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(71) Applicant: THE PROCTER & GAMBLE COMPANY [US/US]; One Procter & Gamble Plaza, Cincinnati, OH 45202 (US).

(72) Inventors: **BERG, Charles, John, Jr.**; 208 Hillcrest Drive, Wyoming, OH 45215 (US). **LODGE, Richard, Worthington**; 11978 Stonequarry Ct., Cincinnati, OH 45251 (US). **COOPER, John, Thomas**; 7333 Tarragon Ct., West Chester, OH 45069 (US). **JACKSON, Beverly, Julian**; 167 East Fairway Drive, Hamilton, OH 45013 (US). **HUPP, Matthew, Todd**; 11624 Timber Ridge Ln., Apt. #3, Sharonville, OH 45241 (US). **MEYER, Eric, Walter**; 27 Worthington Avenue, Wyoming, OH 45215 (US). **BAGGOTT, Steven, John**; 5140 Catalpa Creek Drive, Blue Ash, OH 45242 (US). **ANDES, William, Scott**; 3585 Miller Rd., Springfield, OH 45502 (US).

(74) Agents: **REED, T., David** et al.; The Procter & Gamble Company, 5299 Spring Grove Avenue, Cincinnati, OH 45217-1087 (US).

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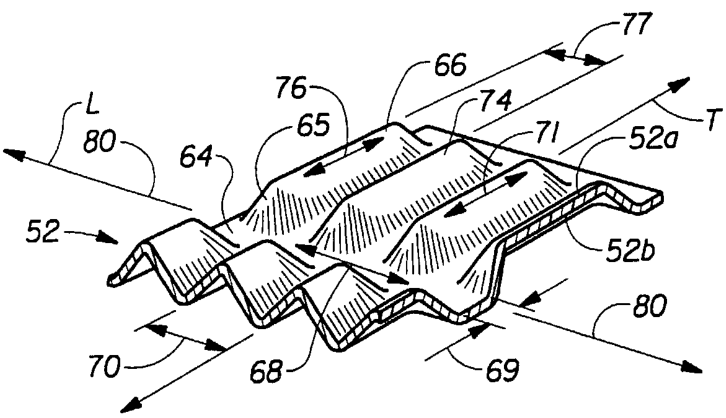
(54) **Title:** STRETCHABLE, CONFORMABLE PROTECTIVE COVERS



(57) **Abstract:** The present invention provides a flexible cover (10) comprising at least one sheet of flexible sheet material assembled to form a semi-enclosed container having a periphery. The cover (10) is expandable in response to forces exerted by an article, item, or material over which the cover is placed to provide an increase in volume of the cover such that the cover accommodates the articles, items, or material placed therein.

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STRETCHABLE, CONFORMABLE PROTECTIVE COVERS

FIELD OF THE INVENTION

The present invention relates to flexible covers of the type commonly utilized for the protection of various articles, items, and/or materials.

BACKGROUND OF THE INVENTION

Flexible covers, particularly those made of comparatively inexpensive polymeric materials, have been widely employed for the protection of various articles, items, and/or materials. Covers may be utilized to "cover" or shield articles, items, and/or materials partially or completely, by themselves or in combination with other covers or opposing surfaces.

As utilized herein, the term "flexible" is utilized to refer to materials which are capable of being flexed or bent, especially repeatedly, such that they are pliant and yieldable in response to externally applied forces. Accordingly, "flexible" is substantially opposite in meaning to the terms inflexible, rigid, or unyielding. Materials and structures which are flexible, therefore, may be altered in shape and structure to accommodate external forces and to conform to the shape of objects brought into contact with them without losing their integrity. Flexible covers of the type commonly available are typically formed from materials having consistent physical properties throughout the cover structure, such as stretch, tensile, and/or elongation properties.

With such flexible covers, it is frequently difficult to provide covers which precisely accommodate the dimensions and volume of the article to be placed therein. Incomplete coverage inevitably leaves part of the article or item unprotected from the elements. As a general proposition, where the precise dimensions are not known beforehand and/or where it is desired to have a given cover fit more than one type or size of article, the covers are typically fabricated to larger dimensions than the foreseeable need to ensure that the article or item can be fully covered. Another issue frequently encountered is that covers which fit the article loosely may be subject to slippage or wind effects which could cause the cover to shift upon the article and/or leave the article completely.

Accordingly, it would be desirable to provide a flexible cover which is capable of closely conforming to the volume and/or dimensions of the articles, items, and/or materials to be protected.

SUMMARY OF THE INVENTION

The present invention provides a flexible cover comprising at least one sheet of flexible sheet material assembled to form a semi-enclosed container having a periphery. The cover is expandable in response to forces exerted by an article, item, or material over which the cover is placed to provide an increase in volume of the cover such that the cover accommodates the articles, items, or material placed therein.

BRIEF DESCRIPTION OF THE DRAWINGS

While the specification concludes with claims particularly pointing out and distinctly claiming the present invention, it is believed that the present invention will be better understood from the following description in conjunction with the accompanying Drawing Figures, in which like reference numerals identify like elements, and wherein:

Figure 1 is a plan view of a representative flexible cover in accordance with the present invention;

Figure 2A is a segmented, perspective illustration of the polymeric film material of flexible covers of the present invention in a substantially untensioned condition;

Figure 2B is a segmented, perspective illustration of the polymeric film material of flexible covers according to the present invention in a partially-tensioned condition;

Figure 2C is a segmented, perspective illustration of the polymeric film material of flexible covers according to the present invention in a greater-tensioned condition;

Figure 3 is a plan view illustration of another embodiment of a sheet material useful in the present invention; and

Figure 4 is a plan view illustration of a polymeric web material of Figure 3 in a partially-tensioned condition similar to the depiction of Figure 2B.

DETAILED DESCRIPTION OF THE INVENTION

FLEXIBLE BAG CONSTRUCTION:

Figure 1 depicts a presently preferred embodiment of a flexible cover 10 according to the present invention. In the embodiment depicted in Figure 1, the flexible cover 10 includes a cover body 20 formed from a piece of flexible sheet material having an edge 30. Cover 10 is suitable for containing and protecting a wide variety of articles, items, and/or materials, and may be initially planar or pre-formed to the general two- or three-dimensional shape of the intended article, item, or material to be covered.

Depending upon the desired application and articles, items, and/or materials to be protected, the cover 10 may include a closure to form a fully-enclosed covering or may include an elasticized edge to engage an edge of the article. Attachment means such as VELCRO® interlocking mechanical fasteners, activatible, protected, or exposed adhesive systems, grommets, laces, fobs, or the like may also be included to secure the cover to or around the article by external means.

Figure 1 shows a plurality of regions extending across the cover surface. Regions 40 comprise rows of deeply-embossed deformations in the flexible sheet material of the cover body 20, while regions 50 comprise intervening undeformed regions.

In accordance with the present invention, the body portion 20 of the flexible cover 10 comprises a flexible sheet material having the ability to elastically elongate to accommodate the forces exerted outwardly by the article, items, and/or materials to be protected in combination with the ability to impart additional resistance to elongation before the tensile limits of the material are reached. This combination of properties permits the cover to readily initially expand in response to outward forces exerted by the protected articles, items, and/or materials by controlled elongation in respective directions. These elongation properties increase the internal volume of the cover by expanding the length of the cover material. The cover therefore exhibits the ability to accommodate the size, shape, and geometry of an article, item, or material to be covered by expanding where necessary and to the extent necessary to conform to the geometry and surface topography of the article, item, or material to be covered.

Additionally, while it is presently preferred to construct substantially the entire cover body from a sheet material having the structure and characteristics of the present invention, it may be desirable under certain circumstances to provide such materials in only one or more portions or zones of the cover body rather than its entirety. For example, a band of such material having the desired stretch orientation could be provided forming a complete circular band around the cover body to provide a more localized stretch property.

Product applications for the covers of the present invention include, for example: covers for motor vehicles such as automobiles, trucks, watercraft, aircraft, farm equipment, and rail equipment; bicycle covers; covers for outdoor cooking appliances such as gas or charcoal grills; indoor and outdoor furniture; personal protective garments, including barber shop drapes; bandages; painting covers and drapes; sanitary or sterile items such as dental and surgical tools; tablecloths; infant seat covers; examination table covers; automobile windshield covers; bicycle and motorcycle seat covers; umbrella covers; light covers; toilet seat covers; airplane seat covers; covers for damage prone motor vehicle components in-transit; beverage container insulating covers; firewood or lumber coverings; etc. In the limiting sense, the sheet material may have sufficient stretch or elongation properties to form a deeply drawn cover of suitable size from an initially flat sheet of material rather than forming a cover by folding and sealing operations.

REPRESENTATIVE MATERIALS:

To better illustrate the structural features and performance advantages of flexible covers according to the present invention, Figure 2A provides a greatly-enlarged partial perspective view of a segment of sheet material 52 suitable for forming the cover body 20 as depicted in Figure 1. Materials such as those illustrated and described herein as suitable for use in accordance with the present invention, as well as methods for making and characterizing same, are described in greater detail in commonly-assigned U.S. Patent No. 5,518,801, issued to Chappell, et al. on May 21, 1996, the disclosure of which is hereby incorporated herein by reference.

Referring now to Figure 2A, sheet material 52 includes a "strainable network" of distinct regions. As used herein, the term "strainable network" refers to an interconnected and interrelated group of regions which are able to be extended to some useful degree in a predetermined direction providing the sheet material with an elastic-like behavior in response to an applied and subsequently released elongation. The strainable network includes at least a first region 64 and a second region 66. Sheet material 52 includes a transitional region 65 which is at the interface between the first region 64 and the second region 66. The transitional region 65 will exhibit complex combinations of the behavior of both the first region and the second region. It is recognized that every embodiment of such sheet materials suitable for use in accordance with the present invention will have a transitional region; however, such materials are defined by the behavior of the sheet material in the first region 64 and the second region 66. Therefore, the ensuing description will be concerned with the behavior of the sheet material in the first regions and the second regions only since it is not dependent upon the complex behavior of the sheet material in the transitional regions 65.

Sheet material 52 has a first surface 52a and an opposing second surface 52b. In the preferred embodiment shown in Figure 2A, the strainable network includes a plurality of first regions 64 and a plurality of second regions 66. The first regions 64 have a first axis 68 and a second axis 69, wherein the first axis 68 is preferably longer than the second axis 69. The first axis 68 of the first region 64 is substantially parallel to the longitudinal axis "L" of the sheet material 52 while the second axis 69 is substantially parallel to the transverse axis "T" of the sheet material 52. Preferably, the second axis of the first region, the width of the first region, is from about 0.01 inches to about 0.5 inches, and more preferably from about 0.03 inches to about 0.25 inches. The second regions 66 have a first axis 70 and a second axis 71. The first axis 70 is substantially parallel to the longitudinal axis of the sheet material 52, while the second axis 71 is substantially parallel to the transverse axis of the sheet material 52. Preferably, the second axis of the second region, the width of the second region, is from about 0.01 inches to about 2.0 inches, and more preferably from about 0.125 inches to about 1.0 inches. In the preferred embodiment of Figure 2A, the first regions 64 and the second regions 66 are substantially linear, extending continuously in a direction substantially parallel to the longitudinal axis of the sheet material 52.

The first region 64 has an elastic modulus E1 and a cross-sectional area A1. The second region 66 has a modulus E2 and a cross-sectional area A2.

In the illustrated embodiment, the sheet material 52 has been "formed" such that the sheet material 52 exhibits a resistive force along an axis, which in the case of the illustrated embodiment is substantially parallel to the longitudinal axis of the web, when subjected to an applied axial elongation in a direction substantially parallel to the longitudinal axis. As used herein, the term "formed" refers to the creation of a desired structure or geometry upon a sheet material that will substantially retain the desired structure or geometry when it is not subjected to any externally applied elongations or forces. A sheet material of the present invention is comprised of at least a first region and a second region, wherein the first region is visually distinct from the second region. As used herein, the term "visually distinct" refers to features of the sheet material which are readily discernible to the normal naked eye when the sheet material or objects embodying the sheet material are subjected to normal use. As used herein the term "surface-pathlength" refers to a measurement along the topographic surface of the region in question in a direction substantially parallel to an axis. The method for determining the surface-pathlength of the respective regions can be found in the Test Methods section of the above-referenced and above-incorporated Chappell et al. patent.

Methods for forming such sheet materials useful in the present invention include, but are not limited to, embossing by mating plates or rolls, thermoforming, high pressure hydraulic forming, or casting. While the entire portion of the web 52 has been subjected to a forming operation, the present invention may also be practiced by subjecting to formation only a portion thereof, e.g., a portion of the material comprising the bag body 20, as will be described in detail below.

In the preferred embodiment shown in Figure 2A, the first regions 64 are substantially planar. That is, the material within the first region 64 is in substantially the same condition before and after the formation step undergone by web 52. The second regions 66 include a plurality of raised rib-like elements 74. The rib-like elements may be embossed, debossed or a combination thereof. The rib-like elements 74 have a first or major axis 76 which is substantially parallel to the transverse axis of the web 52 and a second or minor axis 77 which is substantially parallel to the longitudinal axis of the web 52. The length parallel to the first axis 76 of the rib-like elements 74 is at least equal to, and preferably longer than the length parallel to the second axis 77. Preferably, the ratio of the first axis 76 to the second axis 77 is at least about 1:1 or greater, and more preferably at least about 2:1 or greater.

The rib-like elements 74 in the second region 66 may be separated from one another by unformed areas. Preferably, the rib-like elements 74 are adjacent one another and are separated by an unformed area of less than 0.10 inches as measured perpendicular to the major axis 76 of the rib-like elements 74, and more preferably, the rib-like elements 74 are contiguous having essentially no unformed areas between them.

The first region 64 and the second region 66 each have a "projected pathlength". As used herein the term "projected pathlength" refers to the length of a shadow of a region that would be thrown by parallel light. The projected pathlength of the first region 64 and the projected pathlength of the second region 66 are equal to one another.

The first region 64 has a surface-pathlength, L1, less than the surface-pathlength, L2, of the second region 66 as measured topographically in a direction parallel to the longitudinal axis of the web 52 while the web is in an untensioned condition. Preferably, the surface-pathlength of the second region 66 is at least about 15% greater than that of the first region 64, more preferably at least about 30% greater than that of the first region, and most preferably at least about 70% greater than that of the first region. In general, the greater the surface-pathlength of the second region, the greater will be the elongation of the web before encountering the force wall. Suitable techniques for measuring the surface-pathlength of such materials are described in the above-referenced and above-incorporated Chappell et al. patent.

Sheet material 52 exhibits a modified "Poisson lateral contraction effect" substantially less than that of an otherwise identical base web of similar material composition. The method for determining the Poisson lateral contraction effect of a material can be found in the Test Methods section of the above-referenced and above-incorporated Chappell et al. patent. Preferably, the Poisson lateral contraction effect of webs suitable for use in the present invention is less than about 0.4 when the web is subjected to about 20% elongation. Preferably, the webs exhibit a Poisson lateral contraction effect less than about 0.4 when the web is subjected to about 40, 50 or even 60% elongation. More preferably, the Poisson lateral contraction effect is less than about 0.3 when the web is subjected to 20, 40, 50 or 60% elongation. The Poisson lateral contraction effect of such webs is determined by the amount of the web material which is occupied by the first and second regions, respectively. As the area of the sheet material occupied by the first region increases the Poisson lateral contraction effect also increases. Conversely, as the area of the sheet material occupied by the second region increases the Poisson lateral contraction effect decreases. Preferably, the percent area of the sheet material occupied by the first area is from about 2% to about 90%, and more preferably from about 5% to about 50%.

Sheet materials of the prior art which have at least one layer of an elastomeric material will generally have a large Poisson lateral contraction effect, i.e., they will "neck down" as they elongate in response to an applied force. Web materials useful in accordance with the present invention can be designed to moderate if not substantially eliminate the Poisson lateral contraction effect.

For sheet material 52, the direction of applied axial elongation, D, indicated by arrows 80 in Figure 2A, is substantially perpendicular to the first axis 76 of the rib-like elements 74. The rib-like elements 74 are able to unbend or geometrically deform in a direction substantially perpendicular to their first axis 76 to allow extension in web 52.

Referring now to Figure 2B, as web of sheet material 52 is subjected to an applied axial elongation, D, indicated by arrows 80 in Figure 2B, the first region 64 having the shorter surface-pathlength, L1, provides most of the initial resistive force, P1, as a result of molecular-level deformation, to the applied elongation. In this stage, the rib-like elements 74 in the second region 66 are experiencing geometric deformation, or unbending and offer minimal resistance to the applied elongation. In transition to the next stage, the rib-like elements 74 are becoming aligned with (i.e., coplanar with) the applied elongation. That is, the second region is exhibiting a change from geometric deformation to molecular-level deformation. This is the onset of the force wall. In the stage seen in Figure 2C, the rib-like elements 74 in the second region 66 have become substantially aligned with (i.e., coplanar with) the plane of applied elongation (i.e. the second region has reached its limit of geometric deformation) and begin to resist further elongation via molecular-level deformation. The second region 66 now contributes, as a result of molecular-level deformation, a second resistive force, P2, to further applied elongation. The resistive forces to elongation provided by both the molecular-level deformation of the first region 64 and the molecular-level deformation of the second region 66 provide a total resistive force, PT, which is greater than the resistive force which is provided by the molecular-level deformation of the first region 64 and the geometric deformation of the second region 66.

The resistive force P1 is substantially greater than the resistive force P2 when (L1 + D) is less than L2. When (L1 + D) is less than L2 the first region provides the initial resistive force P1, generally satisfying the equation:

$$P1 = \frac{(A1 \times E1 \times D)}{L1}$$

When (L1 + D) is greater than L2 the first and second regions provide a combined total resistive force PT to the applied elongation, D, generally satisfying the equation:

$$PT = \frac{(A1 \times E1 \times D)}{L1} + \frac{(A2 \times E2 \times |L1 + D - L2|)}{L2}$$

The maximum elongation occurring while in the stage corresponding to Figures 2A and 2B, before reaching the stage depicted in Figure 2C, is the "available stretch" of the formed web material. The available stretch corresponds to the distance over which the second region experiences geometric deformation. The range of available stretch can be varied from about 10% to 100% or more, and can be largely controlled by the extent to which the surface-pathlength L2 in the second region exceeds the surface-pathlength L1 in the first region and the composition of the base film. The term available stretch is not intended to imply a limit to the elongation which the web of the present invention may be subjected to as there are applications where elongation beyond the available stretch is desirable.

When the sheet material is subjected to an applied elongation, the sheet material exhibits an elastic-like behavior as it extends in the direction of applied elongation and returns to its substantially untensioned condition once the applied elongation is removed, unless the sheet material is extended beyond the point of yielding. The sheet material is able to undergo multiple cycles of applied elongation without losing its ability to substantially recover. Accordingly, the web is able to return to its substantially untensioned condition once the applied elongation is removed.

While the sheet material may be easily and reversibly extended in the direction of applied axial elongation, in a direction substantially perpendicular to the first axis of the rib-like elements, the web material is not as easily extended in a direction substantially parallel to the first axis of the rib-like elements. The formation of the rib-like elements allows the rib-like elements to geometrically deform in a direction substantially perpendicular to the first or major axis of the rib-like elements, while requiring substantially molecular-level deformation to extend in a direction substantially parallel to the first axis of the rib-like elements.

The amount of applied force required to extend the web is dependent upon the composition and cross-sectional area of the sheet material and the width and spacing of the first regions, with narrower and more widely spaced first regions requiring lower applied extensional forces to achieve the desired elongation for a given composition and cross-sectional area. The first axis, (i.e., the length) of the first regions is preferably greater than the second axis, (i.e., the width) of the first regions with a preferred length to width ratio of from about 5:1 or greater.

The depth and frequency of rib-like elements can also be varied to control the available stretch of a web of sheet material suitable for use in accordance with the present invention. The available stretch is increased if for a given frequency of rib-like elements, the height or degree of formation imparted on the rib-like elements is increased. Similarly, the available stretch is increased if for a given height or degree of formation, the frequency of the rib-like elements is increased.

There are several functional properties that can be controlled through the application of such materials to flexible covers of the present invention. The functional properties are the resistive force exerted by the sheet material against an applied elongation and the available stretch of the sheet material before the force wall is encountered. The resistive force that is exerted by the sheet material against an applied elongation is a function of the material (e.g., composition, molecular structure and orientation, etc.) and cross-sectional area and the percent of the projected surface area of the sheet material that is occupied by the first region. The higher the percent area coverage of the sheet material by the first region, the higher the resistive force that the web will exert against an applied elongation for a given material composition and cross-sectional area. The percent coverage of the sheet material by the first region is determined in part, if not wholly, by the widths of the first regions and the spacing between adjacent first regions.

The available stretch of the web material is determined by the surface-pathlength of the second region. The surface-pathlength of the second region is determined at least in part by the rib-like element spacing, rib-like element frequency and depth of formation of the rib-like elements as measured perpendicular to the plane of the web material. In general, the greater the surface-pathlength of the second region the greater the available stretch of the web material.

As discussed above with regard to Figures 2A-2C, the sheet material 52 initially exhibits a certain resistance to elongation provided by the first region 64 while the rib-like elements 74 of the second region 66 undergo geometric motion. As the rib-like elements transition into the plane of the first regions of the material, an increased resistance to elongation is exhibited as the entire sheet material then undergoes molecular-level deformation. Accordingly, sheet materials of the type depicted in Figures 2A-2C and described in the above-referenced and above-incorporated Chappell et al. patent provide the performance advantages of the present invention when formed into covers of the present invention.

An additional benefit realized by the utilization of the aforementioned sheet materials in constructing flexible covers according to the present invention is the increase in visual and tactile appeal of such materials. Polymeric films commonly utilized to form such flexible covers are typically comparatively thin in nature and frequently have a smooth, shiny surface finish. While some manufacturers utilize a small degree of embossing or other texturing of the film surface, covers made of such materials still tend to exhibit a slippery and flimsy tactile impression. Thin materials coupled with substantially two-dimensional surface geometry also tend to leave the consumer with an exaggerated impression of the thinness, and perceived lack of durability, of such flexible polymeric covers.

In contrast, sheet materials useful in accordance with the present invention such as those depicted in Figures 2A-2C exhibit a three-dimensional cross-sectional profile wherein the sheet material is (in an un-tensioned condition) deformed out of the predominant plane of the sheet material. This provides additional surface area for gripping and dissipates the glare normally associated with substantially planar, smooth surfaces. The three-dimensional rib-like elements also provide a "cushiony" tactile impression when the cover is gripped in one's hand, also contributing to a desirable tactile impression versus conventional cover materials and providing an enhanced perception of thickness and durability. The additional texture also reduces noise associated with certain types of film materials, leading to an enhanced aural impression.

Suitable mechanical methods of forming the base material into a web of sheet material suitable for use in the present invention are well known in the art and are disclosed in the aforementioned Chappell et al. patent and commonly-assigned U.S. Patent No. 5,650,214, issued July 22, 1997 in the names of Anderson et al., the disclosures of which are hereby incorporated herein by reference.

Another method of forming the base material into a web of sheet material suitable for use in the present invention is vacuum forming. An example of a vacuum forming method is disclosed in commonly assigned U.S. Pat. No. 4,342,314, issued to Radel et al. on August 3, 1982. Alternatively, the formed web of sheet material may be hydraulically formed in accordance with the teachings of commonly assigned U.S. Pat. No. 4,609,518 issued to Curro et al. on September 2, 1986. The disclosures of each of the above patents are hereby incorporated herein by reference.

The method of formation can be accomplished in a static mode, where one discrete portion of a base film is deformed at a time. Alternatively, the method of formation can be accomplished using a continuous, dynamic press for intermittently contacting the moving web and forming the base material into a formed web material of the present invention. These and other suitable methods for forming the web material of the present invention are more fully described in the above-referenced and above-incorporated Chappell et al. patent. The flexible covers may be fabricated from formed sheet material or, alternatively, the flexible covers may be fabricated and then subjected to the methods for forming the sheet material.

Referring now to Figure 3, other patterns for first and second regions may also be employed as sheet materials 52 suitable for use in accordance with the present invention. The sheet material 52 is shown in Figure 3 in its substantially untensioned condition. The sheet material 52 has two centerlines, a longitudinal centerline, which is also referred to hereinafter as an axis, line, or direction "L" and a transverse or lateral centerline, which is also referred to hereinafter as an axis, line, or direction "T". The transverse centerline "T" is generally perpendicular to the longitudinal centerline "L". Materials of the type depicted in Figure 3 are described in greater detail in the aforementioned Anderson et al. patent.

As discussed above with regard to Figures 2A-2C, sheet material 52 includes a "strainable network" of distinct regions. The strainable network includes a plurality of first regions 60 and a plurality of second regions 66 which are visually distinct from one another. Sheet material 52 also includes transitional regions 65 which are located at the interface between the first regions 60 and the second regions 66. The transitional regions 65 will exhibit complex combinations of the behavior of both the first region and the second region, as discussed above.

Sheet material 52 has a first surface, (facing the viewer in Figure 3), and an opposing second surface (not shown). In the preferred embodiment shown in Figure 3, the strainable network includes a plurality of first regions 60 and a plurality of second regions 66. A portion of the first regions 60, indicated generally as 61, are substantially linear and extend in a first direction. The remaining first regions 60, indicated generally as 62, are substantially linear and extend in a second direction which is substantially perpendicular to the first direction. While it is preferred that the first direction be perpendicular to the second direction, other angular relationships between the first direction and the second direction may be suitable so long as the first regions 61 and 62 intersect one another. Preferably, the angles between the first and second directions ranges from about 45° to about 135°, with 90° being the most preferred. The intersection of the first regions 61 and 62 forms a boundary, indicated by phantom line 63 in Figure 3, which completely surrounds the second regions 66.

Preferably, the width 68 of the first regions 60 is from about 0.01 inches to about 0.5 inches, and more preferably from about 0.03 inches to about 0.25 inches. However, other width dimensions for the first regions 60 may be suitable. Because the first regions 61 and 62 are perpendicular to one another and equally spaced apart, the second regions have a square shape. However, other shapes for the second region 66 are suitable and may be achieved by changing the spacing between the first regions and/or the alignment of the first regions 61 and 62 with respect to one another. The second regions 66 have a first axis 70 and a second axis 71. The first axis 70 is substantially parallel to the longitudinal axis of the web material 52, while the second axis 71 is substantially parallel to the transverse axis of the web material 52. The first regions 60 have an elastic modulus E1 and a cross-sectional area A1. The second regions 66 have an elastic modulus E2 and a cross-sectional area A2.

In the embodiment shown in Figure 3, the first regions 60 are substantially planar. That is, the material within the first regions 60 is in substantially the same condition before and after the formation step undergone by web 52. The second regions 66 include a plurality of raised rib-like elements 74. The rib-like elements 74 may be embossed, debossed or a combination thereof. The rib-like elements 74 have a first or major axis 76 which is substantially parallel to the longitudinal axis of the web 52 and a second or minor axis 77 which is substantially parallel to the transverse axis of the web 52.

The rib-like elements 74 in the second region 66 may be separated from one another by unformed areas, essentially unembossed or debossed, or simply formed as spacing areas. Preferably, the rib-like elements 74 are adjacent one another and are separated by an unformed area of less than 0.10 inches as measured perpendicular to the major axis 76 of the rib-like elements 74, and more preferably, the rib-like elements 74 are contiguous having essentially no unformed areas between them.

The first regions 60 and the second regions 66 each have a "projected pathlength". As used herein the term "projected pathlength" refers to the length of a shadow of a region that would be thrown by parallel light. The projected pathlength of the first region 60 and the projected pathlength of the second region 66 are equal to one another.

The first region 60 has a surface-pathlength, L1, less than the surface-pathlength, L2, of the second region 66 as measured topographically in a parallel direction while the web is in an untensioned condition. Preferably, the surface-pathlength of the second region 66 is at least about 15% greater than that of the first region 60, more preferably at least about 30% greater than that of the first region, and most preferably at least about 70% greater than that of the first region. In general, the greater the surface-pathlength of the second region, the greater will be the elongation of the web before encountering the force wall.

For sheet material 52, the direction of applied axial elongation, D, indicated by arrows 80 in Figure 3, is substantially perpendicular to the first axis 76 of the rib-like elements 74. This is due to the fact that the rib-like elements 74 are able to unbend or geometrically deform in a direction substantially perpendicular to their first axis 76 to allow extension in web 52.

Referring now to Figure 4, as web 52 is subjected to an applied axial elongation, D, indicated by arrows 80 in Figure 4, the first regions 60 having the shorter surface-pathlength, L1, provide most of the initial resistive force, P1, as a result of molecular-level deformation, to the applied elongation which corresponds to stage I. While in stage I, the rib-like elements 74 in the second regions 66 are experiencing geometric deformation, or unbending and offer minimal resistance to the applied elongation. In addition, the shape of the second regions 66 changes as a result of the movement of the reticulated structure formed by the intersecting first regions 61 and 62. Accordingly, as the web 52 is subjected to the applied elongation, the first regions 61 and 62 experience geometric deformation or bending, thereby changing the shape of the second regions 66. The second regions are extended or lengthened in a direction parallel to the direction of applied elongation, and collapse or shrink in a direction perpendicular to the direction of applied elongation.

In addition to the aforementioned elastic-like properties, a sheet material of the type depicted in Figures 3 and 4 is believed to provide a softer, more cloth-like texture and appearance, and is more quiet in use.

Various compositions suitable for constructing the flexible covers of the present invention include substantially impermeable materials such as polyvinyl chloride (PVC), polyvinylidene chloride (PVDC), polyethylene (PE), polypropylene (PP), aluminum foil, coated (waxed, etc.) and uncoated paper, coated nonwovens etc., and substantially permeable materials such as scrims, meshes, wovens, nonwovens, or perforated or porous films, whether predominantly two-dimensional in nature or formed into three-dimensional structures. Such materials may comprise a single composition or layer or may be a composite structure of multiple materials.

Once the desired sheet materials are manufactured in any desirable and suitable manner, comprising all or part of the materials to be utilized for the cover body, the cover may be constructed in any known and suitable fashion such as those known in the art for making such covers in commercially available form. Heat, mechanical, or adhesive sealing technologies may be utilized to join various components or elements of the cover to themselves or to each other. In addition, the cover bodies may be thermoformed, blown, or otherwise molded rather than reliance upon folding and bonding techniques to construct the cover bodies from a web or sheet of material.

While particular embodiments of the present invention have been illustrated and described, it would be obvious to those skilled in the art that various other changes and modifications can be made without departing from the spirit and scope of the invention. It is therefore intended to cover in the appended claims all such changes and modifications that are within the scope of this invention.

What is claimed is:

1. A flexible cover characterized by at least one sheet of flexible sheet material assembled to form a semi-enclosed container having a periphery, said cover being expandable in response to forces exerted by an article, item, or material over which said cover is placed to provide an increase in volume of said cover such that said cover accommodates the articles, items, or material placed therein.

2. The flexible cover according to Claim 1, wherein said flexible cover has an elasticized edge.

3. The flexible cover according to any of the preceding claims, wherein said sheet material includes a first region and a second region being comprised of the same material composition, said first region undergoing a substantially molecular-level deformation and said second region initially undergoing a substantially geometric deformation when said sheet material is subjected to an applied elongation along at least one axis.

4. The flexible cover according to Claim 3, wherein said first region and said second region are visually distinct from one another.

5. The flexible cover according to Claim 3 or 4, wherein said second region includes a plurality of raised rib-like elements.

6. The flexible cover according to Claims 3, 4 or 5, wherein said first region is substantially free of rib-like elements.

7. The flexible cover according to any of the preceding claims, wherein said sheet material exhibits at least two significantly different stages of resistive forces to an applied axial elongation along at least one axis when subjected to the applied elongation in a direction parallel to said axis in response to an externally-applied force upon said flexible cover when formed into a closed container, said sheet material comprising: strainable network including at least two visually distinct regions, one of said regions being configured so that it will exhibit a resistive force in response to said applied axial elongation in a direction parallel to said axis before a substantial portion of the other of said regions develops a significant resistive force to said applied axial elongation, at least one of said regions having a surface-pathlength which is greater than that of the other of said regions as

measured parallel to said axis while said sheet material is in an untensioned condition, said region exhibiting said longer surface-pathlength including one or more rib-like elements, said sheet material exhibiting a first resistive force to the applied elongation until the elongation of said sheet material is great enough to cause a substantial portion of said region having a longer surface-pathlength to enter the plane of the applied axial elongation, whereupon said sheet material exhibits a second resistive force to further applied axial elongation, said sheet material exhibiting a total resistive force higher than the resistive force of said first region.

8. The flexible cover according to any of the preceding claims, wherein said sheet material exhibits at least two-stages of resistive forces to an applied axial elongation, D, along at least one axis when subjected to the applied axial elongation along said axis in response to an externally-applied force upon said flexible cover when formed into a closed container, said sheet material comprising: a strainable network of visually distinct regions, said strainable network including at least a first region and a second region, said first region having a first surface-pathlength, L1, as measured parallel to said axis while said sheet material is in an untensioned condition, said second region having a second surface-pathlength, L2, as measured parallel to said axis while said web material is in an untensioned condition, said first surface-pathlength, L1, being less than said second surface-pathlength, L2, said first region producing by itself a resistive force, P1, in response to an applied axial elongation, D, said second region producing by itself a resistive force, P2, in response to said applied axial elongation, D, said resistive force P1 being substantially greater than said resistive force P2 when (L1+D) is less than L2.

9. The flexible cover according to any of the preceding claims, wherein said sheet material exhibits an elastic-like behavior along at least one axis, said sheet material comprising: at least a first region and a second region, said first region and said second region being comprised of the same material composition and each having an untensioned projected pathlength, said first region undergoing a substantially molecular-level deformation and said second region initially undergoing a substantially geometric deformation when said web material is subjected to an applied elongation in a direction substantially parallel to said axis in response to an externally-applied force upon said flexible cover when formed into a closed container, said first region and said second region substantially returning to their untensioned projected pathlength when said applied elongation is released.

10. The flexible cover according to Claims 3, 7, 8, or 9, wherein said sheet material includes a plurality of first regions and a plurality of second regions comprised of the same material composition, a portion of said first regions extending in a first direction while the remainder of said first regions extend in a direction perpendicular to said first direction to intersect one another, said first regions forming a boundary completely surrounding said second regions.

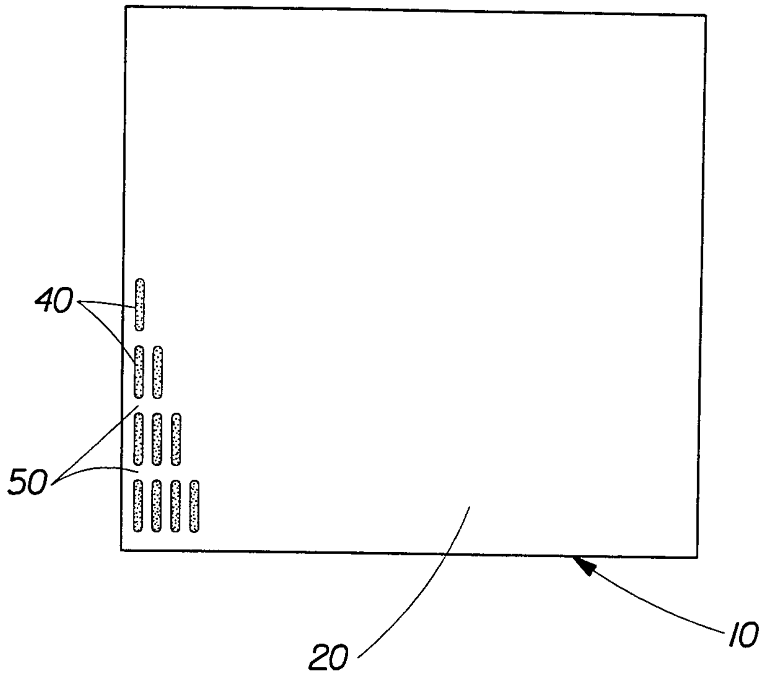

Fig. 1

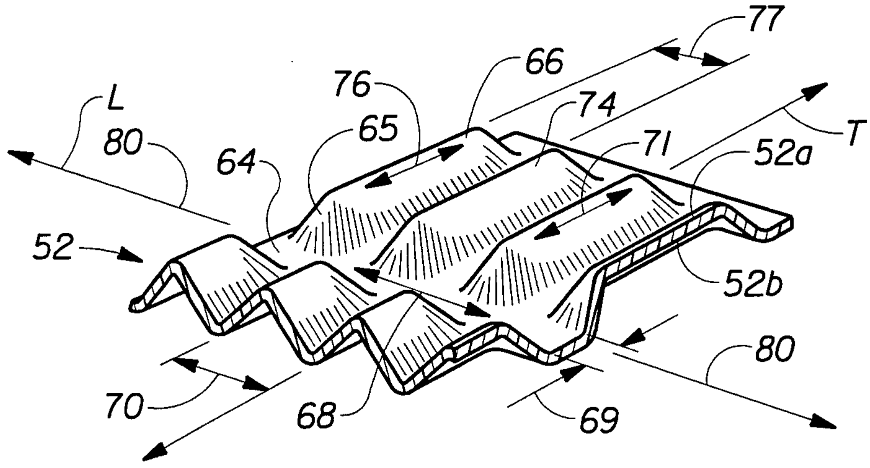

Fig. 2A

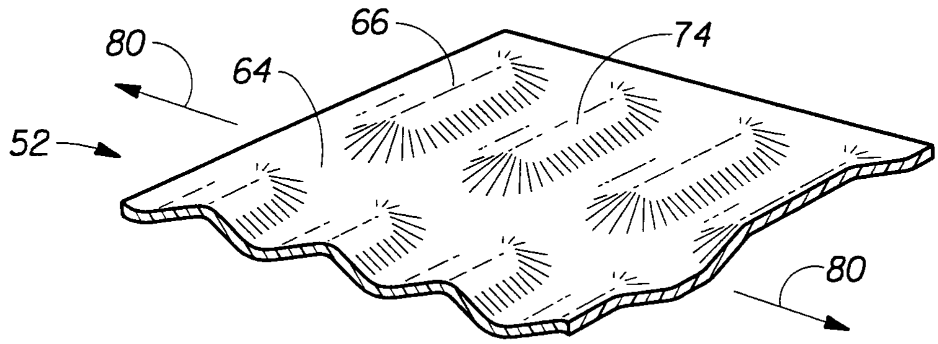

Fig. 2B

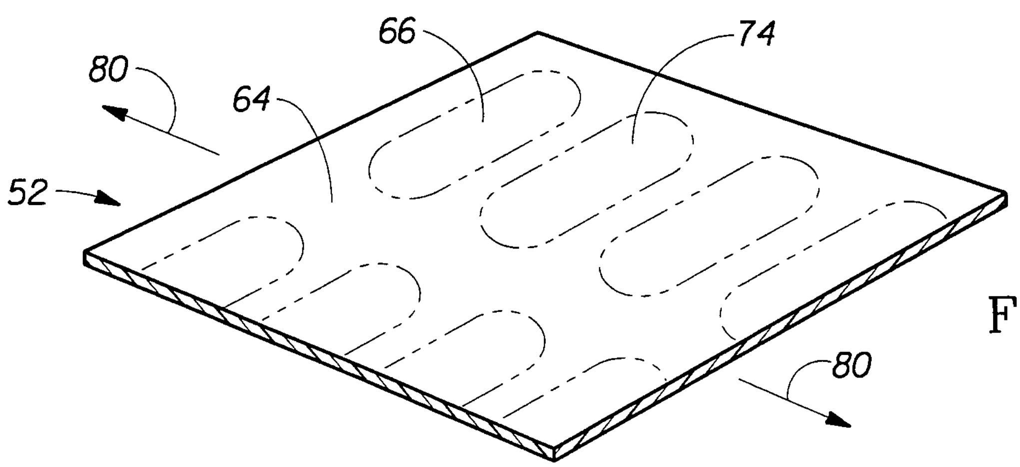

Fig. 2C

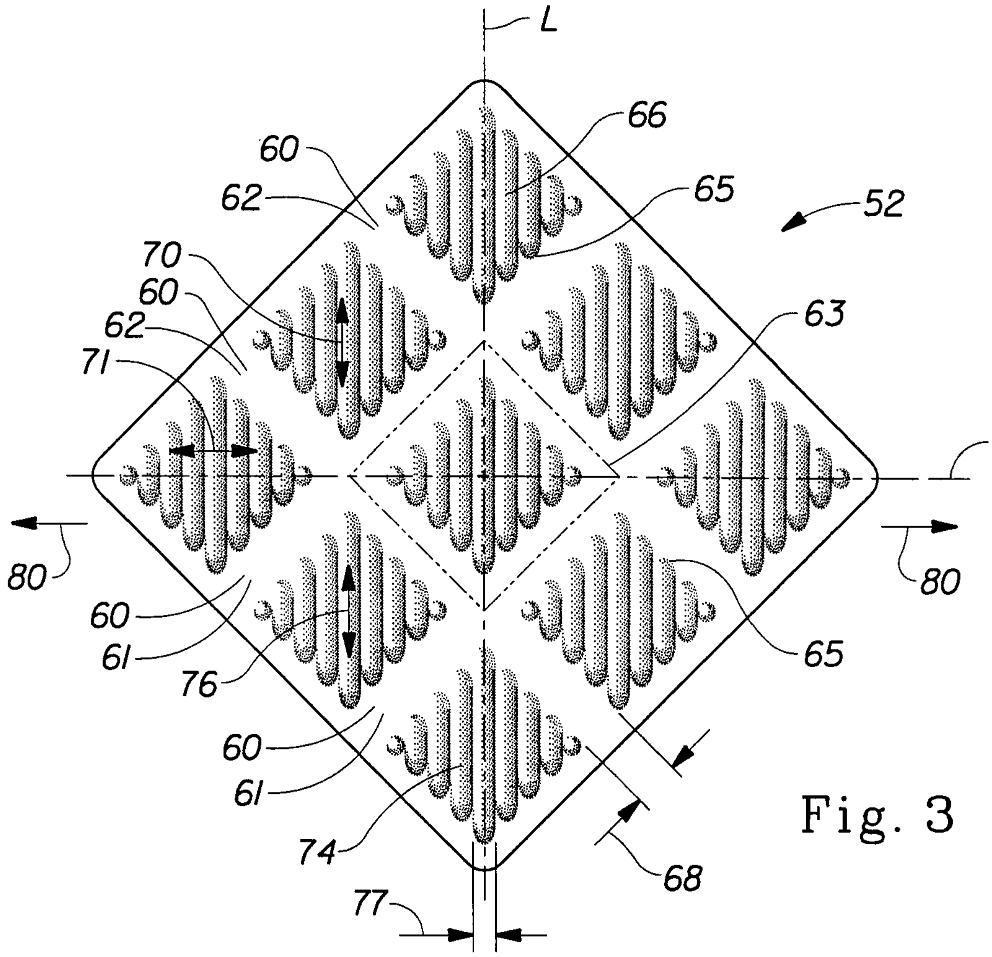
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Fig. 3

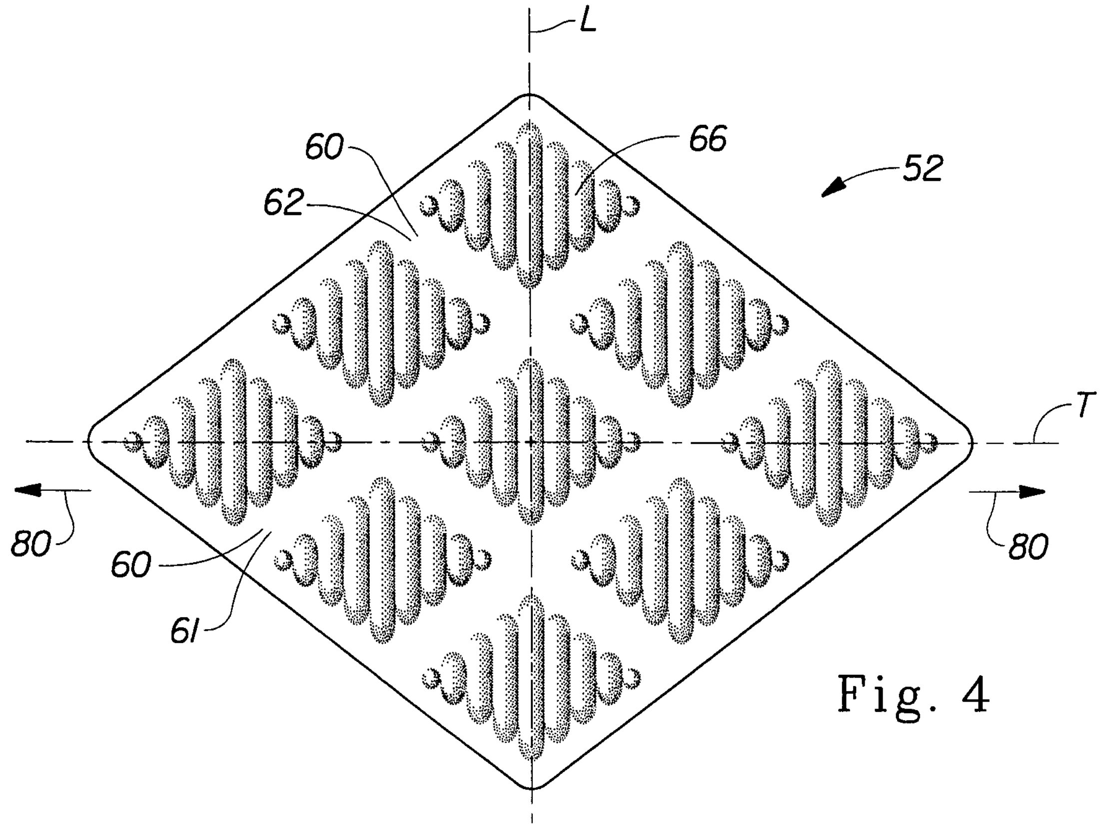
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Fig. 4

INTERNATIONAL SEARCH REPORT

Inte[...]onal Application No
PCT/US 00/16959

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B65D81/03

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B65D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 4 739 884 A (DUPLESSY HERVE) 26 April 1988 (1988-04-26) column 3, line 53 -column 4, line 39; figures 1-11	1 2-10
X	GB 2 175 564 A (NGK INSULATORS LTD) 3 December 1986 (1986-12-03) column 1, line 80 - line 88; claim 2; figures 1-10	1
Y	US 5 518 801 A (MANSFIELD MICHELE A ET AL) 21 May 1996 (1996-05-21) cited in the application column 8, line 41 -column 12, line 25; claims 1-5,19,56,72; figures 5,6	2-9

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 November 2000	22/11/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Fournier, J

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5 650 214 A (GOULAIT DAVID J K ET AL) 22 July 1997 (1997-07-22) cited in the application column 3, line 1 - line 17; figures 3,5,7	10

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Information on patent family members

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