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(54) Heat-shrinkable packaging and method of forming it

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- **Form 10-K**

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Description

BACKGROUND OF THE INVENTION

[0001] This invention relates to the shrink packaging of articles, particularly food articles such as poultry, cheese, primal or subprimal meat cuts, fresh red meat and other processed meat, fruits, vegetables, breads and food products. Shrink packaging refers to the use of a packaging film manufactured in such a way that when it is exposed to a certain amount of heat, it will contract, preferably in both directions, reducing its overall surface area. When this type of film is wrapped around an object, sealed around its edges and passed through a heated shrink tunnel where the package is exposed to an elevated temperature, the film will react to the heat and contract around the object. Depending on the respective application, the air trapped within the package may be evacuated prior to final sealing, or small holes may be provided through the film to allow air to escape during the heat shrinking process. This process results in an attractive skin-tight package. Articles packaged using shrink packaging are numerous and can include food articles, such as frozen pizzas, cheese, poultry, fresh red meat, and processed meat products.

[0002] The shrink packaging of food articles such as poultry, cheese, fresh red meat, and processed meat products requires tough, puncture resistant, yet flexible, film materials suitable for use in fabricating individual heat-shrinkable packaging receptacles, such as pouches and bags for packaging such food articles. Generally, the shrink packaging method of food articles is predicated upon the heat-shrinking property of the receptacle by placing a given food article or articles into an individual receptacle, evacuating the receptacle to remove air so the receptacle collapses, heat sealing across the receptacle's opening or mouth to close the receptacle and thereafter exposing the receptacle to a heat source such as a flow of hot air, infrared radiation, hot water, and the like, thereby causing the receptacle to shrink and come into intimate contact with the contours of the food article or articles. The packaged article prepared by this packaging method has an attractive appearance which adds to the commodity value of the wrapped article, its contents are kept in a hygienic condition, and it allows shoppers to examine the quality of the contents of the packaged article. Packaging in this fashion also excludes air from the package to prolong shelf life.

[0003] This invention relates generally to packaging and specifically to hermetically heat sealable, easy open, heat-shrinkable packaging for food products.

[0004] It is common practice package articles such as food products in thermoplastic films or laminates to protect the product to be packaged from abuse and exterior contamination and to provide a convenient and durable package for transportation and sale to the end user. Shrink packaging of food products has become extensively used due to its many advantageous properties, *e.g.*, strength, compactness, content security, purge resistance, the attractive appearance of the packed article, etc., which add to the commodity value of the packaged article. Shrink packaging refers to the use of a packaging film manufactured in such a way that when it is exposed to a certain amount of heat, the film will contract in at least one direction along its length or width, preferably in both directions, reducing its overall surface area. When articles are packaged in this type of film, air in the package is usually evacuated and the package is typically passed through a heated shrink tunnel where the package is exposed to an elevated temperature which causes the film to react to the heat and contract around the object. This process results in an attractive skin-tight package. Articles packaged using shrink packaging are numerous and can include food articles, such as frozen pizzas, cheese, poultry, fresh red meat, and processed meat products as well as nonfood industrial articles such as wooden blinds, CD's, etc.

[0005] Many food products, such as poultry, fresh red meat, cheeses, and processed meat products, are packaged in individual, pre-manufactured bags of heat-shrinkable film. Typically, individual bags or pouches for packaging food articles include one to three sides heat sealed by the bag manufacturer leaving one side open to allow product insertion and a final seal performed by the food processor. Such individual bags are typically manufactured from shrink films by producing a seamless tube of heat-shrinkable film having a desired diameter, heat sealing one end of a length of the tubular film and cutting off the tube portion containing the sealed portion, thereby forming an individual bag. The bag formed thereby, when it is laid flat, has a bottom edge formed by the heat seal, an open mouth opposite the sealed bottom and two seamless side edges formed by the fold produced when the tube is laid flat. Another method of forming bags from a seamless tube comprises making two spaced-apart transverse seals across the tube and cutting open the side of the tube. If flat sheets of film are used, bags are formed therefrom by heat sealing three edges of two superimposed sheets of film or by end-folding a flat sheet and sealing two sides. U.S. patents describing known heat shrinkable bags include U.S. Patent Nos. 6,511,688, 5,928,740, and 6,015,235. U.S. Patent Application No. 10/371,950, in the name of Thomas Schell et al., filed on February 20, 2003, entitled "HEAT-SHRINKABLE PACKAGING RECEPTACLE", discloses individual heat-shrinkable bags formed from a sheet of film, preferably in a continuous process, wherein opposing side edges of the sheet are sealed longitudinally to form a tube member, which is then sealed and cut transversely to close an end of the tube member thereby forming a backseamed bag.

[0006] The known bags for heat-shrink packaging include strong factory and final closing seals to prevent the heat sealed seams from pulling apart during the heat shrinking operation, or during the handling and transport of the packaged article. Although the strong heat seals provide protection against unwanted seal failure, such seals also make it difficult for the end user to open the package. Accordingly, there is needed an improved heat-shrinkable packaging receptacle that includes seals of sufficient seal strength to survive the heat shrinking process and handling and resist spontaneous opening due to residual shrink forces, yet includes at least one heat seal that is readily openable by application of force without requiring use of a knife or cutting implement and without uncontrolled or random tearing or rupturing of the packaging materials, e.g., away from the seal area, which may result in opening in undesired location or in sudden destruction of the package and inadvertent contamination or spillage of the contents of the package.

[0007] Typically, individual bags or pouches for packaging food articles include one to three sides heat sealed by the bag manufacturer leaving one side open to allow product insertion. Such individual bags are generally manufactured from shrink films by producing a seamless tube of heat-shrinkable film having a desired diameter and heat sealing one end of a length of the tubular film and cutting off the tube portion containing the sealed portion, thereby forming a bag which, when it is laid flat, has a bottom edge formed by the heat seal, an open mouth opposite the sealed bottom and two seamless side edges formed by the fold produced when the tube is laid flat. Another method of forming bags from a seamless tube comprises making two spaced-apart transverse seals across the tube and cutting open the side of the tube. If flat sheets of film are used, bags are formed therefrom by heat sealing three edges of two superimposed sheets of film or by end-folding a flat sheet and sealing two sides.

[0008] Manufacturing bags from a seamless tube requires that the tube be extruded to a specified width for the intended end use. Thus, fabricating small diameter tubes for small width bags does not utilize the full capacity of the film manufacturing equipment and is thus not economical. Seamless tube sizes are also limited by the manufacturing equipment in how small the width can be made. The manufacture of individual bags by superimposing two sheets and sealing about three edges requires costly machinery to handle the separate sheets, properly align the sheets and provide seals around the several edges. Additionally, having a third sealed edge (four sealed edges when closed) increases the risk of a seal failure during the shrinking process. Folding a sheet of film and sealing two sides creates a double thickness of film at the seals which undesirably protrude from the side of the finished package.

[0009] EP0435498 discloses an oriented, heat-shrinkable, packaging film having a layer of polyamide or polyester, and bags made therefrom.

[0010] US4,944,409 discloses an easy open package adapted to be heat sealed closed and peelably reopened including a first package wall comprising an outer layer, an inner sealant layer and a tie layer disposed between and peelably bonded to either the inner layer or the outer layer and a second package wall joined about a portion of its perimeter to the first package wall and comprising at least one layer, that layer being a sealant layer having the same composition as the inner sealant layer of the first package wall and disposed adjacent thereto, the sealant layers being heat sealable together to form a bond having a bond strength greater than the bond between the tie layer and the layer to which it is peelably bonded, that bond strength being predetermined by the selection of the compositions of the adjacent layers.

[0011] Accordingly, although the known shrink bags meet many of the requirements for packaging applications, a need still exists for an improved heat-shrinkable bag structure that can be economically fabricated and sealed using standard bag sealing machinery at the place of packaging.

SUMMARY OF THE INVENTION

[0012] In accordance with the present invention, there is provided an end-sealed packaging receptacle according to claim 1.

[0013] The present invention also provides a method according to claim 43.

BRIEF DESCRIPTION OF THE DRAWING FIGURES

[0014]

FIG. 1 illustrates a schematic view of an end-seal, shrink bag having a lap seal according to the present invention, in a slightly open position from a lay-flat position.

FIG. 2 illustrates a transverse cross-sectional view of the bag illustrated in FIG. 1, taken through section 2-2 of FIG. 1.

FIG. 3 illustrates a schematic view of an end-seal, shrink bag having a butt-seal according to the present invention, in a slightly open position from a lay-flat position.

FIG. 4 illustrates a transverse cross-sectional view of the bag illustrated in FIG. 3, taken through section 6-6 of FIG. 5.

FIG. 5 illustrates a preferred three-layer film structure for forming bags according to the present invention.

FIG. 6 is a schematic representation of a preferred method of manufacturing films for use with the present invention.

FIG. 7 illustrates a preferred seven-layer film structure for forming bags according to the present invention.

FIG. 8 illustrates a schematic view of a film suitable for making a peelable sealed heat shrink bag according to the present invention.

FIG. 9 illustrates a schematic view of a preferred embodiment of a heat-shrinkable bag according to the present invention, in a substantially lay-flat position.

FIG. 10 illustrates a fragmentary cross-sectional view taken along lines A-A of FIG. 9 depicting an enlarged, not to scale, lap seal area of a preferred film for use in fabricating the bag illustrated in FIGS. 9, 12 and 13.

FIG. 11 illustrates a fragmentary cross-sectional view taken along lines B-B of FIG. 9 depicting an enlarged, not to scale, end seal area of a preferred film.

FIG. 12 illustrates schematic view of another preferred embodiment of a heat-shrinkable bag according to the present invention having a pull flap.

FIG. 13 illustrates a transverse cross-sectional view of the bag illustrated in FIG. 14, taken through section C-C of FIG. 14.

FIG. 14 illustrates a cross-sectional view taken along lines D-D of FIG. 13, depicting an end seal.

FIG. 15 illustrates a bag which is outside the scope of the present invention having a fin seal backseam.

FIG. 16 illustrates a cross-sectional view of the bag illustrated in FIG. 15, taken through section E-E.

FIG. 17 illustrates an enlarged fragmentary cross-sectional view of the seal portion of FIG. 16 detailing a preferred film structure.

FIG. 18 illustrates another bag embodiment according to the present invention having a butt-seal backseam.

FIG. 19 illustrates a cross-sectional view of the bag illustrated in FIG. 18, taken through section F-F.

FIG. 20 illustrates another bag according to the present invention having a peel strip.

FIG. 21 illustrates a cross-sectional view of the bag illustrated in FIG. 20, taken along section G-G.

FIG. 22 is a schematic illustration of a preferred method of manufacturing films for use with the present invention.

FIG. 23 is a schematic illustration of a preferred method of manufacturing bags according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0015] A preferred embodiment of the heat-shrinkable packaging receptacle of the present invention is shown in FIGS. 1 and 2 generally as bag 10. The bag 10 is formed from a sheet of heat-shrinkable film 11 having a first edge 12, a second edge 14, a top surface 13 and a bottom surface 15. The bag 10 includes a first seal 16 bonding the first and second edges 12 and 14 in an overlapping arrangement, or lap seal, from the top of the bag to the bottom. A tube member 18 is formed, shown in FIGS. 1 and 2 in a partially lay-flat orientation, having a first bag wall 20, a second bag wall 22, a first bag edge 24, a second bag edge 26, an opening 28 and a bag end 30. In other words, the first and second edges 12 and 14 are placed in an overlapping arrangement and a seal, such as a heat seal, is provided between the top surface 13 of the first edge 12 and bottom surface 15 of the second edge 14 such that the top surface 13 of the first edge 12 is sealed in face-to-face contact with the bottom surface 15 of the second edge. The bag 10 includes a second seal 32 provided through the first and second bag walls 20 and 22 and extending laterally across the bag 10 from the first bag edge 24 to the second bag edge 26, thereby closing the bag end 30 and defining a product receiving chamber 34.

[0016] Although the first seal 16 is illustrated as being positioned between the first and second tube edges 24 and 26 and running parallel thereto, one skilled in the art will appreciate in view of the present disclosure that the position of the first seal 16, when the bag 10 is in a lay-flat orientation, may be any desired position from first edge 24 to second edge 26 of either first or second bag walls 20 and 22, as well as being positioned at either of the first and second bag edges 24 and 26. The second seal 32 is illustrated as being straight and extending perpendicular to the first seal 16; however, the skilled artisan will appreciate that the second seal 32 may take any shape, so long as the second seal 32 operates to close the bag end 30 and thereby define a product receiving chamber 34. For example, common seal configurations include straight, or linear, seals which usually extend perpendicular to the tube edges 24 and 26 (the tube edges 24 and 26 generally extend parallel to each other), and also include nonlinear or curved edges, e.g., such as those described in U.S. Patent No. 5,149,943. Both linear and nonlinear seals may be made by any suitable sealing method known, including hot bar and impulse sealing.

[0017] Another embodiment of the present invention is illustrated in FIGS. 3 and 4 generally as bag 210. Bag 210 is formed from a sheet of heat-shrinkable film 210 having a first edge 212, a second edges 214, an inner surface 213 and an outer surface 215. The bag 210 includes a first seal 216 comprising a butt-seal, that bonds the first and second edges 212 and 214 in a longitudinally abutting relationship with or without directly bonding surfaces of the first and second edges 212 and 214 together. The first seal 216 preferably includes a butt-seal tape 217, one side of which is sealed to the outer surface 215 of the first edge 212 by seal 216a, while an opposing side of the tape 217 is sealed to the outer surface of the second edge by seal 216b, seals 216a and 216b being in regions adjacent to and along the first and second edges 212 and 214. The first seal 216 defines a tube member 218, shown in FIGS 3 and 4 in a partially lay-flat orientation, having a first bag wall 220, a second bag wall 222, a first bag edge 224, a second bag edge 226, an opening 228 and a bag end 230. The bag 210 includes a second seal 232 provided through the first and second bag walls 220 and 222 extending laterally across the bag 210 from the first bag edge 224 to the second bag edge 226, thereby closing the bag end 230 and defining a product receiving chamber 234.

[0018] The film used to fabricate the bags of the present invention may be multilayer or monolayer flexible, heat-shrinkable film manufactured by any known process. For example, in commercial poultry packaging operations, monolayer films made from polyethylene and/or ethylene-vinyl acetate copolymers, and multilayer films containing polyethylene and/or ethylene-vinyl acetate copolymers are used extensively. Likewise, in the packaging of fresh red meat and processed meat products, multilayer heat-shrinkable films containing polyethylene and/or ethylene-vinyl acetate copolymers in one or more layers of the films are commonly employed. Preferred films may also provide a beneficial combination of one or more or all of the below noted properties including high puncture resistance (e.g. as measured by the ram and/or hot water puncture tests), high shrinkage values, low haze, high gloss, and high seal strengths. The film and/or bags may also include an indicia, such as they may be printed. For example, bags according to the invention may preferably include an indicia indicating that the bag includes a bone-containing product. It may be desirable for applications wherein the film is printed to corona treat the film surface to improve ink adhesion. Since corona treated surfaces do not normally heat seal as well as untreated surfaces, it may be desirable to corona treat only those portions that will not form part of a heat seal or to limit the treated area of the film to minimize adverse interaction with later sealed areas. For example, a center portion of the film may be corona treated, while those portions along each of the machine direction edges of the film are not. In this manner, those portions along each machine direction edge, that are sealed together to form the first seals 16 as described above, are not corona treated and should not be adversely affected.

[0019] The film may have an unrestrained shrinkage of at least 20% in at least one direction and preferably 35% or more in one or both the machine and transverse directions. Free shrink is measured by cutting a square piece of film measuring 10 cm in each of the machine and transverse directions. The film is immersed in water at 90 °C for five seconds. After removal from the water the piece is measured and the difference from the original dimension is multiplied by ten to obtain the percentage of shrink.

[0020] Although the films used in the bag according to the present invention can be monolayer or multilayer films, the bags are preferably formed of a multilayer film having 2 or more layers; more preferably 3 to 9 layers; and still more preferably 3 to 5 to 7 layers. Since the inventive bags are primarily intended to hold food products after evacuation and sealing, it is preferred to use a thermoplastic film which includes an oxygen and/or moisture barrier layer. The terms "barrier" or "barrier layer" as used herein means a layer of a multilayer film which acts as a physical barrier to moisture or oxygen molecules. Advantageous for packaging of oxygen sensitive materials such as fresh red meat, a barrier layer material in conjunction with the other film layers will provide an oxygen gas transmission rate(O_2GTR) of less than 70 (preferably 45 or less, more preferably 15 or less) cc per square meter in 24 hours at one atmosphere at a temperature of 73°F (23°C) and 0% relative humidity.

[0021] The bags 10 and 210 are preferably fabricated continuously from a continuous sheet or roll stock. The roll stock is slit to a desired width and fed to the bag making equipment, the machine direction edges of the film are brought together and sealed longitudinally, either with a lap seal (bag 10) or butt-seal (bag 210) to form a continuous single-seamed tube, or tube member. A transverse seal is made across the tube and the section including the transverse seal is severed from the continuous tube to form the individual bag.

[0022] The type of first seal 16 or 216 incorporated into the bags of the present invention will need to be taken into account when selecting a suitable film. Generally, heat seals are made by supplying sufficient heat and pressure between two polymeric film layer surfaces for a sufficient amount of time to cause a fusion bond between the polymeric film layers. Common methods of forming heat seals include hot bar sealing, wherein adjacent polymeric layers are held in face-to-face contact by opposing bars of which at least one is heated, and impulse sealing, wherein adjacent polymeric layers are held in face-to-face contact by opposing bars of which at least one includes a wire or ribbon through which electric current is passed for a very brief period of time to cause sufficient heat to cause the film layers to fusion bond. Less area is generally bonded with an impulse seal relative to a hot bar seal, thus the performance of the film's sealing layer is more critical. However, an impulse seal is generally more aesthetic since less area is used to form the bond. First seal 16, or lap seal, requires that the top surface 13 and bottom surface 15 be capable of forming a suitable heat seal therebetween. If a first seal 216, or butt-seal, is formed, then both the top surface and bottom surfaces must be capable of forming a suitable heat seal. Likewise, the butt-seal tape 217, must also be capable of forming a suitable heat seal with the top surface or a suitable adhesive must be employed to adhere the tape 217 to the top surface 13 or bottom surface 15, depending on whether the tape 217 is place on the inside or outside of the bag 110.

[0023] A preferred multilayer barrier film structure for use with the present invention is shown in FIG. 5 generally as 40. When an oxygen barrier layer 42 is needed, it is usually provided as a separate layer of a multilayer film, most commonly as a core layer sandwiched between an inner heat sealing layer 44 and an outer layer 46, though additional layers may also be included, such as tie or adhesive layers as well as layers to add or modify various properties of the desired film, e.g., heat sealability, toughness, abrasion resistance, tear-resistance, heat shrinkability, delamination resistance, stiffness, moisture resistance, optical properties, printability, etc. Oxygen barrier materials which may be included in the films utilized for the inventive bags include ethylene vinyl alcohol copolymers (EVOH), polyacrylonitriles, polyamides and vinylidene chloride copolymers (PVDC). Preferred oxygen barrier polymers for use with the present invention are vinylidene chloride copolymers or vinylidene chloride with various comonomers such as vinyl chloride (VC-VDC copolymer) or methyl acrylate (MA-VDC copolymer), as well as EVOH. A specifically preferred barrier layer comprises about 85% vinylidene chloride-methyl acrylate comonomer and about 15% vinylidene chloride-vinyl chloride comonomer, as for example described in Schuetz et al. U.S. Pat. No. 4,798,751. Suitable and preferred EVOH copolymers are described in U.S. Patent No. 5,759,648.

[0024] The inner heat sealing layer 44 is generally provided on a side of the barrier layer 42 that becomes the inner surface 38, or bottom surfaces 15 shown in Figs. 1-4, of the bags 10 or 210. Other film layers may optionally be incorporated between the barrier layer 42 and the inner heat sealing layer 44 as previously noted. Substantially linear copolymers of ethylene and at least one alpha-olefin as well as copolymers of ethylene and vinyl esters or alkyl acrylates, such as vinyl acetate, may be usefully employed in one or more layers of the film, and may comprise monolayer and multilayer thermoplastic films. Preferably, the inner heat sealing layer comprises a blend of at least one ethylene-α-olefin copolymer (EAO), with ethylene vinyl acetate (EAO:EVA blend). Suitable α-olefins include C_3 to C_{10} alpha-olefins such as propene, butene-1, pentene-1, hexene-1, methylpentene-1, octene-1, decene-1 and combinations thereof. The heat seal layer is optionally the thickest layer of a multilayer film and may significantly contribute to the puncture resistance of the film. Another desirable characteristic affected by this layer is the heat seal temperature range. It is preferred that the temperature range for heat sealing the film be as broad as possible. This allows greater variation in the operation of the heat sealing equipment relative to a film having a very narrow range. For example, it is desirable for a suitable film to heat seal over a broad temperature range providing a heat sealing window of 62.2°C (80°F) or higher.

[0025] The outer layer 46 is provided on the side of the barrier layer opposite the heat sealing layer 44 and acts as the outer surface 39. In the instance when a lap seal, such as the first seal 32 of bag 10 is incorporated into a bag structure, the outer layer 46 must be heat seal compatible with the inner heat sealing layer. Other polymer layers may optionally be provided between the barrier layer and the outer layer as previously discussed. The outer layer may comprise an ethylene-α-olefin copolymer (EAO), ethylene vinyl acetate copolymer (EVA) or blends thereof. EAOs are copolymers predominately comprising ethylene polymeric units copolymerized with less than 50 % by weight of one or more suitable α-olefins which include C_3 to C_{10} alpha-olefins such as propene, butene-1, pentene-1, hexene-1, methylpentene-1, octene-1, decene-1. Preferred alpha-olefins are hexene-1 and octene-1. Recent developments for improving properties of a heat-shrinkable film include U.S. Pat. No. 5,403,668, which discloses a multilayer heat-shrinkable oxygen barrier film wherein the film outer layer is a four component blend of VLDPE, LLDPE, EVA and plastomer. LLDPE, or linear low density polyethylene, is a class of ethylene-alpha olefin copolymers having a density greater than 0.915 g/cm^3. VLDPE, also called ultra low density polyethylene (ULDPE), is a class of ethylene-alpha olefin copolymers having a density less than 0.915 g/cm^3 and many commercial VLDPE resins are available having densities from 0.900 up to 0.915 g/cm^3. Plastomers are generally EAOs having densities below 0.900 g/cm^3. U.S. Pat. No. 5,397,640 discloses a multilayer oxygen barrier film wherein at least one outer film layer is a three component blend of VLDPE, EVA and a plastomer. Alternatively, the outer layer may be formed of other thermoplastic materials as for example polyamide, styrenic copolymers, e.g., styrenebutadiene copolymer, polypropylene, ethylene-propylene copolymer, ionomer, or an alpha olefin polymer and in particular a member of the polyethylene family such as linear low density polyethylene (LLDPE), very low density polyethylene (VLDPE and ULDPE), high density polyethylene (HDPE), low density polyethylene (LDPE), an ethylene vinyl ester copolymer or an ethylene alkyl acrylate copolymer or various blends of two or more of these materials.

[0026] In general, the monolayer or multilayer films used in the heat-shrinkable bags of the present invention can have any thickness desired, so long as the films have sufficient thickness and composition to provide the desired properties for the particular packaging operation in which the film is used, e.g., puncture-resistance, modulus, seal strength, barrier, optics, etc. For efficiency and conservation of materials, it is desirable to provide the necessary puncture-resistance and other properties using the minimum film thicknesses. Preferably, the film has a total thickness from about 31.75 μm (1.25) to about 203.2 μm (8.0 mils); more preferably from about 44.45 μm (1.75) to about 76.2 μm (3.0 mils).

[0027] Suitable films for use with the present invention are disclosed in U.S. Patent No. 5,928,740. The '740 patent discloses a heat sealing layer comprising a blend of a first polymer of ethylene and at least one α-olefin having a polymer melting point between 55 to 75 °C.; a second polymer of ethylene and at least one α-olefin having a polymer melting point between 85 to 110 °C and a third thermoplastic polymer having a melting point between 115 to 130 °C which is preferably selected from the group of ethylene homopolymers such as HDPE and LDPE, and ethylene copolymers with at least one α-olefin; and optionally and preferably a fourth polymer such as a copolymer of ethylene with an alkyl acrylate or vinyl ester having a melting point between 80 to 105 °C, preferably 90 to 100 °C. The '740 patent also discloses a preferred biaxially oriented, heat-shrinkable three-layer barrier film embodiment for use with the present invention. The three-layer barrier film embodiment comprises an inner heat sealing layer as described above in conjunction with a barrier layer preferably comprising a polyvinylidene chloride (PVDC) or vinylidene chloride methylacrylate copolymer (VDC-MA or MA-saran) or EVOH layer and an outer layer formed of at least 50 wt. %, and preferably at least 70%, of a copolymer of ethylene with at least one alpha-olefin or at least one vinyl ester or blends thereof. Also, preferred EVAs will have between about 3% and about 18% vinyl acetate content.

[0028] Preferred films for use with the present invention are disclosed in U.S. Patent Application Ser. No. 09/401,692 filed September 22, 1999. The '692 application discloses monolayer and multilayer films having at least one layer comprising at least a three-polymer blend, optionally including a fourth polymer, comprising: (a) a first polymer having a melting point of 80 to 98°C, preferably 80-92°C, comprising a copolymer of ethylene and hexene-1; (b) a second polymer having a polymer melting point of 115 to 128°C comprising ethylene and at least one α-olefin; and (c) a third polymer having a melting point of 60 to 110°C comprising a copolymer of ethylene with an alkyl acrylate or vinyl ester; and optionally (d) a fourth polymer having a melting point of 80 to 110°C (preferably of 85 to 105°C), preferably selected from the group of ethylene homopolymers such as HDPE and LDPE, and ethylene copolymers with at least one α-olefin. The inventive blend finds utility as an inner heat sealing layer in many multilayer embodiments. In a preferred three, four or five-layer embodiment, an oxygen barrier layer of a vinylidene chloride copolymer, a polyamide or EVOH is between a layer of the inventive blend and either a layer comprising at least 50% by weight of an EAO or at least one vinyl ester or blends thereof, or another layer comprising the inventive blend.

[0029] Additional preferred films for use with the present invention are disclosed in U.S. Patent Application Ser. No. 09/611,192 filed July 6, 2000. The '192 application discloses multi-layer barrier embodiments formed of a flexible, thermoplastic, biaxially stretched, heat-shrinkable film having at least one layer comprising a blend of at least three copolymers comprising: 45 to 85 weight percent of a first polymer having a melting point of from 55 to 98°C comprising at least one copolymer of ethylene and at least one comonomer selected from the group of hexene-1 and octene-1; 5 to 35 weight percent of a second polymer having a melting point of from 115 to 128°C comprising at least one copolymer of ethylene and at least one α-olefin; and 10 to 50 weight percent of a third polymer having a melting point of from 60 to 110°C comprising at least one unmodified or anhydride-modified copolymer of ethylene and a vinyl ester, acrylic acid, methacrylic acid, or an alkyl acrylate; where the first and second polymers above have a combined weight percentage of at least 50 weight percent based upon the total weight of the first, second and third polymers; and where the bag film has a total energy absorption of at least 0.70 Joule and a shrinkage value at 90°C of at least 50% in at least one of the machine and transverse directions. A barrier layer formed of any suitable oxygen barrier material or blend of materials, for example, ethylene-vinyl alcohol copolymer (EVOH) or copolymers of vinylidene chloride (VDC) such as VDC-vinyl chloride (VDC-VC) or VDC-methylacrylate (VDC-MA) may be used. Preferably the barrier layer comprises a blend of 85 wt.% VDC-MA and 15 wt.% VDC-VC. The outer layer is preferably an EVA-VLDPE blend, and more preferably an EVA-VLDPE-plastomer blend. The '192 application also discloses a film comprising a flexible, thermoplastic film having at least one layer comprising a blend of at least two polymers comprising: 5 to 20 weight percent of (i) an ionomer polymer, e.g., an ethylene-methacrylate acid copolymer whose acid groups have been neutralized partly or completely to forma salt, preferably a zinc or sodium salt; 5 to 95 weight percent of (ii) a copolymer of ethylene and at least one C_6 to C_8 α-olefin, having a melting point of from 55 to 95°C, and a $\overline{M}_w/\overline{M}_n$ of from 1.5 to 3.5; 0 to 90 weight percent of (iii) a copolymer of ethylene and at least one C_4 to C_8 α-olefin, having a melting point of from 100 to 125°C; and 0 to 90 weight percent of (iv) a copolymer of propylene and at least one monomer selected from the group of ethylene and butene-1, where the copolymer (iv) has a melting point of from 105 to 145°C; 0 to 90 weight percent of (v) a copolymer of ethylene and at least one monomer selected from the group of hexene-1, octene-1 and decene-1, where the copolymer (v) has a melting point of from 125 to 135°C; and polymers (ii), (iii), (iv), and (v) have a combined weight percentage of at least 80 weight percent based upon the total weight of polymers (i), (ii), (iii), (iv), and (v); and wherein the film has a total energy absorption of at least 1.2 Joule. Optionally, the same blend may be used as an inner heat sealing layer for a bag film.

[0030] Further preferred films for use with the present invention are described in U.S. Pat. No. 5,302,402 to Dudenhoeffer et al., U.S. Pat. No. 6,171,627, Lustig et al. U.S. Pat. No. 4,863,769, and U.S. Pat. No. 6,015,235 to Kraimer et al..

[0031] In a preferred embodiment of the present invention, the heat-shrinkable bag is formed of a three-layer film. The three-layer film is preferably a biaxially oriented film including a barrier layer disposed between an inner heat sealing layer and an outer layer, as shown in FIG. 5. The inner heat sealing layer comprises a blend of about 37% of an ethylene-vinyl acetate (EVA) copolymer such as ESCORENE™ LD 701.ID available from Exxon Chemical Co., Houston, Texas, USA; about 24% VLDPE resin such as SCLAIR™ 10B available from Nova Chemicals, Ltd., Calgary, Alberta, Canada (0.77 dg/min Melt Index and 0.911 g/cm^3 density); about 33% of a plastomer, such as EXACT™ 4053 available from Exxon Chemical Co., Houston, Texas, USA; about 4% slip/processing aid, such as Spartech A27023 (slip/processing aid in a VLDPE carrier resin); and about 2% of a processing stabilizer such as Spartech A32434 (available from Spartech Polycom of Washington, Pennsylvania, U.S.A.). The barrier layer comprises a blend of about 15% vinylidene chloride-vinyl chloride and about 85% vinylidene chloride-methacrylate, such as further described in U.S. Patent No. 4,798,751. The outer layer comprises a blend of about 40% of an ethylene-vinyl acetate (EVA) copolymer such as ESCORENE™ LD 701.ID; about 33% of a plastomer, such as EXACT™ 4053; about 25% of a VLDPE resin, such as SCLAIR™ 10B; and about 2% of a processing aid/slip concentrate in a VLDPE carrier, such as Ampacet 501236, available from Ampacet Corporation, Tarrytown, New York, USA. The inner layer, barrier layer and outer layer represent about 57.7%, 17.7% and 25.1% respectively based on the total thickness of the three-layer film.

[0032] In another preferred embodiment of the present invention, the heat-shrinkable bag is formed of another three-layer biaxially oriented shrink film including a barrier layer disposed between an inner heat sealing layer and an outer layer, as shown in FIG. 5. The barrier layer preferably comprises a blend of about 15% vinylidene chloride-vinyl chloride and about 85% vinylidene chloride-methacrylate such as further described in U.S. Patent No. 4,798,751. The barrier layer preferably comprises approximately 16.5% of the three-layer film's thickness. The inner heat sealing layer preferably comprises about 57.1% of the film's thickness and comprises a blend of about 35.1 wt. % of an ethylene-hexene-1 copolymer such as EXACT™ 9519 (0.895 g/cm^3 and 2.2 dg/min Melt Index available from Exxon Chemical Co., Houston, Texas, USA); about 36.5% of an ethylene-octene-1 copolymer such as ATTANE™ XU 61509.32 (a C_2C_8 (<10 wt. % C_8) VLDPE having a density of about 0.912 g/cm^3 and 0.5 dg/min Melt Index available from Dow Chemical Co., Midland, Michigan, USA); about 26.5% of an ethylene-vinyl acetate (EVA) copolymer such as ESCORENE™ LD 701.ID (an ethylene-vinyl acetate copolymer available from Exxon Chemical Co., Houston, Texas, USA and reportedly having a density of 0.93 g/cm^3, a vinyl acetate content of 10.5 wt. %, a melt index of about 0.19 dg/min., and a melting point of about 97 °C); about 3% of a slip/processing aid such as Spartech A50050 (1.9% oleamide slip and an fluoroelastomer in a VLDPE carrier resin); and about 2% of a processing stabilizer such as Spartech A32434 (10% DHT4A in VLDPE carrier resin available from Spartech Polycom of Washington, Pennsylvania, U.S.A.). The outer layer preferably comprises about 26.4% of the film thickness and comprises about 35 wt. % of an ethylene-hexene-1 copolymer such as EXACT™ 9519; about 35 % of a ethylene-octene-1 copolymer such as ATTANE™ XU 61509.32; about 27% of a EVA copolymer such as ESCORENE™ LD 701.ID; and about 3% of a slip/processing aid such as Spartech A50050 (available from Spartech Polycom of Washington, Pennsylvania, U.S.A.).

[0033] In another preferred embodiment, the film of the bag comprises a biaxially oriented three-layer heat-shrinkable film having an inner heat sealing layer made of a blend of about 17 wt. % ethylene-octene-1 copolymer such as ATTANE™ XU 61509.32; about 18 wt. % EVA such ESCORENE™ LD 701.ID; 58% of an ethylene-hexene-1 copolymer such as EXACT™ 9110 (0.898 g/cm^3 density, 0.8 dg/min Melt Index and 89 °C melting point); about 2% of a processing stabilizer such as Spartech A32434; and about 5% of a slip/processing aid such as Spartech A50050. The outer layer is about 19 wt. % ethylene octene-1 copolymer such as ATTANE™ XU 61509.32; 18% EVA (ESCORENE™ LD 701.ID); 60% of an ethylene-hexene-1 copolymer such as EXACT™ 9110; and 3% processing aid such as A50056. The barrier layer is 85% vinylidene chloride-methyl acrylate and about 15% vinylidene chloride-vinyl chloride. Preferably, the inner layer:barrier layer:outer layer thickness ratio is about 62:9:29.

[0034] A preferred seven-layer film for use in fabricating bags according to the present invention is illustrated in FIG. 7 generally as film 60. The film 60 includes a first or inner heat sealing layer 61 preferably comprising about 10% of the total mass of the film 60. The inner heat sealing layer 61 preferably comprises a blend of about 94% EXACT™ 3139 (an ethylene-hexene copolymer having a reported Melt Index of 7.5 g/10 min and a density of 0.900 g/cm^3); about 4% Spartech A27023; and about 2% Spartech A32434. A second layer 62, adjacent the first layer 61 preferably comprises about 42.2% of the total mass of the film and comprises a blend of about 37% ESCORENE™ LD 701.ID; about 33% EXACT 4053; about 24% SCLAIR™ 10B; about 4% Spartech A27023; and about 2% Spartech A32434. The film 60 further includes first and second tie layers 63 and 65, each of which individually preferably comprise about 5% of the total mass of the film 60 and further comprise about 100% of VORIDIAN™ SP1330, an ethylene-methyl acrylate copolymer available form Voridian, a division of Eastman Chemical Company, Kingsport, Tennessee, USA. The film 60 includes a barrier layer 64 between the first and second tie layers 63. The barrier layer 64 preferably comprises about 17.7% of the total mass of the film and comprises a blend of about 85% vinylidene chloride-methyl acrylate and about 15% vinylidene chloride-vinyl chloride. Th film includes a third layer 66 that preferably comprises about 15.1 % of the total mass of the film 60. The third layer 66 comprises a blend of about 40% ESCORENE™ 701.ID; about 33% EXACT™ 4053; about 25% SCLAIR™ 10B; and about 2% Spartech A27339. The film 60 includes a fourth layer or outer layer 67 that preferably comprises about 5% of the total mass of film 60 and comprises a blend of about 98% EXACT™ 3139 and about 2% Spartech A27339. The total thickness of the film 60 is preferably about 2 mils or greater.

[0035] Advantageously, it may be desirable to utilize high Melt Flow Index polymers in sealant layer(s) of the film to aid in transversely sealing across the lap or butt seals. High Melt Flow polymers, having a Melt Flow Index greater than about 5 dg/min. The higher Melt Flow Index polymers fill gaps, such as gaps 9a (FIG. 2), and 9c (FIG. 4) that may form due to the dimensional difference encountered when the second seals 32, 132 or 232 are between the first and second bag walls in the area of the first seals 16 and 216, more readily than lower Melt Flow Index polymers. For example, other, high Melt Index polymers, such as EXACT™ 3040, which has a reported

Melt Index of 16.5 g/10 min, could be used in the inner and outer layers 61 and 67 of film 60 to replace the lower Melt Index ethylene-hexene copolymer.

[0036] The films selected to fabricate the inventive receptacles are preferably biaxially oriented by the well-known trapped bubble or double bubble technique as for example described in Pahlke U.S. Pat. No. 3,456,044. In this technique an extruded primary tube leaving the tubular extrusion die is cooled, collapsed and then preferably oriented by reheating and reinflating to form a secondary bubble. The film is preferably biaxially oriented wherein transverse (TD) orientation is accomplished by inflation to radially expand the heated film. Machine direction (MD) orientation is preferably accomplished with the use of nip rolls rotating at different speeds to pull or draw the film tube in the machine direction.

[0037] The stretch ratio in the biaxial orientation to form the bag material is preferably sufficient to provide a film with total thickness of between about 1.5 and 3.5 mils. The MD stretch ratio is typically 3:1-5:1 and the TD stretch ratio is also typically 3:1-5:1.

[0038] Referring now to FIG. 6, a double bubble or trapped bubble process is shown. The polymer blends making up the several layers are coextruded by conveying separate melt streams 311a, 311b, and 311c to the die 330. These polymer melts are joined together and coextruded from annular die 330 as a relatively thick walled multilayered tube 332. The thick walled primary tube 332 leaving the extrusion die is cooled and collapsed by nip rollers 331 and the collapsed primary tube 332 is conveyed by transport rollers 333a and 333b to a reheating zone where tube 332 is then reheated to below the melting point of the layers being oriented and inflated with a trapped fluid, preferably gas, most preferably air, to form a secondary bubble 334 and cooled. The secondary bubble 334 is formed by a fluid trapped between a first pair of nip rollers 336 at one end of the bubble and a second pair of nip rollers 337 at the opposing end of the bubble. The inflation which radially expands the film provides transverse direction (TD) orientation. Orientation in the machine direction (MD) is accomplished by adjusting the relative speed and/or size of nip rollers 336 and nip rollers 337 to stretch (draw) the film in the machine direction. Rollers 337 also collapse the bubble forming an oriented film 338 in a lay-flat condition which may be wound on a reel 339 or slit for further processing close up.

[0039] The biaxial orientation preferably is sufficient to provide a multilayer film with a total thickness of from about 31.75 μm to about 203.2 μm (1.25 to about 8.0 mils), preferably 38.1 to 101.6 μm (1.5 to 4 mils) or more, preferably between 1.75 and 3.0 mils (44 to 76 μ), and more preferably about 63.5 μm (2.5 mils).

[0040] A preferred film and process for making film suitable for use in fabricating bags according to the present invention is described in each of U.S. Patent Applications No. 09/401,692 filed September 22, 1999 for "Puncture Resistant Polymeric Films, Blends and Process"; 09/431,931 filed November 1, 1999 for "Puncture Resistant High Shrink Film, Blend and Process"; and 09/611,192 filed July 6, 2000 for "Ionomeric, Puncture Resistant Thermoplastic Patch Bag, Film, Blend and Process".

[0041] For a monolayer film, the process is similar but utilizes a single extruder (or multiple extruders running the same polymeric formulation) to produce a primary tube, and biaxial orientation is sufficient to provide a monolayer film preferably having a total thickness of between 50.8 μm to 152.4 μm (2 to 6 mil) or higher, and more typically from about 88.9 μm to 114.3 μm (3.5 to 4.5 mils) and is generally in the same draw ratio range as previously discussed, namely about 3:1 to 5:1 for both the MD and TD.

[0042] Although not essential, it is preferred to irradiate the film to broaden the heat sealing range and/or enhance the toughness properties of the inner and outer layers by irradiation induced cross-linking and/or scission. This is preferably accomplished by irradiation with an electron beam at a dosage level of at least 2 megarads (MR) and preferably in the range of 3-5 MR, although higher dosages may be utilized, such as for thicker films. Irradiation may be provided on the primary tube or after biaxial orientation. The latter, called post-irradiation, is preferred and described in Lustig et al. U.S. Patent No. 4,737,391.

[0043] After orientation, the tubular film 338 is collapsed, slit open longitudinally, laid flat and wound on a reel 339 for use as rollstock. One skilled in the art will appreciate that the above method may be used to form the film, films may be made by conventional single bubble, blown film processes, and oriented or nonoriented sheets may be made by slot cast sheet extrusion processes with or without tentering to provide orientation. One skilled in the art will further appreciate that the flatwidth of the collapsed tube will determine the width of the sheet film that results therefrom. Thus, the primary tube dimensions and subsequent processing may be selected to provide a maximum flatwidth and film thickness for the desired application, thereby advantageously maximizing the production capacity of the film making equipment.

[0044] Advantageously, a bag maker may produce bags of various lengths and widths from rolls of film rollstock by adjusting the width of the sheet (by slitting or cutting rollstock to a desired width) and the distances between the transverse end seal and bag mouth for a particular bag or series of bags. This advantageously avoids the costly need to produce specific widths of seamless tubes which are currently widely used by meat packers. Also the present invention permits cost savings and manufacturing efficiencies by permitting creation of numerous widths and lengths of bag from standard rollstock, which was produced utilizing substantially 100% of the film producing equipment's capacity. This reduces the need to carry larger inventories of a vast array of seamless tube rollstock having different widths. The bag maker may simply slit film rollstock to a desired width and form a continuous tube member by longitudinally sealing opposing side edges as described for bags 10. and 210. Bags of adjustable lengths may be made by transversely sealing and cutting through the tube member at a position spaced from the transverse seal. The film may also be made into a continuous tube member rollstock by longitudinally joining opposing side edges of a film as described above to form a continuous tube member, collapsing the continuous tube member and winding the collapsed continuous tube member on a reel. The continuous tube member rollstock may then be provided to the food processor, who then forms the individual bags, such as bags 10, and 210. Such continuous tube member rollstock may have a lay-flat width of up to 508 mm (20 inches), advantageously greater than 508 mm (20 inches), and more advantageously greater than or equal to 558.8 mm (22 inches).

[0045] Preferably, bag making is a continuous process, wherein the film is directed to a bag making assembly (not shown) where individual end-seal bags are made. As previously stated, the rollstock may be slit to a desired width with the unused portion re-wound for later use. Bags are produced by continuously bringing the opposing side edges of the film together and forming a heat seal, such as a lap seal or fin seal to form a continuous tube member, then making lateral, or transverse, heat seals across the tube member width at spaced intervals to weld the first and second bag walls of the tube member together. The tube member is severed preferably at the same time or during the same step that it is transversely heat sealed to form a bag as shown in Figure 1 or 3. Typically as the transverse seal is made for one bag a transverse cut forming the mouth of the adjacent bag is being made. This process forms a so called "end-seal" bag which, when it is laid flat, has a bottom edge formed by the transverse heat seal, an open mouth formed by the severed edge and two side edges formed by the fold produced when the tube member is laid flat. The transverse heat seal should extend across the entire tube member to ensure a hermetic closure. Each bag being formed from a length of the tube member will necessarily be formed by at least two, usually parallel, spaced apart, transverse cuts which cause a segment of the tube member to be made and one transverse seal, usually adjacent one of these cuts, will define a bag bottom which is located opposing the bag opening, which is formed by the distal cut. In typical production the member tube is transversely sealed and an adjacent transverse cut made as part of the same step and the seal and this proximate cut form a sealed end for one bag while the same cut also forms the mouth opening for the adjacent bag, and for that adjacent bag may be referred to as the distal cut. The spacing between the lateral seal and the point of severance, which may vary, will determine the length of the bags formed. The length of the bags can easily be varied by changing the distance between cuts. The width of the bags can also be easily varied by changing the width of the film by slitting the standard rollstock. In another embodiment of the invention, cuts and seals may be made alternately and apart from each other to form dual attached bags in saddle bag fashion.

[0046] The present invention advantageously provides for producing a heat-shrinkable bag wherein the bag manufacturer may produce multiple bag sizes (different lengths and widths) from a single film stock size, which advantageously maximizes film production efficiency by eliminating the need to manufacture different widths of seamless tubes. In other words, the present invention allows the bag manufacturer to produce one standard width of sheet film stock, such as 2.18, 2.39, 2.49, 2.64, 2.84, 3.2, 4.11m (86, 94, 98, 104, 112, 126, 162 inch) or greater, depending on the capacity of the film producing equipment. This standard sheet film stock may then be slit to a desired width, formed into a bag as described herein, and the remaining portion of the sheet film stock rewound for later use on another job. Prior art bags require the manufacturer thereof to produce different seamless tube sizes for each size of bag produced, thereby reducing production efficiency.

[0047] Unless otherwise noted, the following physical properties are used to describe the invention, films and seals. These properties are measured by either the test procedures described below or tests similar to the following methods.

Average Gauge: ASTM D-2103
Tensile Strength: ASTM D-882, method A
1% Secant Modulus: ASTM D-882, method A
Oxygen Gas Transmission Rate (O_2GTR) : ASTM D-3985-81
Percent Elongation at Break: ASTM D-882, method A
Molecular Weight Distribution: Gel permeation chromatography
Gloss: ASTM D-2457, 45 Angle
Haze: ASTMD-1003-52
Melt Index: ASTM D-1238, Condition E (190°C) (except for propene-based (>50% C_3 content) polymers tested at Condition L(230°C.))
Melting Point: ASTM D-3418, peak m.p. determined by DSC with a 10°C/min. heating rate.
Vicat Softening Point (Vsp): ASTM D-1525-82
Seal Strength: ASTM F88-94

[0048] All ASTM test methods noted herein are incorporated by reference into this disclosure.

[0049] <u>Shrinkage Values:</u> Shrinkage values are obtained by measuring unrestrained shrink of a 10 cm. square sample immersed in water at 90°C (or the indicated temperature if different) for ten seconds. Four test specimens are cut from a given sample of the film to be tested. Specimens are cut into squares of 10 cm length (M.D.) by 10 cm. length (T.D.). Each specimen is completely immersed for 10 seconds in a 90°C (or the indicated temperature if different) water bath. The specimen is then removed from the bath and the distance between the ends of the shrunken specimen is measured for both the M.D. and T.D. directions. The difference in the measured distance for the shrunken specimen and each original 10 cm. side is multiplied by ten to obtain percent shrinkage in each direction. The shrinkage of 4 specimens is averaged and the average M.D. and T.D. shrinkage values reported. The term "heat shrinkable film at 90°C" means a film having an unrestrained shrinkage value of at least 10% in at least one direction.

Tensile Seal Strength (Seal Strength) Test

[0050] Five identical samples of film are cut 1 inch (2.54 cm) wide and a suitable length for the test equipment e.g. about 5 inches (77 cm) long with a 1 inch (2.54 cm) wide seal portion centrally and transversely disposed. Opposing end portions of a film sample are secured in opposing clamps in a universal tensile testing instrument. The film is secured in a taut snug fit between the clamps without stretching prior to beginning the test. The test is conducted at an ambient or room temperature (RT) (about 23 °C) test temperature. The instrument is activated to pull the film via the clamps transverse to the seal at a uniform rate of 12.0 inches (30.48 cm) per minute until failure of the film (breakage of film or seal, or delamination and loss of film integrity). The test temperature noted and lbs. force at break are measured and recorded. The test is repeated for four additional samples and the average grams at break reported.

Ram Puncture Test

[0051] The ram puncture test is used to determine the maximum puncture load or force, and the maximum puncture stress of a flexible film when struck by a hemispherically or spherically shaped striker. This test provides a quantitative measure of the puncture resistance of thin plastic films. This test is further described in U.S. Patent Application No. 09/401,692.

[0052] The following example is given to illustrate the invention and should not be construed as limiting that which is described in the appended claims.

[0053] In the following example, the film composition was produced generally utilizing the apparatus and method described in U.S. Pat. No. 3,456,044 (Pahlke) which describes a coextrusion type of double bubble method and in further accordance with the detailed description above. All layers were extruded as a primary tube which was cooled upon exiting the die e.g. by spraying with tap water. This primary tube was then reheated by radiant heaters(although other means known to those skilled in the art, such as conduction or convection heating may be used) with further heating to the draw (orientation) temperature for biaxial orientation accomplished by an air cushion which was itself heated by transverse flow through a heated porous tube concentrically positioned around the moving primary tube. Cooling was accomplished by means of a concentric air ring. Draw point temperature, bubble heating and cooling rates and orientation ratios were generally adjusted to maximize bubble stability and throughput for the desired amount of stretching or orientation. All percentages are by weight unless indicated otherwise.

EXAMPLE 1

[0054] A puncture-resistant bag according to the present invention, as generally illustrated in Figs. 1 & 2, was produced from a film comprising a coextruded three-layer biaxially oriented shrink film having (A) an inner heat sealing layer, (B) a barrier layer and (C) an outer layer. The inner and outer layers being directly attached to opposing sides of the barrier layer. The three layers included the following compositions:

(A) 33 wt. % EXACT™ 4053; 37% ESCORENE™ LD 701.ID; 24% SCLAIR™ 10B; 4% Spartech A27023; and 2% Spartech A32434;
(B) a blend of about 85% vinylidene chloride-vinyl chloride copolymer and about 15% vinylidene chloride-methacrylate copolymer; and
(C) 33 wt. % EXACT™ 4053; 25 % SCLAIR™ 10B; 40% ESCORENE™ LD 701.ID; and 2% Ampacet 501236.

[0055] One extruder was used for each layer. Each extruder was connected to an annular coextrusion die from which heat plastified resins were coextruded forming a primary tube. The resin mixture for each layer was fed from a hopper into an attached single screw extruder where the mixture was heat plastified and extruded through a three-layer coextrusion die into the primary tube. The extruder barrel temperature for the barrier layer (B) was between about 250-300°F (121-149°C); for the inner layer (A) and for the outer layer (C) were about 290-330°F(143-165°C). The coextrusion die temperature profile was set from about 320 to 350°F (163 to 177°C). The extruded multilayer primary tube was cooled by spraying with cold tap water 50-68 °F (about 10-20 °C).

[0056] A cooled primary tube of about 101.6 mm (4 inches) flatwidth was produced passing through a pair of nip rollers. The cooled flattened primary tube was inflated, reheated, biaxially stretched, and cooled again to produce a biaxially stretched and biaxially oriented film which was slit open, laid flat to form a sheet having a width of approximately 406.4 mm (16 inches) and wound on a reel. The M.D. orientation ratio was about 5:1 and the T.D. orientation ratio was about 4:1 . The draw point or orientation temperature was below the predominant melting point for each layer oriented and above that layer's predominant glass transition point and is believed to be about 68-85 °C. The resultant biaxially oriented film had an average gauge of about 63.5 μm (2.5 mil) and had an excellent appearance.

[0057] The film was irradiated at a dosage level of about 5.0 MR. As previously noted, although not essential, it is preferred to irradiate the entire film to broaden the heat sealing range and/or enhance the toughness properties of the inner and outer layers by irradiation induced cross-linking and/or scission. Irradiation may be done on the primary tube or after biaxial orientation. The latter, called post-irradiation, is preferred and described in Lustig et al. U.S. Pat. No. 4,737,391. An advantage of post-irradiation is that a relatively thin film is treated instead of the relatively thick primary tube, thereby reducing the power requirement for a given treatment level.

[0058] The film was unwound and slit to a width of 330.2 mm (13 inches). The film was then fed into the bag making equipment to form a tube member having a continuous longitudinally extending lap seal. Bags according to the bag 10 depicted in FIG. 1 were formed by sealing laterally across the tube member and simultaneously severing the sealed portion from the continuous tube structure.

[0059] Various tests were performed on the film and/or resultant inventive bags. The film thickness was determined to be an average 53.34 μm (2.1 mil). The lap seal was tested to have a very strong average seal strength of about 8,000 to 10,000 grams. The bag also had an average M.D. and T.D. heat shrinkability at 90 °C of 48 and 48, respectively. The ram puncture results were likewise impressive. The puncture resistance of the 53.34 μm (2.1 mil) thick film was measured and had a maximum puncture force of 86 Newtons (N) and a total energy to failure of 0.9 Joules (J). This preferred bag has very good heat shrink percentages which are highly desirable for packaging cuts of fresh red meat and extremely good puncture resistance. Thus, an economical to produce heat shrinkable bag having puncture resistance and strong seals has been made having a unique combination of features and commercial advantages previously unknown.

[0060] Advantageously, the bags 10 may be fabricated of nearly any dimensions economically since the bags 10 are not formed from a seamless tube that must be generated to the desired width. The only limitation on size of fabricated bag is the size of a stock sheet films having great enough widths to meet the specifications. Standard roll stock films are available in widths in excess of 2.54 m (100 inches). The present invention allows a bag manufacturer to fabricate any size bag from the same flat sheet of roll stock, up to the dimensional limits of the roll stock. For example, if the roll stock is 1.32 m (52 inches) in width, a tube member can be fabricated having a lay-flat width of approximately 660.4 mm (26 inches), less the amount of overlap or abutment in the first seal 16 used. If the manufacturer wishes to fabricate a bag having a lay-flat width of 457.2 mm (18 inches), then the manufacturer slits the standard roll stock to the appropriate width (approximately 914.4 mm (36) plus extra for the area of the first seal 16). The unused portion slit form the standard roll stock is rewound for use making bags of another dimension(s). In this manner, standard roll stock films can be manufactured more economically because film manufacturing equipment may be run at or near the upper limits of film width production and thereby use nearly all the equipments capacity. Fabricating bags from seamless tubes requires that the film making equipment be run at limited capacities to form the different smaller width tubes. Additionally, the film making equipment requires costly set-up and breakdown between jobs of differing dimensions that add significantly to the cost of manufacturing the seamless tubes.

[0061] A preferred embodiment of the heat-shrinkable package of the present invention is made from a sheet 410 of heat shrinkable film 411 having a first side edge 412a and opposing, second side edge 412b connected by a third side edge 412c and a fourth side edge 412d. First side edges 412a and second 412b are preferably parallel to each other when film 411 is in a long flat planar state. Third side edge 412c and fourth side 412d are preferably parallel to each other when film 411 is in a lay flat planar state. First and second side edges 412a, 412b are also preferably perpendicular to third and fourth side edges 412c, 412d when film 411 is in a lay flat planar state. Film 411 has four corners at the intersections of the four sides with first corner 412ac defined by the junction of first side edge 412a with third side edge 412c; second corner 412b defined by the junction of first side edge 412a with third side edge 412c; second comer 412bc defined by the junction of second side edge 412b with third side edge 412c; third comer 412ad defined by the junction of first side edge 412a with fourth side edge 412d; and fourth corner 412bd defined by the junction of second side edge 412b with fourth side edge 412d. Film 411 has a top surface 413a circumscribed by a perimeter 414 formed by sides 412a, 412c, 412b and 412d with an opposing bottom surface 413b also circumscribed by said perimeter 414. FIG. 8 Depicts corner 412ad of film 411 turned upward to reveal said bottom surface 413b.

[0062] Referring now to FIG. 9, a preferred embodiment of the present invention is depicted generally as a bag 415 made from said film 411 of FIG. 8. The bag 415 is formed by overlapping the first side edge 412a with the second side edge 412b and sealing preferably by heat to produce a fusion bond lap seal 416 defined by parallel spaced apart dotted lines 417a and 417b, and third side edge 412c and fourth side edge 412d. It should be noted that while said lap seal 416 is depicted as a continuous elongated rectangle extending from side 412c to side 412d, the invention further contemplates that the seal shape may vary and could, for example, form a wavy line or zigzag shape or other shapes as desired. Also, the width of the seal may be varied to be thicker or thinner as desired. Also the seal may optionally be made by alternatives or additional means, including, e.g., by applications of suitable flue or adhesive material known in the art for sealing together films. It is further contemplated that said lap seal 416, while depicted as a continuous lap seal 416 suitable for forming a hermetic package, it is also contemplated that for some applications, e.g., for certain industrial or non-perishable items, a noncontinuous seal having, e.g., the appearance of a dotted or dashed line, may be employed. The intermittent seal embodiment permits air to escape enclosure during packaging operations where it is not desired to either apply a vacuum, or seal with a trapped bubble of air or other gas, or remove air by other means. Optionally, the strength of the seal may be varied by one skilled in the art in view of the teachings of the present application by selection of aforesaid parameters such as seal shape, thickness, continuous or intermittent nature, material selection type of and known parameter for varying the strength of different types of seals, e.g., by adjusting dwell time or temperature for producing heat seals. Such variations and adjustments may be made by those skilled in the art without undue experimentation.

[0063] Referring again to FIG. 9, lap seal 416 is preferably a heat seal forming a fusion bond between top surface 413a and bottom surface 413b of film 411. The overlapped sealed film 411 defines a tube member 418 in which top surface 413a of film 411 forms an inner film surface 419 of said tube member 418. A second seal 420 extends laterally across said tube member 418 adjacent the third side edge 412c of film 411 thereby forming a closed bag end 421. A variety of seals may be used. Preferably second seal 420 will be a heat seal which fusion bonds the bag film inner surface 419 to itself. The second seal 420 by closing bag end 421 both forms a first bag edge 422 and opposing second bag edge 423, and the second seal extends across the tube member 418 from the first bag edge 422 to the second bag edge 423. The second seal may also employ a variety of shapes, thicknesses, structures, etc., as for the previously described lap seal 416. The lap seal does not need to be centered between edges 422 and 423 but preferably is positioned anywhere therebetween.

[0064] Opposite the closed bag end 421 is a bag mount formed by lap sealed film under fourth side edge 412d through which a product (not depicted) may be placed into a product receiving chamber 425 defined by tube member 418, closed bag end 421 and bag mouth 424. The first bag edge 422 may extend from a first bag end comer 426 to a first bag mouth point 427 and a second bag edge 423 may extend from a second bag end corner 428 to a second bag mouth point 429 such that bag 415 may be collapsed into a lay flat condition having first bag edge 422 and opposing second bag edge 423. In a lay flat condition or a state close to lay flat such as depicted in FIG. 9, bag end 421, bag mouth 424 and connecting first bag edge 422 and second bag edge 423 defines a first bag wall 430 and connected opposing bag wall 431. Tube member 418 has an inner surface 419 and an outer surface 433. The first bag wall 430 has first bag wall first side 430a proximate second side edge 412b and extending to second bag edge 423. The first bag wall 430 also has an opposing first bag wall seamed side 430b proximate first side edge 412a and extending to first bag edge 422.

[0065] Preferably, the second seal 420 is provided in a manner such that the first seal 416 is positioned within one of the first and second bag walls 430 and 431, thereby forming a "backseam" of the bag. This provides one seamless bag wall and two seamless bag edges that may include printed images applied to the film before forming bags or after the bag is formed. Additionally, the second seal 420 may take any shape, whether straight or curved, so long as the second seal 420 operates to close the end 421. At least one of the first seal 416 and second seal 420 comprises a peelable seal. "Peelable seal" and like terminology is used herein to refer to a seal, and especially heat seals, which are engineered to be readily peelable without uncontrolled or random tearing or rupturing the packaging materials which may result in premature destruction of the package and /or inadvertent contamination or spillage of the contents of the package. An peelable seal is one that can be manually peeled apart to open the package at the seal without resort to a knife or other implement to tear or rupture the package. In the present invention, the peelable seal must have a seal strength sufficient to prevent failure of the seal during the normal heat-shrinking process and further normal handling and transport of the packaged article. The seal strength must also be low enough to permit manual opening of the seal. Preferably seal parameters such as choice of materials and sealing conditions will be used to adjust the seal strength to the desired level for the particular package and application.

[0066] Many varieties of peelable seals are known in the art and are suitable for use with the present invention. Peelable seals are generally made from thermoplastic films having a peelable system designed therein. Suitable peelable films and/or peelable systems are disclosed in U.S. Patent Nos. 4,944,409 (Busche et al.); 4,875, 587 (Lulham et al.); 3,655,503 (Stanley et al.); 4,058,632 (Evans et al.); 4,252,846 (Romesberg et al.); 4,615,926 (Hsu et al.) 4,666,778 (Hwo); 4,784,885 (Carespodi); 4,882,229 (Hwo); 6,476,137 (Longo); 5,997,968 (Dries, et al.); 4,189,519 (Ticknor); 5,547,752 (Yanidis); 5,128,414 (Hwo); 5,023,121 (Pockat, et al.); 4,937,139 (Genske, et al.); 4,916,190 (Hwo); and 4,550,141 (Hoh) Preferred films for use in fabricating bags according to the invention may be selected from multilayer, heat-shrinkable films capable of forming a peelable seal. Preferred films may also provide a beneficial combination of one or more or all of the below noted properties including high puncture resistance (*e.g.*, as measured by the ram and/or hot water puncture tests), high shrinkage values, low haze, high gloss, high seal strengths and printability. Since the inventive bags may advantageously be used to hold oxygen or moisture sensitive articles such as food products after evacuation and sealing, it is preferred to use a thermoplastic film which includes an oxygen and/or moisture barrier layer. The terms "barrier" or "barrier layer" as used herein means a layer of a multilayer film which acts as a physical barrier to moisture or oxygen molecules. Advantageous for packaging of oxygen sensitive materials such as fresh red meat, a barrier layer material in conjunction with the other film layers will provide an oxygen gas transmission rate(O_2GTR) of less than 70 (preferably 45 or less, more preferably 15 or less) cc per square meter in 24 hours at one atmosphere at a temperature of 73°F (23°C) and 0% relative humidity. In an alternative embodiment, the gas permeability is controlled to allow the escape of CO_2, *e.g.,* for packaging respiring foods such as cheese as described in U.S. Patent No. 6,511,688. The film has an unrestrained shrinkage of at least 20% (preferably at least 35%) at 90°C at least one and preferably both the machine (MD) and transverse (TD) directions. Unrestrained (sometimes referred to as "free") shrink is measured by cutting a square piece of film measuring 10 cm in each of the machine and transverse directions. The film is immersed in water at 90°C for five seconds. After removal from the water the piece is measured and the difference from the original dimensions are each multiplied by ten to obtain the percentage of shrink in each respective direction.

[0067] Oxygen barrier materials which may be included in the films utilized for the inventive bags include ethylene vinyl alcohol copolymers (EVOH), polyacrylonitriles, polyamides and vinylidene chloride copolymers (PVDC). For some applications nylon may provide useful oxygen barrier properties especially at low temperatures, *e.g.*, as used with frozen foods. Preferred oxygen barrier polymers for use with the present invention are vinylidene chloride copolymers or vinylidene chloride with various comonomers such as vinyl chloride (VC-VDC copolymer) or methyl acrylate (MA-VDC copolymer), as well as EVOH. A specifically preferred barrier layer comprises about 85% vinylidene chloride-methyl acrylate comonomer and about 15% vinylidene chloride-vinyl chloride comonomer, as for example described in Schuetz et al. U.S. Pat. No. 4,798,751. Suitable and preferred EVOH copolymers are described in U.S. Patent No. 5,759,648..

[0068] A variety of peelable films and peelable sealing systems may be employed in the present invention. In a preferred embodiment, a film comprising a coextrusion of at least three layers (referred to as three layer peelable system to distinguish it from systems using one or more contaminated seal layers described below) having an outer layer, an inner heat seal layer and a tie layer disposed between the outer layer and the inner heat seal layer is used. In this preferred three layer system embodiment, the film layers are selected such that peeling occurs by breaking apart the tie layer and/or a bond between the tie layer and at least one of the outer and inner layers. Permanent, peelable, and fracturable bonds may be engineered into the coextrusion process, e.g., by providing two adjacent first and second layers having materials with a greater affinity for each other compared to the second layer and an adjacent third layer where this establishes a relatively permanent bond between the layers, when two materials have a lesser affinity for each other. This three layer structure establishes a relatively permanent bond between the first and second layer which have a greater affinity for one another than the second or third layers which have a lesser affinity where the second layer is common to both the first and third layers as a tie layer or connecting layer. Thus, the lesser affinity between the second and third layers relative to the first and second layers produces a relatively peelable bond between the second and third layers. Selection of the various materials determines the nature of the bond, i.e., whether it is permanent, peelable, fracturable or combinations thereof.

[0069] Suitable polymers for use in the outer, tie and inner heat sealable layers include both poly-type material such as ethylene homopolymers and copolymers as well as ionomer type material. Examples of suitable polymers include: ethylene vinyl acetate copolymer (EVA, ethylene α-olefin copolymers, linear low density polyethylene, low density polyethylene, very low density polyethylene (VLDPE), neutralized ethylene acid copolymer, plastomers, ethylene acrylate copolymer, ethylene methyl acrylate copolymer and zinc or sodium salts of partially or completely neutralized ethylene-methacrylate acid copolymers. The inner heat seal layer beneficially uses heat sealable materials. The tie layer is selected to have a relatively low peel strength when peelably bonded to one of either the outer layer or inner heat seal layer. The tie layer is typically comprised of a blend of about 5-30% polybutylene and another constituent, such as ethylene vinyl acetate copolymer, ethylene copolymers with C_4 - C_8 alpha olefin, linear low density polyethylene, ionomers, neutralized ethylene acid copolymer or unneutralized ethylene acid copolymer and mixtures thereof. The term "polybutylene" as used herein includes having polymeric units derived from butene -1 as the major (75% polymeric units) components and preferably at least 80% of its polymeric units will be derived from butene -1. A preferred polybutylene is a random copolymer of butene -1 with ethylene having a reported density of 0.908 g/cm^3 and a melt index of 1.0 g/10 min. and a melting point of 117.2°C (243°F), which is commercially available from Basell Polyolefins Company, N.V., The Netherlands, under the trade name PB 8640. In this preferred peelable embodiment, the heat seal formed between the inner heat seal layer and another layer to which it is heat sealed, whether part of another film or the same, should be permanent, i.e., should have a seal strength greater than the peelable bond between the tie layer and one of its adjacent layers. The preferred three layer coextruded peeling structure described above contemplates optional additional layers to product a film of 4, 5, 6, 7, 8, 9, 10 or more layers. It is further contemplated that one or more additional layers may be coextruded with the described three layers or separately and that the multilayer film structure may be formed not only by coextrusion, but also by other methods well known in the art such as coating lamination, adhesive lamination or combinations thereof.

[0070] It is also contemplated that such one or more additional layers may be adjacent to or between any of the described three layers. In one embodiment of the invention the heat seal layer may be replaced by a permanent adhesive or glue that may or may not be applied hot or in a melt state, liquid state or otherwise. However, it is preferred to utilize a heat sealable layer.

[0071] It is also contemplated that a peelable seal using one or more so-called "contaminated" surface layers may be utilized where peeling occurs at a seal layer interface 432 rather than at an interior layer of film 411. This type of peeling system suffers from disadvantage associate with, e.g., controlling the diverging properties of providing high seal strength with desirable low forms for peelings, as well as problems of sealing under conditions which may adversely affect seal integrity, e.g., where an article being packaged deposits particulates, starch, fat, grease or other components which may lessen seal strength or hamper the ability to provide a seal of desired strength such as a strong hermetic fusion bond, e.g., by heat sealing. Such sealing systems are often referred to as two layer peeling systems, but may include 3, 4, 5, 6, 7, 8, 9, 10 or more layers in the film structure.

[0072] Preferred peelable sealing films and peelable seal systems are disclosed in U.S. Patent No. 4,944,409 entitled "EASY OPEN PACKAGE".

[0073] A preferred multilayer, barrier film structure for use in fabricating bags according to the present invention is illustrated in FIG. 10, which depicts an enlarged, end view of the first seal 416 of FIG. 9 made from the sheet of heat-shrinkable film 411. Layer thicknesses in FIG. 10 and other figures presented herein are not to scale, but are dimensioned for ease of illustration. A preferred easy to peel heat shrinkable film 411 is a five layer coextrusion and includes from inner surface 419 of the tube member 419 (See FIG. 9) to an opposing outer surface 433.

(a) an inner surface heat sealing layer 434 preferably comprising a blend of ethylene vinyl acetate (EVA) and polyethylene;
(b) a barrier layer 435 preferably comprising a vinylidene chloride copolymer (PVDC);
(c) a core layer 436 preferably comprising a blend of EVA and polyethylene;
(d) a tie layer 437 preferably comprising a blend of polyethylene and polybutylene; and,
(e) an outer surface heat sealing layer 438 preferably comprising polyethylene.

[0074] The thicknesses of each layer, based on the total thickness of the film 411, may be typically <50% inner surface heat sealing layer 434; <20% barrier layer 435; <28% core layer 436; <15% tie layer 437; and <15% outer heat sealing layer 438. The first seal 416 is made by longitudinally heat sealing the inner film surface 419 of film 411 to the outer film surface 433 along their respective lengths, such that inner film surface 419 and outer film surface 433 overlap. In this manner, a fusion bond is made between the inner surface heat sealing layer 434 and the outer surface heat sealing layer 438. The peelable bond of the system is provided by the tie layer 437 and peeling occurs there, e.g., at the tie layer interface with the outer surface heat sealing layer 438, and/or at the tie layer interface with core layer 436 and/or between outer layer 438 and core layer 436. Thus, referring to FIGS. 9 and 10, the peelable portion of the film is on the outside of the tube member 418, which is preferable. This will insure that the first seal 416 is peelable, while the second seal 420 and final closing seal (not shown) are strong fusion seals between the inner surface heat sealing layer 434 of each bag wall 430 and 431.

[0075] Referring to FIG. 11, a fragmentary sectional view taken along lines B-B of FIG. 9 illustrates how a preferred embodiment of the invention works to create strong end seals while permitting the lap seal to function as an easy to open peel seal. In FIG. 9, film 411 has an outer surface 433 with consecutive layers therefrom of outer surface layer 438, tie layer 437, core layer 436, barrier layer 435, and inner surface heat sealing layer 434. Referring to FIG. 9, the second seal 420 is provided across tube member 418 to collapse its surface 419 upon itself. Referring again to FIG. 11, this seal joins inner surface heat sealing layer 434 to itself with the peelable tie layer 437 being positioned distal from end seal interface 439. This preferred embodiment of the invention depicted in FIGS. 9-11 combines (a) an end seal which mates like materials with strong seal properties to each other keeping distal the easily peelable tie layer 437 and (b) a lap seal having peelable tie layer 437 proximate the outer surface heat sealing layer 438 and lap seal interface 432 , thereby providing an easily peelable opening in bags or packages made using the described configuration.

[0076] The film 411 is designed to control the film failure when peeled manually. Due to the composition of the peelable tie layer 437, its location proximate the lap seal interface 432, and in the case of the preferred three layer peelable system, the thinness and composition of the outer surface heat sealing layer 438; as the second side edge 412b is manually pulled across, up and away from the lap seal 416, a first rupture or tear will begin. This tear will propagate from the heat seal at the edge 417b of lap seal interface 432 through the outer heat sealing layer 438 thereof. If the peelable bond is designed to occur at the tie layer 437, the continued application of opening force causes: a delamination or breaking of the adhesive bond, along the tie layer 437/outer heat sealing layer 438 interface or along the tie layer 437/core layer 436 interface and/or causes fracture of the tie layer 437, or a combination thereof until the tear reaches the opposite side edge 417a of the heat seal 416, where the tear either propagates to edge 412a or back across the outer layer 438 and the bag is thereby opened.

[0077] In general, the films used in the heat-shrinkable bags of the present invention can have any thickness desired, so long as the films have sufficient thickness and composition to provide the desired properties for the particular packaging operation in which the film is used, e.g., peelable seal, puncture-resistance, modulus, seal strength, barrier, optics, etc. For efficiency and conservation of materials, it is desirable to provide the necessary puncture-resistance and other properties using the minimum film thicknesses. Preferably, the film has a total thickness from about 31.75 μm (1.25) to about 203.2 μm (8.0 mils); more preferably from about 44.45 μm (1.75) to about 76.2 μm (3.0 mils).

[0078] Another embodiment of the present invention is illustrated in FIGS. 12 and 13, generally as bag 415a. Identical reference numerals have been used with respect to elements of Bag 415a, which are also found in bag 415. Bag 415a further includes a pull flap 440. The pull flap 440 is formed by providing additional overlap by moving the first and second sides edge 412a and 412b further apart and positioning the first lap seal 416 such that a portion of the first bag wall, first side 430a, that overlaps the first bag wall second side 430b outside of the product receiving chamber 425 is not sealed to the second side 430b. The pull flap 440 may be readily grasped by the end user and pulled to easily open the package, without resort to a cutting instrument, as is often required when opening packages without a peelable system. Although shown as extending the entire length of the bag 415a, a skilled artisan will appreciate that the pull flap 440 may be cut to a desired shape or that any other known device known to aid initiation of peeling may be incorporated. The preferred film illustrated in FIGS. 8, 10 and 11 described previously is also preferred for use with bag 415a.

[0079] The alternative embodiment illustrated in FIGS. 12 and 13 has reversed the location of the bag mouth 424 and second seal 420 of FIG. 8 which is depicted in FIG. 12 as bag mouth 424a and second seal 420a.

[0080] Referring to FIG. 14, an illustration of the second seal 420a in cross-section shows first bag wall 430 sealed to second bag wall 431 from first bag edge 422 to second bag edge 423 and across first lap seal 416 which is located between first side edge 412a and second side edge 412b. In the well known heat sealing process opposing sealing bars or wires press together layers of film under elevated temperature and pressure for a time sufficient to cause a fusion bond therebetween. These heat seal bars may be rigid and/or flexible but generally are not supple or not as supple as the film being sealed. As depicted in FIG.14, the second seal 420a has a seal interface 439a which has two possible points proximate first side edge 412a and second side edge 412b where sealing pressure may be reduced during the sealing operation sealing pressure may be reduced at second seal interface 439a at a point 441 below edge 412b, and also at point 442 adjacent first edge 412a. It is also possible that a void may exist, e.g., at point 442. In order to produce a desired strong seal particularly at points 441 and 442 as well as all along second seal interface 439a, sealing parameters such as pressure, temperature, dwell time and heat sealing layer composition may be adjusted as desired. In particular, it has been found that use of a high melt index polymer component in the heat seal layer may be advantageous to fill potential voids. It may also be advantageous to taper one or both edges 412a and 412b to increase contact surfaces and/or pressure between the overlapping films particularly at points 441 and 442 and adjacent areas.

[0081] A bag which is not an embodiment of the present invention is illustrated in FIG. 15, generally as bag 415b. Again, like elements include like reference numerals. Bag 415b includes a first fin seal 516 joining the first and second sides 430a and 430b of bag wall 430 such that the inner film surfaces 419 of each side are in a face-to-face abutment, having a fin seal interface 517. One or both of the first and second side edges 412a and 412b may extend outwardly beyond the first fin seal interface 517 such that a pull flap (not shown) is provided. Bag 415a (FIG. 12) is preferred over bag 415b, since the plane of the first seal 416 is parallel to the plane of the shrink forces encountered during the heat-shrinking process. The first fin seal 516 of bag 415b places the plane of the heat seal perpendicular to the shrink forces (as shown by arrows Z' and Z" in FIG. 17), which increases the risk of seal failure (premature peeling) during the heat-shrinking process. Additionally, since the inventive receptacles are advantageously fabricated from a single sheet or web of film, then a fin seal arrangement, such as first seal 516, requires that each seal of the receptacle be a peelable seal. Also, the second seal 420 and final closing seal (not shown) are also necessarily peelable since the first and second bag walls 430a and 430b are sealed with the film in the same abutted relationship. For example, FIG. 17 depicts an enlarged view of the first fin seal 516 shown in cross-section showing discrete layers of the preferred film discussed above with bags 415 and 415a. Each wall 450 and 452 of the seal 516 includes a three layer peelable system (the tie layer 437) equidistant from and proximate to the sealed interface of sealant layer 438. Thus, it not only cannot be predetermined in which wall 450 or 452 the peel failure will occur, but all seals are easily peeled and the shrink force direction further reduces the ability to make strong seals. For all these disadvantages this bag is outside the scope of the present invention.

[0082] Another embodiment of the present invention is illustrated in FIGS. 18 and 19 generally as bag 415c. Again, like elements include like reference numerals. Bag 415c includes a first seal 616 comprising a butt-seal tape 641 comprising a butt-seal film 611 having a first border 607, a second border 609, a sealing surface 615 and an exterior surface 614. The first seal 616 includes a first heat seal 618 longitudinally joining the first side 430a of bag wall 430 to the first border 607 of the butt-seal tape 641, and a second heat seal 619 longitudinally joining the second side 430b of bag wall 430 to the second border 609 of the butt-seal tape 641. Thus, first and second sides 430a and 430b are joined in an abutting edge-to-edge relationship thereby forming bag wall 430 without a heat seal directly there between. Preferably, the butt-seal film 611 comprises the same film as described in reference to bags 415, 415a and 415b described above and illustrated in FIGS. 8-17, with the outer heat sealing layer 438

(FIG. 9) comprising the inner surface 615. Thus, bag 415c may be manufactured from a film that does not include a peelable system therein, but includes a peelable seal by means of the peelable system included in the butt-seal tape 641 used to form the first seal 616. Conversely, the film 411 may preferably include a peelable system while the butt-seal tape 641 does not, or both film 411 and butt-seal film 611 may include a peelable system compatible with the other. The butt-seal film 611 is preferably heat-shrinkable, but need not be. A pull flap 440 may be provided in the butt-seal tape 641 to provide an area for the consumer to manually grasp and pull to easily open the bag 415c. If the butt-seal tape 641 is sealed to the inner surface 419 of the film 411, then a portion of the first or second sides 430a and 430b may extend outwardly past the first or second heat seals 618 and 619 to provide a pull flap for the consumer to grasp. The second seal 420 is preferably a permanent seal made between the inner surfaces 419 of the first and second bag walls 430a and 430b.

[0083] Although depicted in FIG 18 as being sealed to the outer surfaces 415 of the first and second sides 412 and 414, one skilled in the art will appreciate that the butt-seal tape 641 that forms the first seal 616 may be placed on the inside of the bag 410c (not shown), whereby the sealing surface 615 is heat sealed to inner surfaces 419 of the first and second sides 430a and 430b. In this instance, preferably at least one of the first and second sides 430a and 430b include a portion that extends outwardly beyond the heat seal to the butt-seal tape 641. Thus, the consumer is provided with a pull flap to grasp.

[0084] A further embodiment of the present invention is illustrated in FIGS. 20 and 21 generally as bag 415d. Like elements discussed above in connection with bags 415, 415a, 415b and 415c have been given the same reference numerals in bag 415d. Bag 415d includes a first seal 716 comprising a seal strip 741 comprising a strip film 711 having an inside surface 714 and an outward surface 715. The seal strip 741 includes a first margin 718 longitudinally heat sealed to the first side 430a by first heat seal 720, such that the outward surface 715 is sealed in face-to-face contact with the inner surface 419 of film 411. The seal strip 741 includes a second margin 719 longitudinally heat sealed to the second side 430b by second heat seal 721, such that the inside surface 714 is sealed in face-to-face contact with the outer surface 433 of the second side 430b. A pull flap 440 may be provided by including a portion of the strip film 711 that extends outwardly beyond second heat seal 721 joining the second margin 719 and the second side 430b. Alternatively, the first side 430a could be provided with a portion that extends outwardly beyond the second heat seal 420.

[0085] Preferably, the strip film 711 includes a peelable system and comprises the same film as described in reference to bags 415, 415a and 415b described above and illustrated in FIGS. 8-19, with the outer heat sealing layer 438 (FIGS. 10-11) comprising the inside surface 714. In this manner, the heat seal 721 is peelable and the film 411 need not include a peelable system. Alternatively, the outer heat sealing layer 438 could comprise the outward surface 715, such that heat seal 720 is peelable. In this case, the film 411 need not include a peelable system and the second seal 420 may be made permanent. In a similar manner as described for bag 415c, the strip film 711 may not include a peelable system while the film 411 does include a peelable system, or both film 411 and strip film 711 may include compatible peelable systems. The strip film 711 is preferably heat-shrinkable, but need not be.

[0086] The bags according to the invention are preferably fabricated continuously from a continuous sheet or roll stock as described in U.S. Patent Application No. 10/371,950, in the name of Gregory Robert Pockat, et al., filed on February 20, 2003 entitled "HEAT-SHRINKABLE PACKAGING RECEPTACLE". The roll stock is slit to a desired width and fed to bag making equipment, wherein the machine direction sides of the film are brought together and sealed longitudinally, with a lap seal (bags 415 and 415a) to form a continuous single-seamed tube, or tube member. A transverse seal is made across the tube member and the section including the transverse seal is severed from the continuous tube to form the individual bag. Generally, heat seals are made by supplying sufficient heat and pressure between two polymeric film layer surfaces for a sufficient amount of time to cause a fusion bond between the polymeric film layers. Common methods of forming heat seals include hot bar sealing, wherein adjacent polymeric layers are held in face-to-face contact by opposing bars of which at least one is heated, and impulse sealing, wherein adjacent polymeric layers are held in face-to-face contact by opposing bars of which at least one includes a wire or ribbon through which electric current is passed for a very brief period of time to cause sufficient heat to cause the film layers to fusion bond. Less area is generally bonded with an impulse seal relative to a hot bar seal, thus the performance of the film's sealing layer is more critical. However, an impulse seal is generally more aesthetic since less area is used to form the bond.

[0087] The films selected to fabricate the inventive receptacles are preferably biaxially stretched or oriented by the well-known trapped bubble or double bubble technique as for example described in U.S. Patent Nos. 3,456,044 and 6,511,688. In this technique an extruded primary tube leaving the tubular extrusion die is cooled, collapsed and then preferably oriented by reheating, reinflating to form a secondary bubble and recooling. The film is preferably biaxially oriented wherein transverse (TD) orientation is accomplished by inflation to radially expand the heated film. Machine direction (MD) orientation is preferably accomplished with the use of nip rolls rotating at different speeds to pull or draw the film tube in the machine direction. The stretch ratio in the biaxial orientation to form the bag material is preferably sufficient to provide a film with total thickness of between about 1 and 8 mils. The MD stretch ratio is typically 3:1-5:1 1 and the TD stretch ratio is also typically 3:1-5:1.

[0088] Referring now to FIG. 22, a double bubble (also know as a trapped bubble) process is shown. The polymer blends making up the several layers are coextruded by conveying separate melt streams 611a, 611b, and 611c to the die 630. These polymer melts are joined together and coextruded from annular die 630 as a relatively thick walled multilayered tube 632. The thick walled primary tube 632 leaving the extrusion die is cooled and collapsed by nip rollers 631 and the collapsed primary tube 632 is conveyed by transport rollers 633a and 633b to a reheating zone where tube 632 is then reheated to below the melting point of the layers being oriented and inflated with a trapped fluid, preferably gas, most preferably air, to form a secondary bubble 634 and cooled. The secondary bubble 634 is formed by a fluid trapped between a first pair of nip rollers 636 at one end of the bubble and a second pair of nip rollers 637 at the opposing end of the bubble. The inflation which radially expands the film provides transverse direction (TD) stretching and orientation. Orientation in the machine direction (MD) is accomplished by adjusting the relative speed and/or size of nip rollers 636 and nip rollers 637 to stretch (draw) the film in the machine direction.

[0089] The biaxial orientation preferably is sufficient to provide a multilayer film with a total thickness less than 254 μm (10 mil) and typically from about 31.75 μm (1.25) to 203.2 μm (8.0 mils) or more, preferably less than 127 μm (5 mil) and more preferably between 1.75 and 3.0 mils (44.5 to 76 μ).

[0090] After orientation, the tubular film 238 is collapsed preferably to a flatwidth of up to 2.03 m (80 inches), typically between about 127-762 mm (5-30 inches), slit open longitudinally, laid flat and wound on a reel 239 for use as rollstock. One skilled in the art will appreciate that while the above described method may be used to form the film, films may be made by other conventional processes, including single bubble blown film or slot cast sheet extrusion processes with subsequent stretching, e.g., by tentering to provide orientation. One skilled in the art will further appreciate that the flatwidth of the collapsed tube will determine the width of the sheet film that results therefrom. Thus, the primary tube dimensions and subsequent processing may be selected to provide a maximum flatwidth and film thickness for the desired application, thereby advantageously maximizing the production capacity of the film making equipment.

[0091] Advantageously, a bag maker may produce bags of various lengths and widths from rolls of film rollstock by adjusting the width of the sheet and the distances between the transverse end seal and bag mouth for a particular bag or series of bags. This advantageously avoids the costly need to produce specific widths of seamless tubes which are currently widely used by meat packers and which do not include a peelable seal. Also the present invention permits cost savings and manufacturing efficiencies by permitting creation of numerous widths and lengths of bag from standard rollstock. The bag maker may simply slit film rollstock to a desired width and form a continuous tube member by longitudinally sealing opposing sides as described for bags 415, 415a and 415b. Bags of adjustable lengths may be made by transversely sealing and cutting through the tube member at a position spaced from the transverse seal.

[0092] Preferably, bag making is a continuous process; shown schematically in FIG. 23, wherein the film is directed to a bag making assembly (not shown) where individual end-seal bags are made. Film 411 is fed continuously from reel 639 and optionally slit to form a desired width film 411a and an unused film 411b. Film 411a is fed to a bag making assembly (not shown). Unused film 411b is rewound on reel 639b for later use, or may be fed to another bag making assembly. The first and second sides 430a and 430b of film 411a are brought together and sealed longitudinally, preferably in a first seal, e.g., lap seal 416 having an additional overlap portion that will act as a pull flap, to form a continuous back-seamed tube member 418. The second seal 420 is provided transversely across the tube member 418 at a desired location spaced from the opening 424. The tube member 418 is then (or preferably simultaneously) severed to separate the portion containing the second seal from the continuous tube, thereby forming bag 415. Typically as the transverse seal is made for one bag a transverse cut forming the mouth of the adjacent bag is being made. This process forms a so called "end-seal" bag which, when it is laid flat, has a bottom edge formed by the transverse heat seal, an open mouth formed by the severed edge and two side edges formed by the fold produced when the tube member is laid flat. The transverse heat seal should extend across the entire tube member to ensure a hermetic closure where such is desired. Each bag being formed from a length of the tube member will necessarily be formed by at least two, usually parallel, spaced apart, transverse cuts which cause a segment of the tube member to be made and one transverse seal, usually adjacent one of these cuts, will define a bag bottom which is located opposing the bag opening, which is formed by the distal cut. The spacing between the lateral seal and the opening, which may vary, will determine the length of the bags formed. The length of the bags can easily be varied by changing the distance between transverse seals and cuts. The width of the bags can also be easily varied by changing the width of the film by slitting the standard rollstock.

[0093] Unless otherwise noted, the following physical properties are used to describe the invention, films and seals. These properties are measured by either the test procedures described below or tests similar to the following methods.

Average Gauge: ASTM D-2103
Tensile Strength: ASTM D-882, method A
1% Secant Modulus: ASTM D-882, method A
Oxygen Gas Transmission Rate (O_2GTR): ASTM D-

3985-81
Percent Elongation at Break: ASTM D-882, method A
Molecular Weight Distribution: Gel permeation chromatography
Gloss: ASTM D-2457, 45° Angle
Haze: ASTM D-1003-52
Melt Index: ASTM D-1238, Condition E (190°C) (except for propene-based (>50% C_3 content) polymers tested at Condition L(230°C.))
Melting Point: ASTM D-3418, peak m.p. determined by DSC with a 10°C/min. heating rate.
Vicat Softening Point (Vsp): ASTM D-1525-82
Seal Strength: ASTM F88-94 (Standard Test Methods for Seal Strength of Flexible Barrier Materials)

[0094] Shrinkage Values: Shrinkage values are obtained by measuring unrestrained shrink of a 10 cm. square sample immersed in water at 90°C (or the indicated temperature if different) for five to ten seconds. Four test specimens are cut from a given sample of the film to be tested. Specimens are cut into squares of 10 cm length (M.D.) by 10 cm. length (T.D.). Each specimen is completely immersed for 5-10 seconds in a 90°C (or the indicated temperature if different) water bath. The specimen is then removed from the bath and the distance between the ends of the shrunken specimen is measured for both the M.D. and T.D. directions. The difference in the measured distance for the shrunken specimen and each original 10 cm. side is multiplied by ten to obtain percent shrinkage in each direction. The shrinkage of 4 specimens is averaged and the average M.D. and T.D. shrinkage values reported. The term "heat shrinkable film at 90°C" means a film having an unrestrained shrinkage value of at least 10% in at least one direction.

Tensile Seal Strength (Seal Strength) Test

[0095] Five identical samples of film are cut 1 inch (2.54 cm) wide and a suitable length for the test equipment e.g. about 5 inches (12.7 cm) long with a 1 inch (2.54 cm) wide seal portion centrally and transversely disposed. Opposing end portions of a film sample are secured in opposing clamps in a universal tensile testing instrument. The film is secured in a taut snug fit between the clamps without stretching prior to beginning the test. The test is conducted at an ambient or room temperature (RT) (about 23 °C) test temperature. The instrument is activated to pull the film via the clamps transverse to the seal at a uniform rate of 12.0 inches (30.48 cm) per minute until failure of the film (breakage of film or seal, or delamination and loss of film integrity). The test temperature noted and lbs. force at break are measured and recorded. The test is repeated for four additional samples and the average grams at break reported.

Ram Puncture Test

[0096] The ram puncture test is used to determine the maximum puncture load or force, and the maximum puncture stress of a flexible film when struck by a hemispherically or spherically shaped striker. This test provides a quantitative measure of the puncture resistance of thin plastic films. This test is further described in U.S. Patent Application No. 09/401,692.

[0097] Following are examples and comparative examples given to illustrate the invention.

[0098] In all the following examples, unless otherwise indicated, the film compositions were produced generally utilizing the apparatus and method described in U.S. Patent Nos. 3,456,044 (Pahlke) and 6,511,688 (Edwards, et al.) which both describe a coextrusion type of double bubble method and in further accordance with the detailed description above. In the following examples, all layers are extruded (coextruded in the multilayer examples) as a primary tube which is then cooled upon exiting the die e.g. by spraying with tap water. This primary tube is then reheated, and stretched and cooled as taught in the above patents.

EXAMPLE 2

[0099] A heat-shrinkable bag according to the present invention, as generally illustrated in FIGS. 10 & 11, is produced from a film comprising a coextruded five-layer biaxially oriented shrink film having from inner surface to outer surface, (A) an inner heat sealing layer, (B) a barrier layer (C) a core layer, (D) a tie layer and (E) an outer heat sealing layer. The inner and outer layers being directly attached to opposing sides of the barrier layer. The five layers included the following composition:

(A) 37 wt. % VLDE; 24% EVA; 33 % plastomer (Exact 4053); 6% processing aids;
(B) a blend of about 85% vinylidene chloride-vinyl chloride copolymer and about 15% vinylidene chloride-methacrylate copolymer;
(C) 100 wt. % EMA
(D) 20 wt. % VLDPE; 33% plastomer (Exact 4053) and 20 wt. % polybutylene; and,
(E) 40 wt. % VLDPE; 33% plastomer (Exact 4053); 25% EVA; 2% processing air.

[0100] One extruder was used for each layer. Each extruder was connected to an annular coextrusion die from which heat plastified resins were coextruded forming a primary tube. The resin mixture for each layer was fed from a hopper into an attached single screw extruder where the mixture was heat plastified and extruded through a five-layer coextrusion die into the primary tube under conditions similar to those disclosed in copending U.S. Application No. US 2004/0166262.

[0101] Although not essential, it is preferred to irradiate the entire film to broaden the heat sealing range and/or enhance the toughness properties of the inner and outer layers by irradiation induced cross-linking and/or scission. This is preferably done by irradiation with an election beam at dosage level of at least about 2 megarads (MR) and preferably in the range of 3-5 MR, although higher dosages may be employed especially for thicker films or where the primary tube is irradiated. Irradiation may be done on the primary tube or after biaxial orientation. The latter, called post-irradiation, is preferred and described in Lustig et al. U.S. Pat. No. 4,737,391. An advantage of post-irradiation is that a relatively thin film is treated instead of the relatively thick primary tube, thereby reducing the power requirement for a given treatment level.

[0102] The film is unwound and slit to a desired width. The film is then fed into the bag making equipment to form a tube member having a continuous longitudinally extending lap seal. Bags according to the bag 415a depicted in FIG. 12 may be formed by sealing laterally across the tube member and simultaneously severing the sealed portion from the continuous tube structure.

[0103] Various tests may be performed on the resultant inventive bags. The gauge thickness will typically be a film thickness of less than 254 μm (10 mil), and preferably between 31.75 μm (1.25) to 127 μm (5.0 mil). The lap seal should typically have an average seal strength of at least 2 kilograms per 25.4 mm (inch). The end seal will typically have an average seal strength of at least 3 kilograms. The bag will also have an average M.D. and T.D. heat shrinkability at 90 °C of at least 20%, and preferably at least 40% in both directions, respectively. This preferred bag will have very good heat shrink percentages which are highly desirable for packaging cuts of fresh red meat and also have extremely good puncture resistance, yet advantageously incorporate a peelable seal heretofore not seen in individual food packaging bags. Thus an economical to produce, heat shrinkable bag, having a peelable seal, puncture resistance and strong end seals is provided having a unique combination of features and commercial advantages previously unknown.

[0104] The present invention advantageously provides an individual heat-shrinkable bag having an easily peelable seal. Thus, the receptacles or bags of the present invention may be easily opened without resort to a knife or other cutting/opening instrument, which allows food producers to offer a desirable, consumer-friendly package.

[0105] Another preferred embodiment of the present invention uses a 7-layer heat shrinkable film to produce backseamed material. This 7-layer film has several advantages over 3 and 5 layer structures. Use of a polymeric having a high melt index greater than 2.0 dg/10 min, e.g., an ethylene α-olefin copolymer such as Exact 4053 in the sealant layers helps seal through creases and wrinkles in the seal. This is important as the overlapped area creates a crease in the seal.

[0106] Another advantage is use of a strong adhesive polymer, e.g., an ethylene methylacrylate copolymer (EMA) such as Emact SP 1330 (which reportedly has: a density of 0.948 g/cm^3; melt index of 2.0 g/10min.; a melting point of 93°C; is at softening point of 49°C; and a methylacrylate (MA) content of 22% as a PVDC tie layer to give improved adhesion. This has been shown to give a superior bond strength. EMA gives bonds over 100g in the finished film. A preferred 7-layer structure has a first heat seal layer comprising an ethylene α-olefin copolymer (Exxon Exact 3139), a second peelable tie layer comprising a polymeric blend having between 15 to 35% each of EVA (Exxon 701.ID); ethylene butene -1 copolymer (Exxon Exact 4053); ethylene octene -1 copolymer (Nova VLDPE 10B) and a third tie layer, e.g., comprising EMA (Voridian SP 1330); a fourth barrier layer, e.g., as described above in Example 1; a fifth tie layer, e.g., comprising EMA; a sixth intermediate layer comprising a blend of 20-45% each of EVA ethylene-butene -1 copolymer and ethylene-octene -1 copolymer; and a seventh outer surface layer comprising an ethylene α-olefin copolymer, e.g., Exxon Exact 3139.

[0107] The above film is preferably 50.8 μm (2 mils) thick overall and has a layer thickness ratio for the first through seventh layers, respectively of 10:42:5:18:5:15:5.

[0108] The bags 415, 415a, 415b, 415c and 415d may be fabricated of nearly any dimensions economically since the bags are not formed from a seamless tube that must be generated to the desired width. The only limitation on size of fabricated bag is the size of rollstock films. Standard roll stock films are available in widths in excess of 2.54 m (100 inches). The present invention allows a bag manufacturer to fabricate any size bag from the same flat sheet of roll stock, up to the dimensional limits of the roll stock. For example, if the roll stock is 1.32 m (52 inches) in width, a tube member can be fabricated having a lay-flat width of approximately 660.4 mm (26 inches), taking into account the amount of overlap, gap or abutment in the first seal 416, 516, 616 and 716 used. For example, if the manufacturer wishes to fabricate a lap seal or fin seal bag having a lay-flat width of 457.2 mm (18 inches), then the manufacturer slits the standard roll stock to the appropriate width (approximately 914.4 mm (36) plus extra for the area of the first seal 416 or 516). The unused portion slit form the standard roll stock is rewound for use making bags of another dimension(s). In this manner, standard roll stock films can be manufactured more economically because film manufacturing equipment may be run at or near the upper limits of film width production and thereby use nearly all the equipments capacity. Fabricating bags from seamless tubes requires that the film making equipment be run at limited capacities to form the different smaller width tubes. Additionally, the film making equipment requires costly setup and breakdown between jobs of differing dimensions that add significantly to the cost of manufacturing the seamless tubes.

[0109] An easily peelable heat shrinkable film has been described above with respect to end sealed bags having seamless sides, it should be readily apparent in view of the present disclosure that side seal heat shrinkable bags and pouches made from a plurality of films may also be adapted to the present invention to provide easy to peel open heat shrinkable receptacle. The present invention may be utilized with heat shrinkable formed into a pouch as described in U.S. Patent Nos. 6,015,235 (Kraimer, et al.) and 6,206,569 (Kraimer, et al.). .

Claims

1. An end-sealed packaging receptacle (10) formed from a sheet of a heat-shrinkable film (11), said sheet of a heat-shrinkable film (11) having a first side (12), an opposing second side (14), an inner surface (15) and an outer surface (13), said receptacle (10) comprising:

a first seal (16) connecting said first side (12) to said second side (14) and defining a tube member (18) having a first receptacle wall (20), a second receptacle wall (22), opposing first and second receptacle edges (24,26), an end (30) and a second end (28) opposite said first end (30);
a second seal (32) provided through said first and second receptacle walls (20,22), said second seal (32) extending laterally across the width of both said first and second receptacle walls (20,22) at a position proximate said end (30), whereby an empty product receiving chamber (34) is defined by said first receptacle wall (20), said second receptacle wall (22), said second seal (32) and said second end (28); and,
characterised in that the receptacle is an severed and separated individual receptacle, the second end which is an open mouthly (28), said first seal (16) comprises a peelable seal selected from a lap seal, a seal strip or a butt-seal including a butt-seal tape, said second seal (32) is nonpeelable, and said sheet of heat-shrinkable film (11) comprises a biaxially stretched film having a shrinkage value of at least 20% shrink at 90°C in at least one direction.

2. A receptacle (10) according to claim 1, wherein said first seal (16) comprises a butt-seal including a butt-seal tape (217), said butt-seal tape (217) having a first border and a second border, a first heat seal (216a) joining said first border to said first side (212), and a second heat seal (216b) joining said second border to said second side (214).

3. A receptacle (10) according to claim 2, wherein said butt-seal tape (217) includes a pull flap (440).

4. A receptacle according to claim 2 or 3, wherein said first border is heat sealed to the inner surface (15) of said first side (12) and said second border is heat sealed to the inner surface (15) of said second side (14).

5. A receptacle (10) according to any of claims 2 to 4, wherein at least one of said first and second sides (12,14) extends outwardly to form a pull flap (440).

6. A receptacle (10) according to any of claims 2 to 5, wherein said butt-seal tape (217) comprises a butt-seal film including a peelable system.

7. A receptacle (10) according to any of claims 2 to 6, wherein said first and second heat seals (216a,216b) are peelable.

8. A receptacle (10) according to claim 1, wherein said first seal (16) includes a seal strip (741), said seal strip (741) comprising a strip film (711) having a first margin (718), a second margin (719), an inside surface (714) and an outward surface (715); a first heat seal (720) joining said outward surface(715) of said first margin (718) to said inner surface (419) of said first side(430a); and a second heat seal (721) joining said inside surface (714) of said strip film to said outer surface (433) of said second side (430b).

9. A receptacle (10) according to claim 8, wherein said second heat seal (721) is a peelable seal.

10. A receptacle (10) according to claim 8 or 9, wherein said first heat seal (720) is a peelable seal.

11. A receptacle (10) according to any of claims 8 to 10, wherein said strip film (711) comprises a peelable system.

12. A receptacle (10) according to any of claims 8 to 11, wherein said strip film (711) includes a pull flap (440).

13. A receptacle (10) according to any preceding claim, wherein said sheet of heat-shrinkable film (11) includes a peelable system.

14. A receptacle (10) according to claim 1, wherein said film (11) comprises a multilayer barrier film.

15. A receptacle (10) according to claim 14, wherein said multilayer barrier film (411) comprises:

(a) an inner heat sealing layer (434);
(b) a barrier layer (435);
(c) a core layer (436);
(d) a tie layer (437); and,
(e) an outer heat sealing layer (438).

16. A receptacle (10) according to claim 15, wherein said outer heat sealing layer (438) forms the outer surface

(13) of said receptacle (10).

17. A receptacle (10) according to claim 15 or 16, wherein said tie layer (437) is permanently bonded to said core layer (436) and peelably bonded to said outer heat sealing layer (438).

18. A receptacle (10) according to claim 15 or 16, wherein said tie layer (437) is permanently bonded to said outer heat sealing layer (438) and peelably bonded to said core layer (436).

19. A receptacle (10) according to any of claims 15 to 18, wherein said tie layer (437) comprises a blend of polybutylene and at least one other constituent.

20. A receptacle (10) according to claim 19, wherein said at least one other constituent comprises polyethylene.

21. A receptacle (10) according to any of claims 15 to 20, wherein said outer heat sealing layer (438) comprises polyethylene.

22. A receptacle (10) according to any of claims 15 to 21, wherein said core layer (436) comprises a blend of polyethylene and an ethylene-vinyl acetate copolymer.

23. A receptacle (10) according to any of claims 15 to 22, wherein said barrier layer (435) is selected from the group consisting of vinylidene chloride copolymers, ethylene vinyl alcohol copolymers, polyacrylonitriles and polyamides.

24. A receptacle (10) according to claim 23, wherein said barrier layer (435) comprises a vinylidene chloride copolymer.

25. A receptacle (10) according to any of claims 15 to 24, wherein said inner heat sealing layer (434) comprises a blend of polyethylene and ethylene-vinyl acetate copolymer.

26. A receptacle (10) according to any of claims 15 to 25, wherein said tie layer (437) comprises a blend of polybutylene and at least one other constituent; said outer heat sealing layer (438) comprises polyethylene; said core layer (436) comprises a blend of polyethylene and an ethylene-vinyl acetate copolymer; said barrier layer (435) comprises a vinylidene chloride copolymer; and said inner heat sealing layer (434) comprises a blend of polyethylene and ethylene-vinyl acetate copolymer.

27. A receptacle (10) according to claim 26, wherein said at least one other constituent comprises polyethylene and said barrier layer (435) comprises a blend of vinylidene chloride-methyl acrylate copolymer and vinylidene chloride-vinyl chloride copolymer.

28. A receptacle (10) according to claim any of claims 15 to 27, wherein said inner heat sealing layer (434) comprises from 0 to 50%, said barrier layer (435) comprises 0 to 20%; said core layer (436) comprises 0 to 28%; said tie layer (437) comprises 0 to 15%; and said outer heat sealing layer (438) comprises 0 to 15%, based on the total thickness of said film (411).

29. A receptacle (10) according to any of claims 15 to 28, wherein said first seal (16) comprises a lap seal and said inner heat sealing layer (434) forms the inside surface (15) of the receptacle (10).

30. A receptacle (10) according to any of claims 1 or 14 to 29, wherein said first seal (16) comprises a lap seal and said first side (12) includes an unsealed portion extending outwardly beyond said first seal (16).

31. A receptacle (10) according to any of claims 1 or 14 to 30, wherein said first seal (16) is a lap seal and has a seal strength of greater than 3 kilograms per 25.4mm (per inch).

32. A receptacle (10) according to claim 31, wherein said first seal (16) has a seal strength of greater than 6 kilograms per 25.4mm (per inch).

33. A receptacle (10) according to any of claims 1 to 30, wherein said first seal (16) has a seal strength of less than 2 kilograms for a 25.4mm (one inch) strip.

34. A receptacle (10) according to claim 33, wherein said first seal (16) has a seal strength of less than 2 kilograms for a 25.4mm (one inch) strip.

35. A receptacle (10) according to any preceding claim, wherein said sheet of heat-shrinkable film (11) has a thickness from 31.75μm to 203.2μm (1.25 mil to 8.0 mil).

36. A receptacle (10) according to any preceding claim, wherein said sheet of heat-shrinkable film (11) has a thickness from 44.45μm to 76.2μm(1.75 mil to 3.0 mil).

37. A receptacle (10) according to any preceding claim, wherein said shrinkage value is in the machine direction.

38. A receptacle (10) according to any of claims 1 to 36, wherein said shrinkage value is in the transverse direction.

39. A receptacle (10) according to any of claims 1 to 36, wherein said shrinkage value is in both the machine direction and the transverse direction.

40. A receptacle (10) according to any preceding claim, wherein said second seal (32) has a seal strength of greater than 3 kilograms per 25.4mm (per inch).

41. A receptacle (10) according to any preceding claim which is a bag, and wherein said first and second receptacle walls (20,22) are first and second bag walls, and said first and second receptacle edges (24,26) are first and second bag edges.

42. A receptacle (10) according to any preceding claim, wherein said first seal (16) connects said first side (12) to said second side (14) along the lengths thereof and is continuous.

43. A method of forming an end-sealed, heat-shrinkable packaging receptacle (10) from a flat sheet of film (11) comprising:

(a) providing a sheet of heat-shrinkable thermoplastic film (11) having a first side (12) and an opposed second side (14);
(b) providing a first seal (16) between said first and second sides (12,14) to form a tube member (18), said tube member (18) having a first receptacle wall (20), a second receptacle wall (22), a bottom (30) at a first end of the receptacle and second end (28) opposite the bottom; and,
(c) providing a second seal (32) through said first and second receptacle walls (20, 22), said second seal (32) extending laterally across said tube member (18) at a position proximate said bottom (30);

characterised in that the receptacle is formed as an individual receptacle which is severed and separated from the tube member, the second end of the receptacle is an open mouth, said first seal (16) comprise a peelable seal selected from a lap seal, a seal strip or a butt-seal including a butt-seal tape, said second seal (32) is nonpeelable, and said sheet of heat-shrinkable film (11) comprises a biaxially stretched film having a shrinkage value of at least 20% shrink at 90°C in at least one direction.

44. A method according to claim 43, wherein said sheet of heat-shrinkable thermoplastic film (11) is slit to a desired width prior to bringing said first and second sides (12,14) together.

45. A method according to claim 43 or 44, wherein said sheet of heat-shrinkable thermoplastic film (11) comprises a continuous roll of film sheet and said method further includes (d) providing a cut laterally through said tube member (18), said cut extending laterally across at least the width of both said first and second receptacle walls (20,22) thereby separating a portion of said tube member (18) including said second seal (32) from said tube member (18).

46. A method according to any of claims 43 to 44, wherein said heat-shrinkable thermoplastic film (11) is formed by coextruding a primary film tube, cooling the primary film tube, collapsing the primary film tube, inflating the primary tube, reheating the inflated primary film tube, biaxially stretching the primary film tube, cooling and recollapsing the primary film tube, slitting the primary film tube longitudinally and laying open the slit primary tube to produce a flat sheet of biaxially oriented film.

47. A method as claimed in any of claims 43 to 46, wherein said receptacle (10) is a bag and wherein said first and second receptacle walls (20,22) are first and second bag walls, and said first and second receptacle edges (24,26) are first and second bag edges.

Patentansprüche

1. Endenverbundenes bzw. endenverschweißtes (endenversiegeltes) Verpakkungsbehältnis (10) mit einer Lage einer wärmeschrumpfbaren Folie (Film) (11), wobei die wänneschrumpfhare Folie (11) eine erste Seite (12), eine gegenüberliegende zweite Seite (14), eine innere Oberfläche (15) und eine äußere Oberfläche (13) aufweist, wobei das Behältnis (10) aufweist:

- eine erste Siegelung (16), welche die erste Seite (12) mit der zweiten Seite (14) zur Bildung eines Schlauchkörpers (18) verbindet, wobei der Schlauchkörper (18) eine erste Behältniswandung (20), eine zweite Behältniswandung (22), einander gegenüberliegende erste und zweite Behältnisränder bzw. Behältnisflanken (24, 26), ein Ende (30) und ein dem ersten Ende (30) gegenüberliegendes zweites Ende (28) aufweist;
- eine zweite Siegelung (32), welche durch die erste und zweite Behältniswandung (20, 22) gebildet bzw. bereitgestellt ist, wobei sich die zweite Siegelung (32) seitlich bzw. quer über die Breite sowohl der ersten als auch der zweiten Behältniswandung (20, 22) an einer Position in Nähe des Endes (30) erstreckt, so daß ein leerer Raum (34) zur Produktaufnahme von der ersten Behältniswandung (20), der zweiten Behältniswandung (22), der zweiten Siegelung (32) und dem zweiten Ende (28) abgegrenzt ist,

dadurch gekennzeichnet,

daß das Behältnis ein abgetrenntes und einzeln bzw. getrennt vorliegendes eigenständiges Behältnis (Einzelbehältnis) ist, dessen zweites Ende eine Öffnung (28) ist, und daß die erste Siegelung (16) eine abziehbare bzw. lösbare Siegelung aus der Gruppe von überlappenden Siegelungen, Streifensiegelungen bzw. Siegelungsstreifen oder Stumpfsiegelungen einschließlich eines Deckstreifens bzw. Stumpfsiegelungsstreifens umfaßt, die zweite Siegelung (32) nicht abziehbar bzw. nicht lösbar ist und die Lage der wärmeschrumpfbaren Folie (11) eine biaxial gestreckte Folie mit einem Schrumpfwert von mindestens 20 % Schrumpf bei 90 °C in mindestens eine Richtung umfaßt.

2. Behältnis (10) nach Anspruch 1, wobei die erste Siegelung (16) eine Stumpfsiegelung einschließlich eines Deckstreifens (217) mit einer ersten und einer zweiten Grenze, wobei der Deckstreifen (217) eine erste Wärmesiegelung (216a), welche die erste Grenze mit der ersten Seite (212) verbindet, und eine zweite Wärmesiegelung (216b), welche die zweite Grenze mit der zweiten Seite (214) verbindet, aufweist.

3. Behältnis (10) nach Anspruch 2, wobei der Deckstreifen (217) eine Zuglasche (440) besitzt.

4. Behältnis nach Anspruch 2 oder 3, wobei die erste Grenze mit der inneren Oberfläche (15) der ersten Seite (12) wärmeversiegelt ist und die zweite Grenze mit der inneren Oberfläche (15) der zweiten Seite (14) wärmeversiegelt ist.

5. Behältnis (10) nach einem der Ansprüche 2 bis 4, wobei mindestens eine der ersten und zweiten Seiten (12, 14) sich nach außen erstreckt, so daß eine Zuglasche (440) gebildet ist.

6. Behältnis (10) nach einem der Ansprüche 2 bis 5, wobei der Deckstreifen (217) eine Deckstreifenfolie mit einem abziehbaren bzw. lösbaren System umfaßt.

7. Behältnis (10) nach einem der Ansprüche 2 bis 6, wobei die erste und zweite Wärmesiegelung (216a, 216b) abziehbar bzw. lösbar sind.

8. Behältnis (10) nach Anspruch 1, wobei die erste Siegelung (16) eine Streifensiegelung (741) ist, wobei die Streifensiegelung (741) einen Folienstreifen (711) mit einem ersten Rand (718), einem zweiten Rand (719), einer Innenfläche (714) und einer Außenfläche (715) aufweist; eine erste Wärmesiegelung (720), welche die Außenfläche (715) des ersten Randes (718) mit der inneren Oberfläche (419) der ersten Seite (430a) verbindet; und eine zweite Wärmesiegelung (721), welche die Innenfläche (714) des Folienstreifens mit der äußeren Oberfläche (433) der zweiten Seite (430b) verbindet, umfaßt.

9. Behältnis (10) nach Anspruch 8, wobei die zweite Wärmesiegelung (721) eine abziehbare bzw. lösbare Siegelung ist.

10. Behältnis (10) nach Anspruch 8 oder 9, wobei die erste Wärmesiegelung (720) eine abziehbare bzw. lösbare Siegelung ist.

11. Behältnis (10) nach einem der Ansprüche 8 bis 10, wobei der Folienstreifen (711) ein abziehbares bzw. lösbares System aufweist.

12. Behältnis (10) nach einem der Ansprüche 8 bis 11, wobei der Folienstreifen (711) eine Zuglasche (440) aufweist.

13. Behältnis (10) nach einem der vorangegangenen Ansprüche, wobei die Lage der wärmeschrumpfbaren Folie (11) ein ablösbares System aufweist.

14. Behältnis (10) nach Anspruch 1, wobei die Folie (11) eine mehrschichtige Barrierefolie umfaßt.

15. Behältnis (10) nach Anspruch 14, wobei die mehrschichtige Barrierefolie (411) aufweist:

(a) eine innere Wärmesiegelungsschicht (434);
(b) eine Barriereschicht (435);
(c) eine Kernschicht (436);
(d) eine Verbindungsschicht (437) und
(e) eine äußere Wärmesiegelungsschicht (438).

16. Behältnis (10) nach Anspruch 15, wobei die äußere Wärmesiegelungsschicht (438) die äußere Oberfläche (13) des Behältnisses (10) bildet.

17. Behältnis (10) nach Anspruch 15 oder 16, wobei die Verbindungsschicht (437) dauerhaft mit der Kernschicht (436) und abziehbar bzw. lösbar mit der äußeren Wärmesiegelungsschicht (438) verbunden ist.

18. Behältnis (10) nach Anspruch 15 oder 16, wobei die Verbindungsschicht (437) dauerhaft mit der äußeren Wärmesiegelungsschicht (438) und abziehbar bzw. lösbar mit der Kernschicht (436) verbunden ist.

19. Behältnis (10) nach einem der Ansprüche 15 bis 18, wobei die Verbindungsschicht (437) eine Mischung aus Polybutylen und mindestens einem anderen Bestandteil aufweist.

20. Behältnis (10) nach Anspruch 19, wobei der mindestens eine andere Bestandteil Polyethylen aufweist.

21. Behältnis (10) nach einem der Ansprüche 15 bis 20, wobei die äußere Wärmesiegelungsschicht (438) Polyethylen aufweist.

22. Behältnis (10) nach einem der Ansprüche 15 bis 21, wobei die Kernschicht (436) eine Mischung aus Polyethylen und einem Ethylen/Vinylacetat-Copolymer aufweist.

23. Behältnis (10) nach einem der Ansprüche 15 bis 22, wobei die Barriereschicht (435) ausgewählt ist aus der Gruppe von Vinylidenchlorid-Copolymeren, Ethylen/Vinylalkohol-Copolymeren, Polyacrylnitrilen und Polyamiden.

24. Behältnis (10) nach Anspruch 23, wobei die Barriereschicht (435) ein Vinylidenchlorid-Copolymer aufweist.

25. Behältnis (10) nach einem der Ansprüche 15 bis 24, wobei die innere Wärmesiegelungsschicht (434) eine Mischung aus Polyethylen und Ethylen/Vinylacetat-Copolymer aufweist.

26. Behältnis (10) nach einem der Ansprüche 15 bis 25, wobei die Verbindungsschicht (437) eine Mischung aus Polybutylen und mindestens einem weiteren Bestandteil aufweist; die äußere Wärmesiegelungsschicht (438) Polyethylen umfaßt; die Kernschicht (436) eine Mischung aus Polyethylen und einem Ethylen/Vinylacetat-Copolymer aufweist; die Barriereschicht (435) ein Vinylidenchlorid-Copolymer aufweist; und die innere Wärmesiegelungsschicht (434) eine Mischung aus Polyethylen und Ethylen/Vinylacetat-Copolymer aufweist.

27. Behältnis (10) nach Anspruch 26, wobei der mindestens eine andere Bestandteil Polyethylen umfaßt und die Barriereschicht (435) eine Mischung von Vinylidenchlorid/Methylacrylat-Copolymer und Vinylidenchlorid/ Vinylchlorid-Copolymer aufweist.

28. Behältnis (10) nach einem der Ansprüche 15 bis 27, wobei die innere Wärmesiegelungsschicht (434) 0 bis 50 %; die Barriereschicht (435) 0 bis 20 %; die Kernschicht (436) 0 bis 28 %; die Verbindungsschicht (437) 0 bis 15 %; und die äußere Wärmesiegelungsschicht (438) 0 bis 15 %, bezogen auf die Gesamtdicke der Folie (411), umfassen.

29. Behältnis (10) nach einem der Ansprüche 15 bis 28, wobei die erste Siegelung (16) eine überlappende Siegelung umfaßt und die innere Wärmesiegelungsschicht (434) die innere Oberfläche (15) des Behältnisses (10) bildet.

30. Behältnis (10) nach einem der Ansprüche 1 oder 14 bis 29, wobei die erste Siegelung (16) eine überlappende Siegelung umfaßt und die erste Seite (12) einen nichtverschweißten bzw. nichtversiegelten Abschnitt, welcher sich nach außen über die erste Siegelung (16) erstreckt, aufweist.

31. Behältnis (10) nach einem der Ansprüche 1 oder 14 bis 30, wobei die erste Siegelung (16) eine überlappende Siegelung ist und eine Siegelnahtstärke von mehr als 3 Kilogramm pro 25,4 mm (pro Inch) aufweist.

32. Behältnis (10) nach Anspruch 31, wobei die erste Siegelung (16) eine Siegelnahtstärke von mehr als 6 Kilogramm pro 25,4 mm (pro Inch) aufweist.

33. Behältnis (10) nach einem der Ansprüche 1 bis 30, wobei die erste Siegelung (16) eine Siegelnahtstärke von weniger als 2 Kilogramm für einen 25,4 mm (ein Inch) langen Streifen aufweist.

34. Behältnis (10) nach Anspruch 33, wobei die erste Siegelung (16) eine Siegelnahtstärke von weniger als 2 Kilogramm für einen 25,4 mm (ein Inch) langen Streifen aufweist.

35. Behältnis (10) nach einem der vorangehenden Ansprüche, wobei die Lage der wärmeschrumpfbaren Folie (11) eine Dicke von 31,75 μm bis 203,2 μm (1,25 mil bis 8,0 mil) aufweist.

36. Behältnis (10) nach einem der vorangehenden Ansprüche, wobei die Lage der wärmeschrumpfbaren Folie (11) eine Dicke von 44,45 μm bis 76,2 μm (1,75 mil bis 3,0 mil) aufweist.

37. Behältnis (10) nach einem der vorangehenden Ansprüche, wobei sich der Schrumpfwert auf die Maschinenrichtung bezieht.

38. Behältnis (10) nach einem der Ansprüche 1 bis 36, wobei sich der Schrumpfwert auf die Querrichtung bezieht.

39. Behältnis (10) nach einem der Ansprüche 1 bis 36, wobei sich der Schrumpfwert sowohl auf die Maschinenrichtung als auch auf die Querrichtung bezieht.

40. Behältnis (10) nach einem der vorangehenden Ansprüche, wobei die zweite Siegelung (32) eine Siegelnahtstärke von mehr als 3 Kilogramm pro 25,4 mm (pro Inch) aufweist.

41. Behältnis (10) nach einem der vorangehenden Ansprüche, wobei das Behältnis (10) ein Beutel ist, wobei die erste und zweite Behältniswandung (20, 22) die erste und zweite Wandung des Beutels sind und der erste und zweite Behältnisrand (24, 26) der erste und zweite Rand des Beutels sind.

42. Behältnis (10) nach einem der vorangehenden Ansprüche, wobei die erste Siegelung (16) die erste Seite (12) mit der zweiten Seite (14) entlang ihrer Längen verbindet und durchgängig ist.

43. Verfahren zur Herstellung eines endenverschweißten bzw. endenverbundenen (endenversiegelten), wärmeschrumpfbaren Verpackungsbehältnisses (10) aus einer ebenen Lage einer Folie (11), umfassend:

(a) Bereitstellung einer Lage einer wärmeschrumpfbaren thermoplastischen Folie (11) mit einer ersten Seite (12) und einer gegenüberliegenden zweiten Seite (14);
(b) Bereitstellung einer ersten Siegelung (16) zwischen der ersten und der zweiten Seite (12, 14) zur Bildung eines Schlauchkörpers (18), wobei der Schlauchkörper (18) eine erste Behältniswandung (20), eine zweite Behältniswandung (22), einen Boden (30) an einem ersten Ende des Behältnisses und ein dem Boden gegenüberliegendes zweites Ende (28) aufweist; und
(c) Bereitstellung einer zweiten Siegelung (32) durch die erste und zweite Behältniswandung (20, 22), wobei sich die zweite Siegelung (32) seitlich bzw. quer über den Schlauchkörper (18) an einer Position in Nähe des Bodens (30) erstreckt;

dadurch gekennzeichnet,
daß das Behältnis als ein eigenständiges Behältnis (Einzelbehältnis) ausgebildet ist, welches abgetrennt und getrennt von dem Schlauchkörper vorliegt und dessen zweites Ende eine Öffnung ist, und daß die erste Siegelung (16) eine abziehbare bzw. lösbare Siegelung aus der Gruppe von überlappenden Siegelungen, Streifensiegelungen bzw. Siegelstreifen und Stumpfsiegelungen einschließlich eines Deckstreifens bzw. Stumpfsiegelungsstreifens umfaßt, die zweite Siegelung (32) nicht abziehbar bzw. nicht lösbar ist und die Lage der wärmeschrumpfbaren Folie (11) eine biaxial gestreckte Folie mit einem Schrumpfwert von mindestens 20 % Schrumpf bei 90 °C in mindestens eine Richtung umfaßt.

44. Verfahren nach Anspruch 43, wobei die Lage der wärmeschrumpfbaren thermoplastischen Folie (11) vor Zusammenbringen der ersten und der zweiten Seite (12, 14) auf die gewünschte Breite geschnitten wird.

45. Verfahren nach Anspruch 43 oder 44, wobei die Lage der wärmeschrumpfbaren thermoplastischen Folie (11) eine kontinuierliche Rolle der Folienlage umfaßt und das Verfahren weiterhin (d) eine Bereitstellung eines Schnitts seitlich bzw. quer durch den Schlauchkörper (18) umfaßt, wobei sich der Schnitt seitlich bzw. quer über mindestens die Breite sowohl der ersten als auch der zweiten Behältniswandung (20, 22) erstreckt und so einen Teil bzw. Abschnitt des Schlauchkörpers (18) einschließlich der zweiten Siegelung (32) von dem Schlauchkörper (18) abtrennt.

46. Verfahren nach einem der Ansprüche 43 oder 44, wobei die wärmeschrumpfbare thermoplastische Folie (11) durch Coextrudierung eines Primärfolienschlauches, Abkühlen des Primärfolienschlauches, Kollabieren des Primärfolienschlauches, Aufblasen des Primärfolienschlauches, erneutes Erhitzen des aufgeblasenen Primärfolienschlauches, biaxiales Strecken des Primärfolienschlauches, Abkühlen und erneutes Kollabieren des Primärfolienschlauches, längsseitiges Aufschneiden des Primärfolienschlauches und Ausbreiten des aufgeschnittenen Primärfolienschlauches zur Herstellung einer ebenen bzw. flachen Lage einer biaxial ausgerichteten Folie hergestellt wird.

47. Verfahren nach einem der Ansprüche 43 bis 46, wobei das Behältnis (10) ein Beutel ist und wobei die erste und zweite Behältniswandung (20, 22) die erste und zweite Wandung des Beutels bilden und der erste und zweite Rand des Behältnisses (24, 26) den ersten und zweiten Rand des Beutels bilden.

Revendications

1. Réceptacle d'emballage à extrémité scellée (10) formé à partir d'une feuille d'un film thermorétractable (11), ladite feuille de film thermorétractable (11) ayant un premier côté (12), un second côté opposé (14), une surface interne (15), une surface externe (13), ledit réceptacle (10) comprenant :

un premier scellement (16) reliant ledit premier côté (12) audit second côté (14) et définissant un élément tubulaire (18) ayant une première paroi de réceptacle (20), une deuxième paroi de réceptacle (22), des premier et deuxième bords de réceptacles opposés (24, 26), une extrémité (30) et une seconde extrémité (28) opposée à ladite première extrémité (30) ;
un deuxième scellement (32) réalisé sur lesdites première et deuxième parois de réceptacle (20, 22), ledit deuxième scellement (32) s'étendant latéralement sur la largeur desdites première et deuxième parois de réceptacle (20, 22) sur une position proximale de ladite extrémité (30), une chambre vide recevant un produit (34) étant définie par ladite première paroi de réceptacle (20), ladite deuxième paroi de réceptacle (22), ledit deuxième scellement (32) et ladite seconde ex-

trémité (28) ; et

caractérisé en ce que le réceptacle est un réceptacle individuel tranché et séparé, la seconde extrémité duquel est une ouverture à "gueule ouverte" (28), ledit premier scellement (16) comprend un scellement pelable choisi parmi un scellement par recouvrement, une bande de scellement ou un scellement en bout comprenant une bande de scellement en bout, ledit deuxième scellement (32) étant non pelable, et ladite feuille de film thermorétractable (11) comprenant un film étiré biaxialement ayant une valeur de rétraction d'au moins 20 % de retrait à 90 °C dans au moins une direction.

2. Réceptacle (10) selon la revendication 1, dans lequel ledit premier scellement (16) comprend un scellement en bout comprenant une bande de scellement en bout (217), ladite bande de scellement en bout (217) ayant une première bordure et une deuxième bordure, un premier scellement thermique (216a) joignant ladite première bordure audit premier côté (212) et un deuxième scellement thermique (216b) joignant ladite deuxième bordure audit deuxième côté (214).

3. Réceptacle (10) selon la revendication 2, dans lequel ladite bande de scellement en bout (217) comprend un rabat de traction (440).

4. Réceptacle selon la revendication 2 ou 3, dans lequel ladite première bordure est thermoscellée sur la surface interne (15) dudit premier côté (12) et ladite deuxième bordure est thermoscellée sur la surface interne (15) dudit second côté (14).

5. Réceptacle (10) selon l'une quelconque des revendications 2 à 4, dans lequel au moins l'un desdits premier et second côtés (12, 14) s'étend vers l'extérieur pour former un rabat de traction (440).

6. Réceptacle (10) selon l'une quelconque des revendications 2 à 5, dans lequel ladite bande de scellement en bout (217) comprend un film de scellement en bout comprenant un système pelable.

7. Réceptacle (10) selon l'une quelconque des revendications 2 à 6, dans lequel lesdits premier et deuxième scellements (216a, 216b) sont pelables.

8. Réceptacle (10) selon la revendication 1, dans lequel ledit premier scellement (16) comprend une bande de scellement (741), ladite bande de scellement (741) comprenant un film pelliculable (711) ayant une première marge (718), une deuxième marge (719), une surface interne (714) et une surface externe (715) ; un premier scellement thermique (720) joignant ladite surface externe (715) de ladite première marge (718) à ladite surface interne (419) dudit premier côté (430a) ; et un deuxième scellement thermique (721) joignant ladite surface interne (714) dudit film pelliculable à ladite surface externe (433) dudit second côté (430b).

9. Réceptacle (10) selon la revendication 8, dans lequel ledit deuxième scellement thermique (721) est un scellement pelable.

10. Réceptacle (10) selon la revendication 8 ou 9, dans lequel ledit premier scellement thermique (720) est un scellement pelable.

11. Réceptacle (10) selon l'une quelconque des revendications 8 à 10, dans lequel ledit film pelliculable (711) comprend un système pelable.

12. Réceptacle (10) selon l'une quelconque des revendications 8 à 11, dans lequel ledit film pelable (711) comprend un rabat de traction (440).

13. Réceptacle (10) selon l'une quelconque des revendications précédentes, dans lequel ladite feuille de film thermorétractable (11) comprend un système pelable.

14. Réceptacle (10) selon la revendication 1, dans lequel ledit film (11) comprend un film barrière multicouche.

15. Réceptacle (10) selon la revendication 14, dans lequel ledit film barrière multicouche (411) comprend :

(a) une couche thermoscellable intérieure (434) ;
(b) une couche barrière (435) ;
(c) une couche centrale (436) ;
(d) une couche de liaison (437) ; et
(e) une couche de thermoscellable extérieure (438).

16. Réceptacle (10) selon la revendication 15, dans lequel ladite couche thermoscellable (438) extérieure forme la surface externe (13) dudit réceptacle (10).

17. Réceptacle (10) selon la revendication 15 ou 16, dans lequel ladite couche de liaison (437) est liée de façon permanente à ladite couche centrale (436) et liée de façon pelable à ladite couche thermoscellable extérieure (438).

18. Réceptacle (10) selon la revendication 15 ou 16, dans lequel ladite couche de liaison (437) est liée de façon permanente à ladite couche thermoscellable extérieure (438) et est liée de façon pelable à ladite couche centrale (436).

19. Réceptacle (10) selon l'une quelconque des revendications 15 à 18, dans lequel ladite couche de liaison (437) comprend un mélange de polybutylène et d'au moins un autre constituant.

20. Réceptacle (10) selon la revendication 19, dans lequel au moins ledit autre composant comprend du polyéthylène.

21. Réceptacle (10) selon l'une quelconque des revendications 15 à 20, dans lequel ladite couche thermoscellable extérieure (438) comprend du polyéthylène.

22. Réceptacle (10) selon l'une quelconque des revendications 15 à 21, dans lequel ladite couche centrale (436) comprend un mélange de polyéthylène et d'un copolymère éthylène - acétate de vinyle.

23. Réceptacle (10) selon l'une quelconque des revendications 15 à 22, dans lequel ladite couche barrière (435) est choisie dans le groupe comprenant des copolymères de chlorure de vinylidène, des copolymères d'alcool éthylène-vinyle, des polyacrylonitriles et des polyamides.

24. Réceptacle (10) selon la revendication 23, dans lequel ladite couche barrière (435) comprend un copolymère de chlorure de vinylidène.

25. Réceptacle (10) selon l'une quelconque des revendications 15 à 24, dans lequel ladite couche thermoscellable intérieure (434) comprend un mélange de polyéthylène et d'un copolymère d'éthylène - acétate de vinyle.

26. Réceptacle (10) selon l'une des revendications 15 à 25, dans lequel ladite couche de liaison (437) comprend un mélange de polybutylène et d'au moins un autre constituant ; ladite couche thermoscellable extérieure (438) comprenant du polyéthylène ; ladite couche centrale (436) comprenant un mélange de polyéthylène et d'un copolymère d'éthylène - acétate de vinyle ; ladite couche barrière (435) comprenant un copolymère de chlorure de vinylidène ; et ladite couche thermoscellable intérieure (434) comprenant un mélange de polyéthylène et de copolymère d'éthylène - acétate de vinyle.

27. Réceptacle (10) selon l'une des revendications 26, dans lequel au moins ledit autre constituant comprend du polyéthylène et ladite couche barrière (435) comprend un mélange de copolymère de chlorure de vinylidène - méthylacrylate et un copolymère de chlorure de vinylidène - chlorure de vinyle.

28. Réceptacle (10) selon l'une quelconque des revendications 15 à 27, dans lequel ladite couche thermoscellable intérieure (434) comprend de 0 à 50 %, ladite couche barrière (435) comprend de 0 à 20 % ; ladite couche centrale (436) comprend de 0 à 28 % ; ladite couche de liaison (437) comprend de 0 à 15 % et ladite couche thermoscellable extérieure (438) comprend de 0 à 15 % sur la base de l'épaisseur totale dudit film (411).

29. Réceptacle (10) selon l'une quelconque des revendications 15 à 28, dans lequel ledit premier scellement (16) comprend un scellement par recouvrement et ladite première couche thermoscellable intérieure (434) forme la surface interne (15) du réceptacle (10).

30. Réceptacle (10) selon l'une quelconque des revendications 1 ou 14 à 29, dans lequel ledit premier scellement (16) comprend un scellement par recouvrement et ledit premier côté (12) comprend une partie non scellée s'étendant vers l'extérieur au-delà dudit premier scellement (16).

31. Réceptacle (10) selon l'une quelconque des revendications 1 ou 14 à 30, dans lequel ledit premier scellement (16) est un scellement par recouvrement et a une résistance de scellement supérieure à 3 kg par 25,4 mm (par pouce).

32. Réceptacle selon la revendication 31, dans lequel ledit premier scellement (16) a une résistance de scellement supérieure à 6 kg par 25,4 mm (par pouce).

33. Réceptacle (10) selon l'une quelconque des revendications 1 à 30, dans lequel ledit premier scellement (16) a une résistance de scellement inférieure à 2 kg par bande de 25,4 mm (par pouce).

34. Réceptacle (10) selon la revendication 33, dans lequel ledit premier scellement (16) a une résistance de scellement inférieure à 2 kg par bande de 25,4 mm (par pouce).

35. Réceptacle (10) selon l'une quelconque des revendications précédentes, dans lequel ladite feuille de film thermorétractable (11) a une épaisseur de 31,75 μm à 203,2 μm (1,25 à 8,0 millièmes de pouce).

36. Réceptacle (10) selon l'une quelconque des revendications précédentes, dans lequel ladite feuille de film thermorétractable (11) a une épaisseur de 44,45 μm à 76,2 μm (1,75 à 3,0 millièmes de pouce).

37. Réceptacle (10) selon l'une quelconque des revendications précédentes, dans lequel ladite valeur de retrait est dans le sens de la machine.

38. Réceptacle (10) selon l'une quelconque des revendications 1 à 36, dans lequel ladite valeur de retrait est dans le sans transversal.

39. Réceptacle (10) selon l'une quelconque des revendications 1 à 36, dans lequel ladite valeur de retrait est à la fois dans le sens de la machine et dans le sens transversal.

40. Réceptacle (10) selon l'une quelconque des revendications précédentes, dans lequel ledit deuxième scellement (32) a une résistance de scellement supérieure à 3 kg par 25,4 mm (par pouce).

41. Réceptacle (10) selon l'une quelconque des revendications précédentes, qui est un sac, et dans lequel lesdites première et deuxième parois du réceptacle (20, 22) sont les première et deuxième parois du sac et lesdits premier et deuxième bords du réceptacle (24, 26) sont les premier et deuxième bords du sac.

42. Réceptacle (10) selon l'une quelconque des revendications précédentes, dans lequel ledit premier scellement (16) relie ledit premier côté (12) audit second côté (14) le long des longueurs de celui-ci et est continu.

43. Procédé de formation d'un réceptacle d'emballage à extrémité scellée, thermorétractable (10) selon la revendication 1 à partir d'une feuille plane ou d'un film (11) comprenant

(a) la mise à disposition d'une feuille de film thermorétractable thermoplastique (11) ayant un premier côté (12) et un second côté opposé (14) ;
(b) la réalisation d'un premier scellement (16) entre lesdits premier et second côtés (12, 14) pour former un élément tubulaire (18), ledit élément tubulaire (18) ayant une première paroi de réceptacle (20), une deuxième paroi de réceptacle (22), un fond (30) au niveau d'une première extrémité du réceptacle et une seconde extrémité (28) opposée au fond (30); et
(c) la réalisation d'un deuxième scellement (32) au travers desdites première et deuxième parois de réceptacle (20, 22), ledit deuxième scellement (32) s'étendant latéralement sur ledit élément tubulaire (18) et sur une partie proximale dudit fond (30) ;

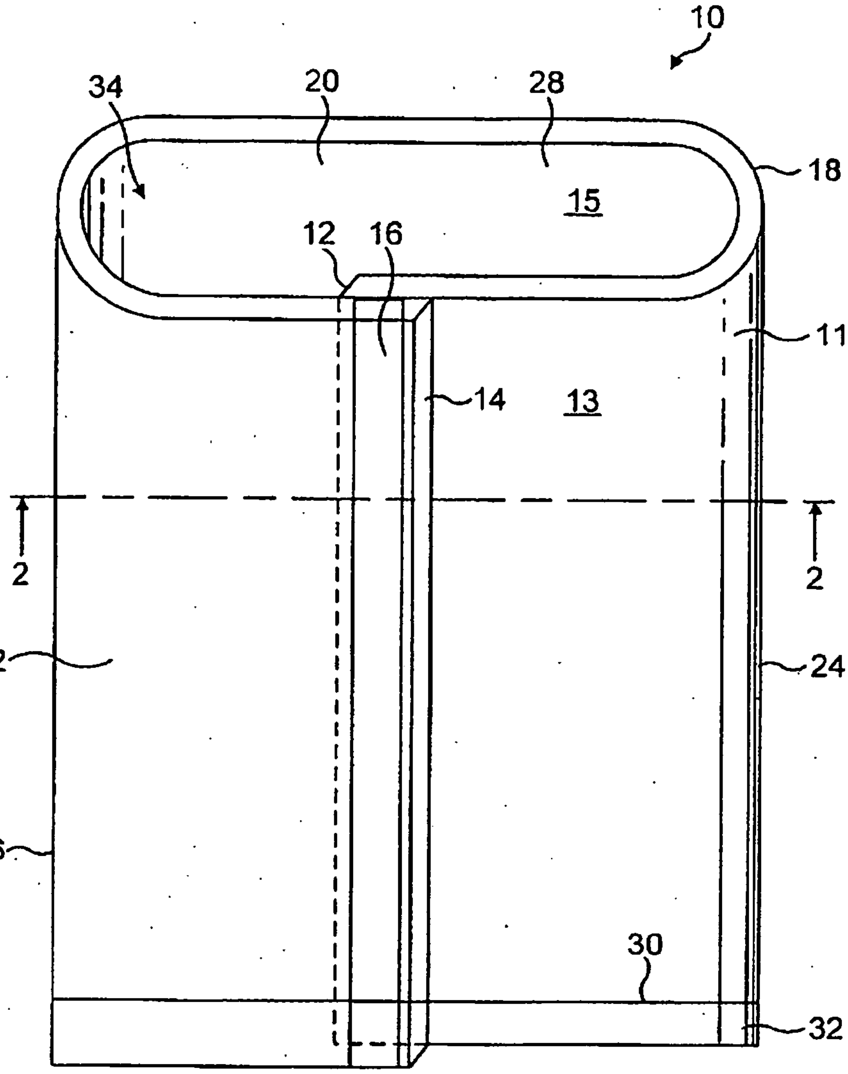
caractérisé en ce que le réceptacle est formé de manière à ce qu'il soit un réceptacle individuel tranché et séparé de l'élément tubulaire, la seconde extrémité étant une ouverture à "gueule ouverte", ledit premier scellement (16) comprend un scellement pelable choisi parmi un scellement par recouvrement, une bande de scellement ou un scellement en bout comprenant une bande de scellement en bout, ledit deuxième scellement (32) étant non pelable, et ladite feuille de film thermorétractable (11) comprenant un film étiré biaxialement ayant une valeur de rétraction d'au moins 20 % de retrait à 90 °C dans au moins une direction.

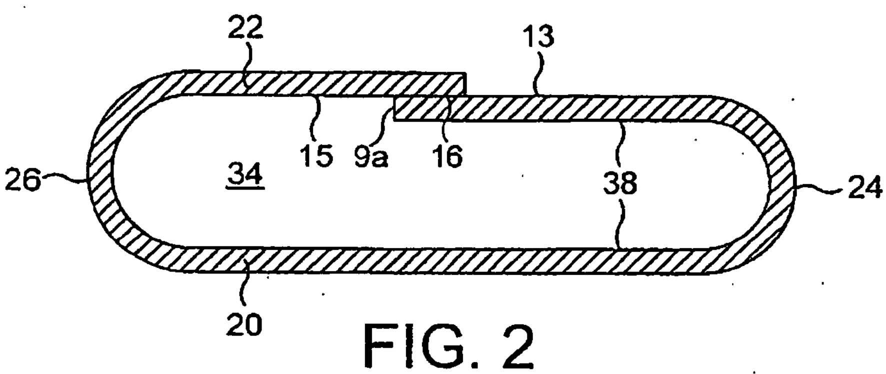
44. Procédé selon la revendication 43, dans lequel ladite feuille de film thermoplastique thermorétractable (11) est fendue jusqu'à une largeur souhaitée avant de joindre lesdits premier et second côtés (12, 14) l'un à l'autre.

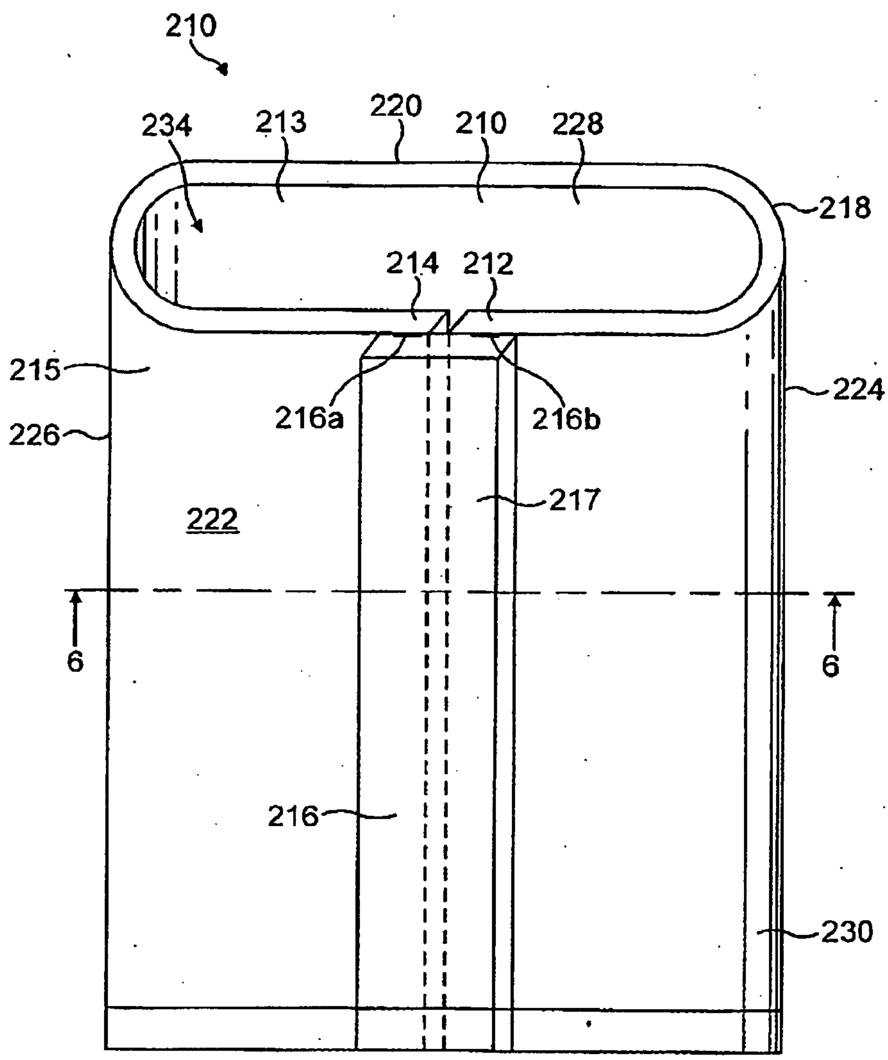
45. Procédé selon la revendication 43 ou 44, dans lequel ladite feuille de film thermorétractable thermoplastique (11) comprend un rouleau continu de film et ledit procédé comprend en outre (d) la réalisation d'une coupe latérale dans ledit élément tubulaire (18), ladite coupe s'étendant latéralement sur au moins la largeur desdites première et deuxième parois de réceptacle (20, 22), séparant ainsi une partie dudit élément tubulaire (18) comprenant ledit deuxième scellement (32) dudit élément tubulaire (18).

46. Procédé selon l'une quelconque des revendications 43 à 44, dans lequel ledit film thermorétractable thermoplastique (11) est formé par co-extrusion d'un tube de film primaire, refroidissement du tube de film primaire, affaissement du tube de film primaire, gonflement du tube de film primaire, réchauffement du tube de film primaire gonflé, étirement biaxial du tube de film primaire, refroidissement et nouvel affaissement du tube de film primaire, incision du tube de film primaire longitudinalement et ouverture du tube primaire fendu pour produire une feuille plane de film orientée biaxialement.

47. Procédé selon l'une quelconque des revendications 43 à 46, dans lequel ledit réceptacle (10) est un sac et dans lequel lesdites première et deuxième parois du réceptacle (20, 22) sont les première et deuxième parois du sac et lesdits premier et deuxième bords du réceptacle (24, 26) sont les premier et deuxième bords du sac.


10
34
20
28
18
15
12
16
11
14
13
2
2
22
24
26
30
32
FIG. 1


22
13
26
15
9a
16
34
38
24
20
FIG. 2


210
234
213
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218
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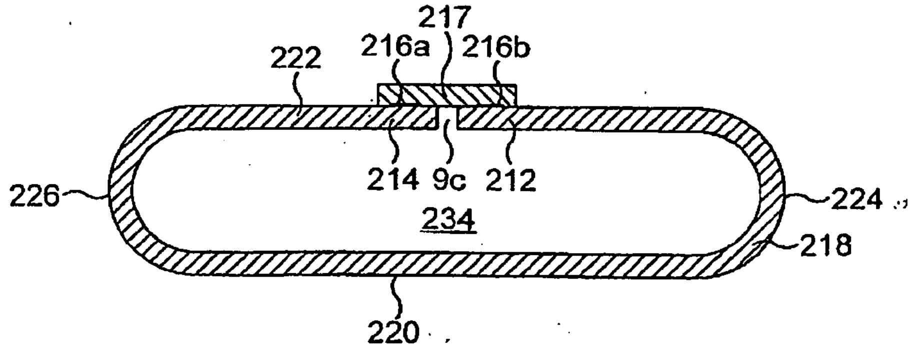
212
215
216a
216b
224
226
217
222
6
6
216
230

FIG. 3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216a
216b
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214
9c
212
224
234
218
220

FIG. 4

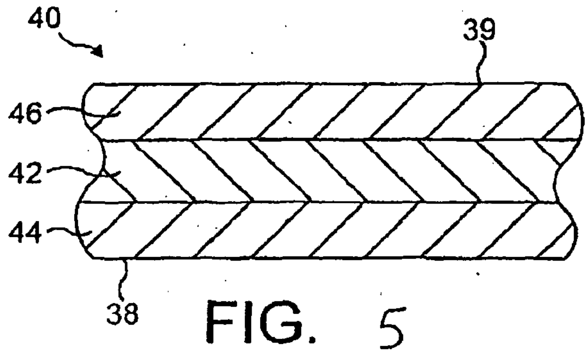


FIG. 5

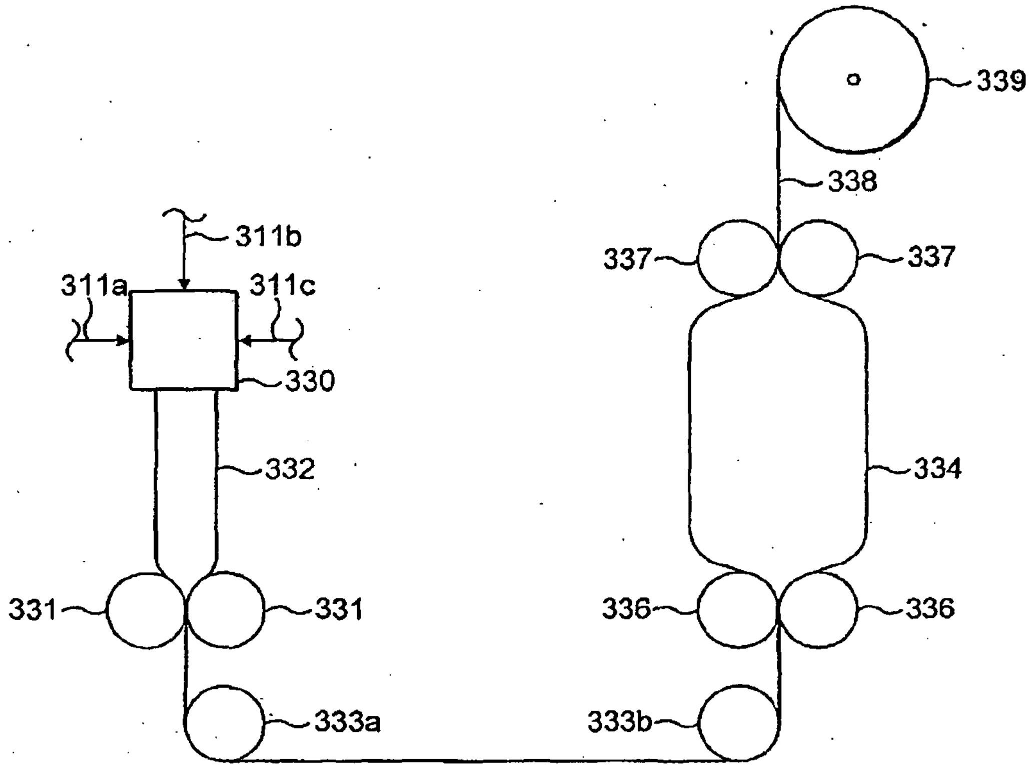


FIG. 6

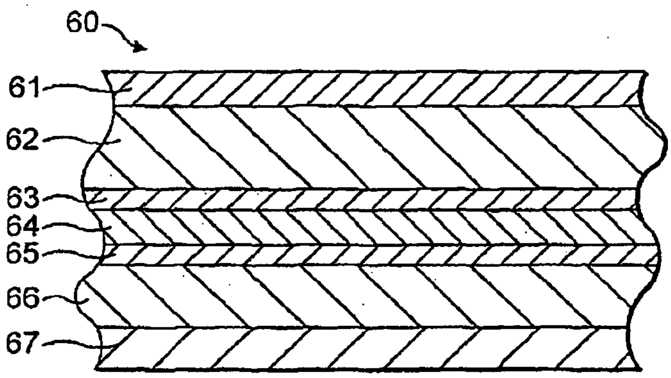


FIG. 7

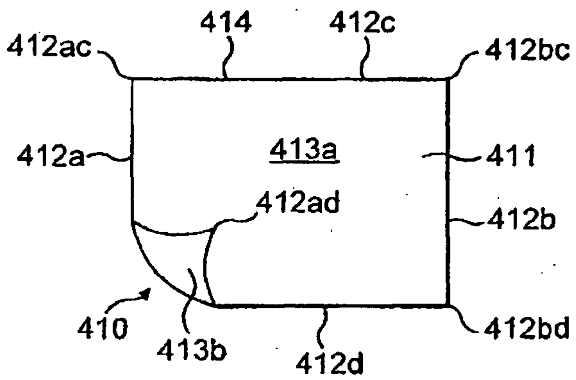

414
412c
412ac
412bc
413a
412a
411
412ad
412b
410
413b
412d
412bd

FIG. 8

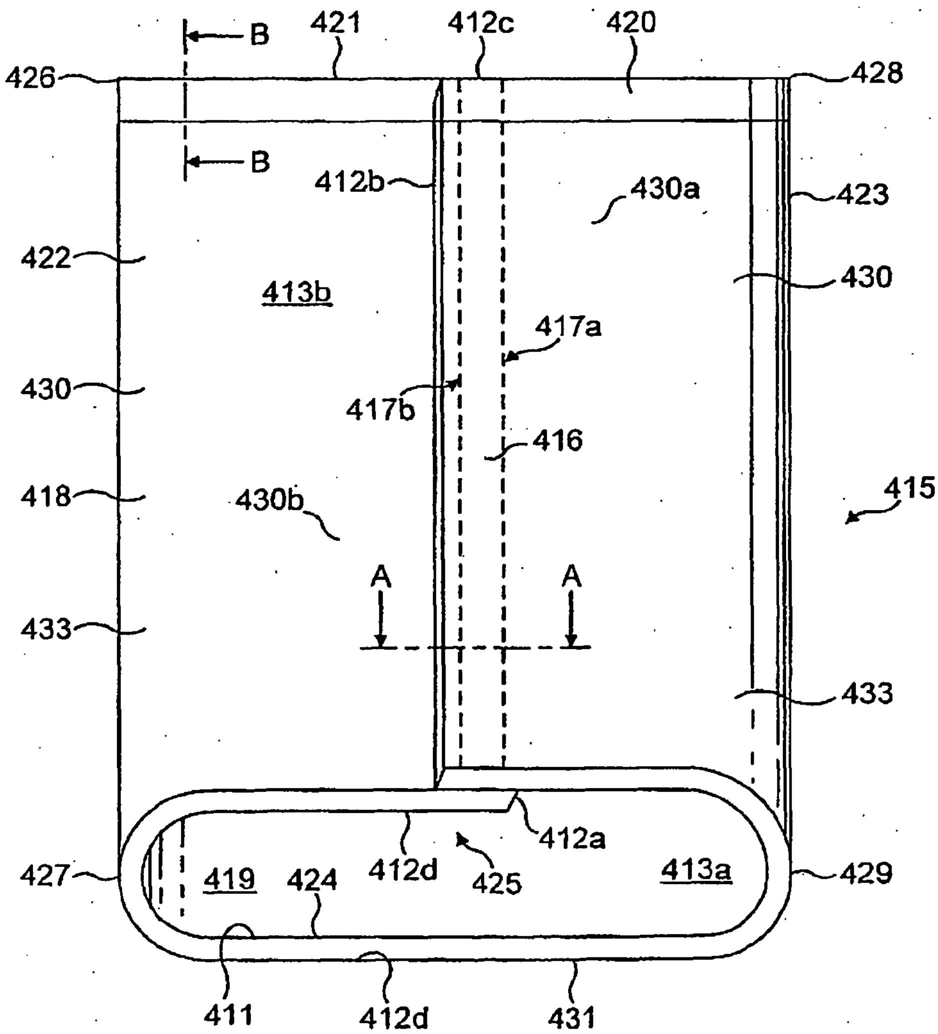
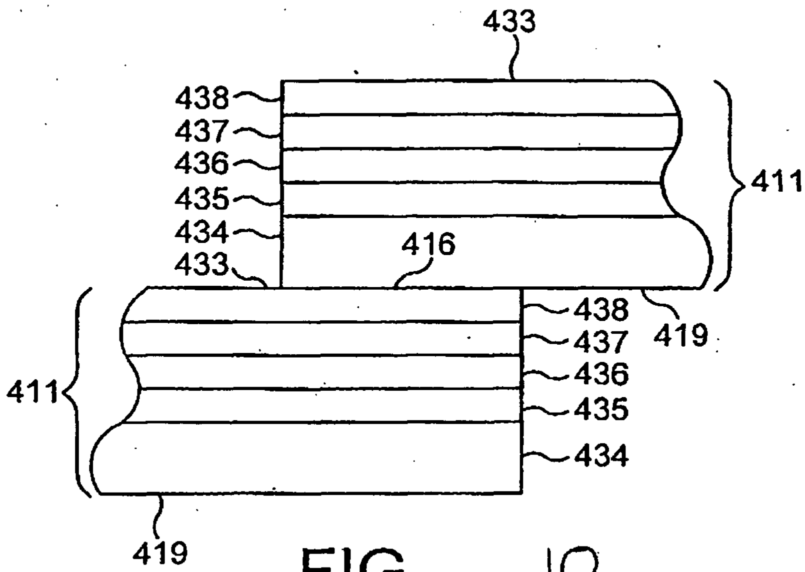

B
421
412c
420
426
428
B
412b
430a
423
422
413b
430
417a
430
417b
416
418
430b
415
A
A
433
433
412a
427
419
424
412d
425
413a
429
411
412d
431

FIG. 9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436
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411
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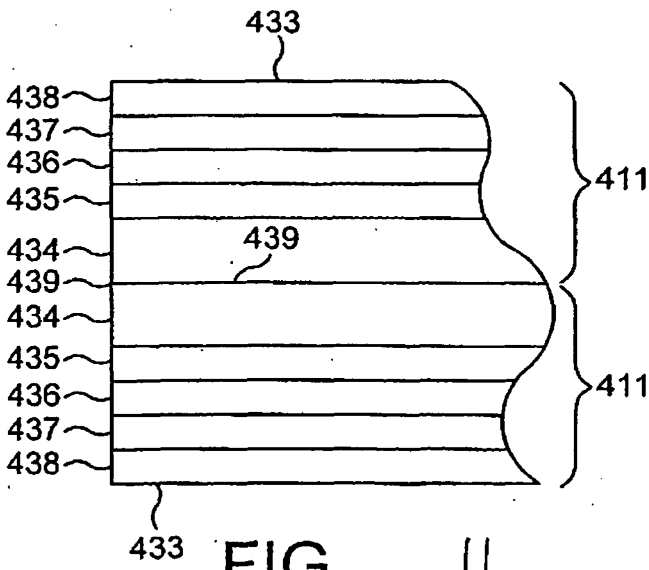
419
411
419

FIG. 10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438
411
411
433

FIG. 11

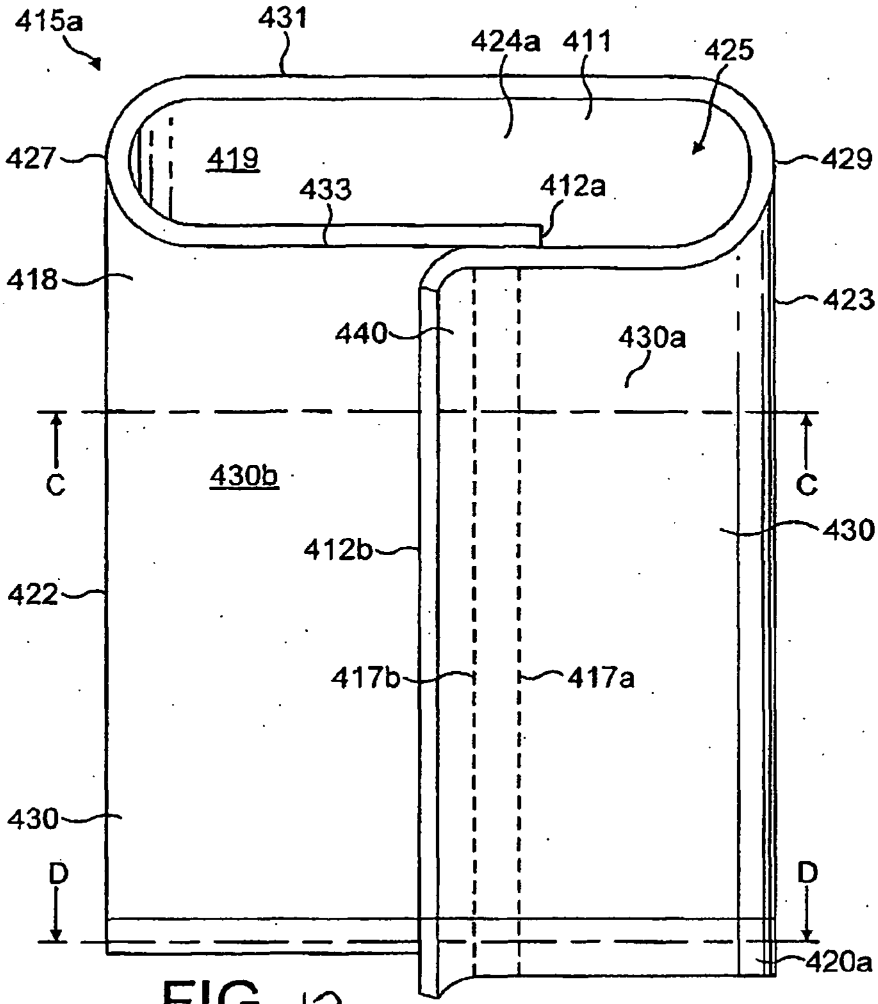
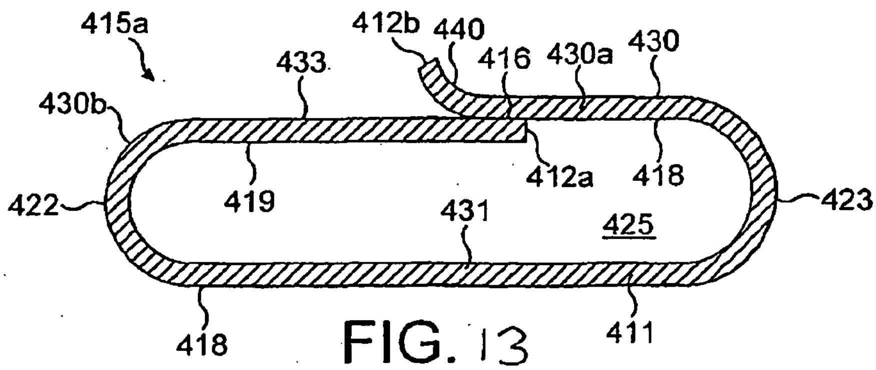

415a
431
424a
411
425
427
419
433
412a
429
418
423
440
430a
C
430b
C
430
412b
422
417b
417a
430
D
D
420a

FIG. 12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430a
430
433
430b
422
419
412a
418
423
431
425
418
411

FIG. 13

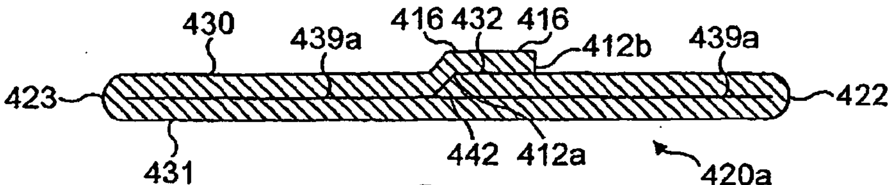

430
439a
416
432
416
412b
439a
423
422
431
442
412a
420a

FIG. 14

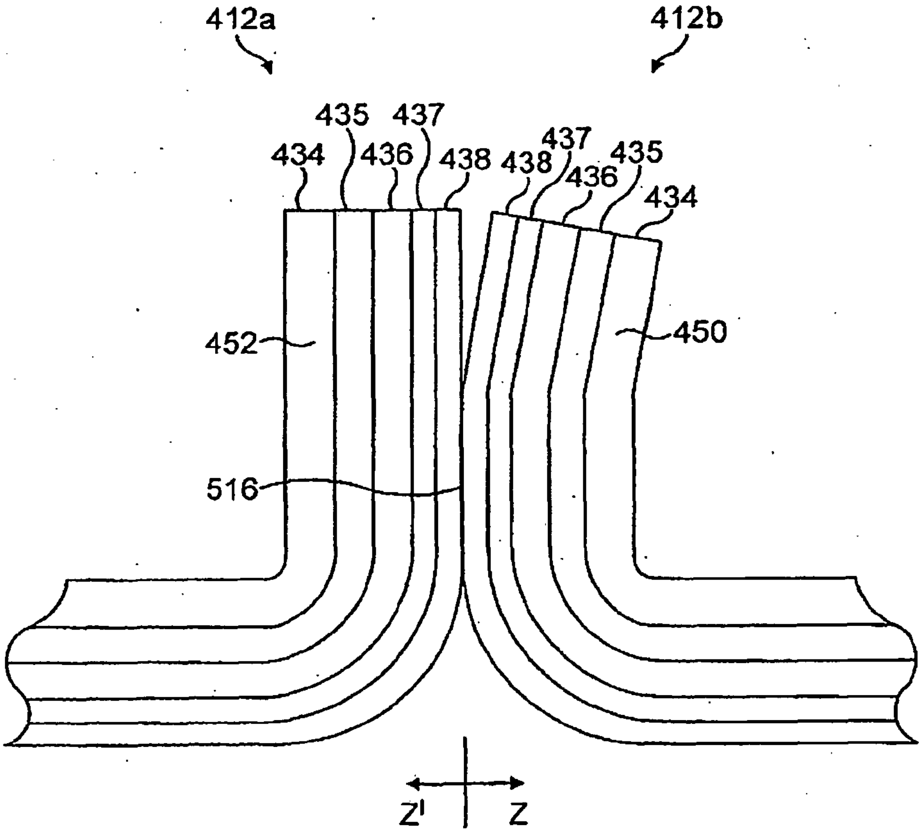

412a
412b
435
437
434
436
438
438
437
436
435
434
452
450
516
Z'
Z

FIG. 17

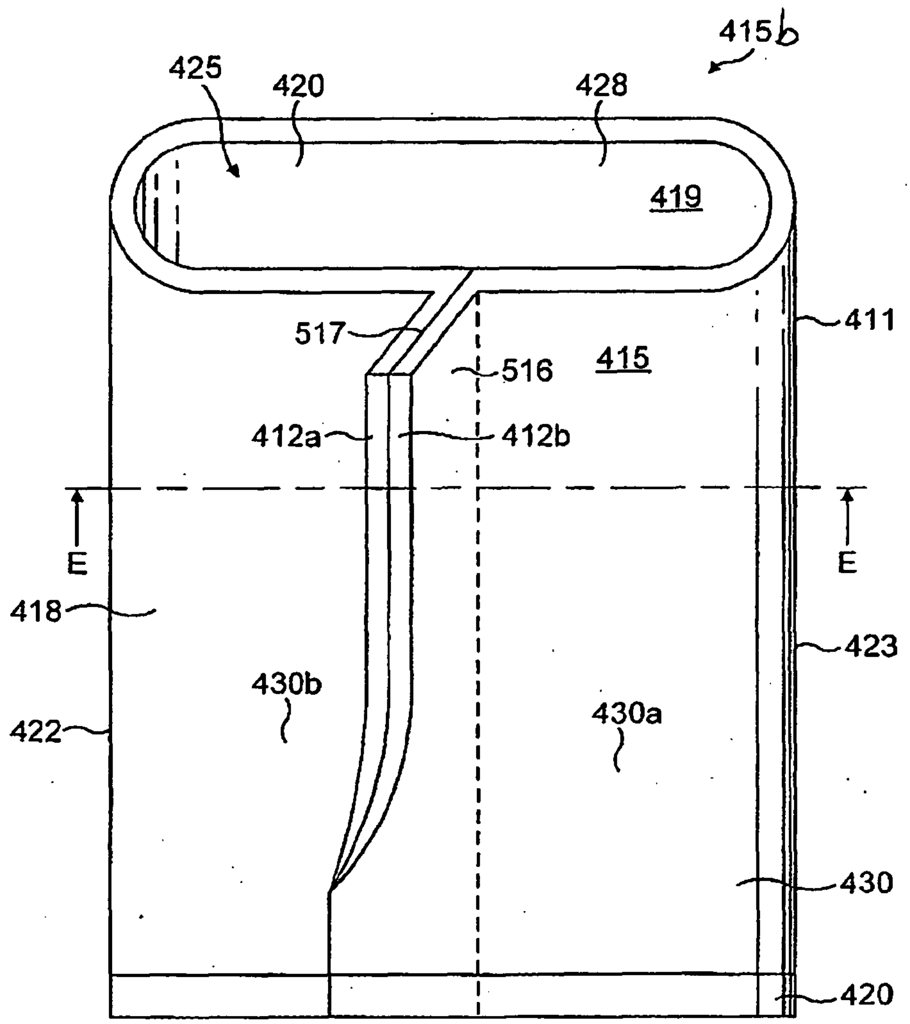
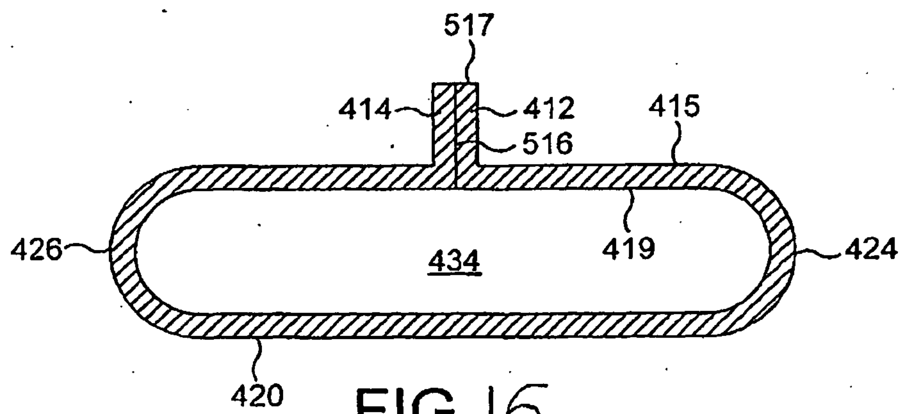

415b
425
420
428
419
517
516
415
411
412a
412b
E
E
418
423
430b
422
430a
430
420

FIG. 15


517
414
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426
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419
424
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FIG. 16

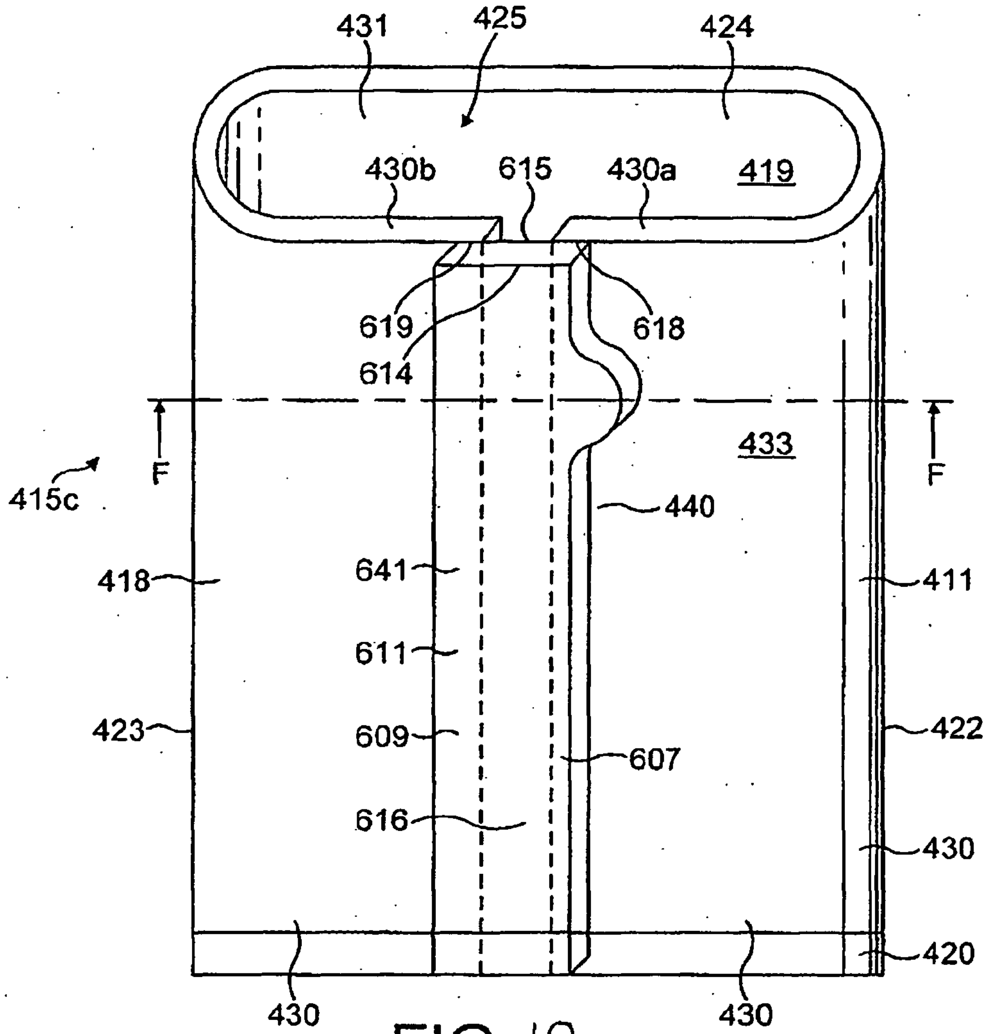
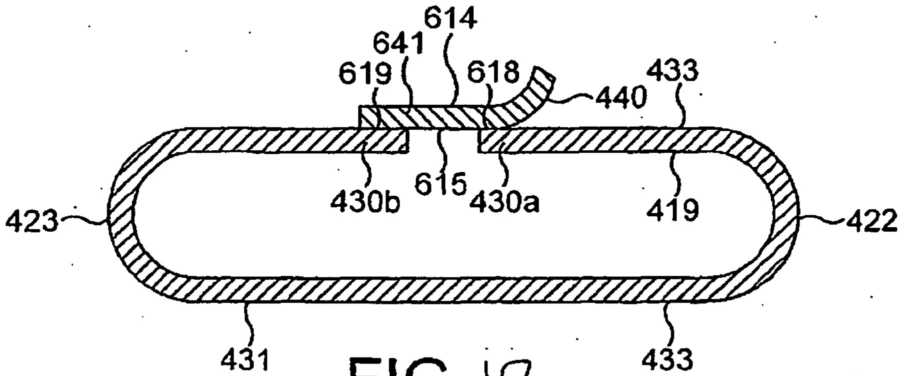

431
425
424
430b
615
430a
419
619
614
618
F
F
433
415c
440
418
641
411
611
423
609
422
607
616
430
420
430
430

FIG. 18


614
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619
618
433
440
430b
615
430a
419
423
422
431
433

FIG. 19

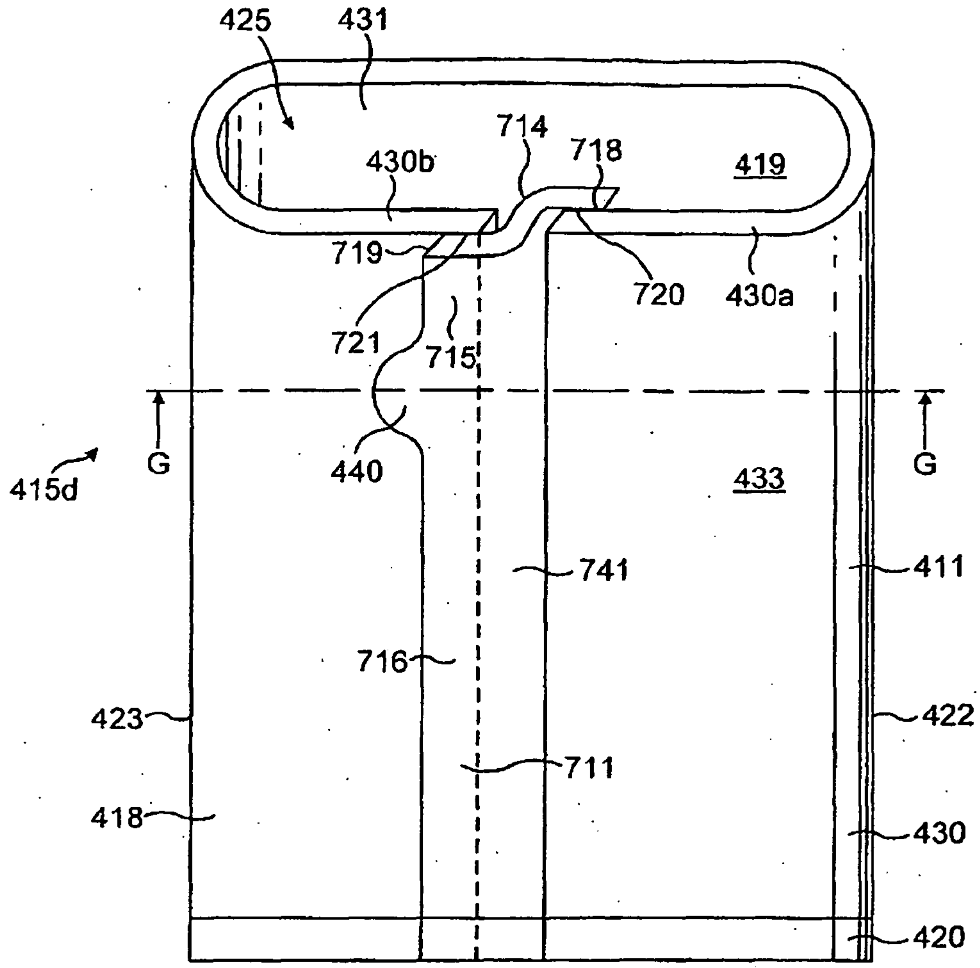

425
431
714
718
430b
419
719
720
430a
721
715
440
G
G
415d
433
741
411
716
423
422
711
418
430
420

FIG. 20

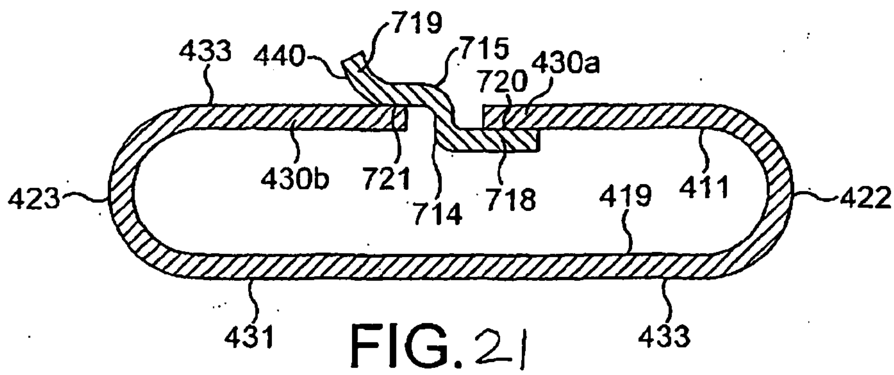
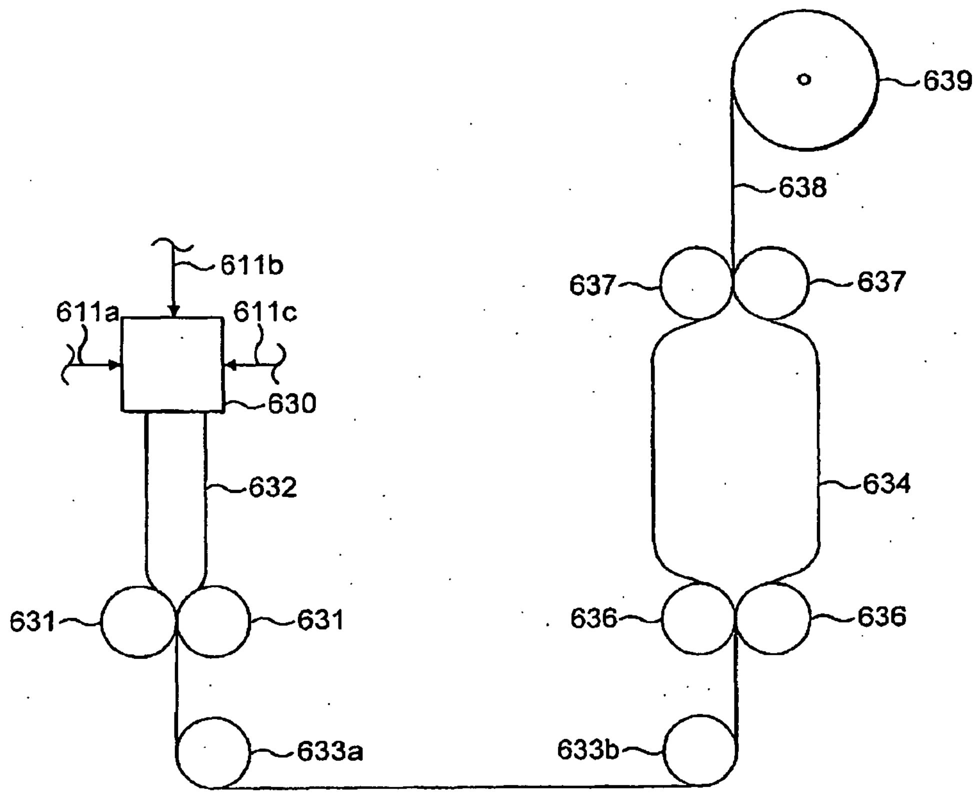

719
433
440
715
430a
720
423
430b
721
714
718
419
411
422
431
433

FIG. 21


611b
611a
611c
630
632
631
631
633a
639
638
637
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636
636
633b

FIG. 22

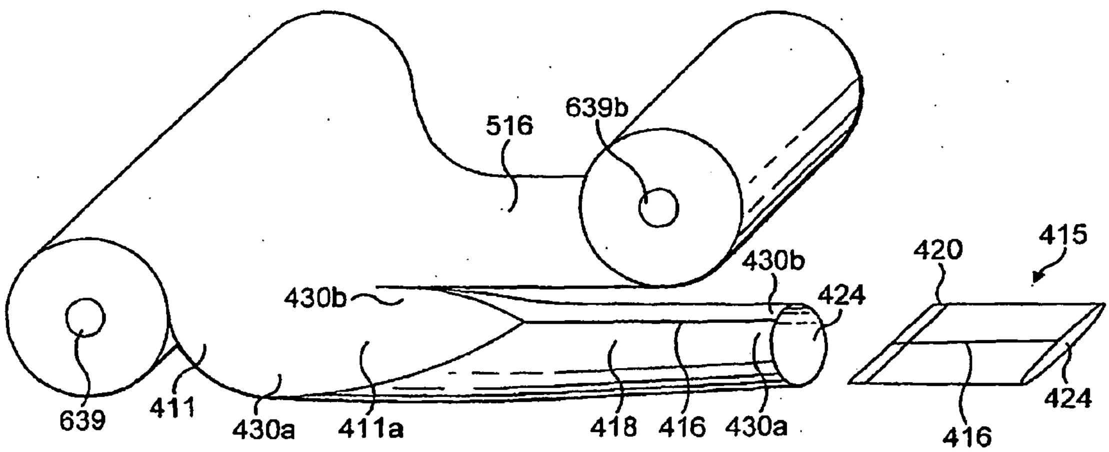
516
639b
430b
430b
424
420
415
639
411
430a
411a
418
416
430a
416
424

FIG. 23

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