot, and any bias tending to separate the flange/panel portions adjacent to the interlock portions is resisted thereby. While it is possible to use a slider having a complementary geometry to closure systems of the prior art (single step embodiments), optimal results are achieved by the preferred embodiments of the invention. For convention purposes, this region of pinch or return portion influence is also referred to as a divergence resistance means.

Slider embodiments of the invention may also comprise, in addition to or in the alternative, at least one laterally displaceable element to facilitate engagement of the sealing members. The at least one laterally displaceable element comprises less than 50% of the total container contacting area of the slider, and preferably less than 10%. The laterally displaceable element preferably comprises a hinged, interlock portion contacting tab. The distance between an internal contacting surface of the tab (the surface that contacts the interlock region of one sealing member) and the opposing internal surface of the slider body is preferably equal to the nominal thickness of a mated pair of sealing members at their interlock portions, thereby reducing creep potential in both the sealing members and the slider when a closure incorporating this feature of the invention is in a closed position. Moreover, such a tab is capable of flexing laterally outwardly to accommodate interlock portions of closures systems having a greater nominal thickness, and is capable of receiving user biased laterally inward force to increase closure bias provided by the tab. In select embodiments of the invention, two opposing tabs are used, both performing substantially the same function. A preferred material of construction is acetal resin, which provides low friction, high stiffness, and low creep properties. In addition, acetal resin responds mechanically to temperature variations similarly to the preferred sealing members composition.

To enhance usability of embodiments employing at least one laterally displaceable element to facilitate engagement of the sealing members, the internal surface thereof may have a compound curvature: a compound curvature or surface progressively acts on the interlock portion of a sealing member pair, *i.e.*, during translation of the slider, a first part of the interlock portions is mated

and then a second part is mated. This feature reduces engagement forces during the sealing process.

It should be noted that the at least one laterally displaceable element is preferably functionally independent of the divergence resistance means, which is used to minimize sealing surface separation forces, as previously mentioned. This separation of function and physical location permits one to tailor both the geometry and composition of each element/feature for its intended purpose, and avoid functionally undesirable compromises.

In addition to the foregoing, sliders according to the invention may incorporate various surface features and apertures to increase functionality of the slider and increase the utility of any container linked thereto. For example, certain embodiments may include a raised feature adjacent to the at least one laterally displaceable element to facilitate movement of the slider across a closure system. This raised feature also provides increased structural foundation for the at least one laterally displaceable element, thereby distributing forces over a larger area, which increases longevity of the slider. In addition, various holes may be formed in the slider or extending handle interface, both for increasing functionality (structural mounting interfaces such as for use with hanging clips commonly employed with hydration reservoirs) as well as reducing weight.

In addition to the foregoing, the slider may be constructed with an integral handle (either a closed aperture or a projecting arm such as a "J" or "T" handle), or provide a handle interface for receiving a removable gripping member, as will be discussed below.

While any form of handle that is removable from the slider (or a slider providing removable handle means) is considered within the scope of the invention, certain embodiments of the invention providing for a removable handle have at least one handle receiving portion, and preferably two handle receiving portions. In selected embodiments thereof, a handle interface of the slider defines two lug receiving holes, preferably longitudinally displaced along the slider interface. A flexible elongate handle, having lugs at the terminal ends thereof, is then received by the slider. If the handle is not desired or weight considerations are paramount, it can be omitted and the integral apertures of

certain embodiments of the slider can be solely relied upon. Moreover, because of the generic nature of the handle receiving portions defined by the slider, different forms of handles can be adapted for use with the slider. In addition to the foregoing, the lug receiving holes can be configured such that the mounting interface is self-energizing, *i.e.*, the higher the handle load, the greater the securing force between the handle and the slider.

BRIEF DESCRIPTION OF THE FIGURES

Fig. 1 is a perspective partial view of a flexible fluid container having an integrated spout;

Fig. 2 is a is a plan partial view of a flexible fluid container;

Fig. 3 is an end view of a prior art two part closure system having two sealing members each including a flange/panel portion, a grip portion and an interlock portion wherein one sealing member includes a step;

Fig. 4 is an end view of a two part closure system according to an embodiment of the invention having two sealing members each including a flange/panel portion, a grip portion and an interlock portion wherein both sealing member include a step;

Fig. 5 is a cross section elevation view of the closure system of Fig. 4 shown bonded to two panels of a flexible container;

Fig. 6 is a perspective view of a slider embodiment according to the invention;

Fig. 7 is a front elevation view of the slider of Fig. 6;

Fig. 8 is an end view, in perspective, of the slider of Fig. 6 particularly detailing a throat and hinged tabs used to effectuate engagement between sealing members of a two part closure system;

Fig. 9 is a cross section bottom plan view taken along the lines 9—9 in Fig. 7 particularly detailing a cavity formed by the body side walls and upper wall;

Fig. 10 is a detailed view of the hinged tabs shown in Fig. 9 at the body throat;

Fig. 11 is a perspective view of the slider of Fig. 6 engaged with closure system and container of Fig. 5;

Fig. 12 is a bottom plan view of the slider of Fig. 6 particularly illustrating a slot defined by a lower wall of the slider body;

Fig. 13 is a cross section elevation view taken along the lines 13—13 in Fig. 12;

Fig. 14 is an end elevation view, in perspective, of the slider of Fig. 6 particularly detailing the slider body throat, hinged tabs and slot; and

Fig. 15 is a cross section elevation view in perspective of a system according to the invention including a container having a two part closure system according to an embodiment of the invention and a slider according to an embodiment of the invention.

DESCRIPTION OF THE INVENTION EMBODIMENTS

Preface: The terminal ends of numeric lead lines in the several drawings, when associated with any structure, references or landmarks described in this section, are intended to representatively identify such structure, references or landmarks with respect to the object being described. They are not intended, nor should be inferred, to delimit or define *per se* boundaries of the referenced object, unless specifically stated as such or facially clear from the drawings and the context in which the term(s) is/are used. Unless specifically stated as such or facially clear from the several drawings and the context in which the term(s) is/are used, all words and visual aids should be given their common commercial and/or scientific meaning consistent with the context of the disclosure herein.

Turning then to the several drawings, wherein like parts are numbered the same, embodiments of the invention are shown. The invention embodiments are directed to flexible containers of the type commonly used for holding solids and fluids. Figures 1 and 2 provide representative views of container 20, which includes panels 22a and 22b, spout 24 and welds 26. Handles or orifices 28 may be formed in the weld areas to increase the utility of container 20.

While spout 24 provides convenient fluid ingress and egress into and from container 20, a larger orifice is needed with respect to many solids, *e.g.*, ice cubes. In this respect, a full panel opening may be necessary, which then requires the ability to fluidly seal such opening. Conventional two part closure systems have been used in the past to accomplish this objective, and have relied upon structure the same as or similar to that shown in Fig. 3. While adequate for their intended purposes, such systems provide inadequate in certain environments and when constructed from non-conventional polymeric formulations.

Two part closure system 30, which is shown in Fig. 4, particularly in conjunction with slider 80 shown representatively in Fig. 6, permits one to use optimized polymeric formulations while retaining structural integrity, *i.e.*, the ability to retain fluids with out common failure. When bonded to panels 22a and 22b of container 20, a final result is shown in Fig. 5.

Each sealing member 32a and 32b, registered and opposed pairs of which form closure system 30, comprises strip 34 with three primary portions, namely, panel portion 40, grip portion 50, and interlock portion 70. For convenient reference, each such portion or element for any given seal will include the seal's suffix, *i.e.*, "a" or "b". Thus, interlock portion 70a is necessarily associated with sealing member 32a. However, when any such portion or element is referred to generically, no such suffix will be used.

As intimated from the chosen nomenclature, grip portion 50 of strip 34 functions to provide a user with an accessible means for separating grip strips 52a and 52b, and therefore interlocking portions 60a and 60b. To enhance the usability of grip strips 52a and 52b, raised features and/or protrusions 54 may be formed one, the other or both grip strips. Such protrusions may be formed on inner surface 36a of strip 34a at grip portion 50a, on inner surface 36b of strip 34b at grip portion 50b, on outer surface 38a of strip 34a at grip portion 50a, on outer surface 38b of strip 34b at grip portion 50b, and/or combinations of the above. The protrusions may be discrete, *e.g.*, dots, bumps, and/or geometric forms, and/or may be extended rectilinear and/or curvilinear lines. These friction enhancing means can be provided to address gripping issues that may arise due to the presence of gloves on a user's hands, the presence of a lubricant-type

substance on the user's hands, lack of dexterity of a user's hands due to extreme temperatures, and similar manipulation handicaps. In addition, certain forms of these raised features and/or protrusions provide additional structural rigidity to grip portion 50, thereby facilitating association with slider 80 as will be set forth in more detail below.

While sealing members 32a and 32b are shown as being strip-like and not integral to panel 22a or 22b, the skilled practitioner will appreciate that sealing members 32a and 32b may be formed integrally with a panel or panels during its formation, or may be separately bonded or otherwise secured to a panel in a post panel formation action, as is the case for the illustrated example. Therefore, each respective panel portion 40 as shown in the several drawings is intended to be sealing secured to panels 22a and 22b, and may be considered in this embodiment to comprise panel portions 40a and 40b.

Positioned between panel portion 40 and grip portion 50 is interlock portion 60. Interlock portions 60a and 60b are formed to sealingly mate with each other when in registered opposition to each other and subject to compression as is known in the art. Each interlock portion comprises a base 62 from which extend lands 64 having heads 66 that define geometrically complementary grooves 68. In the illustrated embodiment, strip 34a at interlock portion 60a forms base 62a while base 62b is offset from strip 34b by offset 63b. While presently preferred, the skilled practitioner will appreciate that the presence or absence of offset 63b or the coextensive nature of strip 34a and base 62a at interlock portion 60a is not necessary to the function of providing a fluid-tight seal between sealing members 32a and 32b.

The skilled practitioner will also appreciate the geometric form and asymmetry of heads 66, which beneficially resist disengagement from corresponding grooves when the container is a sealed state and panel portions 40a and 40b are displaced. The location and nature of offset 63 further benefits this objective. However, such structure and geometry is not necessary to the operation of the invention embodiments, and only represent one form of expression thereof.

Located approximately at the interface between panel portion 40 and interlock portion 60 is step 72 for each sealing member 32a and 32b. Steps 72a and 72b provide a means for displacing interlock elements 70a and 70b from each other, thereby permitting panel portions 40a and 40b at pinch zones 44a and 44b (see Fig. 5) to retain close proximity to each other when sealing members 32a and 32b are engaged. As will be seen below, steps 72a and 72b beneficially provide a means for interaction with slider 80, enabling slider 80 to function, in addition to a means for compressively mating sealing members 32a and 32b, as a means for transporting container 20 by compressively contacting bearing surfaces 74a and 74b of steps 72a and 72b, respectively.

While the illustrated embodiment shows steps 72 as extending generally orthogonally from panel portions 40, the skilled practitioner will appreciate that any extension angle and/or geometric form achieving the function of interlock element displacement to any degree will suffice. Preferably, any such angle and/or form will also permit panel portions 40a and 40b at pinch zones 44a and 44b (see Fig. 5) to retain close proximity to each other when sealing members 32a and 32b are engaged.

Slider 80, which is best shown in Figs. 6-15, is preferably constructed from an acetal polymeric material, which provides high strength and longevity while also providing a light weight product. Although shown in linear form, slider 80 may be formed with a constant radius curvature in planar and/or compound geometry. The skilled practitioner will appreciate that any corresponding closure system will need to take such geometry into account.

Slider 80 performs several functions in combination with container 20, each of which may be separately exploited and/or exploited in various combinations, and which are considered to be within the scope of the invention. In a non-exclusive and non-ordered listing, a first function of slider 80 relates to its ability to progressively compress interlock portions 60a and 60b thereof. A second function relates to its ability to retain panel portions 40a and 40b at pinch zones 44a and 44b in close proximity to each other when sealing members 32a and 32b are engaged. A third function relates to its ability to function as a container carrying interface by exploiting the geometry of interlock portion 60. A fourth function relates to its ability to be fully removed from container 20 should a

user so desire (*e.g.*, when maximum displacement between sealing members 32a and 32b, or enhanced ability to store or use, is desired).

Slider 80 comprises body 82 having upper portion 84, lower portion 90, ends 104 and 108, and sides 100a and 100b. Upper portion 84 comprises upper wall 86 and handle interface 120 extending there from. End 108 includes end wall 109, which together with upper wall 86 and sides 100a and 100b define body cavity 102 (see Fig. 9, 10, 13, and 14). End 104 includes throat 106, which is generally defined by upper wall 86 and sides 100a and 100b, as best shown in Figs. 6, 8, 10, and 14. Lower portion 90 includes slot 92, which is defined by lower wall 94 as best shown in Figs. 8, 12 and 14. In particular, side surfaces 96a and 96b define slot 92, and, as will be described in more detail below, bear against pinch zones 44a and 44b during use of container 20 to prevent separation of panels 22a and 22b. In addition, lower portion 90 includes bearing surfaces 98a and 98b that, as will be described in more detail below, provide compressive support to bearing surfaces 74a and 74b of steps 72a and 72b, respectively.

Body 82 of slider 80 further includes dynamic elements in the form of hinged tabs 110a and 110b having interlock portion contacting surfaces 112a and 112b, which when opposingly compressed by a user when sealing members 32a and 32b are present there between, operate to provide the necessary compressive force to interlock portion 60. By translating sealing members 32a and 32b there past, a user can wholly interlock the seals. A benefit to this configuration is that seals of various geometries and thicknesses can be accommodated, which is not true for static sealing arrangements.

The skilled practitioner will of course appreciate that a hinged linkage or association with body 82 is not the only means for accomplishing a dynamic compressive bias to the seals, that the illustrated location and/or orientation of hinged tabs 110a and 110b on sides 100a and 100b of body 82 is/are not exclusive (e.g., the illustrated tab orientation could be rotated 90°, 180° or 270°, or for that matter any degree) and/or that more than one such dynamic element is required. As such, any laterally displaceable element or elements positioned on slider 80 that is/are able to compressively contact at least one of sealing members 32a and 32b when operatively disposed within cavity 102 will meet the

requirements of this aspect of the invention embodiment. Collectively, such (an) element(s) is/are referred to as (a) dynamic compressor(s).

A benefit to the arrangement disclosed above and equivalents thereof is that a relatively large distance between active contacting surfaces 112a and 112b of hinged tabs 110a and 110b can be maintained to accommodate sectionally thick closures (and if provided with outward movement capabilities as is the case with the illustrated embodiment, up to the minimum lateral distance within cavity 102), while still retaining the ability to functionally engage interlock portion 60 for a given seal. Thus, slider 80 can be used in conjunction with a wide variety of closures.

The association or use of slider 80 with container 20 also provides a means for resisting the divergence of panels 22a and 22b at pinch zone 44 when container 20 is full or the internal pressure thereof exceeds ambient/external pressure. While the geometry of interlock zone elements attempts to mitigate the effects of this divergence, additional resistance is provided by side surfaces 96a and 96b, which define slot 92, through which pinch zones 44a and 44b extend. This divergence resistance means is particularly useful in conjunction with containers and/or seals having a comparatively high EVA content (i.e., softer and/or compliant panels and/or seals).

As the skilled practitioner will appreciate, lower wall 94 and/or side surfaces 96a and 96b of slider body 82 need not be continuous in order to realize the benefits to separation resistance provided by this structure. Segmented walls and/or surfaces can be employed and achieve the same or similar end results and are therefore considered equivalents thereof.

Lower wall 94 of slider body 82 also may provide functionality in addition to panel divergence resistance, namely, support of container 20 against gravity (e.g., carrying, hanging, etc.). As described previous, steps 72a and 72b comprise bearing surfaces 74a and 74b that compressively interact with bearing surfaces 98a and 98b of body lower wall 94 when slider body 82 and container 20 are in relative tension as is best shown in Fig. 15. As was the case with respect to the panel divergence resistance means, the skilled practitioner will appreciate that lower wall 94 and/or bearing surfaces 98a and 98b of slider body

82 need not be continuous in order to realize the tension resistance benefits provided by this structure. Segmented walls and/or surfaces can be employed and achieve the same or similar end resistance to orthogonal separation there between, and are therefore considered equivalents thereof. As used herein, the term "orthogonal" refers to a direction substantially perpendicular to the direction of slider travel along the container wherein a tension force is present between the slider and the container.

In addition to providing means for resisting orthogonal separation between slider body 82 and container 20, slider 80 functions as an interface for container carrying, hanging and the like. To this end, handle interface 120 extends from upper wall 86, and provides in the illustrated embodiment several holes and a receiving arrangement for a flexible handle (see Figs. 6-8). By so doing, a user need not rely upon holes and other structure formed in or attached to container 20, which may be susceptible to tearing, peeling or other forms of structural failure, particularly when container 20 is large or has significant mass. Moreover, this robust means for placing or carrying container 20 is removable; when not needed, slider 80 can be removed and later re-engaged. Of course, the skilled practitioner will appreciate that any variety of placement and/or transporting accoutrements can be associated with handle interface 120, and such are not to be limited to those explicitly disclosed herein.

A feature of slider 80 is its ability to receive flexible handle 122. Handle 122 comprises polymeric ribbon 124 having two end to which are attached lugs 126. In turn, lugs 126 fit in receivers 128 formed in handle interface 120. Following the theme of presence only when desired, handle 122 can be conveniently removed and again installed as desired.

What is claimed:

1. A flexible container for holding solids, liquids, gasses or combinations thereof comprising:

a first panel having an outer surface, an inner surface and a perimeter at the outer periphery thereof; and

a second panel having an outer surface, an inner surface and a perimeter at the outer periphery thereof

wherein at least part of the first panel perimeter is sealingly joined to at least a part of the second panel perimeter and part of the first panel perimeter opposes at least a part of the second panel perimeter to define a sealable opening, and wherein at least one of the first panel inner surface or second panel inner surface comprises polyethylene, and at least one of the first panel outer surface or second panel outer surface comprises polyurethane.

2. A flexible container according to claim 1 further comprising a removable slider adapted to removingly engage at least a portion of the sealable opening.

3. A flexible container according to any previous claim wherein the removable slider comprises a slot defined by a lower wall sized to receive at least the two panels and provide resistance to separation there between when disposed therein.

4. A flexible container according to any previous claim wherein the sealable opening comprises a two part closure system having first and second interlock portions each having a step adjacent to corresponding interlock elements.

5. A flexible container according to any previous claim wherein the slider comprises bearing surfaces to contact at least a portion of each step when a tension force is applied between the slider and the container.

FIG. 1

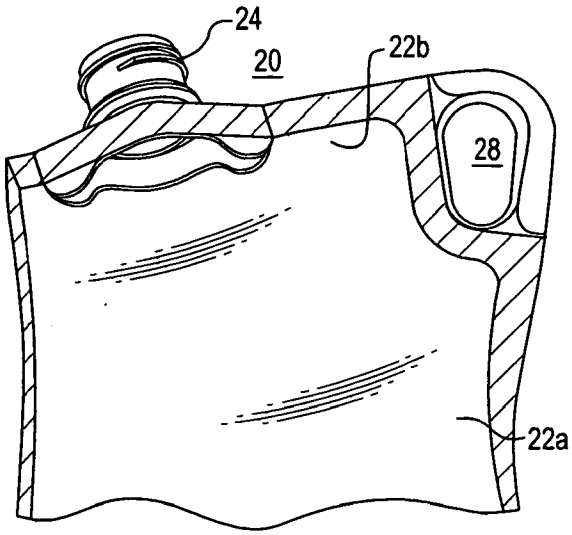

FIG. 2

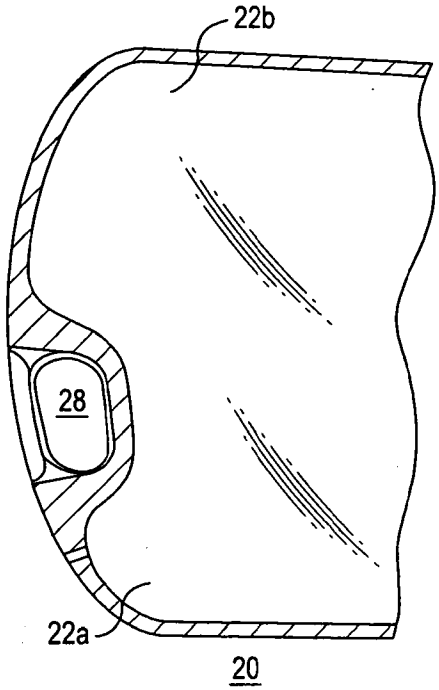

FIG. 3
PRIOR ART

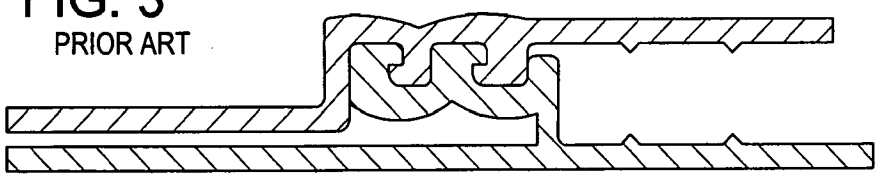

FIG. 4

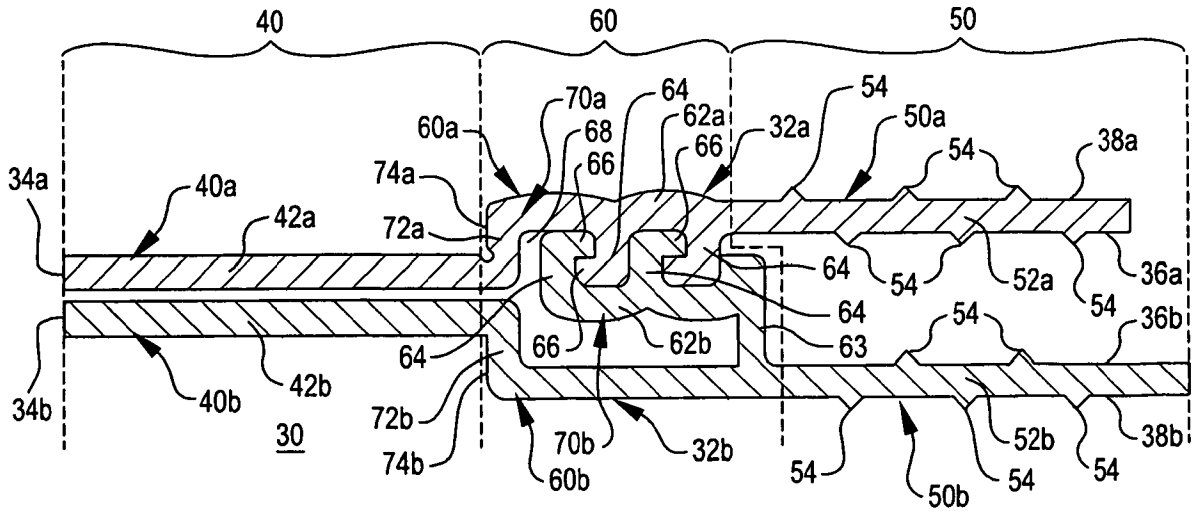

FIG. 5

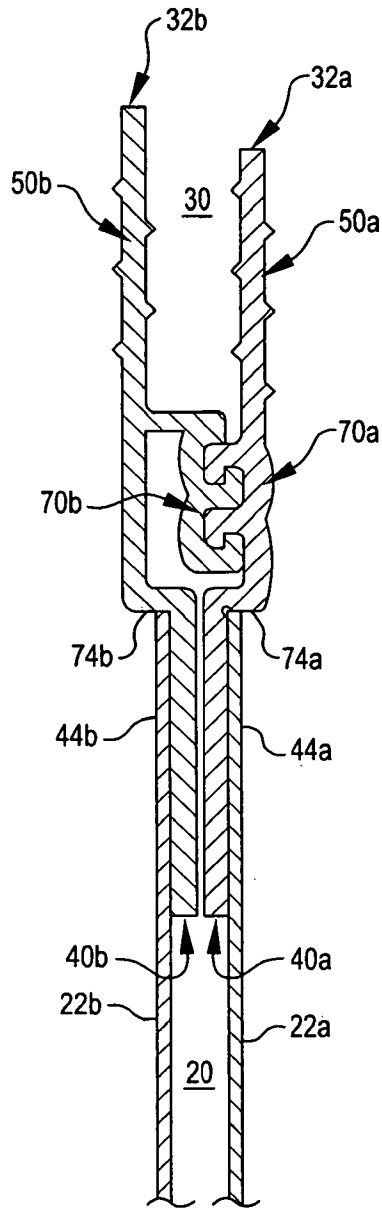
32b
32a
50b
30
50a
70a
70b
74b
74a
44b
44a
40b
40a
22b
22a
20

FIG. 6

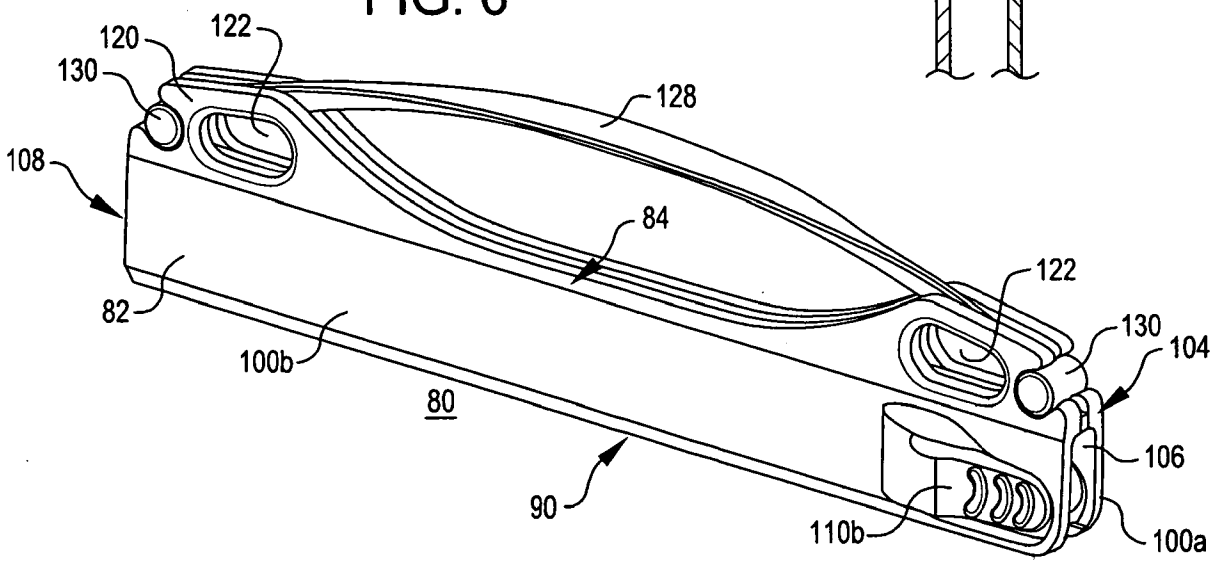
120
122
130
128
108
84
82
122
130
104
100b
80
106
90
110b
100a

FIG. 7

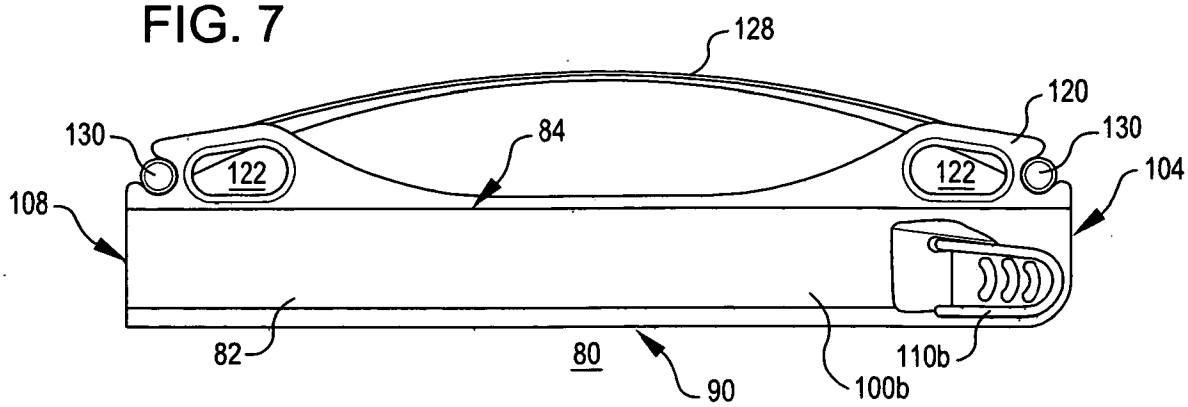

FIG. 8

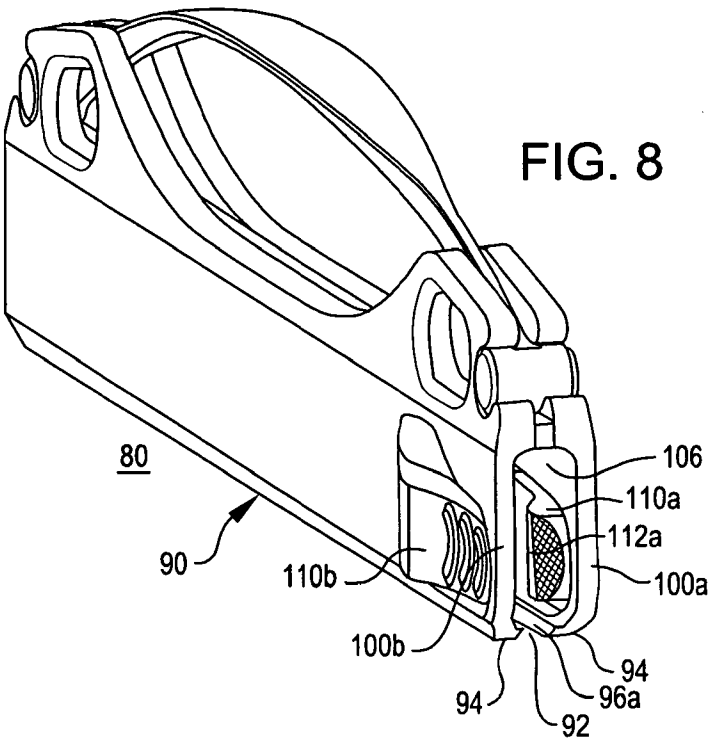

FIG. 9

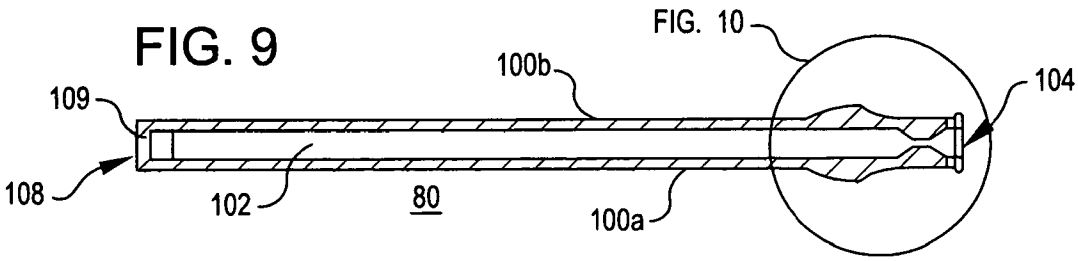

FIG. 10

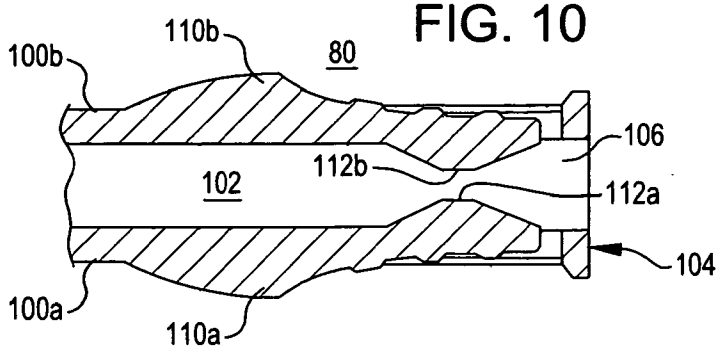

FIG. 11

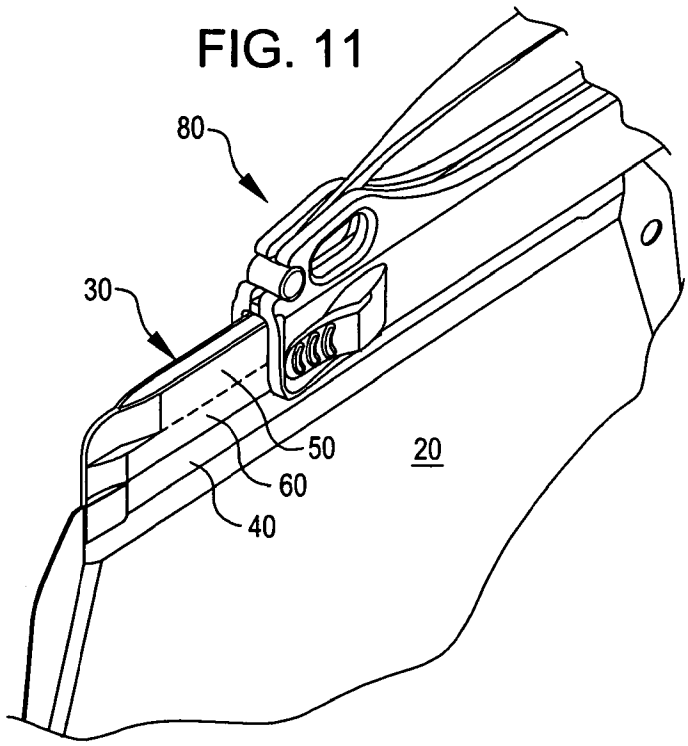

FIG. 12

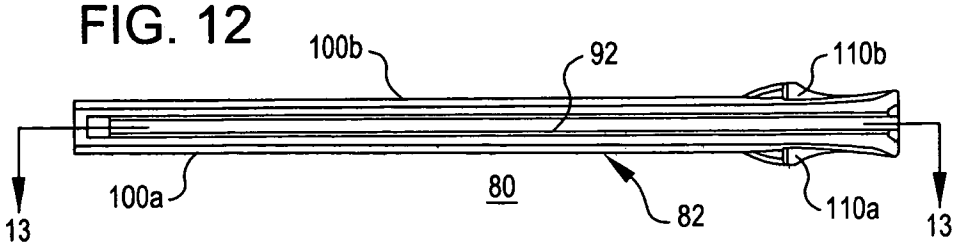

FIG. 13

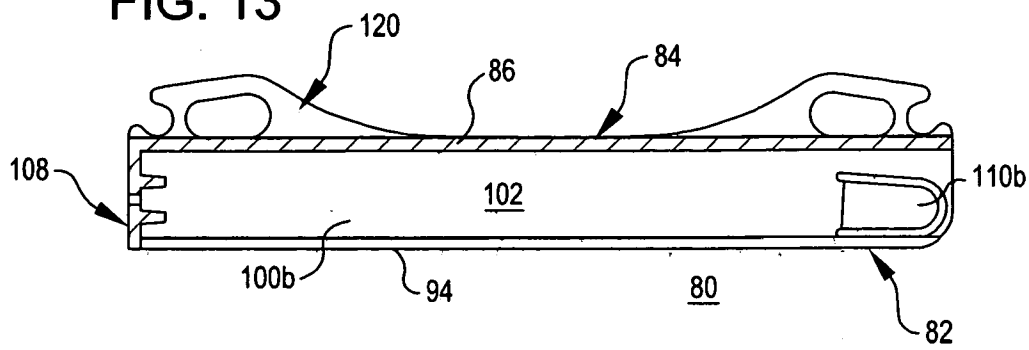

FIG. 14

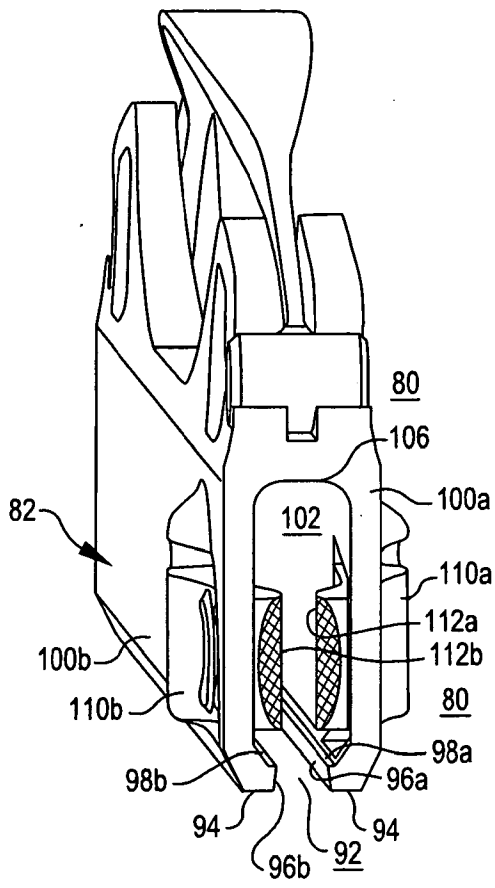

FIG. 15