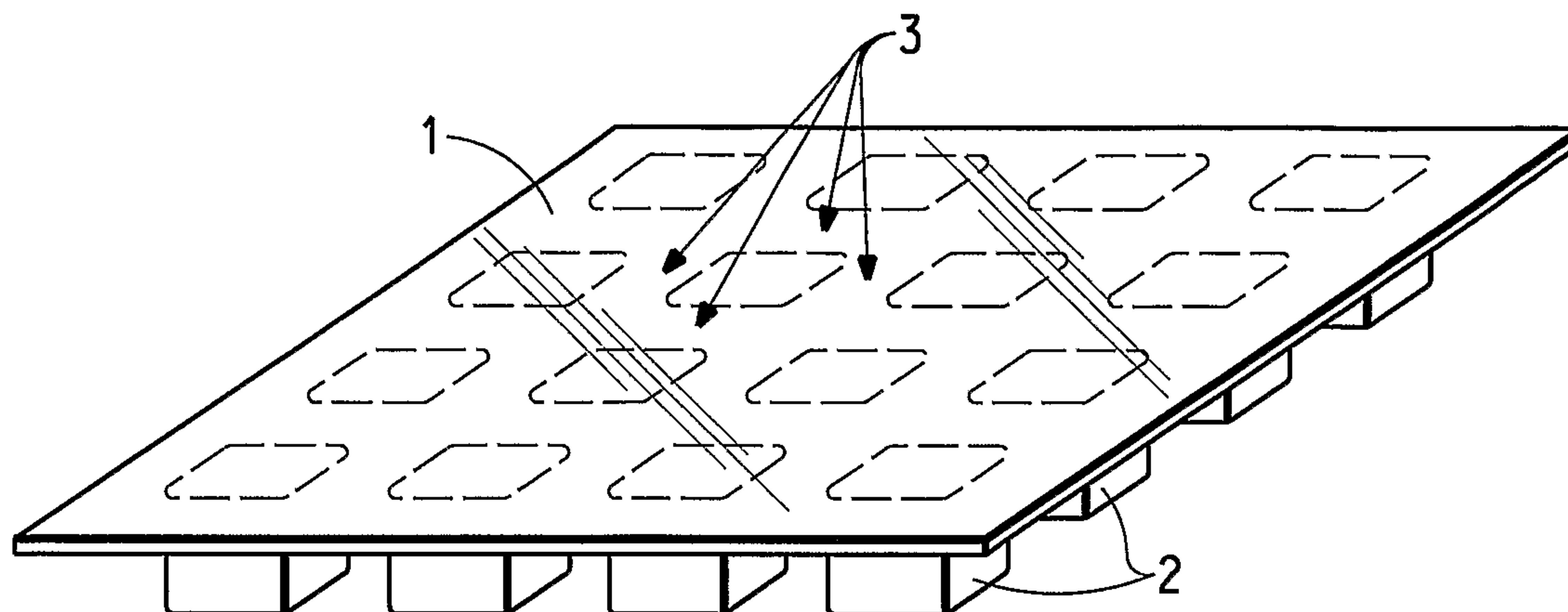




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(71) Demandeur/Applicant:
E.I. DU PONT DE NEMOURS AND COMPANY, US
(72) Inventeurs/Inventors:
MILLER, MARK RALPH, US;
TRIPLETT, EDITH GOTTEMOLLER, US
(74) Agent: BENNETT JONES LLP

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(71) Applicant (for all designated States except US): **E.I. DUPONT DE NEMOURS AND COMPANY** [US/US];
1007 MARKET STREET, WILMINGTON, Delaware
19898 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **MILLER, Mark, Ralph** [US/US]; 4156 Royal Ridge Court, Louisa, Virginia
23093 (US). **TRIPLETT, Edith, Gottemoller** [US/US];
3020 Ellesmere Drive, Midlothian, Virginia 23113 (US).

(74) Agent: **STEINBERG, Thomas, W.**; E. I. DU PONT
DE NEMOURS AND COMPANY, LEGAL PATENT
RECORDS CENTER, 4417 Lancaster Pike, Wilmington,
Delaware 19805 (US).

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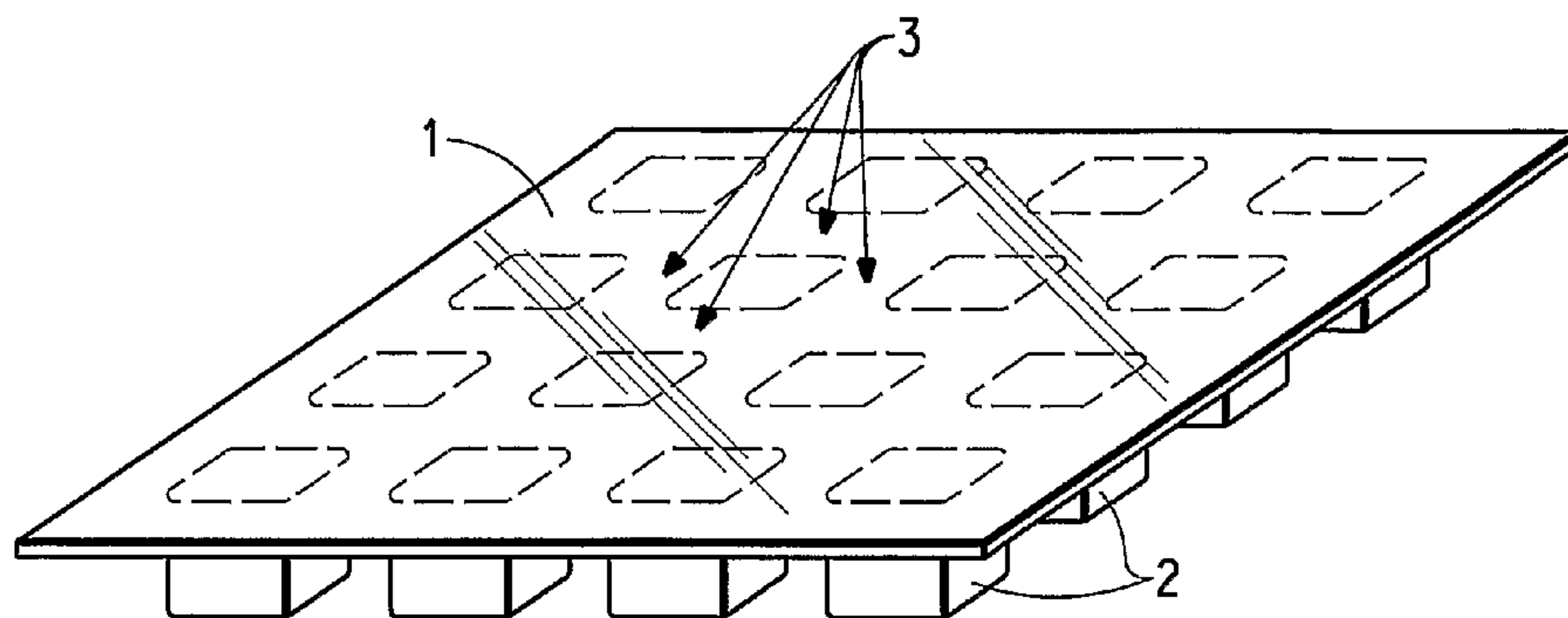
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Child-Resistant Blister Package

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BACKGROUND OF THE INVENTION

The present invention relates to improved child-resistant blister packaging. More particularly, this invention relates to blister packaging that includes a lidding component that comprises at least one nonwoven layer selected from the group consisting of melt-spun continuous filament
10 nonwoven sheets and flash spun plexifilamentary sheets.

Blister packages are known in the art, for example as packaging for pharmaceuticals and other materials. Blister packages include a blister component having at least one cavity formed therein into which the medicine or other packaged material is placed prior to being sealed to a
15 lidding or top web component. Blister components known in the art include soft-tempered aluminum foils, hard-tempered aluminum foils, multi-layer cold formable foils, and thermoformed films. Lidding components known in the art include films, and combinations of films, paper, and/or foil. The lidding component generally has a heat-seal layer
20 applied to one side thereof which is used to heat seal the lidding component to the blister component during the manufacture of the blister package. When used for packaging pharmaceuticals and other materials that are oxygen- and/or moisture-sensitive, the blister package should have sufficient barrier properties to ensure a reasonable shelf-life for the
25 packaged materials. When used for packaging pharmaceuticals or other materials that may be harmful to children, a blister package should also be child-resistant so that a child cannot open the package, bite through it, or otherwise damage the packaging in a way that exposes the packaged pharmaceutical or other packaged material. At the same time, it is
30 generally desirable that an adult can open the blister package without undue effort.

Examples of blister packages known in the art include peel-open, tear-open, push-through, and peel off-push through packages. In a peel-

open package, the lidding component is peeled away from the blister component to reveal the packaged material. In a tear-open package, the lidding and blister components contain a notch or perforation that extends from an edge of the package in the direction of the cavity. The notch can
5 be made in an external edge of a package, or, for packages comprising multiple blisters separated by perforations, the notch is preferably contained internal to the package such that when an individual blister is separated at the perforations from the rest of the blisters in the package, the notch in the separated blister is on an exposed edge thereof. The
10 package is then torn at the notch and the tear is propagated until the contents of the package are capable of being removed. In a push-through package, the packaged material is pushed through the lidding component by applying finger pressure to the exterior of the blister cavity. In a peel off-push through package, the lidding component is a multi-layer
15 laminate that generally includes an outer paper layer bonded by an intermediate adhesive layer to a film layer (e.g. polyester film), with the film layer also being bonded by a peelable adhesive layer to a foil layer on the side of the film opposite that which is bonded to the paper layer. The foil layer generally has a heat-seal layer coated or otherwise applied to the
20 side of the foil opposite the film which provides a non-peelable seal when heat-sealed to the blister component. To open the package, the lidding is peeled between the film and the foil layers, leaving the foil layer attached to the blister component. After peeling off the combined paper and film lidding layers, the packaged material is pushed through the lidding layer(s)
25 that remains attached to the blister component. Generally the peelable adhesive layer remains adhered to the film layer during peeling such that only the foil layer remains attached to the blister component after peeling. An example of a peel off-push through blister package is described in Brunda, U.S. Patent No. 3,899,080. The blister package comprises a
30 peelable outer layer, for example film, cardboard, or paper that is adhered by a peelable adhesive to a rupturable layer such as paper, selected plastics, or metal foil.

One challenge in the manufacture of blister packaging is to make a package that is child resistant that can also be opened by an adult without undue difficulty. Certain child-resistant blister packages known in the art include peel-open packages that comprise a laminated paper-film lidding component adhered to a plastic blister component by a peelable sealant. Further child-resistance is obtained using peel off-push through packages, which comprise the multi-layer lidding material described above. One disadvantage of current peel off-push through packages is that paper-film-foil laminates used in the lidding do not generally peel cleanly in one piece and often tear at the perforation, making it difficult to initiate a new peel. Some paper-film laminates and paper-film-foil laminates also have poor puncture resistance and can be chewed through by a child. Another disadvantage of using paper-film laminates or paper-film-foil laminates in the lidding component is that it is not unusual to have problems with moisture being sealed in the blister when moisture that is retained in the paper forms steam at the high temperatures used in the heat-sealing process.

Poore, British patent GB 2151581 describes push-through strip packaging described as child-resistant that includes first and second planar sheet materials with the packaged elements enclosed therebetween. Neither of the planar sheet materials contains pre-formed blisters, but rather the necessary accommodation of the packaged elements is afforded by stretching of the material of each sheet as they are sealed together. The first sheet is a laminate of a paper or a foil with a tear-resistant biaxially oriented plastic material together with an adhesive layer that is preferably a heat-sealable adhesive layer. The second sheet preferably has a push through force of at least about 70 N and comprises a laminate of paper or metal foil and a layer of plastic or other material that can provide adhesive properties, preferably a heat-sealable adhesive. The package permits the removal of individual elements through the second sheet by application of finger pressure.

Gerber published European Patent Application 0959020 describes a peel off-push through type blister package that includes a cover sheet

containing a metal foil-free push-through penetrable plastic layer, a peelable release adhesive, and a non-penetrable cover layer. The cover layer is peeled off the release adhesive in a first step and the packaged material is pushed through the metal foil-free penetrable plastic layer.

- 5 Suitable cover layers include mono-films, film laminates containing thermoplastics, papers or layered materials of thermoplastic paper. Suitable papers include cellulose papers, security papers, and papers made of synthetic fibers.

10 Carter, U.S. 4,947,620 describes a blister pack suitable for steam sterilization that includes a lidding material of Tyvek® nonwoven material that is coated with an adhesive only on the areas of the lidding that are bonded to the blister component. The Tyvek® nonwoven material is breathable and therefore such packaging is not suitable for packaging pharmaceuticals and other materials that are oxygen or moisture sensitive.

- 15 There remains a need for improved child-resistant blister packaging that protects materials packaged therein from moisture and/or oxygen that is also economical to manufacture.

BRIEF SUMMARY OF THE INVENTION

20 In a first embodiment, the present invention is directed to a blister package comprising a blister component having an inner surface and an outer surface and a multi-layer lidding component having an inner surface and an outer surface, wherein selected portions of the inner surfaces of the blister and lidding components are adhered together to form at least
25 one cavity therebetween, the blister component comprising a first barrier layer selected from the group consisting of polymeric films, coated polymeric films, metal foils, and film-foil laminates, and the lidding component comprising a second barrier layer and a nonwoven layer comprising at least one melt-spun continuous filament nonwoven sheet.

30 A second embodiment of the present invention is a blister package comprising a blister component having an inner surface and an outer surface and a multi-layer lidding component having an inner surface and an outer surface, wherein selected portions of the inner surfaces of

the blister and lidding components are bonded together to form at least one cavity therebetween, the blister component comprising a first barrier layer selected from the group consisting of polymeric films, coated polymeric films, metal foils, and film-foil laminates, and the lidding component comprising a flash spun plexifilamentary sheet and a second barrier layer comprising a sheet layer selected from the group consisting of polymeric films, coated polymeric films, and metalized polymeric films.

BRIEF DESCRIPTION OF THE DRAWINGS

10 Figure 1 is a schematic elevation view of a blister package.

Figure 2a is a schematic cross-sectional view of a lidding material useful in blister packages of the present invention.

Figure 2b is a schematic cross-sectional view of a second embodiment of a lidding material useful in blister packages of the present invention.

Figure 3 is a schematic diagram of a process suitable for preparing a blister package of the present invention.

Figure 4 is a portion of the product made by the process of Fig. 3, showing multiple blister packages.

20

DETAILED DESCRIPTION OF THE INVENTION

The present invention relates to an improved child-resistant blister package that comprises a multi-layer lidding component and a blister component. The multi-layer lidding component includes at least one barrier layer and at least one nonwoven layer selected from the group consisting of melt-spun continuous filament nonwoven sheets and flash spun plexifilamentary sheets. The blister packages of the present invention include peel-open, tear-open, and peel off-push through packages. The use of a melt-spun continuous filament nonwoven sheet or flash spun plexifilamentary sheet in the lidding results in a blister package that is difficult or impossible to open by pushing the packaged item through the lidding or by chewing through the lidding, thus improving the degree of child resistance compared to packages known in the art. The

term "copolymer" as used herein includes random, block, alternating, and graft copolymers prepared by polymerizing two or more comonomers and thus includes dipolymers, terpolymers, etc.

The term "polyethylene" (PE) as used herein is intended to encompass not only homopolymers of ethylene, but also copolymers wherein at least 85% of the recurring units are ethylene units, and includes "linear low density polyethylenes" (LLDPE) which are linear ethylene/ α -olefin copolymers having a density of less than about 0.955 g/cm³, and "high density polyethylenes" (HDPE), which are polyethylene homopolymers having a density of at least about 0.94 g/cm³.

The term "polyester" as used herein is intended to embrace polymers wherein at least 85% of the recurring units are condensation products of dicarboxylic acids and dihydroxy alcohols with linkages created by formation of ester units. Examples of polyesters include poly(ethylene terephthalate) (PET), which is a condensation product of ethylene glycol and terephthalic acid, and poly(1,3-propylene terephthalate), which is a condensation product of 1,3-propanediol and terephthalic acid.

The term "polyamide" as used herein is intended to embrace polymers containing recurring amide (-CONH-) groups. One class of polyamides is prepared by copolymerizing one or more dicarboxylic acids with one or more diamines. Examples of polyamides suitable for use in the present invention include poly(hexamethylene adipamide) (nylon 6,6) and polycaprolactam (nylon 6).

The term "barrier layer" as used herein refers to a sheet layer, including films and coatings that restrict the permeation of oxygen and/or water vapor into a blister package that comprises the sheet layer. Barrier layers suitable for use in the present invention preferably have a moisture vapor transmission rate (MVTR) of less than 6 g/m²/24 hr measured according to ASTM F1249 under the conditions of 38°C and 90% Relative Humidity and/or an oxygen transmission rate of less than 28 cm³/m²/24 hr measured according to ASTM D3985 under the conditions of 23°C, 100% oxygen, and 100% Relative Humidity.

The terms “nonwoven fabric”, “nonwoven sheet”, “nonwoven layer”, and “nonwoven web” as used herein refer to a structure of individual fibers, filaments, or threads that are positioned in a random manner to form a planar material without an identifiable pattern, as opposed to a knitted or woven fabric. Examples of nonwoven fabrics include meltblown webs, spunbond nonwoven webs, flash spun webs, carded webs, spunlaced webs, and composite sheets comprising more than one nonwoven web.

The term “machine direction” (MD) is used herein to refer to the direction in which a nonwoven web is produced (e.g. the direction of travel of the supporting surface upon which the fibers are laid down during formation of the nonwoven web). The term “cross direction” (XD) refers to the direction generally perpendicular to the machine direction in the plane of the web.

The term “spunbond fibers” as used herein means fibers that are melt-spun by extruding molten thermoplastic polymer material as fibers from a plurality of fine, usually circular, capillaries of a spinneret with the diameter of the extruded fibers then being rapidly reduced by drawing and then quenching the fibers.

The term “meltblown fibers” as used herein, means fibers that are melt-spun by meltblowing, which comprises extruding a melt-processable polymer through a plurality of capillaries as molten streams into a high velocity gas (e.g. air) stream.

The term “spunbond-meltblown-spunbond nonwoven fabric” (“SMS”) as used herein refers to a multi-layer composite sheet comprising a web of meltblown fibers sandwiched between and bonded to two spunbond layers. Additional spunbond and/or meltblown layers can be incorporated in the composite sheet, for example spunbond-meltblown-meltblown-spunbond webs (“SMMS”), etc.

The term “multiple component fiber” as used herein refers to a fiber that is composed of at least two distinct polymeric components that have been spun together to form a single fiber. The at least two polymeric components are arranged in distinct substantially constantly positioned

zones across the cross-section of the multiple component fibers, the zones extending substantially continuously along the length of the fibers.

The term "bicomponent fiber" is used herein to refer to a multiple component fiber that is made from two distinct polymer components, such as sheath-core fibers that comprises a first polymeric component forming the sheath, and a second polymeric component forming the core; and side-by-side fibers, in which the first polymeric component forms at least one segment that is adjacent at least one segment formed of the second polymeric component, each segment being substantially continuous along the length of the fiber with both polymeric components being exposed on the fiber surface. Multiple component fibers are distinguished from fibers that are extruded from a single homogeneous or heterogeneous blend of polymeric materials. The term "multiple component nonwoven web" as used herein refers to a nonwoven web comprising multiple component fibers. The term "bicomponent web" as used herein refers to a nonwoven web comprising bicomponent fibers. A multiple component web can comprise single component and/or polymer blend fibers in addition to multiple component fibers.

The term "plexifilamentary" as used herein, means a three-dimensional integral network or web of a multitude of thin, ribbon-like, film-fibril elements of random length and with a mean film thickness of less than about 4 microns and a median fibril width of less than about 25 microns. In plexifilamentary structures, the film-fibril elements are generally coextensively aligned with the longitudinal axis of the structure and they intermittently unite and separate at irregular intervals in various places throughout the length, width and thickness of the structure to form a continuous three-dimensional network. A nonwoven web of plexifilamentary film-fibril elements is referred to herein as a "flash spun plexifilamentary sheet". Conventional flash spinning processes for forming web layers of plexifilamentary film-fibril strand material are disclosed in U.S. Pat. Nos. 3,081,519 (Blades et al.), 3,169,899 (Steuber), 3,227,784 (Blades et al.), 3,851,023 (Brethauer et al.), the contents of which are hereby incorporated by reference.

As used herein, the term "film" includes layers that are extruded directly onto one of the other layers in the lidding or blister components, as well as films that are formed in a separate film-forming step and then laminated to one or more other layers.

5 The term "full-surface bonded nonwoven fabric" as used herein refers to a nonwoven fabric that has been bonded by applying heat and pressure to the nonwoven fabric between two substantially smooth bonding surfaces. A full-surface bonded nonwoven fabric is bonded over substantially 100% of its outer surfaces by fiber-to-fiber bonds. The use of
10 smooth bonding surfaces results in each side of the full-surface bonded nonwoven fabric being substantially uniformly bonded. Full surface bonded nonwoven fabrics are described in co-pending U.S. Patent Application no. 60/529,997 (DuPont Docket no. TK-3820), filed on even date herewith and incorporated herein by reference in its entirety.

15 Figure 1 illustrates a schematic elevation view of a blister package according to the present invention. Lidding component 1 is heat-sealed to a blister component comprising a plurality of cavities 2. The lidding and blister components are heat-sealed in the shoulder areas 3 that separate the individual cavities. The shoulder areas generally include perforations
20 (not shown) between the individual blisters or groups of individual blisters.

 The blister component is formed from a forming web that comprises at least one barrier layer, for example a polymeric film, coated polymeric film, or metal foil. Forming webs suitable for forming the blister component are known in the art. For example, the blister component can be prepared
25 by thermoforming cavities into a barrier film. Alternately, the blister component can be formed from a soft-tempered or a hard-tempered foil such as an aluminum foil layer. Films and foils suitable for forming the blister component generally have a thickness between about 5.0 mils (0.125 mm) and 15 mils (0.38 mm) for child-resistant packaging. For
30 example, a typical film thickness is about 10 mils (0.25 mm). The blister component can be formed from a multi-layer sheet structure, for example a multi-layer film or a film-foil laminate.

Figure 2a is a cross-sectional view of an embodiment of a lidding component suitable for use in peel-open, tear-open, and peel off-push through blister packages of the present invention. Nonwoven layer 5, which comprises at least one melt-spun continuous filament sheet or flash spun plexifilamentary sheet, is bonded to barrier layer 7 by intervening adhesive tie layer 6. Heat-seal layer 8 is adhered to the barrier layer on the side of the barrier layer opposite the tie layer. A blister package is formed by heat-sealing the lidding component to the blister component with heat-seal layer 8 facing the blister component such that nonwoven layer 5 forms one of the outer surfaces of the blister package. Tie layer 6 can form a peelable seal (e.g. in a peel off-push through package) or a non-peelable seal (e.g. in a peel-open or tear-open package) between the nonwoven layer and the barrier layer, depending on the desired method for opening the blister package. A seal or bond is considered non-peelable if the layers bonded by the non-peelable seal are not readily opened by an adult by hand-peeling. Generally a seal having a peel strength between about 3 to 4 lb/in is preferred for a peelable seal. Peel strengths less than about 3 lb/in are generally peeled too easily to be useful in child-resistant packages. Seals having a peel strength greater than about 4 lb/inch are generally considered to be non-peelable or permanent seals. Peel strength can be measured according to ASTM F 88-0, which is hereby incorporated by reference, using the unsupported method of clamping the sample described therein. Similarly, heat-seal layer 8 can form a peelable seal (e.g. in a peel-open package) or a non-peelable seal (e.g. in a peel off-push through or tear-open package) between the barrier layer and the blister component. Examples of lidding constructions according to Figure 2a include: (a) melt-spun continuous filament nonwoven sheet/adhesive tie layer/metal foil/heat-seal layer, (b) melt-spun continuous filament nonwoven sheet/adhesive tie layer/barrier film (metalized or unmetalized, coated or uncoated)/heat-seal layer, and (c) flash spun plexifilamentary sheet/adhesive tie layer/barrier film (metalized or unmetalized, coated or uncoated) /heat-seal layer. The barrier film can be a film that is laminated to the nonwoven sheet or can be

a layer that is co-extruded with the adhesive tie layer onto the nonwoven sheet.

Barrier layers suitable for use in the lidding component shown in Figure 2a include foil sheets such as aluminum foil and laminated
5 structures comprising a foil layer such as film-foil laminates, as well as mono-layer, multi-layer, and coated polymeric films, and metalized polymeric films.

Examples of other materials useful as either the barrier layers suitable for use in the lidding component, or as the blister component
10 include poly(vinyl chloride) (PVC) used as a mono-layer film, PVC film coated with poly(vinylidene chloride) (PVdC), PVC film laminated with poly(chlorotrifluoroethylene) (PCTFE) film such as Aclar® PCTFE film available from Honeywell, Inc. (Morris Township, NJ), cyclo-olefin-
15 copolymer (COC) used as part of a laminated or co-extruded structure, cold-formable foil such as PVC/aluminum/nylon laminated structures, mono-layer aluminum foil, polypropylene (PP) used as a mono-layer film, poly(ethylene terephthalate) (PET) used as a mono-layer film, and
20 poly(ethylene terephthalate) copolymers that have been modified with 1,4-cyclohexanedimethanol, available from Eastman Chemicals (Kingsport, TN) as PETG copolymers, used as a mono-layer film.

In one embodiment the barrier layer comprises a polymeric film comprising a polymeric coating. For example, the barrier layer can
comprise a PVdC-coated polyester film such as PVdC-coated Mylar® polyester films (e.g. M30 and M34 films, available from DuPont Teijin
25 Films). In another embodiment, the barrier layer comprises a polymeric film that has been coated with a ceramic material. Ceramic materials suitable for coating polymeric films include oxides, nitrides, or carbides of silicon, aluminum, magnesium, chromium, lanthanum, titanium, boron, zirconium, or mixtures thereof. Methods for depositing ceramic coatings
30 onto a substrate are known in the art, such as by deposition from the vapor or gaseous phase under vacuum onto a film layer in thicknesses of between about 5 to 500 nm. Suitable ceramic-coated films include films made of a thermoplastic material, such as polyolefin films having a

thickness of 23 to 100 μm or polyester films having a thickness of 12 to 80 μm , that have been coated with at least one 5 to 500 nm thick layer of SiO_x , where x is a number ranging from 1.1 to 2, or with Al_yO_z , where the ratio y/z is a number ranging from 0.2 to 1.5. Alternately, the barrier layer
5 can comprise a metalized film prepared using processes known in the art such as vacuum deposition or sputter coating. In one embodiment, the barrier layer is a metalized polyester film, for example a poly(ethylene terephthalate) film, that has a layer of aluminum metal coated thereon; preferably the metal layer is between about 10 Angstroms to 1000
10 Angstroms thick and the film is preferably at least 12 microns thick. Metalized polyester films are known in the art and include aluminum-coated polyester films such as Mylar® MC2 aluminum-coated polyester film (available from DuPont Teijin Films). When the barrier layer of the lidding component comprises a ceramic-coated or a metalized polymeric
15 film, the film can be ceramic-coated or metalized on one or both sides. The polymeric film is preferably ceramic-coated or metalized on one side thereof and the lidding is preferably constructed such that the metalized or ceramic-coated side of the film contacts adhesive tie layer 6 to avoid flaking off of the metalized or ceramic layer onto the packaged material
20 when the package is opened. Metalized and ceramic-coated films generally have better barrier properties than unmetalized and uncoated films and therefore are preferred when higher barrier is required than can be achieved with an un-metalized or uncoated film.

Figure 2b is a cross-sectional view of a second embodiment of a
25 lidding component suitable for use in peel-open and tear-open blister packages of the present invention. The lidding component includes nonwoven layer 5' and heat-seal layer 8'. In this embodiment, the heat-seal layer is selected such that it is a barrier layer as well as being heat-sealable, thus eliminating the need for separate barrier and heat-seal
30 layers. The nonwoven layer comprises at least one melt-spun continuous filament nonwoven sheet or at least one flash spun plexifilamentary sheet. When the heat-sealable barrier layer is applied as a coating on the nonwoven layer, it completely coats the nonwoven layer to provide the

desired barrier properties in the blister package. For example, PVdC at a basis weight ranging from 5 g/m² to 120 g/m² coated on a nonwoven layer provides sufficient barrier properties as well as functioning as a heat-seal layer. Depending on the selection of the heat-sealable barrier layer and the blister component, the heat seal can be peelable or non-peelable. When it is desired to form a peel-open package, the heat-sealable barrier layer and the blister component are selected such that the heat seal is peelable. When it is desired to form a tear-open package, the heat seal is preferably non-peelable. In one embodiment of the present invention according to Figure 2b, a tear-open package is formed using a PVdC blister component and a PVdC heat sealable barrier layer (heat seal is non-peelable). In another embodiment of the present invention according to Figure 2b, a peel-open package is formed using a PVC blister component and a PVdC heat-sealable barrier layer, where the PVdC formulation is selected to form a peelable seal with the PVC blister. The lidding shown in Figure 2b optionally includes a non-peelable tie layer (not shown) between the nonwoven layer and heat-seal/barrier layer. For example the tie layer can be a polyester-based polyurethane composition such as Adcote® polyurethane adhesives available from Rohm & Haas (Philadelphia, PA).

Melt-spun continuous filament nonwoven sheets suitable for use in the nonwoven layer in the lidding component include spunbond nonwoven webs and composite nonwoven fabrics that comprise at least one spunbond nonwoven web. Spunbond webs suitable for use in the lidding component of the blister package of the present invention can be prepared using spunbonding methods known in the art. Alternately, the melt-spun continuous filament nonwoven sheet can be formed from previously collected continuous filaments that are laid down on a collecting surface, for example as in the process described in Davies et al. U.S. Patent 3,595,731. Polymers suitable for forming the melt-spun continuous filament nonwoven sheet include polyesters such as poly(ethylene terephthalate) and poly(1,3-propylene terephthalate), polyamides such as

nylon 6,6 and nylon 6, polyolefins such as polyethylene and polypropylene, and copolymers thereof.

The melt-spun continuous filaments of the continuous filament nonwoven sheet can be spun from a single polymer or from a
5 homogeneous or heterogeneous blend of two or more polymers. Alternately, the melt-spun continuous filament nonwoven sheet can comprise a multiple component spunbond nonwoven web. Multiple component spunbond webs preferably comprise a polymeric component that has a melting point that is lower than the melting point(s) of the other
10 polymeric component(s) to facilitate thermal bonding of the web. Examples of suitable multiple component fiber cross-sections include bicomponent fibers such as those having side-by-side or sheath-core cross-sections. In one embodiment of the present invention, the melt-spun continuous filament nonwoven sheet comprises multiple component
15 sheath-core spunbond fibers having a substantially concentric cross-section wherein the melting point of the sheath component is at least 10°C, preferably at least 20°C, less than the melting point of the core component. Examples of suitable sheath/core polymer combinations are polyethylene/polyester such as fibers comprising a linear low density
20 polyethylene sheath with a poly(ethylene terephthalate) core or a sheath comprising a blend of LLDPE and HDPE with a PET core. In one embodiment, the melt-spun continuous filaments comprise a polyester copolymer sheath and a polyester core. For example, the sheath can comprise a poly(ethylene terephthalate) copolymer and the core can
25 comprise poly(ethylene terephthalate). Poly(ethylene terephthalate) copolymers suitable for use as the sheath component include amorphous and semi-crystalline poly(ethylene terephthalate) copolymers. For example, poly(ethylene terephthalate) copolymers in which between about 5 and 30 mole percent based on the diacid component is formed from di-
30 methyl isophthalic acid, as well as poly(ethylene terephthalate) copolymers in which between about 5 and 60 mole percent based on the glycol component is formed from 1,4-cyclohexanedimethanol are suitable for use as the lowest-melting component in the multiple component fibers.

Poly(ethylene terephthalate) copolymers that have been modified with 1,4-cyclohexanedimethanol are available from Eastman Chemicals (Kingsport, TN) as PETG copolymers. Poly(ethylene terephthalate) copolymers that have been modified with di-methyl isophthalic acid are available from E.I. du Pont de Nemours and Company (Wilmington, DE) as Crystar® polyester copolymers.

Composite nonwoven fabrics comprising a spunbond nonwoven web suitable for use in the lidding component include spunbond-meltblown (SM) composite nonwoven fabrics, SMS composite nonwoven fabrics, and composite nonwoven fabrics that include other combinations of spunbond and/or meltblown nonwoven webs such as SMMS composite webs, etc. The meltblown web(s) used to prepare the composite nonwoven fabrics can be single component or multiple component meltblown web(s) and can be prepared using methods known in the art.

The nonwoven layer used in the lidding component can comprise a flash spun nonwoven sheet. Polymers suitable for forming flash spun plexifilamentary sheets useful in the lidding component of the blister package of the present invention include polyethylene, polypropylene, and poly(ethylene terephthalate). One such flash spun plexifilamentary sheet is Tyvek® flash spun high density polyethylene, available from E.I. du Pont de Nemours & Company (Wilmington, DE).

A particularly suitable lidding component can be obtained by smooth-surface thermal bonding of a nonwoven web can be achieved by heating the web between two smooth bonding surfaces to a temperature sufficient to melt or soften the surfaces of the fibers on one or both sides of the nonwoven web such that fiber-to-fiber thermal fusion bonds are formed at the fiber cross-over points on one or both surfaces of the nonwoven web, as disclosed in U.S. Serial No. 60/529,997 (DuPont Docket no. TK-3820), filed on even date herewith and incorporated herein by reference in its entirety.

Thermal calendering processes using a variety of roll configurations are known in the art. The nonwoven layer can be calender bonded such that one side of the nonwoven layer is thermally bonded, with the

thermally bonded side forming one of the outer surfaces of the final blister package. Alternately the nonwoven layer can be calendered such that both sides of the nonwoven layer are thermally bonded. Examples of other calendering processes suitable for bonding the nonwoven layer
5 include those disclosed in David, U.S. Patent No. 3,532,589, Janis, U.S. Patent 5,972,147, and Lim et al., U.S. Patent No. 5,308,691, which are each incorporated herein by reference.

In one embodiment, the nonwoven layer comprises a full-surface bonded melt-spun multiple component continuous filament nonwoven
10 fabric or full-surface bonded flash spun plexifilamentary sheet that has been thermally bonded on both sides in a smooth-calendering process. Full-surface bonded melt-spun multiple component continuous filament nonwoven fabrics have an improved combination of tensile and tear strength for a given fabric thickness compared to comparable smooth-
15 calendered single component melt-spun nonwoven fabrics. Suitable full-surface bonded melt-spun multiple component continuous filament nonwoven fabrics include full-surface bonded bicomponent spunbond webs such as a spunbond web comprising sheath/core fibers, wherein the melting point of the sheath is at least 10°C less than the melting point of
20 the core, that has been smooth-calendered and bonded on both sides. Suitable sheath components include polyester copolymers, poly(1,4-butylene terephthalate) (4GT), and poly(1,3-propylene terephthalate) (3GT), and polyamides such as polycaprolactam (nylon 6). Suitable core components include poly(ethylene terephthalate) and poly(hexamethylene
25 adipamide) (nylon 6,6). For example, the full-surface bonded bicomponent spunbond web can comprise bicomponent fibers having a polyester copolymer sheath and a poly(ethylene terephthalate) core.

The nonwoven layer preferably has a Spencer Puncture (measured according to ASTM D3420, modified for 9/16 in. diameter probe) of at least
30 0.98 Joules, preferably at least 1.18 Joules, and more preferably at least 1.97 Joules; a tensile strength (measured according to ASTM D5035) in both the machine direction and cross-direction of at least 20 lb/in (35 N/cm), preferably at least 22 lb/in (38.5 N/cm), and more preferably at

least 25 lb/in (43.8 N/cm); an elongation in both the machine direction and cross-direction of at least 15%, preferably at least 18%, and more preferably at least 20%; and an Elmendorf Tear (measured according to ASTM D1424) in both the machine direction and the cross-direction of at
5 least .075 lb (0.33 N), preferably at least 0.10 lb (0.45 N), and more preferably at least 0.20 lb (0.89 N).

In one embodiment of the present invention the heat-seal layer comprises a peelable sealant, thus providing a peel-open blister package. Whether or not a particular heat-seal layer forms a peelable seal may
10 depend on the nature of the layers to which it is sealed (e.g. the blister component and barrier layer for the embodiment shown in Figure 2a or the blister component and the nonwoven layer for embodiments shown in Figure 2b). In a peel-open configuration, the package is opened by peeling the multi-layer lidding component away from the blister
15 component, with the peeling occurring between the heat-seal layer and the blister component. Peelable sealants suitable for use in the heat-seal layer of the packages of the present invention include poly(vinylidene chloride), or solvent-based sealants such as modified vinyl/acrylic sealants available from Watson Rhenania (Pittsburgh, PA) such as JVHS-157-LT1
20 sealant, as well as extrudable sealants, for example blends of polyolefin resins comprising primarily ethylene vinyl acetate or ethylene methyl acrylate copolymers, such as Appeel® resins, available from E.I. du Pont de Nemours and Company (Wilmington, DE). The heat-seal layer can be applied to the barrier layer of the lidding component using methods known
25 in the art including but not limited to roll coating, gravure coating, spray coating, and extrusion coating. In a peel-open package, a non-peelable adhesive tie layer is preferably used to join the nonwoven layer to the barrier layer so that the nonwoven and barrier layers are strongly bonded together, allowing the multi-layer lidding to be cleanly pulled away from the
30 blister component without delamination occurring between the nonwoven and barrier layers. Non-peelable adhesive tie layers suitable for use in lidding used in a peel-open package of the present invention include solvent-based two-component dry-bond adhesive compositions such as

polyester-based polyurethane adhesives, for example Adcote®
polyurethane-based adhesives available from Rohm & Haas (Philadelphia,
PA). In a dry-bond adhesive process, the adhesive is applied to either the
barrier layer or the nonwoven layer or both, and the two layers are bonded
5 together while the adhesive is "dry" or substantially free of solvent. If the
starting adhesive composition comprises a solvent, it is dried prior to
laminating the nonwoven layer to the barrier layer. Other adhesive
compositions which provide a non-peelable tie layer include extrudable
resins such as modified ethylene vinyl acetate, ethylene vinyl acetate, and
10 ethylene methyl acrylate based resins, for example Bynel® and Nucrel®
modified ethylene vinyl acetate and modified ethylene methyl acrylate
resins, available from E.I. du Pont de Nemours and Company (Wilmington,
DE).

In another embodiment of a blister package of the present
15 invention, the blister package is a peel off-push through package wherein
the outer nonwoven layer is adhered to a frangible barrier layer by a
peelable tie layer, and is peeled from the package to reveal the frangible
barrier layer through which the packaged material is pushed. A layer is
considered to be frangible if a packaged material can be removed by
20 rupturing the layer by applying pressure to the exterior of the blister cavity.
Peeling may occur between the nonwoven layer and the adhesive tie layer
or between the adhesive tie layer and the barrier layer. The adhesive tie
layer is preferably selected such that it remains adhered to the nonwoven
layer and peels cleanly away from the barrier layer when the package is
25 opened without tearing or otherwise rupturing the barrier layer. That is,
the adhesive tie layer preferably has a high adherence to the nonwoven
layer and a relatively lower adherence to the frangible barrier layer. If
peeling occurs between the nonwoven layer and the adhesive tie layer,
the adhesive tie layer should also be a frangible layer. For example, in a
30 peel off-push through package comprising a lidding component according
to Figure 2a, the adhesive tie layer is a peelable layer such that the
nonwoven layer can be peeled away from the barrier layer of the lidding
component, and wherein the combined barrier layer/heat-seal layer (for

peeling between the adhesive tie layer and the barrier layer) or combined adhesive tie layer/barrier layer/heat-seal layer (for peeling between the nonwoven layer and tie layer) is frangible. Examples of frangible barrier layers include metal foils (e.g. aluminum foil), frangible polymeric films (e.g. biaxially-oriented poly(chlorotrifluoroethylene) films), frangible metalized polymeric films, and frangible ceramic-coated polymeric films. The frangible layer(s) are selected such that once the nonwoven layer (or combined nonwoven/adhesive tie layer) is peeled away from the package, the pharmaceutical or other packaged material can be pushed through the frangible layer(s). The adhesive tie layer can be extruded or coated onto one or both of the nonwoven layer (e.g. Tyvek® flash spun high density polyethylene or melt-spun continuous filament polyester-based spunbond nonwoven) or frangible barrier layer and the nonwoven and barrier layer bonded together by the intermediate tie layer. Examples of suitable peelable tie layers include modified vinyl/acrylic compositions, such as JVHS-157-LT1 modified vinyl/acrylic adhesive available from Watson Rhenania (Pittsburgh, PA), or blends of polyolefin resins comprising primarily ethylene vinyl acetate or ethylene methyl acrylate copolymers, such as Appeel® polyolefin resins, available from E.I. du Pont de Nemours and Company (Wilmington, DE), and solvent-based modified acrylic pressure sensitive adhesive, such as Adcote L74X105 from Rohm & Haas (Philadelphia, PA). The heat-seal layer in a peel off-push through package is selected such that it forms a non-peelable seal between the blister component and the barrier layer in the lidding. Examples of suitable permanent (non-peelable) sealants include modified vinyl/acrylic compositions such as JVHS-157-2, or a modified polyester sealant such as GNS01-014, both available from Watson Rhenania (Pittsburgh, PA).

When a tear-open package is desired, the adhesive tie layer and heat-seal layer of Figures 2a and 2b are selected such that non-peelable bonds/seals are formed between the barrier layer and the blister component and between the nonwoven layer and the barrier layer. This allows the package to be torn cleanly at a pre-formed notch in the package

without peeling occurring between the various layers in the multi-layer lidding component.

The blister package of the present invention can be manufactured using methods known in the art. Figure 3 illustrates a process that is
5 suitable for forming a blister package of the present invention. The blister cavities 10 are generally thermoformed into a forming web in-line just prior to filling the cavities with the material 12 to be packaged. The lidding component 14 is unwound from roll 15 and brought into contact with the formed and filled blister component such that the heat-seal layer of the
10 lidding component contacts the blister component. The lidding and blister components are heat sealed, typically using a heated platen 16 with or without a pattern. Generally, some areas are not sealed to provide a starting point for peeling off the lidding or selected layers of the lidding prior to removing the product. If the lidding component is not pre-printed,
15 printing is generally done just before heat sealing (not shown). After heat-sealing, the individual blisters are generally perforated using methods known in the art (not shown) so that they can be removed at point of use. If the blister package is a tear-open package, notches are formed in the individual blisters during the perforation step. The notches are preferably
20 contained internal to the package such that they are not exposed until the individual blister is removed at point of use. The notch can also be formed on one of the external edges of the blister package, however forming the notches internal to the package decreases the likelihood that a child will be able to tear open the package. Individual blister packages 18, which
25 can comprise multiple blisters (as shown in Figure 4) or a single blister, are then cut from the continuous sheet of sealed blisters. It is important that all materials maintain dimensional stability through the blister package process due to the platen registry, the print registry and the perforation registry.

30 The improved tear resistance provided by the continuous filament or plexifilamentary nonwoven layer in the lidding component of the packages of the present invention provides peel off-push through and peel-open packages wherein the lidding or nonwoven layer peels cleanly

away from the package without tearing, whereas packages known in the art that utilize paper-film-foil laminates often do not provide a clean peel, thus making it difficult for even an adult to open the package. The present invention also reduces the number of processing steps required to
5 manufacture the lidding compared to the prior art by replacing three layers (paper-adhesive-film) with a single nonwoven layer. Although the tear resistance of the lidding component of the packages of the present invention is improved compared to prior art lidding materials, they can also be used in tear-open packages wherein the tear is initiated by a pre-
10 formed notch.

TEST METHODS

In the description above the following test methods are employed to determine various reported characteristics and properties. ASTM refers to the American Society for Testing and Materials.

15 Basis Weight is a measure of the mass per unit area of a fabric or sheet and is determined by ASTM D-3776, which is hereby incorporated by reference, and is reported in g/m².

Spencer Puncture is a measure of the ability of a substrate to resist puncture by impact. Spencer puncture is measured for nonwoven fabrics
20 and nonwoven/foil laminates using a bullet-shaped probe and is determined by ASTM D3420 (modified for 9/16 inch diameter probe) with a pendulum capacity of 5.4 Joules, which is hereby incorporated by reference. It is reported in Joules. Spencer puncture was measured for nonwoven/film laminates according to ASTM D3420 using a pointed probe
25 (modified for 9/16 inch diameter probe) with a pendulum capacity of 5.4 Joules, and is reported in units of Joules.

Tensile Strength is a measure of the force required to break the material apart by pulling. For nonwoven fabrics and nonwoven/foil laminates, tensile strength is determined according to ASTM D5035, which
30 is hereby incorporated by reference, and is reported in units of lb/in or N/cm. For nonwoven/film laminates, tensile strength was measured according to ASTM D882, which is hereby incorporated by reference, and is reported in units of psi.

Elongation is a measure of the extent a substrate with stretch before it breaks and is determined by ASTM D5035, which is hereby incorporated by reference. It is reported in %.

5 Elmendorf Tear is a measure of the force required to propagate an initiated tear from a cut or a nick. Elmendorf Tear is measured for nonwoven fabrics and nonwoven/foil laminates according to ASTM D1424, which is hereby incorporated by reference, and is reported in units of lb or N. Elmendorf Tear was measured for nonwoven/film laminates according to ASTM 1922, and is reported in units of g/mm.

10 Graves Tear is a measure of the force required to initiate a tear and is measured according to ASTM D1004, which is hereby incorporated by reference, and is reported in units of Newtons.

Moisture Vapor Transmission rate (MVTR) was measured for Example 2 using ASTM F1249, which is hereby incorporated by reference, 15 under the conditions of 38°C and 100% Relative Humidity, and is reported in units of g/m²/24 hr.

Oxygen Transmission Rate was measured for Example 2 using ASTM D3985, which is hereby incorporated by reference, at 23°C, 50%RH, and 100% oxygen, and is reported in units of cc/m²/24 hr.

20

EXAMPLE 1

This example demonstrates preparation of a blister package comprising a lidding component according to Figure 2a, wherein the nonwoven layer was a smooth-calendered full-surface bonded spunbond 25 nonwoven web and the barrier layer in the lidding was a metal foil.

A spunbond bicomponent nonwoven web was prepared in which the fibers were continuous core/sheath fibers having a poly(ethylene terephthalate) (PET) core component and a co-polyester sheath component composed of 17 mole percent modified di-methyl isophthalate 30 PET copolymer.

The thermally calendered bicomponent spunbond web was then laminated to a 0.93 mil (0.024 mm) thick soft-tempered aluminum foil obtained from Alcoa (Pittsburgh, PA) using Adcote 503 A/Cat F solvent-

based poly(ethylene terephthalate)-based polyurethane permanent adhesive tie layer obtained from Rohm & Haas (Philadelphia, PA). An Inta-Roto dry-bond coater/laminator (Model 'The Delaware') was used to perform the lamination. The Adcote 503A/Cat F was mixed at a ratio of 62 percent by weight 503A, 3.5 percent by weight CatF, and 34.5 percent by weight methyl ethyl ketone and the adhesive was applied using a reverse gravure coating process. The bicomponent spunbond web was unwound from a primary unwind and the adhesive was applied to the bicomponent spunbond web using a reverse rotating gravure roll. Alternately, the adhesive can be applied to the barrier layer. The gravure roll was engraved with a 35 line per inch (13.8 line per cm) tri-helical pattern, where a continuous triangular channel in the helical pattern circumvents the gravure roll. The machine speed was 65 ft/min (19.8 m/min). Typical line speeds used in a reverse gravure coating process are usually between about 15 m/min to 305 m/min. The adhesive was applied at a dry coating weight of about 8 g/m². An adhesive tie layer dry coating weight between about 3 g/m² and 10 g/m² is generally used, with a dry coating weight between about 4 g/m² and 8 g/m² generally being preferred. A hot air impingement dryer was used to dry the coated spunbond web to remove the solvent present in the tie layer adhesive. Air heated to a temperature of 74°C was forced through a slotted nozzle assembly onto the adhesive-coated surface of the spunbond web evaporate the solvent.

After drying, the adhesive-coated spunbond nonwoven web layer was laminated to the foil layer which was unwound from a roll and contacted with the adhesive-coated side of the spunbond web in a nip formed by two cylindrical calender rolls. One of the rolls was a rubber-covered roll and the second roll was a steel roll heated to 82°C by internal water heating. The nonwoven web contacted the heated steel roll in the nip and the aluminum foil contacted the rubber-surfaced roll. The laminated substrate was then rewound on the rewinder.

A solvent-based peelable heat seal layer was then applied to the aluminum foil side of the above-described spunbond nonwoven/aluminum foil laminate using the reverse gravure coating process described above.

The peelable heat seal composition used was a vinyl/acrylic solvent-based sealant (JVHS-157-LT1, supplied by Watson-Rhenania, Pittsburgh, PA). The heat-seal coating was applied at 5.2 g/m² to the nonwoven/foil laminate. Generally, heat seal coatings applied at a dry coating weight of
5 between about 4.8 to 5.6 g/m² are preferred. After applying the sealant, the coated material was dried using the same hot air impingement dryer described above and an air temperature of 275°F (135°C) to remove the ethyl acetate solvent. After drying the laminate was rewound on the
10 rewinder. The multi-layer laminate can be used directly as a lidding component to prepare a blister package or further processed by printing on the nonwoven surface of the laminate prior to forming a blister package. Properties of the lidding component are compared to a conventional paper-film-foil laminate that is used in the art as lidding in blister packages (CR-417, available from Hueck Foils (Wall, NJ) in Table I
15 below. The results demonstrate the significant improvement in Spencer Puncture of the lidding of the present invention compared to the prior art lidding material. The puncture resistance of the laminate prepared in Example 1 was more than three times greater than the conventional lidding material. Blister packages prepared according to the present
20 invention are expected to be much more difficult for a child to chew through than conventional blister packages.

Blister packages were prepared according to the process shown in Figure 3 using a Klockner Medipak CP-2 form-fill-seal blister packaging machine. The forming web used to form the blister component was 10 mil
25 (0.254 mm) Pentaparm M570/01 poly(vinyl chloride) film supplied by Klockner Pentaplast of America (Gordonsville, VA). The platen used to heat seal the lidding to the blister component was heated to a temperature of 180°C to obtain a peel-open package. Numerous blister packages of the present invention were peeled open and each sample peeled cleanly,
30 which represents a significant improvement compared to blister packages known in the art that utilize a paper/film/foil laminate in the lidding which are prone to tearing during peeling.

Table 1. Properties of Lidding Component for Example 1

	Example 1 (nonwoven/foil)	Conventional Lidding (paper/film/foil)
Basis Weight (g/m ²)	102.7	72.5
MD Tensile Strength (N/cm)	123.4	73.7
XD Tensile Strength (N/cm)	56.6	55.5
MD Elongation (% at 3 lbs)	0.117	0.097
XD Elongation (% at 3 lbs)	0.25	0.2
MD Elmendorf Tear (N)	1.16	1.11
XD Elmendorf Tear (N)	0.98	0.89
Spencer Puncture (J)	1.34	0.39
Thickness (mm)	0.144	0.093

EXAMPLE 2

5 This example demonstrates preparation of a lidding component comprising a flash spun plexifilamentary sheet and a metalized polyester film suitable for use in peel-open child-resistant blister packages.

 A multi-layer laminated sheet was prepared using an extrusion lamination process with an Egan Coater/Laminator. First, a permanent
10 adhesive tie layer was used to bond a layer of Tyvek® flash spun high density polyethylene sheet (Tyvek® 1073D, basis weight 74.6 g/m², available from E.I. du Pont de Nemours and Company (Wilmington, DE)) to a metalized poly(ethylene terephthalate) film (Mylar® 7100 metalized (aluminum) film having a thickness of 12 microns, available from DuPont-
15 Teijin Films). The permanent adhesive tie layer was Nucrel® 1214 ethylene methyl acrylate resin. The Nucrel® 1214 resin was extruded between the nonwoven and film substrates by extruding onto the

metalized side of the Mylar® polyester film at a thickness of 0.5 mil and subsequently contacting the extruded adhesive layer with the Tyvek® flash spun sheet. The Nucrel® copolymer was extruded using a single screw extruder (with an exit temperature of 450°F (232°C) through a feedblock with a 40 inch (101.6 cm) wide (internally deckled to 28 inches (71.1 cm)) Cloeren edge bead reduction die having 30 mil gap operated at 321°C and a backpressure of 500 psig (3447 kPa) to form a 0.5 mil thick adhesive layer. The air gap between the die exit and the nip (where the extrudate contacts the metalized film) was 6 inches (15.2 cm) and the lead-in was -0.5 inch (-1.27 cm). The line speed was 399 ft/min (122 m/min). The side of the metalized Mylar® 7100 film that contacted the Nucrel® adhesive was corona treated in-line at 3 kW prior to extruding the adhesive layer. The Tyvek® flash spun sheet was laminated to the adhesive-coated film and the assembly (Tyvek® nonwoven/permanent Nucrel® adhesive/metalized Mylar® film) was then passed over a chill roll having a matte finish and operated at 10°C.

The above assembly was then extrusion coated with a layer of peelable heat-sealable sealant on the film side of the metalized Mylar® film using the Egan Coater/Laminator. The peelable sealant used was Appeel® 20D745 ethylene methyl acrylate copolymer sealant. The film side of the metalized film was corona treated in-line at 3kW prior to coating with the sealant. The line speed was 299 ft/minute (91 m/min), the extruder exit temperature was 490°F (254°C), die width 40 in (101.6 cm) (internally deckled to 28 inches (71.1 cm)), air gap 6 inches (15.2 cm), lead in of -0.5 inch (-1.27 cm), a Teflon® fluoropolymer-coated pressure roll and a matte finish chill roll, with a nip pressure of 60 psi (414 kPa). The laminate structure can be processed on a blister packaging machine as the lidding component to form a child-resistant blister package.

The properties of the lidding material are given in Table 2 below.

30

Table 2 – Properties of Lidding Component Comprising Flash Spun Sheet and Metalized Film

Property	Example 2
Tensile Strength MD (psi)	8614
Tensile Strength XD (psi)	9120
Graves Tear Strength MD (N)	33.82
Graves Tear XD (N)	34.35
Elmendorf Tear MD (g/mm)	1990
Elmendorf Tear XD (g/mm)	2225
Spencer Puncture (J)	0.62
Oxygen Transmission Rate (cc/m ² /24 hr)	40.967
MVTR g/ m ² /24 hr	0.324

5

WHAT IS CLAIMED IS:

1. A blister package comprising a blister component having an inner surface and an outer surface and a multi-layer lidding component having an inner surface and an outer surface, wherein selected portions of the inner surfaces of the blister and lidding components are adhered together to form at least one cavity therebetween, the blister component comprising a first barrier layer selected from the group consisting of polymeric films, coated polymeric films, metal foils, and film-foil laminates, and the lidding component comprising a second barrier layer and a nonwoven layer comprising at least one melt-spun continuous filament nonwoven sheet.

2. A blister package according to claim 1 wherein the second barrier layer comprises a sheet layer selected from the group consisting of polymeric films, coated polymeric films, metalized polymeric films, and metal foils.

3. A blister package according to claim 2 wherein the lidding component further comprises an adhesive tie layer intermediate the second barrier layer and the nonwoven layer, and a heat-seal layer adhered to the side of the second barrier layer opposite the adhesive tie layer, such that the inner surface of the lidding component comprises the heat-seal layer and the outer surface of the lidding component comprises the nonwoven layer, and wherein the lidding and blister components are heat sealed to each other to form a seal therebetween.

4. A blister package according to claim 3 wherein the heat-seal layer comprises a heat-sealable sealant selected from the group consisting of poly(vinylidene chloride), vinyl/acrylic compositions, blends of polyolefin resins comprising ethylene vinyl acetate copolymers, blends of polyolefin resins comprising ethylene methyl acrylate copolymers, and polyester-based compositions.

5. A blister package according to claim 3 wherein the tie-layer comprises an adhesive composition selected from the group consisting of vinyl/acrylic compositions, blends of polyolefin resins comprising ethylene vinyl acetate copolymers, blends of polyolefin resins comprising ethylene

methyl acrylate copolymers, ethylene vinyl acetate resins, ethylene methyl acrylate resins, and polyester-based polyurethanes.

6. A blister package according to claim 3 wherein the seal between the heat-seal layer and the blister component is peelable such that the blister package can be opened by peeling the lidding component from the blister component.

7. A blister package according to claim 6 wherein the heat-seal layer comprises a sealant selected from the group consisting of poly(vinylidene chloride), vinyl/acrylic compositions, blends of polyolefin resins comprising ethylene vinyl acetate copolymers, and blends of polyolefin resins comprising ethylene methyl acrylate copolymers.

8. A blister package according to claim 3 wherein the second barrier layer is frangible.

9. A blister package according to claim 8 wherein the adhesive tie layer is a peelable layer such that the combined nonwoven and adhesive tie layers can be peeled away from the second barrier layer and a material packaged in the blister package can be removed from the package after said peeling by pushing the packaged material through the frangible barrier layer.

10. A blister package according to claim 9 wherein the adhesive tie layer comprises an adhesive composition selected from the group consisting of vinyl/acrylic compositions, blends of polyolefin resins comprising ethylene vinyl acetate copolymers, and blends of polyolefin resins comprising ethylene methyl acrylate copolymers.

11. A blister package according to claim 9 wherein the second barrier layer comprises a frangible sheet layer selected from the group consisting of frangible polymeric films and frangible metal foils.

12. A blister package according to claim 3 wherein the second barrier layer comprises a metalized polymeric film that is metalized on one side thereof, and wherein the metalized side of the second barrier layer is adjacent the adhesive tie layer.

13. A blister package according to claim 3 wherein the second barrier layer comprises a polymeric film that is coated on one side thereof

with a ceramic material, and wherein the coated side of the second barrier layer is adjacent the adhesive tie layer.

14. A blister package according to claim 12 wherein the metalized polymeric film comprises a metalized polyester film.

5 15. A blister package according to claim 14 wherein the metalized polyester film is a poly(ethylene terephthalate) film having a layer of aluminum metal deposited thereon.

10 16. A blister package according to claims 1, 9 or 14 wherein the nonwoven layer comprises a full-surface bonded multiple component spunbond web.

17. A blister package according to claim 13 wherein the ceramic material is selected from the group consisting of oxides, nitrides, and carbides of silicon, aluminum, magnesium, chromium, lanthanum, titanium, boron, or zirconium, and mixtures thereof.

15 18. A blister package according to claims 1 or 2 wherein the nonwoven layer comprises at least one meltblown web sandwiched between first and second melt-spun continuous filament nonwoven sheets.

20 19. A blister package according to claim 18 wherein the first and second melt-spun continuous filament nonwoven sheets are multiple component spunbond nonwoven webs.

20. A blister package according to claim 19 wherein the at least one meltblown web is a multiple component meltblown web.

25 21. A blister package according to claim 20 wherein the first and second spunbond nonwoven webs comprise bicomponent sheath-core spunbond fibers wherein the melting point of the sheath component is lower than the melting point of the core component by at least 10°C, and the at least one meltblown web comprises bicomponent side-by-side meltblown fibers.

30 22. A blister package according to claim 18 wherein the nonwoven layer comprises a plurality of meltblown webs sandwiched between the first and second melt-spun continuous filament nonwoven sheets.

23. A blister package according to claim 19 wherein the nonwoven layer is a thermally calendered nonwoven layer.

24. A blister package according to claim 23 wherein the nonwoven layer is a full-surface bonded nonwoven layer.

25. A blister package according to claim 24 wherein the first and second multiple component spunbond nonwoven webs comprise sheath-core spunbond fibers wherein the core component comprises a polyester and the sheath component comprises a polyester copolymer.

26. A blister package according to claims 1 or 2 wherein the at least one melt-spun continuous filament nonwoven sheet comprises a spunbond nonwoven web.

10 27. A blister package according to claim 26 wherein the spunbond nonwoven web is a multiple component spunbond nonwoven web.

28. A blister package according to claim 27 wherein the multiple component spunbond nonwoven web comprises bicomponent spunbond fibers comprising a sheath component and a core component, wherein the melting point of the sheath component is lower than the melting point of the core component by at least 10°C.

29. A blister package according to claim 28 wherein the core component comprises a polyester and the sheath component comprises a polyester copolymer.

20 30. A blister package according to claim 29 wherein the core component comprises poly(ethylene terephthalate) and the polyester copolymer is selected from the group consisting of poly(ethylene terephthalate) copolymers that have been modified with 1,4-cyclohexanedimethanol and poly(ethylene terephthalate) copolymers that have been modified with di-methyl isophthalic acid.

31. A blister package according to any of claims 27 - 30 wherein the multiple component spunbond nonwoven web is a thermally calendered multiple component spunbond nonwoven web.

32. A blister package according to claim 31 wherein the thermally calendered multiple component spunbond nonwoven web is a full-surface bonded spunbond nonwoven web.

33. A blister package according to claim 1 wherein the second barrier layer is a heat-sealable barrier layer adhered to the nonwoven

layer, the inner surface of the lidding component comprises the heat-sealable barrier layer, and the lidding and blister components are heat sealed together to form a seal therebetween.

5 34. A blister package according to claim 33 wherein the seal is a peelable seal such that the blister package can be opened by peeling the lidding component from the blister component.

35. A blister package according to claim 33 where in the seal is a non-peelable seal and the blister package further comprises at least one notch located internal to the package or on an external edge of the
10 package.

36. A blister package according to claim 34 or 35 wherein the heat-sealable barrier layer comprises poly(vinylidene chloride).

37. A blister package according to claim 34 or 35 wherein the at least one melt-spun continuous filament nonwoven sheet comprises a full-
15 surface bonded multiple component spunbond nonwoven web.

38. A blister package comprising a blister component having an inner surface and an outer surface and a multi-layer lidding component having an inner surface and an outer surface, wherein selected portions of the inner surfaces of the blister and lidding components are bonded
20 together to form at least one cavity therebetween, the blister component comprising a first barrier layer selected from the group consisting of polymeric films, coated polymeric films, metal foils, and film-foil laminates, and the lidding component comprising a flash spun plexifilamentary sheet and a second barrier layer comprising a sheet layer selected from the
25 group consisting of polymeric films, coated polymeric films, and metalized polymeric films.

39. A blister package according to claim 38 wherein the lidding component further comprises an adhesive tie layer intermediate the second barrier layer and the flash spun plexifilamentary sheet, and a heat-
30 seal layer adhered to the side of the second barrier layer opposite the adhesive tie layer, such that the inner surface of the lidding component comprises the heat-seal layer and the outer surface of the lidding component comprises the flash spun plexifilamentary sheet, and wherein

the lidding and blister components are heat sealed to each other to form a seal therebetween.

40. A blister package according to claim 39 wherein the heat-seal layer comprises a heat-sealable sealant selected from the group
5 consisting of poly(vinylidene chloride), vinyl/acrylic compositions, blends of polyolefins comprising ethylene vinyl acetate copolymers, blends of polyolefin resins comprising ethylene methyl acrylate copolymers, and polyester-based compositions.

41. A blister package according to claim 39 wherein the tie-layer
10 comprises an adhesive composition selected from the group consisting of vinyl/acrylic compositions, blends of polyolefin resins comprising ethylene vinyl acetate copolymers, blends of polyolefin resins comprising ethylene methyl acrylate copolymers, modified ethylene vinyl acetate resins, ethylene vinyl acetate resins, ethylene methyl acrylate resins, and
15 polyester-based polyurethanes.

42. A blister package according to claim 39 wherein the seal between the heat-seal layer and the blister component is peelable such that the blister package can be opened by peeling the lidding component from the blister component.

20 43. A blister package according to claim 41 wherein the heat-seal layer comprises a heat-sealable sealant selected from the group consisting of poly(vinylidene chloride), vinyl/acrylic compositions, blends of polyolefin resins comprising ethylene vinyl acetate copolymers, and blends of polyolefin resins comprising ethylene methyl acrylate copolymers.

25 44. A blister package according to claim 39 wherein the second barrier layer is frangible.

45. A blister package according to claim 44 wherein the adhesive tie layer is a peelable layer such that the combined flash spun plexifilamentary sheet and adhesive tie layer can be peeled away from the
30 second barrier layer and a material packaged in the blister package can be removed from the package after said peeling by pushing the packaged material through the frangible barrier layer.

46. A blister package according to claim 45 wherein the adhesive tie layer comprises an adhesive composition selected from the group consisting of vinyl/acrylic compositions, blends of polyolefin resins comprising ethylene vinyl acetate copolymers, and blends of polyolefin
5 resins comprising ethylene methyl acrylate copolymers.

47. A blister package according to claim 45 wherein the second barrier layer comprises a metalized polymeric film that is metalized on one side thereof, and wherein the metalized side of the second barrier layer is adjacent the adhesive tie layer.

10 48. A blister package according to claim 45 wherein the second barrier layer comprises a polymeric film that is coated on one side thereof with a ceramic material, and wherein the coated side of the second barrier layer is adjacent the adhesive tie layer.

49. A blister package according to claim 47 wherein the metalized
15 polymeric film comprises a metalized biaxially-oriented film.

50. A blister package according to claim 38 wherein the second barrier layer is heat sealable and is adhered to the flash spun plexifilamentary sheet, the inner surface of the lidding component comprises the heat-sealable barrier layer, and the lidding and blister
20 components are heat sealed together to form a seal therebetween.

51. A blister package according to claim 50 wherein seal is a peelable seal such that the blister package can be opened by peeling the lidding component from the blister component.

52. A blister package according to claim 50 wherein the seal is a
25 non-peelable seal and the blister package further comprises at least one notch located internal to the package or on an external edge of the package.

53. A blister package according to claim 51 or 52 wherein the heat-sealable barrier layer comprises poly(vinylidene chloride).

30 54. A blister package according to claim 38 or 39 wherein the flash spun plexifilamentary sheet is formed from at least one polymer selected from the group consisting of polyethylene, polypropylene, and poly(ethylene terephthalate).

55. A blister package according to claim 54 wherein the second barrier layer comprises a sheet layer selected from the group consisting of polyester films and polyester films having a coating of aluminum metal deposited on at least one side thereof.

5 56. A blister package according to claim 55 wherein the second barrier layer comprises a polyester film comprising poly(ethylene terephthalate).

57. A blister package according to claim 1 wherein the nonwoven layer has a Spencer Puncture measured according to ASTM D3420 with a
10 9/16 inch diameter probe and a pendulum capacity of 5.4 Joules of at least 0.98 Joules, a tensile strength measured according to ASTM D5035 in both the machine direction and cross-direction of at least 35 N/cm, an elongation measured according to ASTM D5035 in both the machine direction and cross-direction of at least 15%, and an Elmendorf Tear
15 measured according to ASTM D1424 in both the machine direction and the cross-direction of at least 0.33 N.

58. A blister package according to claim 57 wherein the nonwoven layer has a Spencer Puncture of at least 1.97 Joules, a tensile strength in both the machine and cross-direction of at least 43.8 N/cm, an elongation
20 in both the machine direction and cross-direction of at least 20%, and an Elmendorf Tear of at least 0.89 N.

59. A blister package according to claim 57 or 58 wherein the nonwoven layer is a bicomponent spunbond web.

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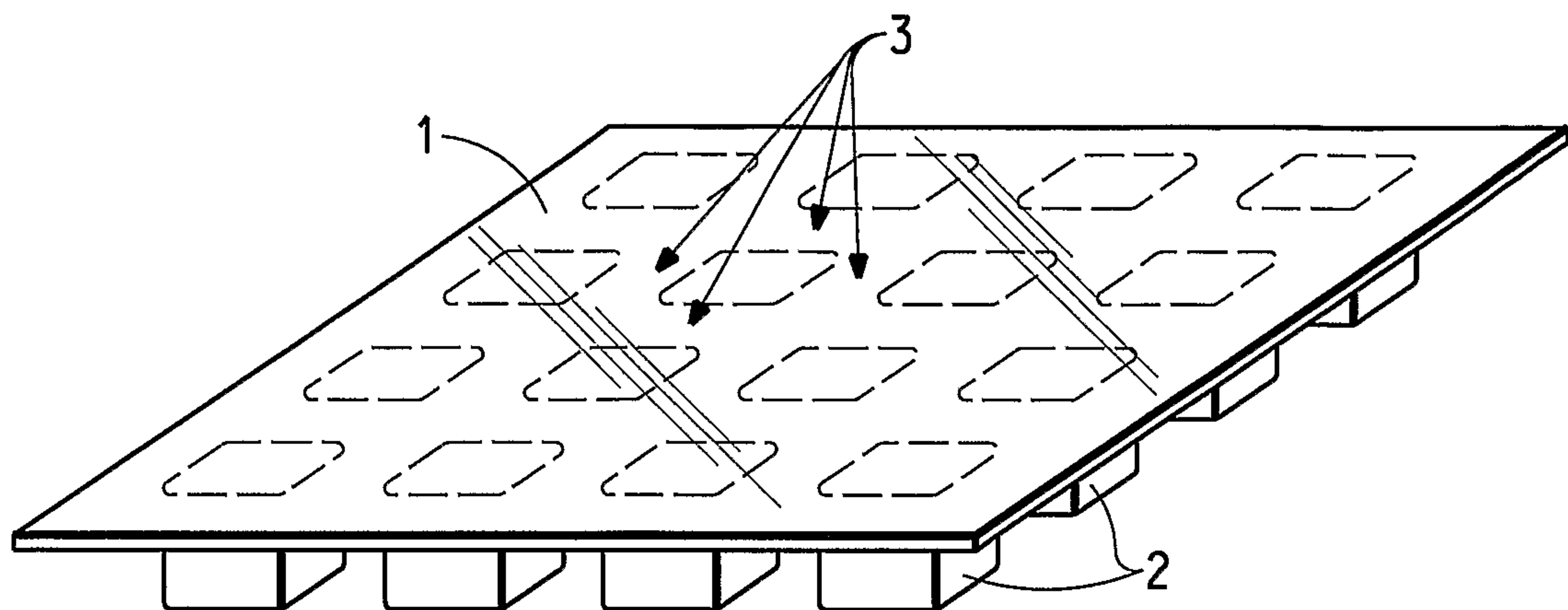


FIG. 1

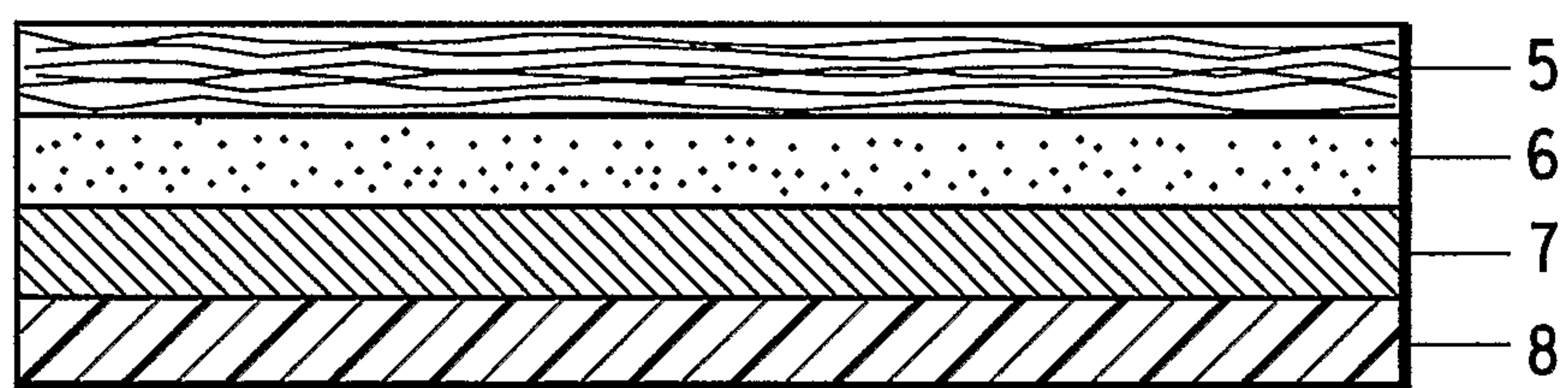


FIG. 2A



FIG. 2B

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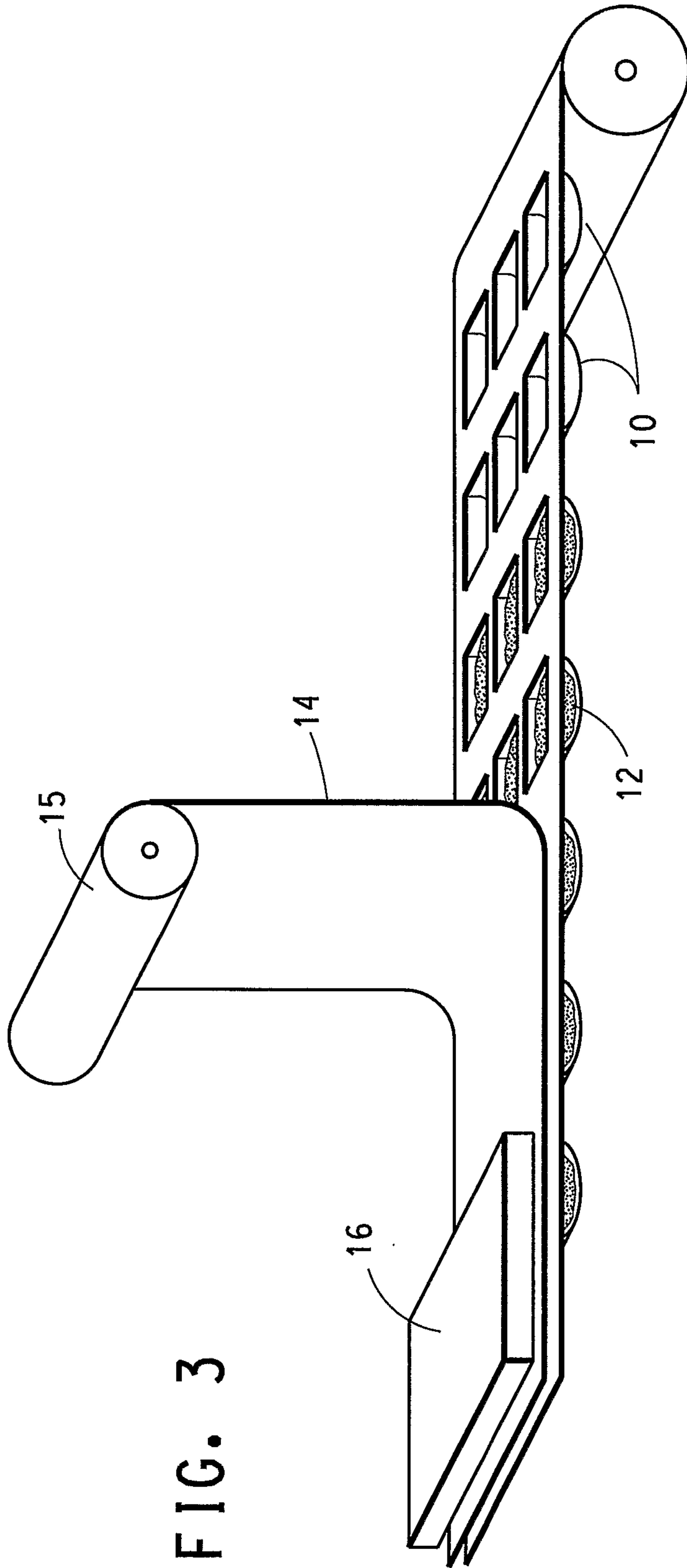


FIG. 3



FIG. 4

