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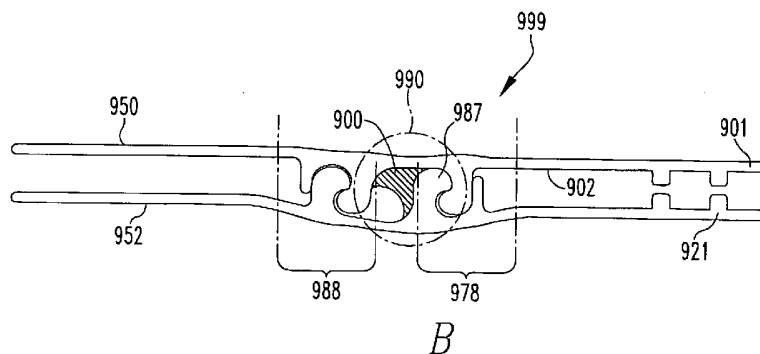
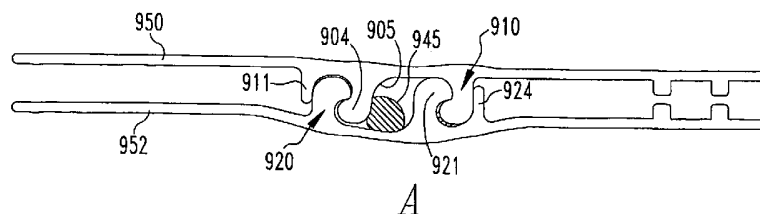
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[Continued on next page]

(54) Title: HIGH-INTEGRITY CLOSURE



(57) Abstract: The present invention provides a resealable closure structure (999) which provides at least one region of continuous gas-sealing abutment (900) upon engaging the interengaging members (988, 978) of the closure. The closure provides a region of gas sealing abutment by one or more of: (i) mechanical abutment of closure features (1010, 1013) and associated therewith a caulking composition (990) and/or a sealing material (945); and (ii) defining a void region (1030) by proximity of closure features when interengaging members of the closure are engaged (1020, 1021) which has gas-sealingly infiltrated thereinto a caulking composition (945).



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HIGH-INTEGRITY CLOSURE

Cross Reference to Related Applications

[0001] This application claims the benefit of U.S. Provisional Application Serial Nos. 60/590,858 filed on July 23, 2004, 60/602,685 filed on August 19, 2004, 60/609,920 filed on September 15, 2004 and U.S. Application Serial No. 11/186,131 filed on July 20, 2005, the disclosure of each of which is fully incorporated by reference herein.

Field of the Invention

[0002] The present invention relates to a closure comprising at least two interengaging profiles which optionally includes a sealing material and which optionally has associated therewith a caulking composition. The present invention also relates to a storage device having a closure which defines the opening of the storage device and a method of manufacturing the same.

Background of the Invention

[0003] Flexible, sealable storage devices, such as Consumer Storage Bags are commonly used to store items such as, but not limited to, food. These packages typically have a bag body made from a thin, flexible plastic material and include an opening defined by a resealable closure. Typically the resealable closure includes at least one pair of profiles which interlock to close the package opening. In general the profiles are designed with undercut portions which interlock when the profiles are pressed together, and disengage when the profiles are pried apart. However, in general, in a resealable closure engagement of the structures does not provide continuous sealing contact between structures on opposite portions of the closure, leaving gaps along the region where the closure profiles are engaged. Consequently, closures containing gaps between the interlocking portions permit exchange of gases and vapors between the interior of the package and the ambient environment in which the packaged materials are stored. Moreover, during manufacture of reclosable devices, frequently seals at the ends of the reclosable device distort the engaging portions of the closure which can also provide an unsealed region in the closure.

[0004] As a consequence, when a bag have a resealable closure is subjected to a pressure differential, for example, when it is evacuated or when there is a partial pressure differential of a particular gas between the inside and outside of the bag, gas and/or vapor exchange readily occurs across the resealable closure, entering or leaving the sealed package through the closure. Thus, gases, for example, air may penetrate into a sealed bag, or for

example water vapor may leak from a sealed bag. This is especially a problem when the interior of the bag is at a different pressure than the ambient air, for example, when the bag is under a vacuum, or when the bag contains a gas at a higher or lower partial pressure than the gas or vapor than is present in the ambient, for example, when a package containing a high moisture content material is stored in a refrigerated environment where there is a low partial pressure of water vapor. Developments have been undertaken in the design of bag bodies to address such gas and vapor exchange through the walls of the package, for example, forming the storage device body from materials which comprise multiple layers of material, for example, the bags described in U.S. Patent No. 4,756,422, which is incorporated herein by reference.

[0005] Exchange of gas and vapor in a stored food item, for example, oxygen and water vapor, can lead to despoliation of a foodstuff contained in the storage device. As mentioned above, excessive air within a storage device containing food is not desirable as the air reacts with the food and will cause spoilage. This problem is exacerbated when storage bags are placed in a below freezing environment, typically in a freezer, imparting "freezer burn" to the stored food items. Freezer burn occurs when moisture is drawn from the food item and forms ice, typically on the food item. Freezer burn is reduced when entrapped air is substantially eliminated from the storage device, for example, by contouring of the bag wall of the storage device around the food item, providing for a reduction in the amount of moisture drawn out of the food item. However, expulsion of residual air prior to sealing the storage device is rendered nugatory when exchange of gas and vapor is possible between the ambient environment and the interior of the sealed storage device across a resealable closure. This problem has been solved in some vacuum systems by providing a package which does not utilize a resealable closure, but instead utilizes a heat sealing mechanism to permanently seal the storage device after evacuation. Such systems however, have the disadvantage that once opened the storage bag is useless for further storage. Attempts to address this problem in packages having a resealable closure include the provision of an adhesive seal within the opening of the package inboard of the reclosable structure. However, such adhesive seals are generally reserved for commercially prepared packages in which a consumable commodity is placed in the bag prior to making the seal. In such packages, the adhesive seal is broken by the end user prior to consumption and is not reusable. Accordingly, such adhesive seals are

not suitable for applications involving resealable storage packages for use in providing a reusable bag which is initially filled by an end user.

[0006] Heretofore, resealable closures have utilized one or more pairs of interlocking profiles to close the opening of the storage device. These closures comprise a pair of opposed flanges on either side of the package opening, each of which contains at least one stem projecting therefrom having a profile attached to the free end of the stem which contains an undercut feature disposed to interlock with an undercut feature on a similar profile affixed to the free end of a stem projecting from the opposite flange. Accordingly, previous closures employ interlocking parts configured to resist separation of the interlocked parts, but which are not designed to insure that at least some portion of each profile maintains sealing contact with a portion of the opposite profile to form a high-integrity seal between the two halves of the closure. Accordingly, the gaps between the engaged profiles of these prior art closures provide a pathway for ready exchange of gas and vapors between the interior of the sealed package and the ambient environment in which the package is placed.

[0007] Thus, there is need for a resealable closure which provides for a high-integrity, resealable seal in at least some portion of the closure between a feature on each of the opposed flanges of the closure. Accordingly, there is a need for a flexible, resealable storage device wherein the sealing structure has a resistance to gas and vapor (fluid) permeability across the sealing device. Moreover, there is a need for a closure providing reduced permeability to oxygen, atmosphere intrusion or transmission, bacteria, molds and/or other sources of contamination when placed in an environment where there is a pressure differential across the closure.

Summary of the Invention

[0008] These needs, and others, are met by the present invention which in one embodiment provides a resealable closure comprising at least one pair of interengaging members affixed to opposed portions of the closure, characterized in that engaging said interengaging members creates at least one region of gas-sealing abutment between said pair of opposed closure portions. In some embodiments the resealable closure comprises more than one pair of interengaging members. In some embodiments engaging said interengaging members creates more than one region of gas-sealing abutment between said opposed closure portions.

[0009] In some embodiments the present invention provides a resealable closure comprising: (i) at least one set of interengaging members disposed on opposing portions of the closure such that bringing together said opposing portions with an applied engaging force engages said interengaging members; (ii) optionally a member selected from the group consisting of a slider and a closing clip disposed on the closure to bring said opposing closure portions together with an engaging force when operated from a first position to a second position; (iii) optionally a sealing material comprising one or more portions of the closure; and (iv) a caulking composition provided on the closure in void-sealing disposition to at least one pair of opposing features, each said feature disposed on one of said opposed closure portion to abut the other said feature when said interengaging members are engaged, the caulking composition characterized in that engaging said interengaging members abuts said at least one pair of opposed closure features and gas-sealingly infiltrates said caulking composition into at least one void defined by said abutted opposing closure features, thereby providing a region of gas-sealing abutment between said void-defining abutting opposed features.

[0010] In some embodiments the closure is formed from a material comprising a high melt index (MI) polyolefin. In some embodiments the high MI polyolefin has a density of at least about 0.925 g/cm³ as measured in accordance with ASTM D1505-03 (November 1, 2003). In some embodiments, welded portions of the closure comprise a sealing material.

[0011] In some embodiments, a region of gas-sealing abutment is provided by providing a sealing material disposed in at least one abutting portion of at least one of said opposed pair of closure portions. In some embodiments, a region of the closure comprising a sealing material is formed by co-extruding a high melt index polymer and the sealing material to form the closure.

[0012] In some embodiments the sealing material comprises a material selected from low melt index polymers, for example, a low density polyolefin, for example, polyolefin having a density of less than about 0.925 g/cm³ as measured in accordance with ASTM D1505-03 (November 1, 2003), low density polyethylene and polyolefins containing an amount of vinyl acetate to yield a blend having a low melt index, as measured in accordance with ASTM D-1238 – 04c.

[0013] In some embodiments a region of gas-sealing abutment is provided by a caulking composition disposed to infiltrate at least one void defined by abutting portions of the two opposed closure portions. In some embodiments the caulking composition comprises a

bead of material associated with the interengaging portions of the closure. In some embodiments the caulking composition is disposed proximal to at least one crush weld area of the closure.

[0014] In some embodiments the caulking composition comprises a mixture suitable for at least incidental contact to food items. In some embodiments the caulking composition is constituted to maintain caulking properties without denaturing or separating over a temperature range of from about -10°F to about +160°F. In some embodiments the caulking composition is selected to change state from a free-flowing liquid to a viscous solid as the temperature decreases, for example, over a temperature range from about -40 °F to about 140 °F.

[0015] In one embodiment the caulking composition comprises liquid silicone and fumed silica, in proportions to provide a grease with a grease consistency number of approximately 2.0, as characterized by National Lubricating Grease Institute (NLGI) standards. In one embodiment the caulking composition comprises a soy adhesive, for example, Pro-cote® soy polymer available from DuPont™ (E. I. du Pont de Nemours and Company). In another embodiment, the caulking composition comprises soy oils, for example, those available from Cargill™ Industrial Oils & Lubricants. In one embodiment the caulking composition comprises two reactive constituents, each residing on a different portion of the closure, such that when the interengaging profiles of the closure are engaged the two constituents are admixed, providing a reaction product which infiltrates at least one void defined by the interengaging closure profiles.

[0016] In some embodiments the inventive resealable closure defines an opening into the interior space of a storage package. In some embodiments said opposed portions of the closure comprise opposed flanges and each of said interengaging members of the closure is affixed to a proximal face of one of each of said flanges. In some embodiments the opposed portions of the closure comprise plastic sheets forming opposed walls of a flexible package proximal to a package opening and said first interengaging and profile members of the closure are each affixed directly to one of said opposed walls.

[0017] In some embodiments the interengaging members of the closure comprises a single locking member on one of the opposing portions of the closure which is disposed to engage a profile on the other opposing portion of the closure when the two opposing portions of the closure are brought together with an engaging force. In some embodiments the

interengaging members comprise a pair of interlocking profiles each mounted on one of the opposing portions of the closure and disposed to interengage when the opposing portions are brought together with an engaging force. In some embodiments each of the interengaging members comprises multiple pairs of locking members which are configured and disposed on opposing portions of the closure to define a series of voids such that the locking members affixed to one opposed portion of the closure interdigitate with those affixed to the other opposed portion of the closure when the opposing portions are brought together with an engaging force.

[0018] In some embodiments at least one pair of interengaging members of the closure comprises:

- (A) a first interengaging member comprising:
 - (1) at least one profile portion affixed to the proximal face of a first opposed portion of the closure, said profile portion comprising:
 - (a) a first locking member comprising:
 - (i) a first stem member joined to the proximal face of said first opposing portion of the closure; and
 - (ii) a first head member affixed to the free end of said first stem member;
 - (b) a first post affixed to said first opposed portion proximal face substantially parallel and proximal to said first stem member, said first post disposed to define a first channel with said first head member, and wherein said first stem member, first head member, and said first post together are configured and disposed to define a first void region;
 - (c) optionally a third post affixed to said first opposed proximal face substantially parallel to said stem on the side of the stem distal from said first post;
 - (d) optionally a fourth post affixed to said opposed proximal face substantially parallel and proximal to said first post on the side of said first post distal from said first head member;
- (B) a second interengaging member comprising:
 - (1) at least one second locking member joined to a proximal face of a second opposed portion of the closure, said second locking member comprising:
 - (a) a second stem member joined to said proximal face of a second opposed portion of the closure;

- (b) a second head member affixed to the free end of said second stem member;
- (2) optionally a second post affixed to said second opposed portion proximal face substantially parallel to said second locking member, disposed to define a second channel with said second head member, wherein said second stem member, said second head member and said second post are configured and disposed to define a second void region; and
- (3) optionally, when a second post is present, a fifth post mounted substantially parallel and proximal to said second post on the side of said second post distal from said second locking member,

wherein the closure is further characterized in that each of said first and second interengaging members are disposed such that when the proximal faces of the opposed closure portions are brought together with an applied engaging force, the head of said second locking member is received into the channel defined by said first stem and first head member, and said second locking member is engaged within the void region defined by said first engaging member.

[0019] In some embodiments, the head members have a cross-sectional shape which is asymmetric relative to the centerline of their respective stem members. In some embodiments, the head members have a cross-sectional shape which is symmetric relative to the centerline of their respective stem members.

[0020] In some embodiments, each opposing closure portion contains a series of locking members defining a series of channels and void spaces. In some embodiments the interengaging members of the resealable closure comprise:

- (a) at least two locking members, each said locking member comprising:
 - (1) a stem affixed to a proximal face of an opposed portion of the closure;
 - (2) a head member affixed to the free end of said stem; and
- (b) optionally, one or more posts,

wherein, when the interengaging members are engaged the locking members affixed to each said opposed closure portion are interdigitated. In some embodiments the series of locking members have asymmetrically mounted head members and the locking members comprising one of said interengaging members are rotationally symmetrical with the locking members of the other of said interengaging members. In some embodiments, the head members are symmetrically attached to said stems, and, when present, said posts are configured and disposed to form, together with an adjacent locking member, a void which has a cross-

sectional shape that is complimentary to a locking member comprising said opposed interengaging member which is interdigitated between said post and adjacent member upon engagement of said interengaging members.

Brief Description of the Drawings

[0021] A full understanding of the invention can be gained from the following description of the preferred embodiments when read in conjunction with the accompanying drawings in which:

[0022] Figure 1 is a cross-sectional side view of a resealable closure of the invention utilizing an interengaging member on each flange, each of which defines also a profile.

[0023] Figure 2 is a cross-sectional side view of a closure having a single set of interengaging members wherein the interengaging members define also a profile on each flange and wherein each profile has associated therewith an additional post.

[0024] Figure 3 is a cross-sectional side view of a closure having a single set of interengaging members wherein the interengaging members define also a profile on each flange and wherein one profile has associated therewith an additional post distal from the engaging face of the profile.

[0025] Figure 4 is a plan view of a profile comprising one half of a closure illustrating regional distribution of sealing material and regional application of caulking composition across the profile.

[0026] Figure 5 is a cross-sectional side view of the closure of Figure 3 which contains additional an adhesive caulking composition.

[0027] Figure 6 is a cross-sectional side view of a closure illustrating the distribution of caulking composition external to the interengaging portions of the closure.

[0028] Figure 7 is a cross-sectional side view of a closure having symmetrical interengaging members.

[0029] Figure 8 is a cross-sectional side view of a closure which includes a sealing material coextruded at the tips of the interengaging members.

[0030] Figure 9A is a cross-sectional side view of a closure having a pair of interengaging members, and distributed therebetween, a caulking composition which is not infused into the voids in the interengaged closure members.

[0031] Figure 9B is a cross-sectional side view of a closure having a pair of interengaging members, and distributed therebetween, a caulking composition which is infused into the voids between the interengaged closure members.

[0032] Figure 10 is a cross-sectional side view of a closure having a pair of interengaging members and additional post members configured to abut each of the interengaging members on their exterior edge.

[0033] The present invention is now discussed in more detail referring to the drawings that accompany the present application. In the accompanying drawings, like and/or corresponding elements are referred to by like reference numbers.

Detailed Description of Preferred Embodiments

The Closure

[0034] With reference to Figure 1, the closure of the present invention comprises a pair of opposed portions (101, 121) having mounted on each proximal face thereof (110, 130) at least one of a pair of interengaging members (100, 120) disposed on the proximal faces such that when the opposed portions of the closure are brought together with an engaging force the interengaging members are engaged. The closure is further characterized in that when the interengaging members are engaged, at least one region of gas-sealing abutment is created between the opposed portions of the closure.

[0035] In closures of the present invention, gas-sealing abutment comprises one or more of: (i) mechanical contact (abutment) between one or more features or regions of each of the opposed closure portions in conjunction with: (a) a caulking composition disposed to gas-sealingly infiltrate any voids defined by the abutting features; and/or (b) one or more of said contacting features on at least one of the opposed closure portions comprising a sealing material (discussed herein below in greater detail); and (ii) gas-sealing infiltration of a caulking composition into one or more void spaces defined by one or more features on each of the opposed closure portions being positioned proximal when the interengaging members of the closure are engaged (described herein below in greater detail). Accordingly, gas-sealing abutment can comprise a region of mechanical contact between features affixed to each of the two opposed portions of the closure, or a void region defined by a feature on each of the opposed portions of the closure that are positioned proximal upon engagement of the interengaging members and into which a caulking composition is gas-sealingly infiltrated.

[0036] An example of gas-sealing abutment arising from mechanical contact is illustrated, for example, in Figure 9A wherein a bead of sealing material (945) is placed into abutment with locking member (905) when the interengaging members are engaged. An example of void defined upon engagement of the interengaging members by features on each of the opposing portions of the closure being placed proximal with gas-sealing infiltration of a caulking composition thereinto is illustrated, for example, in Figure 2, by the shaded area about the engaged interengaging members located between post (226) and post (206) which has been infiltrated with a caulking compound (shaded portion designated generally 250), and in Figure 9B, the void region traversing the length of the closure between opposing closure portions (901, 921) in which caulking compound (900) is infiltrated. With reference to Figure 10, for example, mechanical contact is illustrated by abutment in region (1011) of post (1001) with post (1010), and in region (1013) of post (1002) with post (1012), which occurs when interengaging member pairs (1020, 1021) are engaged.

[0037] Mechanical abutment and void-defining proximity can be established upon engagement of the interengaging members using either features associated on or within the interengaging members, for example, as shown and discussed above in Figures 9 and 2, or between features affixed to each of the opposed closure portions remote from the interengaging members of the closure, for example, as shown in Figure 6, wherein abutment occurs between posts (606, 626) abutting closure bead features (646, 645) respectively, outside of the portion of the closure comprising the interengaging members, that is, outside of region (650). In further example, as illustrated in Figure 10 by void region (1030) which traverses the closure, and which is defined by the proximity posts (1001, 1010, 1002, and 1012) upon engagement of the pairs of interengaging members.

[0038] In some embodiments the closure will comprise more than one set of interengaging members, for example, as illustrated in Figures 9A and 9 B and in Figure 10 which has two pairs of interengaging members residing in parallel (1020 and 1021, respectively). When multiple pairs of interengaging members are present, gas-sealing abutment can comprise a caulking composition infiltrated into the void region defined between the sets of engaged interengaging members of the closure, for example, region (1030).

[0039] In addition to the interengaging members and the structures forming the region of gas-sealing abutment between opposed closure portions discussed above, the closures of the present invention may comprise other features, for example, gripping tabs (70), as

illustrated in Figure 1, and (868, 869), as illustrated in Figure 8. Optionally the closure may include also a closing clip such as are known in the art to engage the interengaging members or a slider, such as are known in the art to facilitate opening and reclosing the closure.

[0040] The closure of the present invention will be most useful when employed to close the opening of a flexible package, for example, a plastic bag. Accordingly, the opposing portions of the closure may comprise a pair of flanges for example, as illustrated in Figure 1, flanges (101, 121), and as illustrated in Figure 8, flanges (850, 852), which will be used to affix the closure to a bag opening. Alternatively, the closure of the present invention may comprise portions of the opposing walls of a bag into which the features of the closure have been directly molded.

[0041] As will be appreciated, when the opposed portions of the closure comprise a flange, in some embodiments the closure features may be disposed at one edge of the flange, also termed herein sometimes for convenience as a two-flange closure. In some embodiments comprising a flange the closure features may be disposed centrally on the flanges, also termed herein sometimes for convenience as a four-flange closure.

[0042] In general, whether formed on a flange or as a molded-in portion of a bag, the closure will be extruded as a continuous strip. For some applications in which the closure is formed as part of a flange, sections of the closure strip may be precut to desired length before being utilized in the formation a package. In general, the flanges of the inventive closure will be affixed to the opening of a package, for example, a bag. The flanges may be welded or adhered to the package opening. In some embodiments the ends of the closure will include a crush-weld or crush-seal region that bonds the two opposed portions of the closure together. In some embodiments, with reference to Figure 4, the closure will be extruded having intermittent regions comprising a sealing material (230) such that a length of closure which is crush-welded will include in the weld a sealing material. In this manner the sealing material serves as a flux, melting at a lower temperature than the base material from which the closure is made, thus insuring that the weld junction between the closure portions has hermetic properties and does not permit gases to leak past the closure crush-seal area.

[0043] In accordance with the extruded nature of the closure described above, it will be appreciated that many of the closure features which are described in terms of a cross-sectional shape will be features that traverse the length of the closure. Within the length of a closure, particularly with regard to features of the closure which abut in providing a region of

gas-sealing abutment, local imperfections, defects, and irregularities in the abutting closure surfaces may give rise to local void regions being defined. Moreover, in some embodiments which include a crush-weld or crush-seal region bonding the two opposed portions of the closure together, a void will be defined in the closure proximal to the region of the crush seal wherein the opposed closure portions are distorted from abutting by the weld. In other embodiments, for example, as illustrated in Figure 9B, features on opposed portions of the closure will be placed proximal by engagement of the interengaging members of the closure define a void region that traverses the length of the closure, for example, the region occupied by caulking composition (900) which traverses the length of the closure between interengaging members (978, 988) which has been gas-sealingly infiltrated by caulking composition (900, shaded). When the opposed closure portions define either a local void or a closure traversing void, gas-sealing abutment is provided by gas-sealing infiltrating of a caulking compound into the void when the interengaging members are engaged. This is discussed herein below in detail.

[0044] As will be appreciated, the closure of the present invention may also comprise features in common with known closures, for example, markings to facilitate production and/or fixture of the closure to a package, for example stripes or colored portions to aid optical placement equipment in the assembly of a closure to a package during manufacture of the package.

[0045] In general, the inventive closure will be prepared from a high melt index (MI) polyolefin. In some embodiments the high MI polyolefin has a density of at least about 0.925 g/cm³ as measured in accordance with ASTM D1505-03 (November 1, 2003). In some embodiments, the package of which the inventive closure defines an opening, will also be prepared from a high MI polyolefin. In some embodiments, the package can comprise a multi-layer structure comprising a combination of a layer of puncture-resistant polymer, for example, nylon, and an inner layer of a sealing material, for example polyethylene. Bags of this type are described, for example, in U.S. Patent No. 4,267,960 to Lind et al., which is incorporated herein by reference in its entirety.

[0046] As will be appreciated, the structural details of the interengaging members utilized in closures of the present invention may vary, as illustrated, for example, in Figures 1-3 and 5-9 showing cross-sectional profiles of several embodiments of the inventive closure.

[0047] Next will be described in turn the interengaging members of the closure and various structures related thereto, the sealing material, and the caulking composition.

The Interengaging Members

[0048] As mentioned above, in the present closure at least one pair of interengaging members is disposed on one of the opposed portions of the closure. Engaging the interengaging members causes at least one region of each of the opposed portions of the closure to gas-sealingly abut. In one embodiment of the present closure, to insure that continuous gas sealing abutment is provided between opposed portions of the closure in at least one region, with reference to Figure 5 the closure has at least one pair of interengaging members comprising:

- (A) a first interengaging member comprising:
 - (1) at least one profile portion (500) affixed to the proximal face of a first opposed portion (501) of the closure, said profile portion comprising:
 - (a) a first locking member (502) comprising:
 - (i) a first stem member (503) joined to the proximal face (505) of said first opposing portion (501) of the closure; and
 - (ii) a first head member (504) affixed to the free end of said first stem member (503);
 - (b) a first post (506) affixed on said first opposed portion proximal face (501) substantially parallel and proximal to said first stem member (503), said first post (506) disposed to define a first channel (507) with said first head member (504), and wherein said first stem member (503), first head member (504), and said first post (506) together are configured and disposed to define a first void region (508);
 - (c) optionally a third post (509) affixed to said first opposed portion proximal face (505) substantially parallel to said stem on the side of the stem distal from said first post;
 - (d) optionally a fourth post (510) affixed to said first opposed proximal face substantially parallel and proximal to said first post on the side of said first post distal from said first head member;
- (B) a second interengaging member (520) comprising:

- (1) at least one second locking member (522) joined to a proximal face (525) of a second opposed portion (521) of the closure, said second locking member (520) comprising:
 - (a) a second stem member (523) joined to said proximal face of a second opposed portion of the closure (521);
 - (b) a second head member (524) affixed to the free end of said second stem member;
- (2) optionally, a second post (526) affixed to said second opposed portion proximal face (525) substantially parallel to said second locking member (522), dimensioned and disposed to define a second channel (527) with said second head member (524), wherein said second stem member (523), said second head member (524) and said second post (526) are configured and disposed to define a second void region (528); and
- (3) optionally, when a second post is present, a fifth post (529) affixed substantially parallel and proximal to said second post (526) on the side of said second post distal from said second locking member,

wherein the closure is further characterized in that each of said first and second interengaging members are disposed such that when the proximal faces of the opposed closure portions are brought together with an applied engaging force, the head (524) of said second locking member (522) is received into the channel (507) defined by said first post (506) and first head member (504), and said second locking member (522) is engaged within the void region (508) defined by said first engaging member (500). In some embodiments, for example, those illustrated in Figures 2, 9A and 9B, the head member of the locking members has a cross-sectional shape which is asymmetric relative to the centerline of the stem affixing the locking member to the opposed closure portion. In other embodiments, for example, those illustrated in Figure 7, the head member of the locking members have a cross-sectional shape which is symmetric relative to the centerline of the stem affixing them to the opposed closure portion.

[0049] In some embodiments one of the opposed closure portions contains at least one locking member as a stand alone feature, for example, with reference to Figure 1, locking member (103). In some embodiments, both opposing closure portions have a locking member and post defining a channel which is rotationally symmetric with the locking member and post on the other opposing portion of the closure, for example, as illustrated in Figure 2. In these

embodiments, the closure is also referred herein sometimes for convenience as “a closure containing interlocking profiles.”

[0050] In some embodiments, the interengaging portions of the closure comprise at least one pair of interlocking profiles wherein the head member of the stem and head portion of the profile is mounted asymmetrically on the stem. Accordingly, the head and stem portion of each profile, which functions as a first interengaging member with respect to the profile mounted on the opposed portion of the closure, has an engaging face (side of head proximal to said stem) and a non-engaging face (side of the head distal from the stem). In this embodiment the engaging faces of the stem and head portion are disposed on the opposing portions of the closure in an inverted relationship with respect to each other, and thus the engaging faces of each head member interlock when the opposing profiles are engaged. In one embodiment having interlocking profiles, for example, as illustrated in Figure 2, the stems (231, 232) and head member (204, 224) of each opposing locking member (203, 223) has a cross-sectional profile comprising a “J”-shape, disposed such that the stem and head member(s) of each opposing profile are positioned with the projecting portion of the “J”-shape defining the engaging face of the head member such that the stem and head member of the profile on each opposing portion of the closure are in an inverted relationship with respect to the stem and head member of corresponding interlocking profile on the opposed portion of the closure.

[0051] In some embodiments, the interengaging members of the closure comprise multiple locking members affixed to each of the opposing portions of the closure disposed such that upon engagement of said interengaging members said opposed multiple locking members are interdigitated.

[0052] In another embodiment of the present invention, the resealable closure device further comprises more than one set of interengaging members, for example, two sets of interlocking profiles positioned in close proximity and substantially parallel to each other. For example, as illustrated in Figures 9A, 9B and 10. In one embodiment having multiple pairs of interlocking profiles, a bead of caulking composition may be positioned within the space separating the substantially parallel sets of opposed interlocking profiles.

[0053] In some embodiments, for example, those illustrated in Figures 7 and 8, the closure comprises interengaging members comprise a series of locking members affixed to each of the opposed portion of the closure, which interdigitate when the opposed portions are

brought together with an engaging force. Accordingly, with reference to Figure 7, the interengaging members can comprise multiple locking members (766, 762) and (764, 760) affixed to each proximal face accompanied by one or more posts (782 and 780, respectively), which are configured symmetrically and disposed such that the post and locking members affixed to the proximal face of one opposed portion (e.g., 780, 764 and 760) define a complimentary void region in which the heads of the locking members affixed to the other opposed portion (782, 762 and 766) are engaged when the opposed portions of the closure are brought together with an engaging force. In the example illustrated in Figure 7, the heads of locking members (760, 762, 764 and 766) are affixed to their respective stems such that they are in cross-section symmetrically disposed on the stem. The posts contain an asymmetric shape which compliments the post and stem of the adjacent locking member to define a void region between the post and locking member suitable to engage the locking member affixed to the opposed closure portion.

[0054] Alternatively, as illustrated in Figure 8, the heads of locking members (868, 866, 864 and 863, 865, 867) are attached offset on their respective stems by which they are affixed to opposed closure portions (852 and 850, respectively). Accordingly, they have an asymmetric cross-sectional profile. Moreover, the two sets of locking members are disposed on their respective opposed closure portions such that they are rotationally symmetric, the offset portion of the head of locking members (868, 866 and 864) being disposed to engage the offset portion of the head of locking members (867, 865 and 863, respectively). Posts (880, 882) are configured to compliment the configuration of the non-offset face of locking members (868, 863, respectively).

[0055] As mentioned above, numerous configurations of interengaging members will be suitable for use in a closure of the present invention, so long as they provide sufficiently robust engagement to maintain the closure in a sealed condition under the conditions of use. In general, when engaged the interengaging members hold one or more portions of the closure in proximity to define a void region into which a caulking composition is gas-sealing infiltrated, or place one or more features on each of the opposed portions of the closure into mechanical abutment which, in conjunction with a caulking composition associated with the abutted features and/or a sealing material incorporated into at least one of the abutted features, provides at least one region of gas-sealing abutment between the opposed closure portions.

[0056] Mechanical abutment can be provided by selecting the dimensions and/or placement of closure features. For example, with reference to Figure 6, mechanical abutment can be provided by selecting the dimensions of parts of the interengaging members to create an interference fit between the engaging portions of the interengaging members. For example, by selecting the dimensions for the closure parts illustrated such that the gap between post (606) and head member (615) of interengaging member (650) is narrower than the width of stem (623) of locking member (624) provides abutment between the sides and head of locking member (614) and stem (623) of locking member (624). Alternatively, abutment can be provided by two features not associated with the interengaging members, for example, with reference to Figure 5, selecting the dimensions of post (509) to abut flange (521) in the region between posts (526, 529) when the interengaging members are engaged.

[0057] Alternatively, the placement of multiple pairs of interengaging members can be selected to provide mechanical abutment between features affixed to opposed portions of the closure. Accordingly, with reference to Figure 9A, selecting the disposition of locking member (910) and the center of the channel defined by post (911) and head member (904) to be greater or lesser than the distance between locking member (920) and the center of the channel defined by post (924) and head member (921) forces abutment between various portions of the pair of interengaging members when the two pairs of interengaging members are engaged.

[0058] Additional features may also be provided on at least one of the opposed portions of the closure to provide mechanical abutment with a feature on the other opposed portion of the closure. For example, with reference to Figure 9, a bead of sealing material (945) disposed on opposed closure portion (952) to abut the back side of locking member (905) will provide a region of gas-sealing abutment when the interengaging members are engaged. It will be appreciated that numerous other arrangements of the features of the closure can be utilized to provide an abutting interaction between at least one region of each of the opposed closure portions which, when coupled with a caulking composition and/or a sealing material provides gas-sealing abutment.

[0059] In some embodiments, the interengaging members are provided with locking members having a portion that comprises a sealing material, described in detail herein below. With reference to, for example, Figure 8, locking members (864, 866 and 868) comprise sealing material (899) disposed as a bead traversing the length of the locking member head, in

the center of the head of each locking member. In this manner, when the interengaging members on opposed closure portions (850, 852) are interdigitated, the bead of sealing material (899) is abutted to the opposed closure portion, as described below, providing a gas-sealing abutment.

[0060] Interengaging members are known, for example, those used in conventional resealable closures, for example, as described in U.S. Patent Nos. 5,356,222, 5,252,281 and 5,248,201, each of which is incorporated herein by reference in its entirety. These known closure can be employed in the present invention so long as they are sufficiently robust in their engaging properties to maintain sealing abutment in the closure and additionally, they employ means for insuring at least one region of gas-sealing abutment between opposing portions of the closure when the closure portions are engaged. Examples of means for insuring gas-sealing abutment include, for example, a caulking composition disposed to gas-sealingly infiltrate voids defined in the abutting regions of the closure and a sealing material provided in one or more of the abutting regions of the closure, as described in detail herein.

The Caulking Composition

[0061] In closures of the present invention, the closure comprises a caulking composition gas-sealingly infiltrated into at least one void defined by proximal features of opposing portions of the closure when the interengaging members of the closure are engaged or defined by incomplete mechanical abutment between abutting features affixed to opposing portions of the closure. Accordingly, prior to engagement of the interengaging member, the caulking composition is associated with portions of the closure which either will mechanically abut upon engagement of the closure, or associated with features of the closure that will impinge the caulking compound in defining a void region by their proximity when the interengaging members of the closure are engaged, thereby in either case gas-sealingly infiltrating the void region or regions defined by the opposed portions of the closure.

[0062] With reference to Figure 2, the void defined by a region of abutment between the pair of opposed closure portions upon engaging the locking members (231, 232) of the interengaging members of the closure of Figure 2 can be a small localized gap, for example, one that exists over just a localized region, for example, region (220) defined by the engaged interengaging members of the closure where there is a gap in mechanical abutment. Alternatively, or additionally, with further reference to Figure 2, a caulking compound can be infiltrated into a gap traversing the closure which is defined by features on each of the opposed

portions of the closure maintained proximal by engagement of the interengaging members, for example, the void illustrated as region (250, shaded), which extends the length of locking members (231, 232), between locking member (232) and flange (201).

[0063] Thus, for example, as illustrated in Figure 3, a bead of caulking composition can be distributed on locking member (324) and/or in the channel defined by locking member (303) and post (304) prior to engagement of the interengaging members, which will be distributed, by virtue of mechanical abutment of the closure features, within any voids present in the members when engagement occurs, and thus gas-sealingly infiltrated into at least one void defined between the locking members of the opposed closure portions. In addition, or alternatively, a bead of caulking can be placed in or along a feature on one or both opposing portions of the closure where a feature affixed to one opposing portion of the closure closely approaches a feature on the other opposing portion of the closure. Accordingly, the closely approaching feature(s) contact the caulking bead and distribute the caulking composition within the void defined between the proximal opposing closure portions. For example, with reference to Figure 3, a bead of caulking composition placed into the well formed by post (313) and locking member (303) will be gas-sealingly infiltrated into the void defined by post (333) and region (314) when the interengaging members are engaged by virtue of the caulking bead being impinged by post (333) upon engagement of the interengaging members. A further illustration is with reference to Figure 9B, wherein a bead of caulking material residing on opposing closure portion (901) between interengaging members (978, 988) is impinged by locking member (987) upon engagement of the interengaging members, and gas-sealingly infiltrated (900) within the void defined by locking member (987) and proximal face (902) of opposing portion (901) between the pairs of interengaging members.

[0064] In some embodiments a caulking composition is associated with multiple regions of the opposed closure portions including the interengaging members and features remote from the interengaging members that are abutted when the interengaging members are engaged. It will be appreciated that the physical properties of the caulking composition and the dimensions and features of the closure can be selected to provide closures having many other shapes and sizes of abutting features and features defining void areas, and associated therewith, disposed to gas-sealingly infiltrate one or more voids defined by these closure portions, a caulking composition.

[0065] In some embodiments the caulking composition is placed on or proximal to selected areas of the closure to seal portions of the closure that are prone to have gaps, for example, applied to the ends of a closure near a crush area affixing opposing portions of the closure together. In some embodiments the caulking composition is applied to the closure as a continuous bead along the closure, for example, on or between one or more of the interengaging members of the closure.

[0066] In closures of the present invention, the constituents of the caulking composition are selected such that when the caulking composition infiltrates one or more voids defined by the engaged interengaging members of the closure, it imparts a gas and vapor permeation-resistant seal to that portion of the closure. Thus, the caulking composition is selected generally to have an affinity for the materials of construction of the closure and to resist degradation in the ambient environment. Moreover, in general the caulking composition maintains plastic characteristics under the conditions of use such that it will flow under applied pressure, for example, pressure suitable to engage the interengaging members.

[0067] In some embodiments the caulking composition comprises a mixture suitable for at least incidental contact to food items and in some embodiments it is suitable for direct food contact. In some embodiments the caulking composition comprises constituents such that it maintains caulking properties without denaturing or separating over a temperature range of from about -10°F to about +160°F. In some embodiments the caulking composition is selected to change state from a free-flowing liquid, for example, at a temperature at which a fill is provided within the package, for example, about 65°F, to a viscous semi-solid, for example, at a temperature at which the filled package is stored, for example, about (minus)-40°F.

[0068] In one embodiment the caulking composition comprises liquid silicone and a filler, e.g. fumed silica, in proportions to provide a grease with a grease consistency number of approximately 2.0, as characterized by National Lubricating Grease Institute (NLGI) standards. In one embodiment the caulking composition comprises a soy adhesive, such as Pro-Cote® soy polymer available from DuPont™. In another embodiment, the caulking composition comprises soy oils, for example, those available from Cargill™ Industrial Oils & Lubricants. In one embodiment the caulking composition comprises two reactive constituents, each residing on a different portion of the closure, such that when the interengaging profiles of the closure are engaged the two constituents are admixed, providing a reaction product which

infiltrates at least one void defined by the interengaging closure profiles. For example, with reference to Figure 5, a bead of reactant (540) which, upon engaging the interengaging members, admixes with a bead of reactant (541) when post (509) contacts flange (521) in the vicinity of reactant (541).

The Sealing Material

[0069] In some embodiments, one or more portions of the closure comprise a sealing material. In some embodiments comprising a sealing material the material is selected to have a high degree of conformance and is disposed on the closure to gas-sealingly abut an opposing portion of the closure. In some embodiments at least one portion of the closure includes a coextruded bead of sealing material, for example, a bead along a portion of a profile or a bead along the head of a locking member. In some embodiments comprising a sealing material, the closure comprises a sealing material incorporated into a welded area of the closure, for example, a crush seal at a closure end.

[0070] With reference to Figure 1, region (102) of opposed closure portion (101), which is located at the bottom of a well defined by adjacent posts (103, 104) affixed to opposed portion (101), comprises a sealing material. When the interengaging members (104, 120) are engaged, post (123), which is affixed to opposed closure portion (121), will abut the region of the closure comprising sealing material (102). Post (123) is formed from a high melt polyolefin which is harder than the sealing material. Accordingly, the region of sealing material will yield and conform to the end of post (123), thereby establishing gas-sealing abutment between post (123) and the region of sealing material (102). As will be appreciated, a sealing material could also, or alternatively, be placed in the region between post (123) and locking member (124). In this case, engagement of the interengaging members would abut post (104) to region (125), and in the example wherein region (125) comprises a sealing material, thereby establishing gas-sealing abutment between these two closure features.

[0071] In some embodiments at least one portion of the closure includes a coextruded sealing material, for example, as described in each of U.S. Patent Nos. 5,356,222, 5,252,281 and 5,248,201, each of which is incorporated herein by reference in its entirety. In some embodiments having a sealing material, the sealing material comprises a material selected from low melt index polymers, for example, a low density polyolefin, for example, polyolefin having a density of less than about 0.925 g/cm³ as measured in accordance with ASTM D1505-03 (November 1, 2003), low density polyurethane and polyolefin containing an amount of vinyl

acetate to yield a blend having a low melt index, as measured in accordance with ASTM standard ASTM D-1238 – 04c. For example a melt index of about 7. In some embodiments the sealing material has a melt index of from about 5 to about 9, preferably, from about 5 to about 7, and, more preferably, about 7. In some embodiments the sealing material provides a region in the closure which insures the formation of a leak-free seal when the closure flange is fused to another material, for example, the opening of a package, or when opposing portions of the closure are fused together at the ends of the closure to form an end seal. In some embodiments the sealing material provides a region in the closure having a high degree of conformance with a portion of the closure in which the sealing material engages in compressive abutment, for example, upon engaging the interengaging member and profile portions of the closure, thereby providing for a reduction or elimination in the void areas present between the opposed portions of the closure and thus providing a seal having reduced gas permeability. In some embodiments the sealing material comprises a portion of one or both opposed portions of interengaging closure members. In some embodiments the sealing material comprises a portion of the flange or of a post of the closure which is compressively abutted by a feature on the opposite flange when the interengaging members are engaged. In some embodiments the sealing material comprises the entire length of at least one portion of at least one closure profile. In some embodiments the sealing material comprises selected portions of at least one closure profile, for example, the periphery portions of the closure.

[0072] Having described the presently preferred embodiments, it is to be understood that the invention may be otherwise embodied within the scope of the appended claims.

What is claimed is:

1. A resealable closure comprising:
 - (i) at least one pair of opposed interengaging members, each said member affixed to an opposed portion of the closure and disposed to engage when said opposed portions of the closure are brought together with an applied engaging force; and
 - (ii) optionally, a sealing material comprising one or more portions of said closure; and
 - (iii) optionally, disposed on the closure to bring said opposing closure portions together with an engaging force when operated from a first position to a second position, a member selected from the group consisting of a slider and a closing clip,

wherein the closure is further characterized in that engaging said interengaging members creates at least one region of continuous gas-sealing abutment between said pair of opposed closure portions.

2. The resealable closure of claim 1 wherein said region of gas-sealing abutment comprises at least one pair of opposing features, each said feature disposed on one said opposed closure portion to abut the other said feature when said interengaging members are engaged, and a caulking compound disposed on the closure to gas-sealingly infiltrate at least one void region defined by said abutted features when said interengaging members are engaged.

3. The resealable closure of claim 1 wherein the closure contains at least one weld, said weld comprising a sealing material.

4. The resealable closure of claim 1 wherein said region of gas-sealing abutment comprises at least one pair of opposing features, each said feature disposed on one said opposed closure portion to abut the other said feature when said interengaging members are engaged, at least one said feature comprising a sealing material.

5. The closure of claim 4 further comprising a caulking compound disposed on the closure to gas-sealingly infiltrate at least one void defined by abutting said pair of opposing features when said interengaging members are engaged.

6. The closure of claim 4 wherein said sealing material is selected from the group consisting of polyolefins having a density of less than about 0.925 g/cm³ as measured in accordance with ASTM D1505-03 (November 1, 2003), low density polyethylene and polyolefin containing an amount of vinyl acetate to yield a blend having a low melt index of less than about 7, as measured in accordance with ASTM D-1238 – 04c.

7. The resealable closure of claim 2 having at least one pair of interengaging members comprising:

- (i) a first interengaging member comprising:
 - (1) at least one profile portion affixed to the proximal face of a first opposed portion of the closure, said profile portion comprising:
 - (a) a first locking member comprising:
 - (i) a first stem member joined to the proximal face of said first opposing portion of the closure; and
 - (ii) a first head member affixed to the free end of said first stem member;
 - (b) a first post affixed on said first opposed portion proximal face substantially parallel and proximal to said first stem member, said first post disposed to define a first channel with said first head member, and wherein said first stem member, first head member, and said first post together are configured and disposed to define a first void region;
 - (c) optionally a third post affixed to said first opposed proximal face substantially parallel to said stem on the side of the stem distal from said first post;
 - (d) optionally a fourth post affixed to said opposed proximal face substantially parallel and proximal to said first post on the side of said first post distal from said first head member;
 - (B) a second interengaging member comprising:
 - (1) at least one second locking member joined to a proximal face of a second opposed portion of the closure, said second locking member comprising:
 - (a) a second stem member joined to said proximal face of a second opposed portion of the closure;
 - (b) a second head member affixed to the free end of said second stem member;
 - (2) optionally a second post affixed to said second opposed portion proximal face substantially parallel to said second locking member, disposed to define a

second channel with said second head member, wherein said second stem member, said second head member and said second post are configured and disposed to define a second void region; and

- (3) optionally, when a second post is present, a fifth post mounted substantially parallel and proximal to said second post on the side of said second post distal from said second locking member,

wherein the closure is further characterized in that each of said first and second interengaging members are disposed such that when said proximal faces are brought together with an applied engaging force, the head of said second locking member is received into the channel defined by said first stem and first head member, and said second locking member is engaged within the void region defined by said first engaging member.

8. The resealable closure of claim 2 wherein each said interengaging member comprises:

- (a) at least two locking members, each said locking member comprising:
 - (3) a stem affixed to a proximal face of an opposed portion of the closure;
 - (4) a head member affixed to the free end of said stem; and
- (c) optionally, one or more posts,

wherein, when the interengaging members are engaged the locking members affixed to each said opposed closure portion are interdigitated.

9. The resealable closure of claim 8 wherein said head members are asymmetrically attached to said stems, and the locking members comprising one of said interengaging members are rotationally symmetrical with the locking members of the other of said interengaging members.

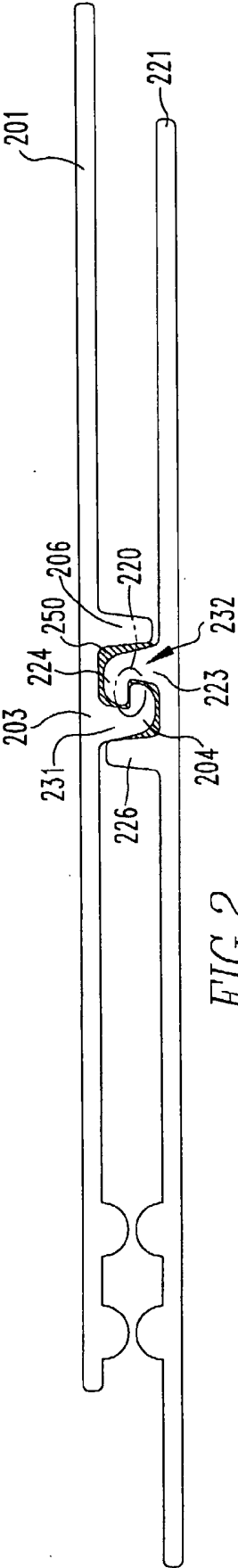
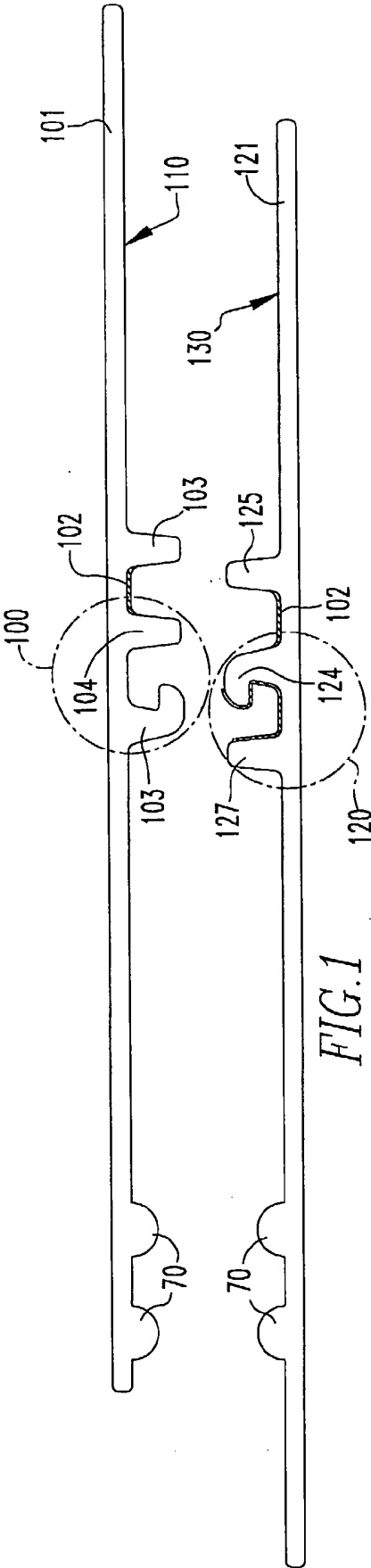
10. The resealable closure of claim 8 wherein said head members are symmetrically attached to said stems, and, when present, said posts are configured and disposed to form, together with an adjacent locking member, a void which has a cross-sectional shape that is complimentary to a locking member affixed to said opposed interengaging member which is interdigitated between said post and adjacent member upon engagement of said interengaging members.

11. The resealable closure of claim 8 wherein a sealing material is coextruded to form at least a portion of at least one said head member, wherein said portion of sealing material disposed to sealingly abut a portion of an interengaging member with which it is engaged.
12. The resealable closure of claim 7 comprising at least two pairs of interengaging members mounted substantially parallel on said opposing closure portions.
13. The resealable closure of claim 7 further comprising a crush seal area at the ends of said closure joining together said opposed closure portions, wherein the crush seal area further comprises a sealing material.
14. The resealable closure of claim 7, wherein interengaging members comprises a high melt index polyolefin and said regions of sealing material comprises a low melt index polyolefin.
15. The resealable closure of claim 7 wherein said caulking composition comprises a member selected from the group consisting of a silicone oil, a silicone grease, a soy polymer, and a soy adhesive.
16. The resealable closure of claim 8 wherein one said interlocking profile contains a distal post mounted on said opposed portion proximal face substantially parallel to said stem on the side of the stem distal to said first post forming a well distal from said channel, the bottom of which is abutted by the post of the opposing profile when said interengaging members are engaged.
17. The resealable closure of claim 7 which includes said fourth and fifth posts, wherein said fourth and first posts form a well having therebetween a region of the opposed closure portion comprising a well bottom, and wherein the free end of said fifth post abuts said well bottom region when said interengaging members are engaged.
18. The resealable closure of claim 17 wherein at least one of said well bottom and the free end of said fifth post comprises a member of the group selected from: (a) a sealing material; (b) a caulking composition; (c) an adhesive; (d) a soy polymer; (e) a silicone grease.

19. The resealable closure of claim 17 wherein each of said well bottom and the free end of said fifth post comprise one part of a two part reactive composition such that when said interengaging members are engaged each said part of the two part reactive composition is admixed, providing a reaction product.

20. A package comprising the closure of claim 2.

21. The closure of claim 7 wherein said caulking composition is rated for at least incidental contact to food items.



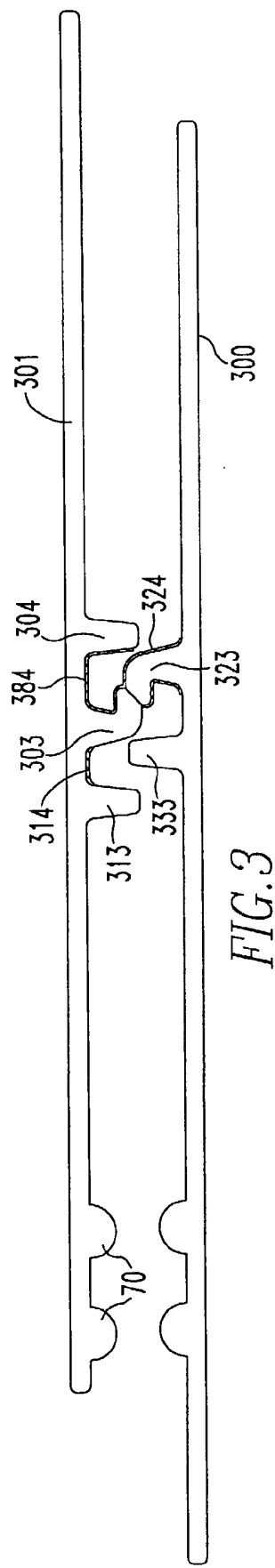


FIG. 3

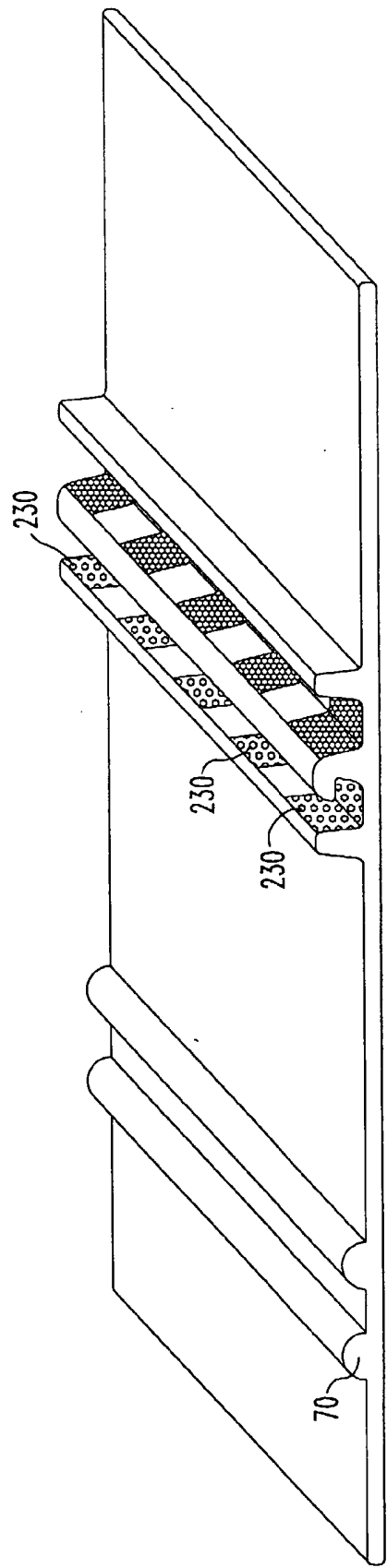


FIG. 4

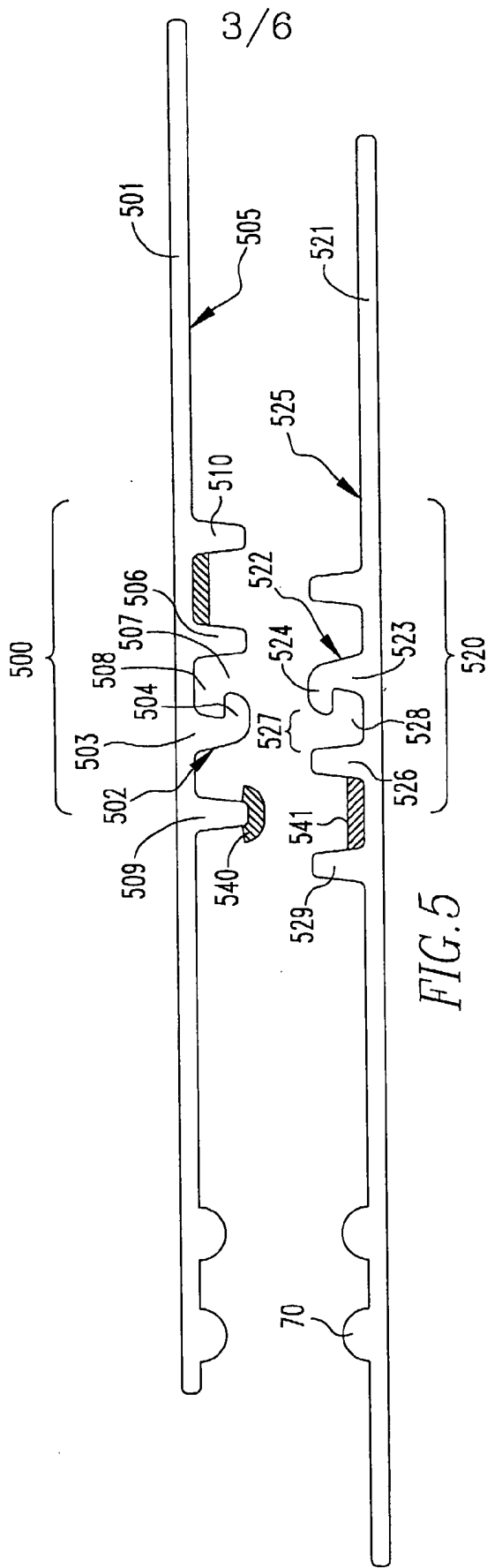
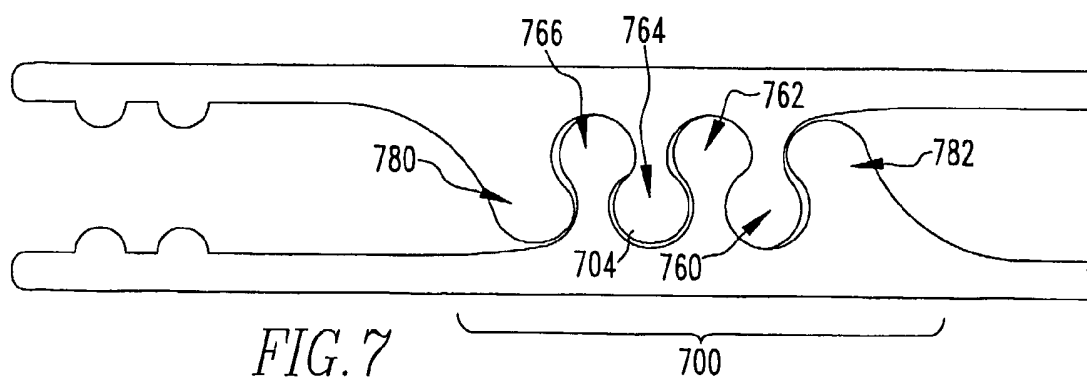
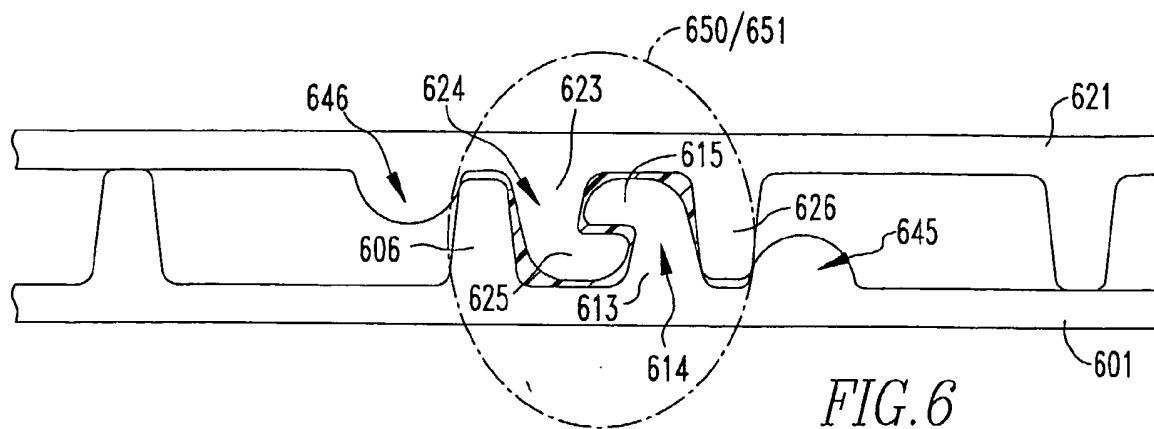


FIG. 5

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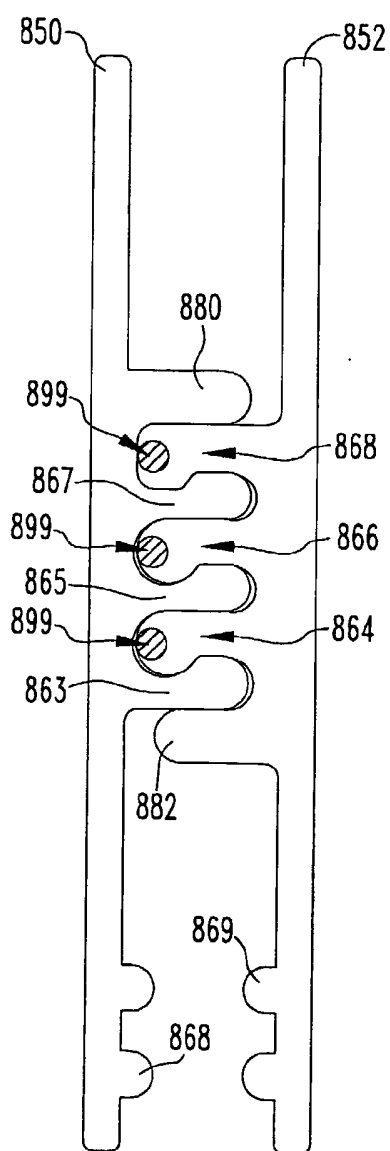


FIG. 8

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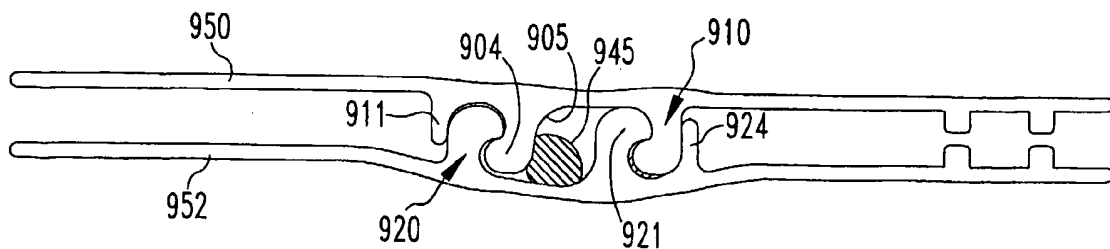


FIG. 9A

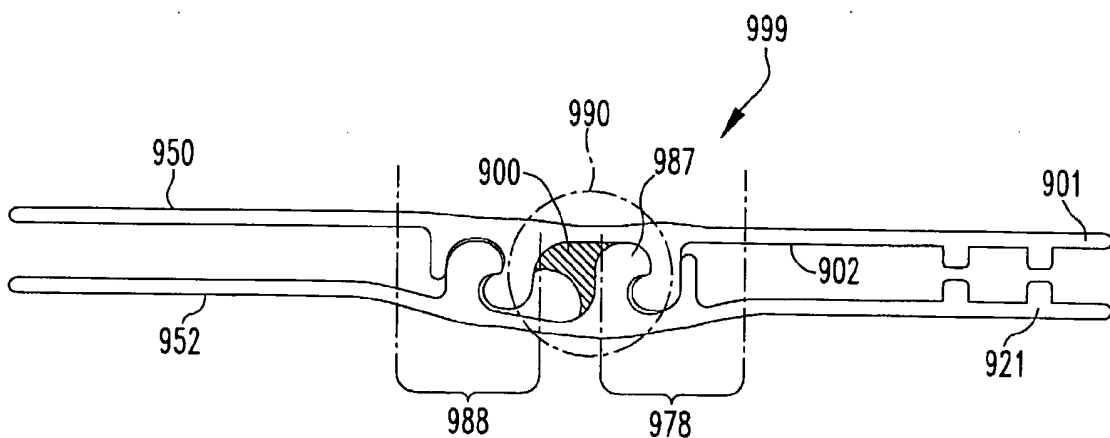


FIG. 9B

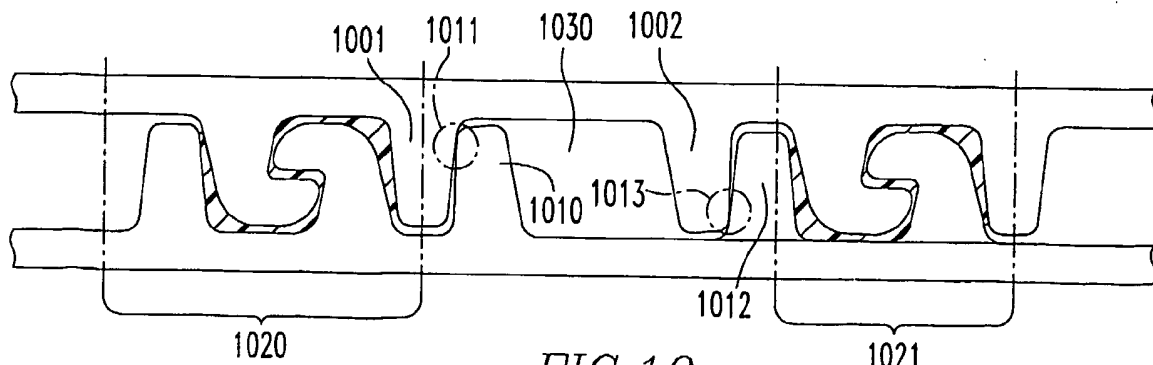


FIG. 10