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[BE/BE]; Rechtestraat 4, B-2290 Vorselaar (BE). **WEST-ERHUIS, Martin** [NL/NL]; Valkenierstraat 130, NL-5555 JE Valkenswaard (NL).

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(74) Agent: **MURPHY, Cynthia S.**; Renner, Otto, Boisselle & Sklar, LLP, 1621 Euclid Avenue, 19th Floor, Cleveland, OH 44115 (US).

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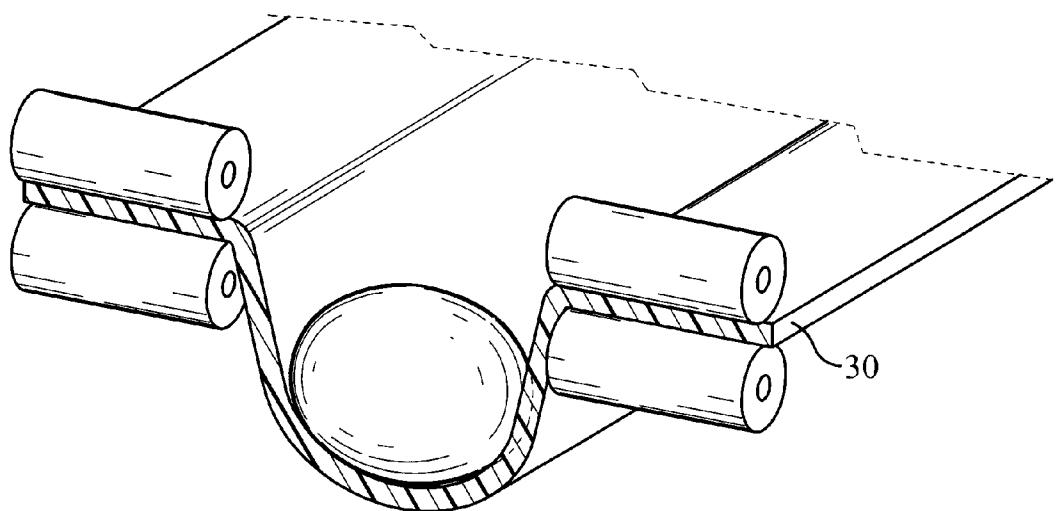
(71) Applicant (for all designated States except US): **AVERY DENNISON CORPORATION** [US/US]; 150 North Orange Grove Boulevard, Pasadena, CA 91103 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **VERHAERT, Anne**

[Continued on next page]

(54) Title: ELASTIC DIAPER COMPONENT



(57) Abstract: A method of making an elastic component for incorporation into a diaper. The elastic diaper component begins as an elastic laminate (e.g., an elastic layer and a fabric layer) having a recoverable extension of at least 20% when an extension force E_1 is applied. The method comprises the step of integratively pre-stretching the elastic laminate so that the elastic laminate will stretch to the same recoverable extension when a reduced extension force E_2 is applied. In this manner, when the elastic laminate is used in the elastic diaper component, a lesser fitting force F_{fit} is required to extend the elastic component to a desired length during an initial fitting of a diaper on a wearer.

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ELASTIC DIAPER COMPONENT

A diaper commonly comprises a chassis having a front portion, a rear portion, and a crotch portion therebetween. When diapering a wearer, the crotch portion is placed between his/her legs and the rear portion is fastened, via a fastener, to the front portion to form a waist around the wearer. The fastener can
5 be carried by a fastening tape component secured to the respective lateral edge of the rear chassis portion, or the fastener can be carried by a side panel component or belt component secured to this lateral edge.

Fastening tape components, side panel components, and/or belt components are often components comprising an elastic laminate (e.g., a laminate
10 having a recoverable extension of at least 20% when an extension force E is applied). During the diapering process, the elastic component is stretched (e.g., it is pulled by the parent of the to-be-diapered baby) at a force F_{fit} to an extended length and the fastener is fastened to the front chassis portion or an appendage thereof. Once fastening is accomplished, and the fitting force F_{fit} is released, the
15 inherent recovery retraction force of the elastic component causes it to retract thereby snugly securing the diaper around the wearer's waist. As the wearer's belly expands and contracts during use of the diaper, the elastic component extends and retracts to comfortably accommodate this movement while maintaining the snug fit of the diaper.

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SUMMARY

An elastic diaper component (e.g., a side panel component, a fastening tape component, and/or a belt component) comprises an elastic laminate which initially has a recoverable extension of at least 20% when stretched at an extension force
25 E_1 . This elastic laminate is subjected to integrative pre-stretching to thereby allow the elastic laminate to be stretched to the same recoverable extension at a reduced extension force E_2 . In this manner, when the elastic laminate is used as an elastic diaper component, the force reduction instilled by the integrative pre-stretching step lowers the fitting force F_{fit} (e.g., the magnitude of the "pull") necessary to extend the

component to a desired length during fitting of a diaper. Also, the pre-stretching decreases the extension force necessary to accommodate the expansion of the wearer's belly (or other conditions increasing waist circumference) during use of the diaper.

5 The recovering retraction forces R_2 of the pre-stretched elastic laminate can be substantially the same as the recovering retraction force R_1 of the original laminate (*i.e.*, the elastic laminate prior to the pre-stretching step). Thus, the pre-stretched elastic component can retract in much the same manner as the original elastic laminate. In this manner, the pre-stretched component can appropriately
10 retract to accommodate contraction of the wearer's belly (or other conditions decreasing waist circumference) during use of the diaper.

 In an original elastic laminate (*i.e.*, an elastic laminate prior to or without pre-stretching), the extension force often increases substantially linearly from minimum to maximum extension. With the pre-stretched component, the extension force
15 increases substantially linearly in early/intermediate stages of material extension and then inclines more sharply in the longer stages of material extension. There will be a sudden increase in resistance when the elastic laminate is stretched beyond the intermediate lengths and, when the person fitting the diaper feels this resistance, his/her reflexive reaction is usually to cease elongation of the
20 component. Thus, pre-stretched elastic laminate can guard against over-extension of the component during the diapering process. Also, the linear (gradual) region of extension forces often corresponds to the linear regions of the retraction forces, whereby they will be gradual (as opposed to sudden and snap-like) retraction during diaper use.

25 With the pre-stretched diaper component, the elastic qualities of the original laminate will be enhanced (*e.g.*, the force required to stretch to a recoverable extension will be reduced) prior to use of the diaper. This allows the sometimes stringent specifications imposed on elastic laminates to be matched more easily. Thanks to the integrative pre-stretching step, a wider range of elastic laminates
30 (and perhaps more economical laminates) will qualify as suitable candidates for the production of elastic diaper components.

With particular reference to activated elastic laminates (e.g., laminates which achieve elasticity upon incremental stretching of inelastic nonwoven layers), an integrative pre-stretching (post-activation) step provides the welcome option of less aggressive activation. For example, with a ring rolling method, the groove pitch of the incremental-strain-imposing rollers need not be as deep as would be necessary to achieve the same fitting force F_{fit} characteristics without integrative pre-stretching. This less destructive approach can decrease the risk of material damage (e.g., the creation of weak spots in the elastic layer that are susceptible to tearing or breaking) during activation. On this same note, the use of integrative pre-stretching techniques (as opposed to incremental pre-stretching techniques) eliminates the disadvantages and dangers associated with localized and/or discrete strain imposition. That being said, such integrative pre-stretching techniques may be suitable for situations wherein rupturing of a fabric layer is desired to create, for example, fabric segments which diverge upon laminate elongation and converge upon laminate recovery.

DRAWINGS

Figures 1A - 1F are plan schematic views of some of the possible diaper designs incorporating pre-stretched elastic components (e.g., side panel components, fastening tape components, and/or belt components).

Figures 2A - 2J, Figures 3A - 3J, Figures 4A - 4I, Figures 5A - 5H and Figures 6A - 6H are side schematic views of some of the possible elastic laminates that can be used in elastic diaper components.

Figures 7 - 9 are schematic views of some of the possible integrative pre-stretching techniques.

Figures 10A - 10B are side views of an elastic laminate with distal severing and proximal severing, the laminate being shown in relaxed state in Figure 10A and in an elongated state in Figure 10B.

Figure 10C is a close-up view of severed/ruptured regions of the elastic laminate of Figures 10A - 10B.

Figures 11A - 11B are side views of an elastic laminate with proximal severing and distal rupturing, the laminate being shown in relaxed state in Figure 10A and in an elongated state in Figure 10B.

Figure 11C is a close-up view of severed/ruptured regions of the elastic laminate of Figures 11A - 11B.

Figures 12A and 12B are schematic magnified representations of a ruptured region and a severed region, respectively.

GRAPHS

Graphs 1 - 3 each are plots of extension forces E and retraction forces R for three different elastic laminate constructions, respectively.

Graphs 4 - 6 are each plots of extension forces E and retraction forces R for the same elastic laminate construction with differing degrees of pre-stretching.

The hysteresis tests used to obtain the data for the graphs were performed on a tensile tester with a load cell 100 N, a cross head speed of 300 mm/m, an initial clamp separation of 30 mm, and a maximum cross head position of 60 mm. Test samples each had a width of 25 mm and a minimum length of 50 mm, and were conditioned for at least 24 hours at 23° C ($\pm 2^\circ$ C) and relative humidity of 50%. During the testing, the cross head moved the sample (clamped in the grips of the tensile tester) to a predetermined maximum position, held the sample in this position for 30 seconds, and released the retaining force allowing the sample to retract. A subsequent cycle began after the sample rested in its retracted condition for 30 seconds.

DETAILED DESCRIPTION

Referring now to the drawings, and initially to Figures 1A - 1F, a diaper 10 can comprise a chassis 12 having a front portion 14, a rear portion 16, and a crotch portion 18 therebetween. The diaper chassis 12 can include a liquid permeable topsheet, a liquid impermeable backsheet, and an absorbent core interposed therebetween. The diaper 10 can be made, for example, in smaller sizes for a baby or child, and/or in larger sizes for an adult. The term "diaper" as used in this specification refers to an absorbent article worn around the waist of a wearer for the

purpose of collecting body fluids. The diaper can be a disposable article intended to be used until soiled and then discarded. Alternatively, the diaper can be a reusable article adapted to be washed and used again.

5 The diaper 10 can include a side panel component 20 attached to each lateral edge of the chassis rear portion 16 (Figures 1A - 1D). The side panel shape can include a curved lower edge (Figures 1A and 1B), can be rectangular (Figures 1C and 1D), and/or any other suitable geometry. A fastening tape component 22, can extend outward from side panel component 20 and carry a fastener 26 thereon (Figures 1A and 1C).

10 Alternatively, the side panel component 20 can carry the fastener 26 directly thereon (Figures 1B and 1D). If the diaper 10 does not include side panel components, the fastening tape components 22 can extend outward from each lateral edge of the rear chassis portion 16 (Figure 1E). The fastener 26 can comprise any suitable fastening means (e.g., hooks/loops, snaps, adhesive/cohesive area(s), magnetic connections etc.) which allows selective
15 attachment to an area on the front chassis portion 14. When diapering a wearer, the chassis crotch portion 18 is placed between his/her legs and the chassis rear portion 16 is fastened, via the fastener 26, to the chassis front portion 14 to form a waist around the wearer.

20 Instead of side panel components, the diaper 10 can include a belt component 24 attached to each lateral edge of the chassis rear portion 16 (Figure 1F). One belt component 24 is folded around the user's waist (e.g., the left-hand belt in the illustrated diaper) and the other belt component 24 is then folded thereover. The belt components 24 are held in place by a fastener 26 carried by
25 at least one of the belt components 24 (e.g., the right-hand belt in the illustrated diaper).

The side panel components 20, the fastening tape components 22, and/or the belt components 24 comprise elastic components whereby, during the diapering process, they can be stretched (e.g., it is pulled by the parent of the to-be-diapered
30 baby) at a force F_{fit} to an extended length and the respective fastener 26 fastened to the front chassis portion 14. Once fastened, and the fitting force F_{fit} released, the recovery retraction force of the elastic component causes it to retract thereby

snugly securing the diaper 10 around the wearer's waist. As the wearer's waist circumference expands and contracts during use of the diaper, the elastic component 20/22/24 extends and retracts to comfortably accommodate this movement while maintaining the snug fit of the diaper.

5 The illustrated diaper 10 is one in which the chassis front/rear portions 14/16 are attached together to form the waist during the initial fitting of the diaper. However, other diaper designs are possible and contemplated. For example, "pants-like" diaper designs could incorporate side panel components 20 and/or belt components 24 which are attached to the chassis front/rear portions 14/16 prior to
10 the initial fitting. In this case, the relevant fitting force F_{fit} can be that required to extend the components 20/24 when pulling the diaper up to the waist of the wearer (e.g., over his/her buttocks).

 In a method of making the elastic diaper component 20/22/24, an elastic laminate 30 is provided, such as the laminates 30 shown in Figures 2A - 2J, Figures
15 3A - 3J, Figures 4A - 4I, Figures 5A - 5H or Figures 6A - 6H. The thicknesses of the laminate 30 (and/or its layers 32/34/36 introduced below) are somewhat exaggerated in the drawings for the sake of clarity and explanation. If these thicknesses were drawn to scale with the illustrated lengths, it would probably be difficult to decipher and/or number the various layers. Also, with particular
20 reference to Figures 5A - 5H and Figures 6A - 6H, these thicknesses may give the impression that certain aligned layer sections and/or areas are separated by spaces or gaps and do not contact one another. This may not be accurate as adjacent surfaces of neighboring layers in a laminate will generally be positioned flush against each other.

25 The elastic laminate 30 has a recoverable extension of at least 20% upon application of a corresponding extension force. The term "recoverable extension" refers to the ability of the laminate 30 to retract, via its inherent retraction recovery force, to substantially the same length (e.g., within 15%) upon release of the extension force. Thus, the elastic laminate 30 can be extended to a length
30 representing at least a 20% increase (i.e., the extended laminate length will be equal or greater than 1.20 times the original laminate length) and return approximately to its original length upon release of the extension force. The

potential recoverable extension of the elastic laminate 30 can, and will be in many cases, much higher than 20% (e.g., at least 50%, at least 100%, at least 200%, at least 300% etc.).

The laminate 30 can comprises an elastic layer 32 and a fabric layer 34 (Figures 2A - 2G), or an elastic layer 32, a fabric layer 34, and another fabric layer 36 (Figures 3A - 3G, Figures 4A - 4F, Figures 5A - 5D and Figures 6A - 6D). The fabric layer 34 can be an elastic layer (Figure 2A, Figure 3A, Figure 5A, and Figure 6A), or the fabric layer 34 can be an inelastic layer (Figures 2B - 2G, Figures 3B - 3G, Figures 4A - 4F, Figures 5B - 5D, and Figures 6B - 6D). The fabric layer 36 can be an elastic layer (Figures 3A - 3G) or it can be an inelastic layer (Figures 4A - 4F, Figures 5A - 5D, and Figures 6B - 6D).

If the fabric layer 34/36 is an inelastic layer, it can be manipulated to allow extension/retraction with the elastic layer 32. For example, the layer 34/36 may be mechanically manipulated by incremental stretching or "activation." (Figures 2B-2C, Figures 3B - 3C, Figures 4A - 4B, Figure 5B and Figure 6B.)

Additionally or alternatively, the layer 34/36 can be die-cut, kiss-cut, slit, scored, laser-cut, ultrasound-cut, or otherwise interrupted. (Figures 2D - 2G, Figures 3D - 3G, Figures 4C - 4F, Figure 5C - 5D and Figures 6C - 6D.) In the illustrated drawings, interruptions are schematically shown as being rather large for the purposes of simplicity. However, the interruptions can be spaced, for example, between 1 millimeter to 10 millimeters apart and can be evenly, or unevenly spaced, along the laminate.

The interruptions can extend partially through the layer thickness of the fabric layer 34/36 (e.g., 10% to 99%, 20% to 99%, 30% to 99%, 40% to 99%, 50% to 99%, 60% to 99%, 70% to 99%, and/or 80% to 99%), with tendons occupying the rest of the layer thickness. For example, if the interruption is a cut/slit/score, the tendon is the region of the cut/slit/score line which has not been cut/slit/scored.

If the elastic layer 32 is used as a reference layer, the fabric layer 34/36 will have a proximal side located closest to the elastic layer 32 and a distal side located away from the elastic layer 32. (The thickness of the fabric layer 34/36 is the distance between its proximal and distal sides.) The interruptions can be distal interruptions extending through the distal side of the fabric layer 34/36, (Figures 2D,

2F, 3D, 3F, 4C, 4E, 5C, and 6C) whereby the tendons would be proximal tendons extending from the proximal side of the fabric layer 34/36 to the aligned interruption. Alternatively, the interruptions can be proximal interruptions extending through the proximate side of the fabric layer 34/36 (Figures 2E, 2G, 3E, 3G, 4D, 4F, 5D and 6D) whereby the tendons would be distal tendons extending the rest of the way through the fabric. Although not specifically shown in the drawings, it may be possible for one fabric layer 34/36 to have distal/proximal interruptions while the other fabric layer 36/34 has proximal/distal interruptions, and/or for one fabric layer 34/36 to have both distal and proximal interruptions.

If the layer 34/36 is continuous across the width of the laminate 30 and the width of the elastic layer 32, the incrementally stretched or slitted portion can occupy only a section of the laminate width (Figures 2B, 2D and 2E, Figures 3B, 3D, and 3E, and Figures 4A, 4C, and 4D) or the increments/slits can occupy the entire laminate width (Figures 2C, 2F and 2G, Figures 3C, 3F and 3G, and Figures 4B, 4E, and 4F).

If the layer 34/36 is continuous across the width of the laminate 30, but not across the width of the elastic layer 32, the incrementally stretched or slitted portion can occupy only a section of the laminate width (Figures 5B - 5D and Figures 6A - 6D). For example, the incrementally stretched or interrupted portion can be aligned with the elastic layer 32 and coextensive therewith. The incrementally stretched or interrupted portion can not extend beyond the extent of the elastic layer 32 in the cross-direction C. The incremental stretches and/or interruptions can extend almost, but not quite the full cross-extent of the elastic layer 32 on each side, thereby leaving an unstretched/uninterrupted margin aligned with the elastic layer. This latter option may be desirable to, for instance, securely attached the elastic layer 32 to the fabric layers 34/36 when they are kiss-cut, die-cut, scored, slit, laser-cut, or ultrasound-cut, or otherwise interrupted. Margin widths in the range of 2 - 20 millimeters, 4 - 12 millimeters, and/or 6 - 10 millimeters may be sufficient for this purpose.

In the case where the incrementally stretched or slitted portion occupies a portion (e.g., a central portion) of the laminate width (Figures 2B, 2D and 2E, Figures 3B, 3D and 3E, Figures 4A, 4C, and 4D, Figure 5B, 5C and 5D, and

Figures 6A, 6C, and 6D), a “double” laminate construction, such as shown in Figures 2H - 2J, Figures 3H - 3J, Figures 4G - 4I, Figures 5F - 5H, and Figures 6F - 6H, may be adopted. A “double” laminate construction may also be useful when the elastic layer 32 and/or the fabric layer 36 is not continuous, as shown in Figure 5E and Figure 6E.

The elastic layer 32 can comprise a pre-formed film compiled with the fabric layers 34/36 or can comprise an extrudate extruded onto the fabric layers 34/36. In either or any event, the elastomer can be selected from the group consisting of styrene block copolymers, polyurethanes, polyesters, polyethers, and polyether block copolymers. Additionally or alternatively, the elastic layer 32 can comprise a vinyl arene-containing block copolymer (e.g., a block copolymer comprising SBS and/or SEBS).

The fabric layer(s) 34/36 can be nonwoven layers and they can be, for example, polyolefin, such as polyethylene and/or its copolymers, or polypropylene and/or its copolymers, or mixtures of the aforementioned polyolefins, polyurethanes, polyester, polyether or polyamide. The nonwoven materials can comprise, for example, spunbonded webs, meltblown webs, air laid layer webs, bonded carded webs, hydroentangled webs, wet-formed webs or any combination thereof.

The elastic laminate 30 is integratively pre-stretched to reduce the fitting force F_{fit} required to extend the elastic component 20/22/24 to a desired length during an initial fitting of the diaper 10. This allows a wider range of elastic laminates (and probably some more economical laminates) to qualify as suitable candidates for the production of the elastic diaper components 20/22/24. Additionally or alternatively, less aggressive activation procedures may be used to produce original activated elastic laminates.

The pre-stretching step is “integrative” in that it stretches the laminate 30 in an amalgamated manner across its width (or portions of its width) as opposed to a sequence of small discrete stretching steps incrementally individually subjected to localized regions. The integrative pre-stretching step may be performed by gradually urging the elastic laminate 30 laterally outward to temporarily widen its span (Figure 7), by causing the laminate 30 to travel through a curved route to

temporarily widen its span (Figure 8), or by conveying a portion of the laminate 30 through an offset path to temporarily widen its span (Figure 9). In the latter technique, the integrative stretching is concentrated around a portion (e.g., the center portion) of the laminate 30 and it may be especially suitable for laminate constructions wherein a particular portion is intended to be rendered more elastic (Figures 2B, 2D and 2E, Figures 3B, 3D, and 3E, Figures 4A, 4C, and 4D, Figures 5B - 5D, and Figures 6B - 6D).

When the layer 34/36 is die-cut, kiss-cut, scored, laser-cut, ultrasound-cut, or otherwise interrupted (Figures 2D - 2G, Figures 3D - 3G, Figures 4C - 4F, Figures 5C - 5D, and Figures 6C - 6D), the integrative pre-stretching step can comprise rupturing of at least some of the tendons. If such rupturing results in most and/or all of the tendons, the fabric layer 34/36 is divided into separable fabric segments 38/40 as is shown in Figures 10A - 10B and Figures 11A - 11B. The segments 38/40 may diverge upon laminate elongation, whereby the elastic layer 32 may be visible therebetween, (Figures 10B and 11B) and/or the segments 38/40 may converge upon laminate recovery, whereby the elastic layer 32 may be hidden thereby (Figures 10A and 11A).

The fabric-segmenting seams (a seam being formed by the combination of an interruption and an aligned rupture) will constitute an interrupted region and a ruptured region. (Figure 10C and Figure 11C.) With distal interruptions (Figures 2D and 2F, Figures 3D and 3F, Figures 4C and 4E, Figure 5C, and Figure 6C), the ruptured region will be a proximal region (Figures 10A - 10C). With proximal interruptions (Figures 2E and 2G, Figures 3E and 3G, Figures 4D and 4F, Figure 5D, and Figure 6D), the ruptured region will be a distal region (Figures 11A - 11C). If the interrupted region is die-cut, kiss-cut, slit, scored, laser-cut, or ultrasound-cut, or otherwise sharply split, it will be defined by primarily severed fabric strand ends, that is fabric strand ends which have been severed cleanly and neatly, as shown schematically in Figure 12A. The rupture regions will, in contrast, be defined by primarily fractured fabric strand ends, that is fabric strand ends which have been broken roughly and/or unevenly, as shown schematically in Figure 12B.

If the elastic laminate 30 is to be used to make the side panel components 20, the laminate 30 can be separated into side panel shapes and the side panel

components 20 secured to the diaper chassis 12 to incorporate them into the diaper 10. If the elastic laminate 30 is to be used to make the fastening tape components 22, the laminate 30 can be separated into fastening shapes and the fastening components 22 secured to the appropriate surface (e.g., the side panel 20 or the chassis 12) to incorporate them into the diaper 10. If the elastic laminate 30 is to be used to make the belt components 24, the laminate 30 can be separated into belt shapes and secured to the diaper chassis 12. The separating step and/or the securing step can be performed after the integrative stretching step. In any event, the integrative pre-stretching step is performed prior to the initial fitting of the diaper 10 on a wearer and the elastic component 20/22/24 is in a relaxed (*i.e.*, unstretched) state until the fitting process begins.

Referring now to Graphs 1 - 3, the two cycles of extension forces E and retraction forces R for three different elastic laminate constructions are plotted in relation to extension percentage. Graph 1 reflects data obtained with an elastic laminate 30 comprising an elastic film layer 32 and inelastic nonwoven layers 34/36 which are activated by incremental stretching. (See e.g., Figure 4A, above.) Graph 2 reflects data obtained from a similar elastic laminate 30, except with a thinner elastic film layer 32. Graph 3 reflects data obtained from an elastic laminate 30 comprising an elastic film 32 and elastic nonwoven layers 34 and 36. (See e.g., Figure 3A, above.)

The Graphs 1 - 3 each include an upper (greater) extension force E_1 curve and a lower (lesser) extension force E_2 curve. The upper curve corresponds to the stretch characteristics prior to integrative pre-stretching and the lower curve corresponds to stretch characteristics after integrative pre-stretching at 200%. As was indicated or alluded to above, an elastic laminate (prior to or without integrative pre-stretching) will have a recoverable extension of at least 20% upon application of a corresponding extension force E_1 .

If a non-pre-stretched elastic laminate was used as the elastic diaper component 20/22/24, the fitting force F_{fit} required to extend the elastic component 20/22/24 to a desired length during an initial fitting of the diaper 10 on a wearer would correspond to the upper E_1 extension force curve. When a pre-stretched

elastic laminate is used as the diaper component 20/22/24, the required fitting force F_{fit} corresponds to the lower E_2 extension force curve.

For each elastic laminate, the first cycle extension forces E_1 are higher than the second cycle extension forces E_2 for the same recoverable extensions. With the laminate 30 plotted in Graph 1, the original elastic laminate (*i.e.*, prior to pre-stretching) required an extension force E_1 of over 10N to reach a 100% extension, while the extension force E_2 required to extend the pre-stretched elastic component 20/22/24 to this same length would be just over 5N. With the laminate 30 plotted in Graph 2, the extension force E_1 is about 5N and the extension force E_2 is about 2N to reach a 100% extension. With the laminate 30 plotted in Graph 3, the corresponding not-pre-stretched and pre-stretched values are over 6N and less than 3N for a 100% elongation.

Graphs 1 - 3 also reflect that the recovery retraction forces R_1 and R_2 for the first cycle and the second cycle are substantially the same. Thus, the pre-stretched elastic laminate retracts in much the same manner as the original elastic laminate. In this manner, the pre-stretched component 20/22/24 can snugly secure the diaper around the wearer's waist during the initial fitting and can adequately retract to accommodate contraction of the wearer's belly (or other decreases in waist circumference) during use of the diaper.

In the first cycle curves, the extension forces E_1 gradually increase (*i.e.*, the slope of the curve is linear) throughout material extension. In the second cycle curves, however, the extension forces E_2 gradually (*i.e.*, linearly) increase in the early stages of material extension and then more sharply incline as the extension percentages increase. (In the illustrated graphs, this increase occurs above about 140%, however this will vary depending upon the elastic laminate, pre-stretching conditions, and/or other factors.) When an integratively pre-stretched elastic component 20/22/24 is used, the reflexive reaction to a sudden increase in resistance will typically be to cease extension of the component 20/22/24. Thus, a fitting force F_{fit} will usually not extend beyond the linearly-sloped region of the E_2 curve. This can help prevent over-extension of the component 20/22/24 during the diapering process (and the corresponding compromise of elastic recoverable extension properties). Also, the linearly sloped region of the E_2 curve corresponds

to the linearly sloped region of the R_2 curve, whereby retraction during use of the diaper 10 will also be gradual.

Graphs 4 - 6 are each a plot of hysteresis curves showing two cycles of extension forces E and retraction forces R for the same elastic laminate construction, with Graph 4 showing these forces without integrative pre-stretching the elastic laminate, Graph 5 showing these forces after integratively pre-stretching the elastic laminate 100%, and Graph 6 showing these forces after integratively pre-stretching the elastic laminate 150%. In each of these graphs, the first cycle extension forces E_1 would correspond to the fitting force F_{fit} and the second cycle extension forces E_2 would correspond to the extension forces during use of the diaper (e.g., when the wearer's belly expands). Graphs 4 - 6 demonstrate that the magnitude/profile of the reduction of the extension force E_2 due to integrative pre-stretching can differ depending upon the degree of pre-stretching (e.g., 50%, 100%, 150%, 200%, etc.). In any or every event, the pre-stretching extension should not exceed the upper recoverable extension limit of the elastic laminate.

One may now appreciate that integrative pre-stretching of an elastic laminate can reduce required fitting forces for the elastic component 20/22/24 during the initial fitting of the diaper, facilitate comfortable waist extensions/retractions of the component 20/22/24 during use of the diaper, allow production of the component 20/22/24 from a wider range of elastic laminates, and/or guard against over-extension of the component 20/22/24.

Although the diaper 10, the components 20/22/24, the laminate 30, the method, and/or method steps have been shown and described with respect to certain embodiments, equivalent alterations and modifications will occur to others skilled in the art upon the reading and understanding of this specification and the annexed drawings. In regard to the various functions performed by the above described elements (e.g., components, assemblies, systems, devices, compositions, etc.), the terms (including a reference to a "means") used to describe such elements are intended to correspond, unless otherwise indicated, to any element which performs the specified function of the described element (i.e., that is functionally equivalent), even though not structurally equivalent to the disclosed structure which performs the function. In addition, while a particular feature may

have been described above with respect to only one or more of several illustrated embodiments, such features may be combined with one or more other features of the other embodiments, as may be desired and advantageous for any given or particular application.

CLAIMS

1. A method of making an elastic diaper component (20/22/24), comprising the steps of:

5 providing an elastic laminate (30) including an elastic layer (32) and a fabric layer (34), wherein the elastic laminate (30) has a recoverable extension of at least 20% when an extension force E_1 is applied; and

10 integratively pre-stretching the elastic laminate (30) so that the elastic laminate (30) will stretch to the same recoverable extension when a reduced extension force E_2 is applied;

whereby, when the elastic laminate (30) is used in the elastic diaper component (20/22/24), a lesser fitting force F_{fit} is required to extend the elastic component (20/22/24) to a desired length during an initial fitting of a diaper (10) on a wearer.

15 2. A method as set forth in the preceding claim wherein the elastic laminate (30) has a recovering retraction force R_1 when the extension force E_1 is released and a recovering retraction force R_2 when the extension force E_2 is released; and wherein the recovering retraction force R_2 is substantially the same as the recovering retraction force R_1 .

25 3. A method as set forth in either of the two preceding claims, wherein the integrative pre-stretching step comprises an at least 50% extension of the elastic laminate (30).

4. A method as set forth in claim 3, wherein the integrative pre-stretching step comprises an at least 100% extension of the elastic laminate (30).

30 5. A method as set forth in claim 3, wherein the integrative pre-stretching step comprises an at least 150% extension of the elastic laminate (30).

6. A method as set forth in claim 3, wherein the integrative pre-stretching step comprises an at least 200% extension of the elastic laminate (30).

7. A method as set forth in any of the preceding claims, wherein the
5 elastic layer (32) is not continuous across the width of the elastic laminate (30).

8. A method as set forth in any of the preceding claims, wherein the fabric layer (34) is a nonwoven layer.

10 9. A method as set forth in claim 8, wherein the fabric layer (34) is an elastic nonwoven layer.

10. A method as set forth in claim 8, wherein the fabric layer (34) is an inelastic nonwoven layer.

15 11. A method as set forth in any of the preceding claims, wherein the fabric layer (34) is continuous across the laminate width.

12. A method as set forth in any of the preceding claims, wherein the
20 elastic laminate (30) comprises a second fabric layer (36).

13. A method as set forth in claim 12, wherein the second fabric layer (36) is a nonwoven layer.

25 14. A method as set forth in claim 13, wherein the second fabric layer (36) is an elastic nonwoven layer.

15. A method as set forth in claim 13, wherein the second fabric layer (36) is an inelastic nonwoven layer.

30 16. A method as set forth in any of claims 12 - 15, wherein the second fabric layer (36) is continuous across the laminate width.

17. A method as set forth in any of claims 12 - 15, wherein the second fabric layer (36) is not continuous across the laminate width.

18. A method as set forth in any of claims 12 - 17, wherein the elastic layer (32) is positioned between the two fabric layers (34/36).

19. A method as set forth in any of the preceding claims, wherein the fabric layer (34) and/or the fabric layer (36) is manipulated prior to said integrative pre-stretching step to allow it to extend/retract with the elastic layer (32).

10

20. A method as set forth in claim 19, wherein the fabric layer (34) and/or the fabric layer (36) is mechanically manipulated prior to said integrative pre-stretching step to allow it to extend/retract with the elastic layer (32).

21. A method as set forth in claim 20, wherein the fabric layer (34) and/or the fabric layer (36) is incrementally stretched prior to said integrative pre-stretching step.

22. A method as set forth in claim 21, wherein the incrementally stretched portion is continuous across the laminate width.

23. A method as set forth in claim 21, wherein the incrementally stretched portion occupies only a section of the laminate width.

24. A method as set forth in any of the preceding claims, wherein the fabric layer (34/36) has interruptions formed therein prior to said integrative pre-stretching step.

25. A method as set forth in claim 24, wherein the interruptions extend partially through the layer thickness of the fabric layer (34/36) and tendons extend through the rest of the layer thickness.

26. A method as set forth in claim 25, wherein the interruptions extend 10% to 99% through the thickness of the fabric layer (34/36).

27. A method as set forth in claim 26, wherein the interruptions extend
5 20% to 99% through the thickness of the fabric layer (34/36).

28. A method as set forth in claim 27, wherein the interruptions extend 30% to 99% through the thickness of the fabric layer (34/36).

10 29. A method as set forth in claim 28, wherein the interruptions extend 40% to 99% through the thickness of the fabric layer (34/36).

30. A method as set forth in claim 29, wherein the interruptions extend 50% to 99% through the thickness of the fabric layer (34/36).

15 31. A method as set forth in claim 30, wherein the interruptions extend 60% to 99% through the thickness of the fabric layer (34/36).

32. A method as set forth in claim 31, wherein the interruptions extend
20 70% to 99% through the thickness of the fabric layer (34/36).

33. A method as set forth in claim 32, wherein the interruptions extend 80% to 99% through the thickness of the fabric layer (34/36).

25 34. A method as set forth in any of claims 24 - 33, wherein the interruptions comprise die-cuts, kiss-cuts, slits, scores, laser-cuts, and/or ultrasound-cuts.

35. A method as set forth in any of claims 24 - 34, wherein the
30 interruptions are proximal interruptions and the tendons are distal tendons.

36. A method as set forth in any of claims 24 - 34, wherein the interruptions are distal interruptions and the tendons are proximal interruptions.

37. A method as set forth in any of claims 24 - 36, wherein said
5 integrative pre-stretching step comprises rupturing at least some of said tendons.

38. A method as set forth in the preceding claim, wherein said rupturing step results in the fabric layer (34/36) being divided into separable fabric segments (38/40) which diverge upon elongation and converge upon recovery.

10

39. A method as set forth in any of claims 24 - 38, wherein the interrupted portion is continuous across the laminate width.

40. A method as set forth in any of claims 24 - 38, wherein the interrupted
15 portion occupies only a section of the laminate width.

41. A diaper component (20/22/24) comprising the pre-stretched elastic laminate (30) made by the method set forth in claims 37 - 40, the laminate (30) comprising separable fabric segments (38/40) which diverge upon elongation of the
20 laminate (30) and converge upon recovery of the laminate (30), the segments (38/40) being formed by the interruptions and the tendons ruptured by the integrative stretching.

42. A method as set forth in any of claims 1 - 40, wherein said
25 integratively stretching step comprises urging the elastic laminate (30) laterally outward to temporarily widen its span.

43. A method as set forth in any of claims 1 - 40, wherein said
30 integratively stretching step comprises causing the elastic laminate (30) to travel through a curved route to temporarily widen its span.

44. A method as set forth in any of claims 1 - 40, wherein said integratively stretching step comprises conveying a portion of the elastic laminate (30) through an offset path to temporarily widen its span.

5 45. A method as set forth in any of claims 1 - 40, wherein said integratively stretching step comprises stretching the elastic laminate in an amalgamated manner across its width.

10 46. A method as set forth in any of claims 1 - 40, wherein said integratively stretching step comprises stretching the elastic laminate in an amalgamated manner across portions of its width.

47. A method as set forth in any of claims 1 - 46, further comprising the step of separating the elastic laminate (30) into side panel shapes.

15 48. A method as set forth in any of claims 1 - 46, further comprising the step of separating the elastic laminate (30) into fastener tape shapes.

20 49. A method as set forth in any of claims 1 - 46, further comprising the step of separating the elastic laminate (30) into belt shapes.

50. A method as set forth in claim 47 or claim 48, wherein said separating step is performed after said integrative stretching step.

25 51. A method comprising incorporating a pre-stretched component (20/22/24) made by the method set forth in any of the preceding claims into a diaper (10).

30 52. A method as set forth in claim 51, wherein said integrative pre-stretching step is performed prior to said incorporation.

53. A method comprising the step of integratively pre-stretching an elastic laminate (30) so that, when the elastic laminate (30) is used in a elastic diaper component (20/22/24), a lesser fitting force F_{fit} is required.

5 54. A method comprising the steps of providing a laminate (30) and integratively pre-stretching the elastic laminate (30);

wherein the laminate (30) comprises an elastic layer (32) and at least one fabric layer (34/36) laminated thereto;

10 wherein the fabric layer (34/36) has interruptions formed therein prior to said integrative pre-stretching step;

wherein the interruptions extend partially through the layer thickness of the fabric layer (34/36) and tendons extend the rest of the way through the fabric thickness; and

15 wherein said integrative pre-stretching step comprises rupturing at least some of said tendons and dividing the fabric layer (34/36) into separable fabric segments (38/40) which diverge upon elongation and converge upon recovery.

20 55. A method as set forth in claim 54, wherein the interruptions extend 10% to 99% through the thickness of the fabric layer (34/36).

56. A method as set forth in claim 55, wherein the interruptions extend 20% to 99% through the thickness of the fabric layer (34/36).

25 57. A method as set forth in claim 56, wherein the interruptions extend 30% to 99% through the thickness of the fabric layer (34/36).

58. A method as set forth in claim 57, wherein the interruptions extend 40% to 99% through the thickness of the fabric layer (34/36).

30 59. A method as set forth in claim 58, wherein the interruptions extend 50% to 99% through the thickness of the fabric layer (34/36).

60. A method as set forth in claim 59, wherein the interruptions extend 60% to 99% through the thickness of the fabric layer (34/36).

61. A method as set forth in claim 60, wherein the interruptions extend
5 70% to 99% through the thickness of the fabric layer (34/36).

62. A method as set forth in claim 61, wherein the interruptions extend 80% to 99% through the thickness fo the fabric layer (34/36).

10 63. A method as set forth in any of the claims 54 - 62, wherein the interruptions comprise die-cuts, kiss-cuts, slits, scores, laser-cuts, and/or ultrasound-cuts.

64. A method as set forth in any of claims 54 - 63, wherein the
15 interruptions are proximal interruptions and the tendons are distal tendons.

65. A method as set forth in any of claims 54 - 63, wherein the interruptions are distal interruptions and the tendons are proximal interruptions.

20 66. A method as set forth in any of claims 54 - 65, wherein the interrupted portion is continuous across the laminate width.

67. A method as set forth in any of claims 54 - 66, wherein the interrupted portion occupies only a section of the laminate width.

25

* * *

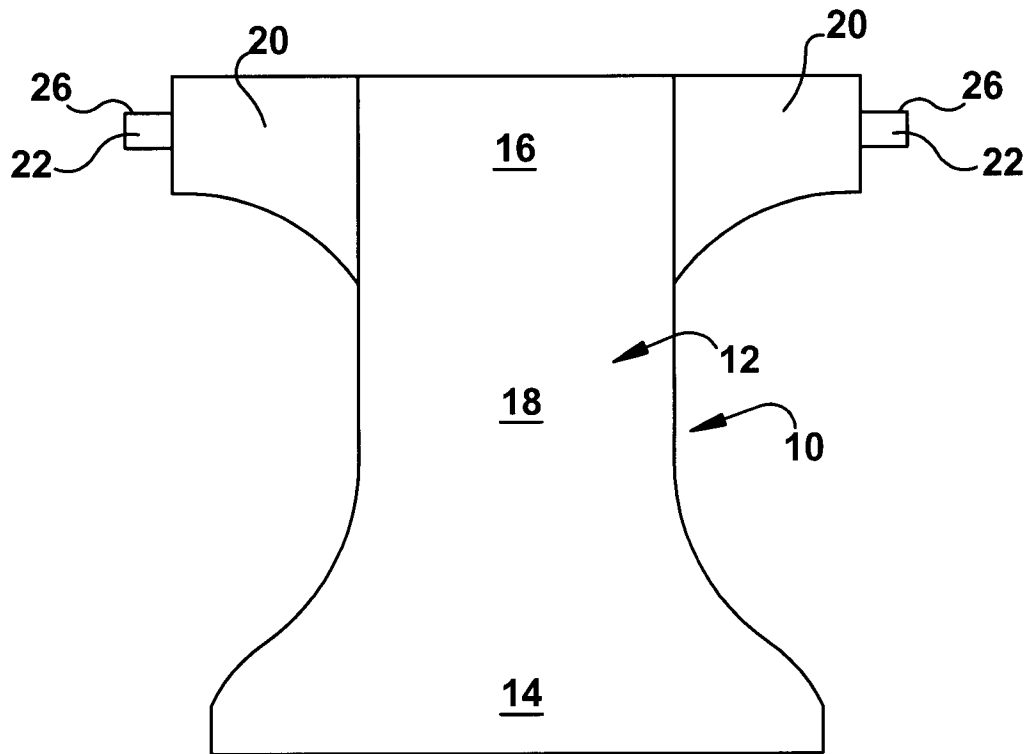


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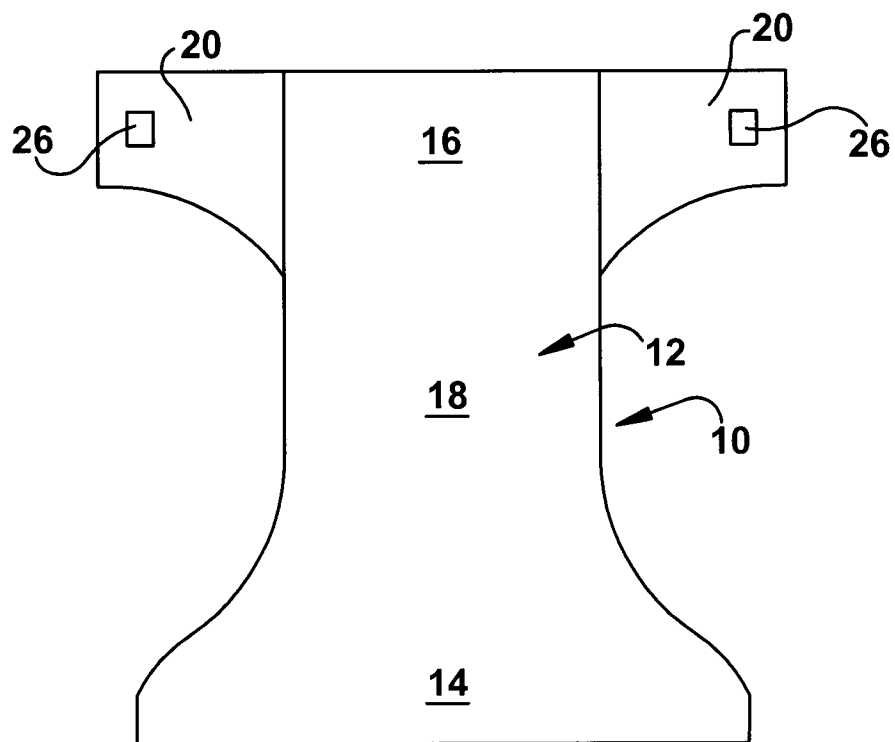


Figure 1B

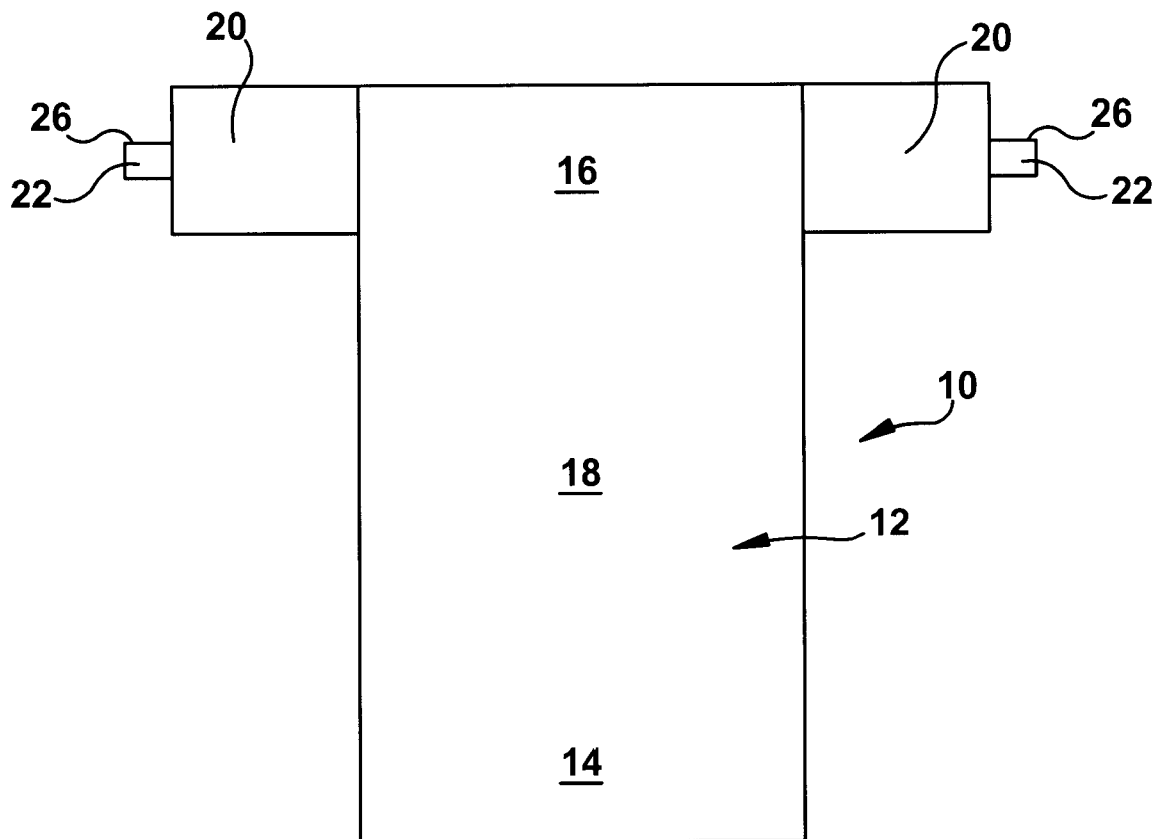


Figure 1C

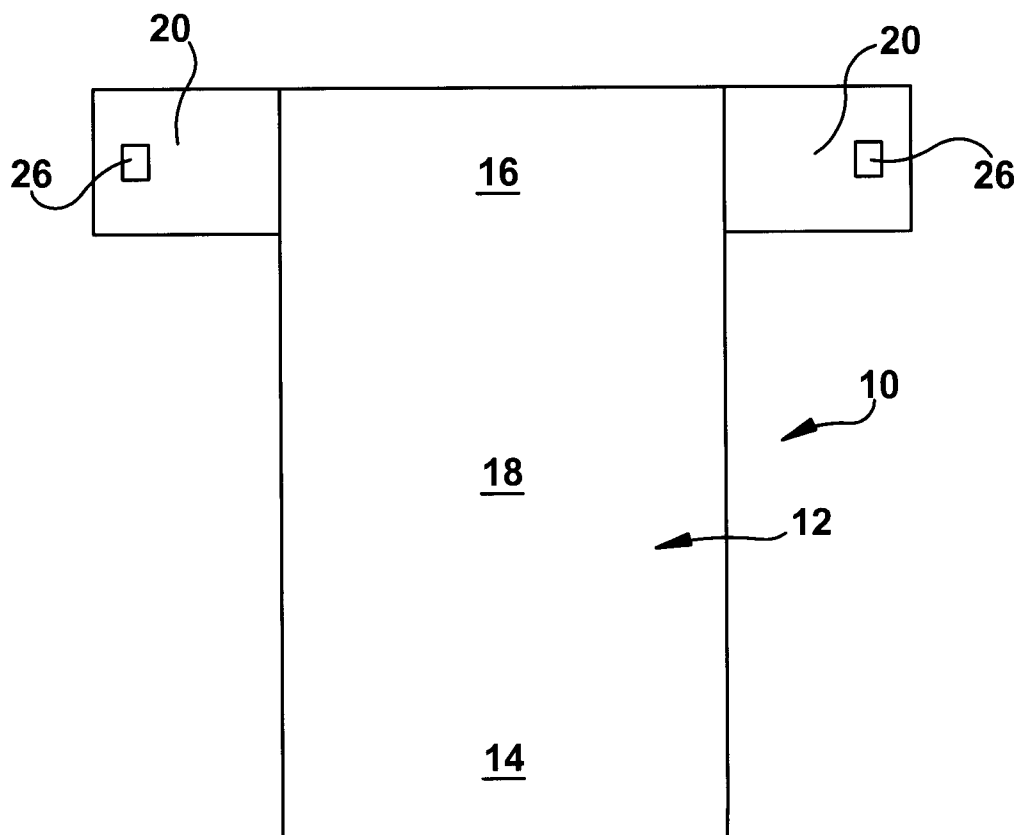


Figure 1D

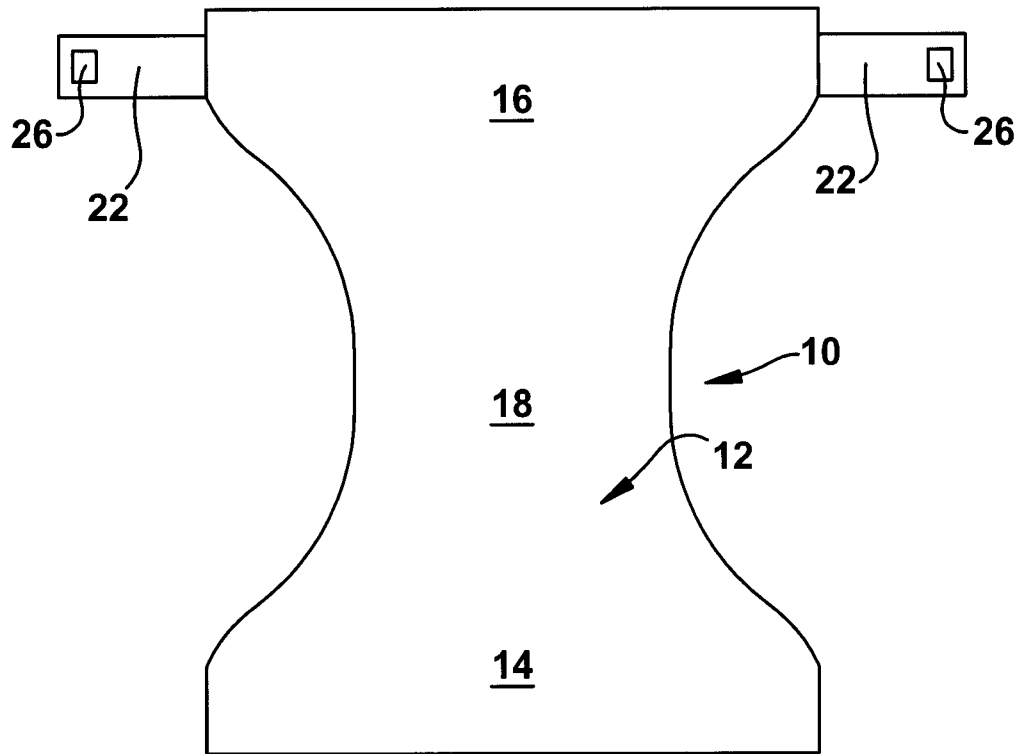


Figure 1E

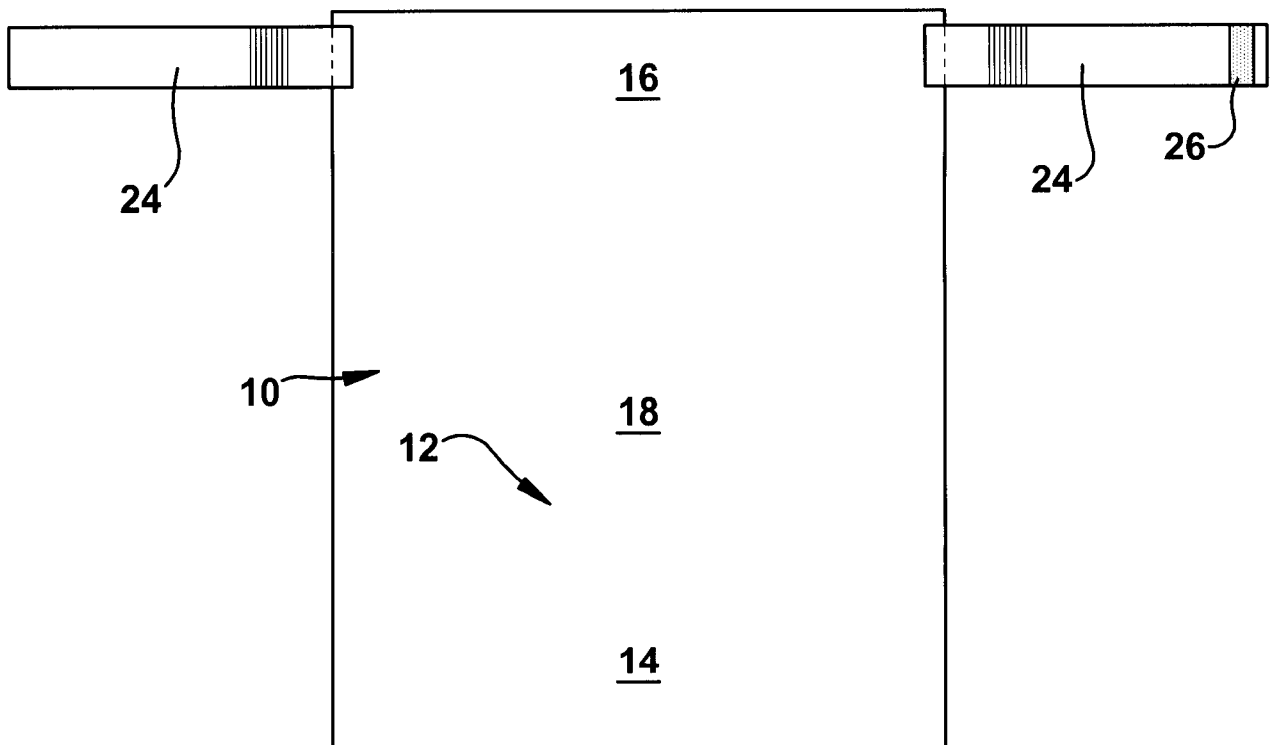


Figure 1F



Figure 2A

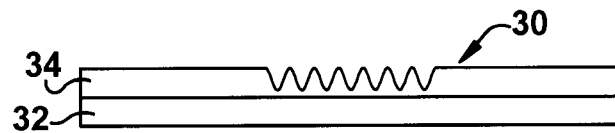


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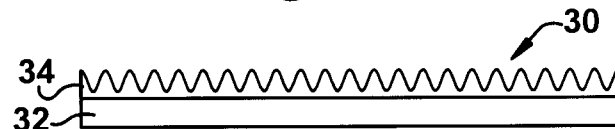


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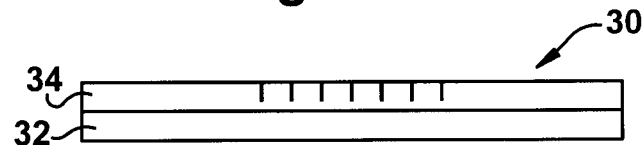


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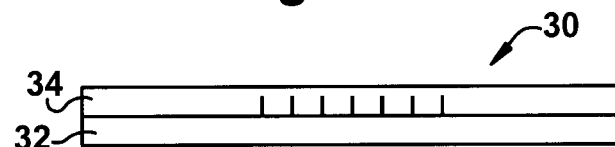


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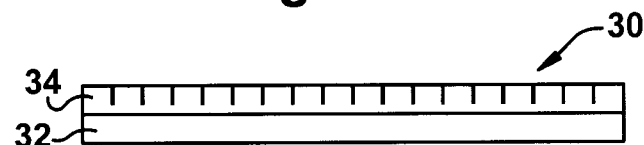


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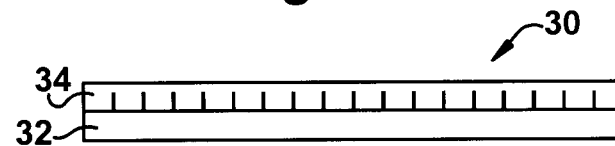


Figure 2G

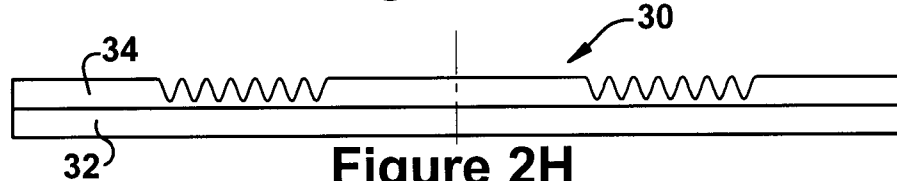


Figure 2H

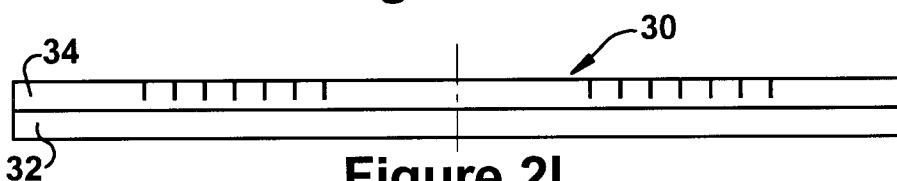


Figure 2I



Figure 2J

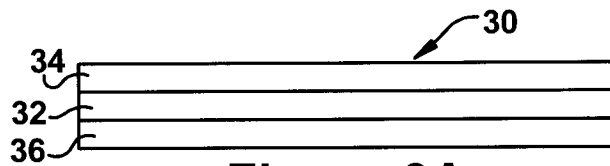


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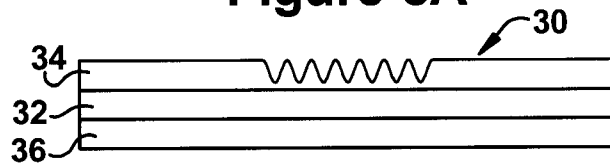


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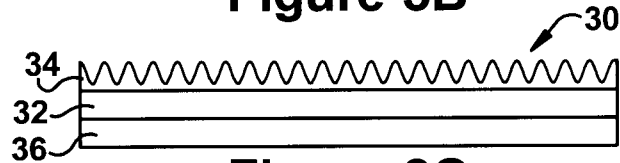


Figure 3C

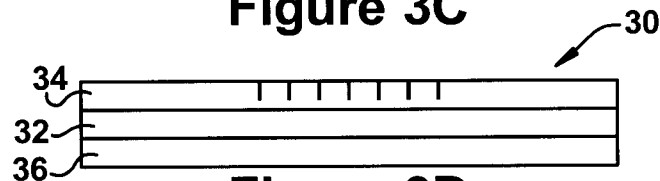


Figure 3D

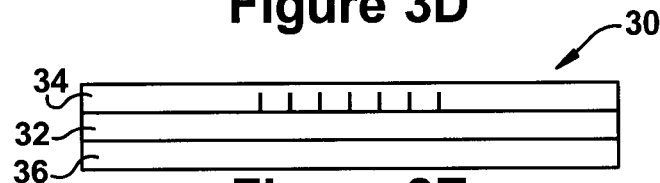


Figure 3E

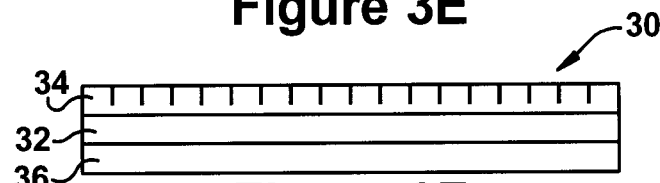


Figure 3F

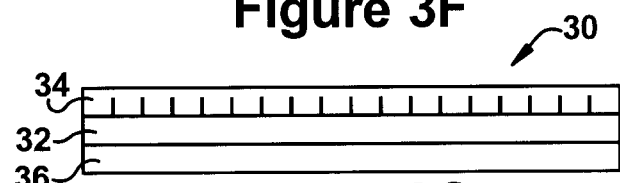


Figure 3G

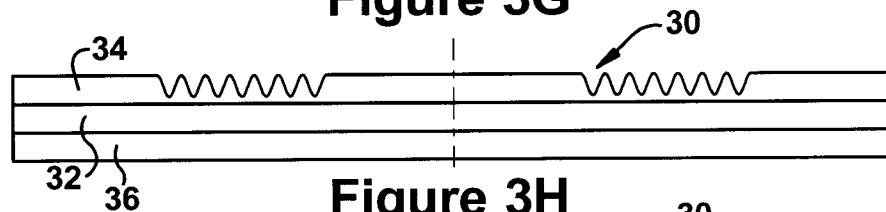


Figure 3H

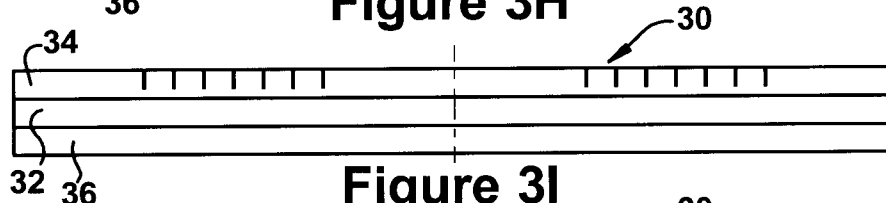


Figure 3I

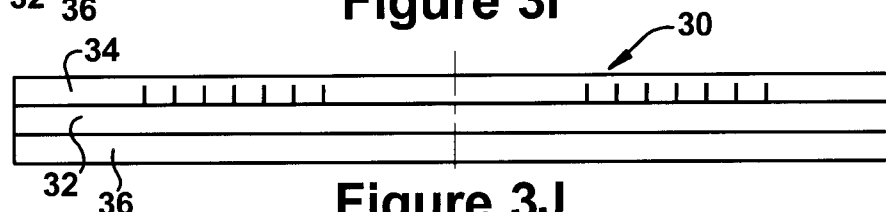


Figure 3J

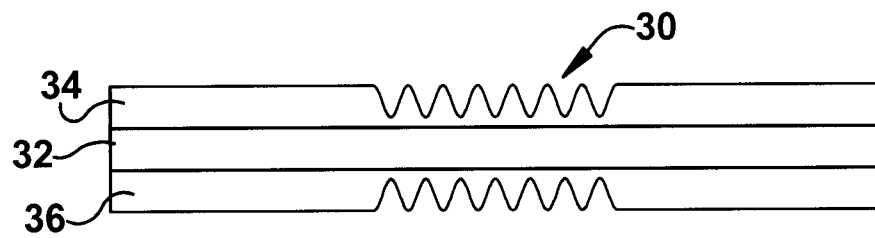


Figure 4A

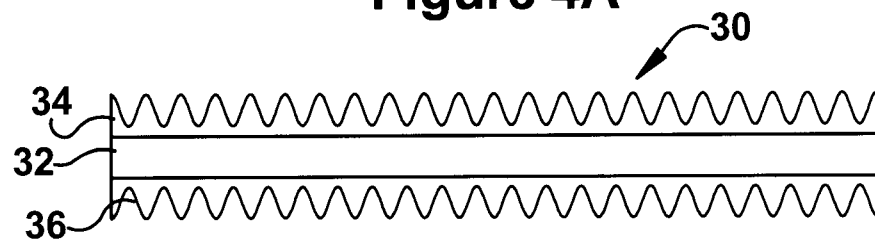


Figure 4B

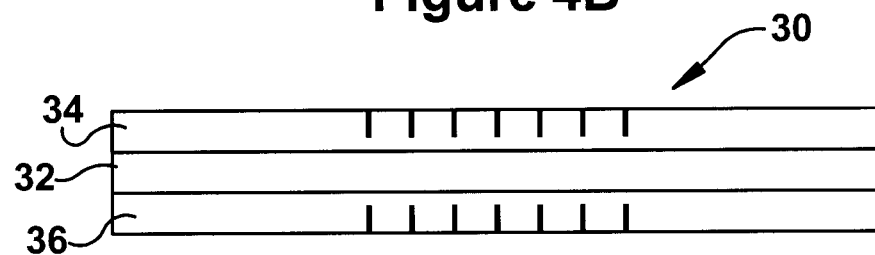


Figure 4C

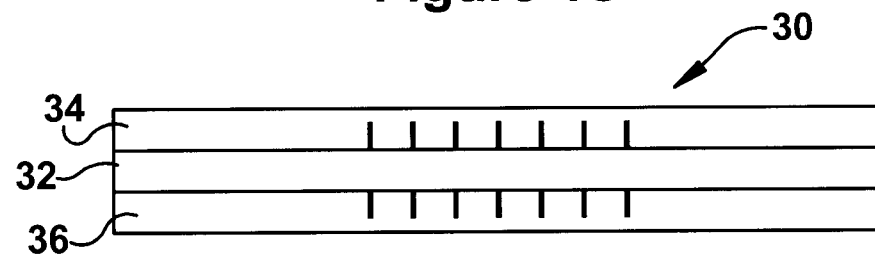


Figure 4D

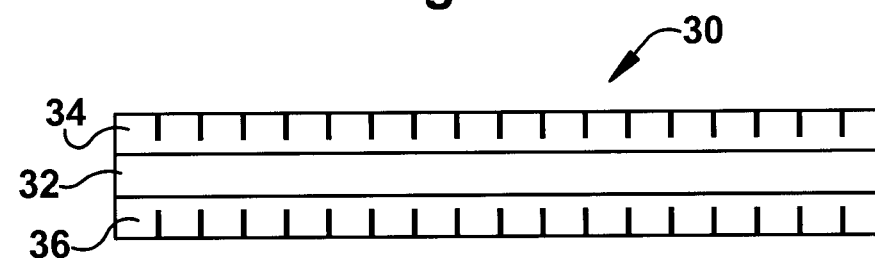


Figure 4E

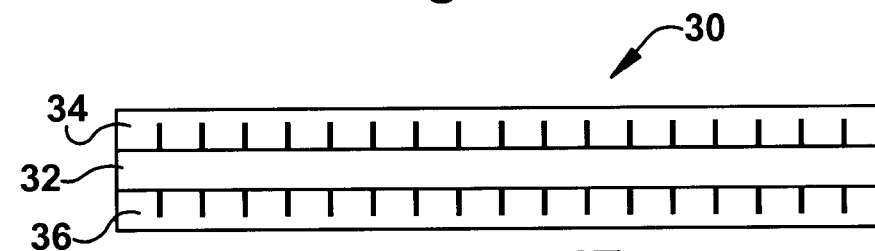
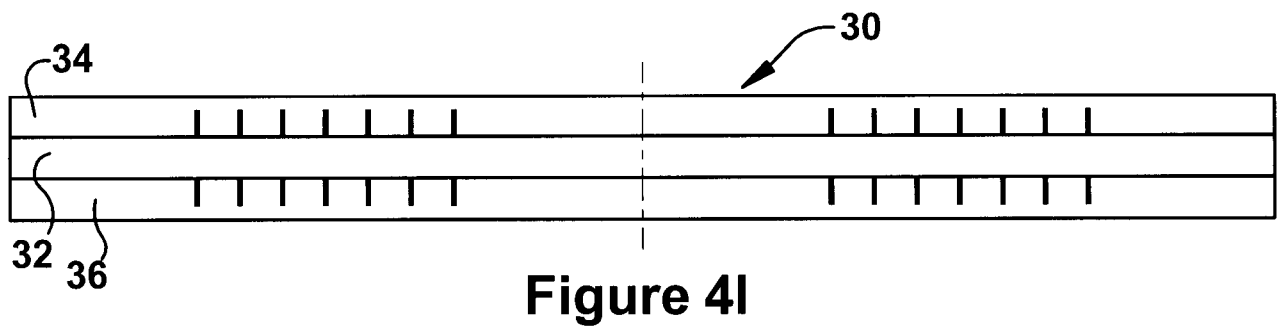
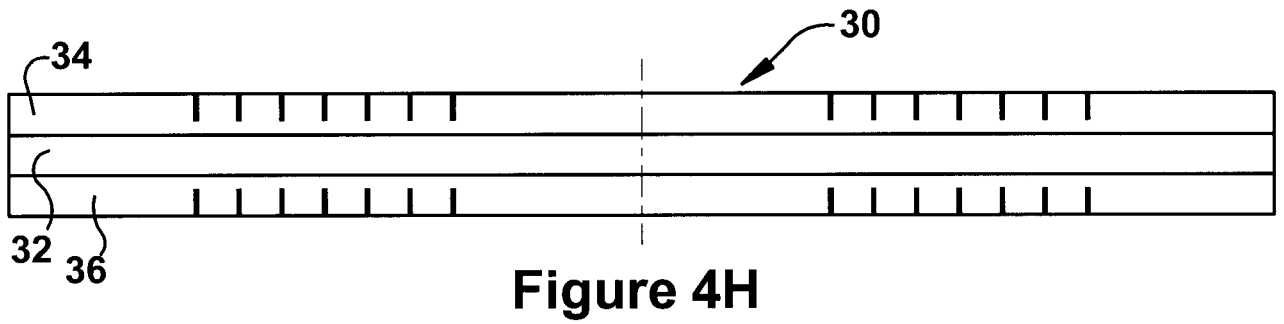
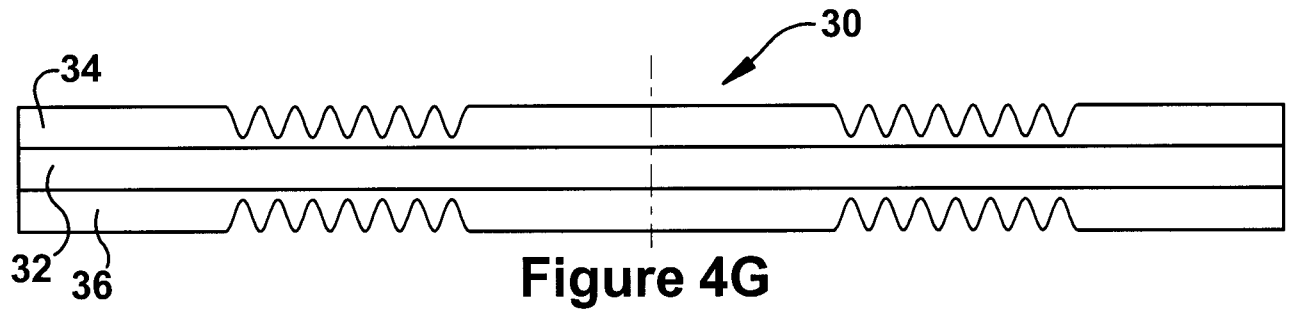


Figure 4F



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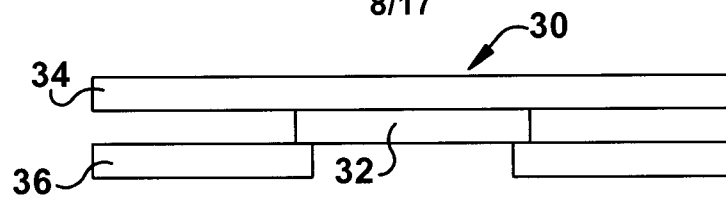


Figure 5A

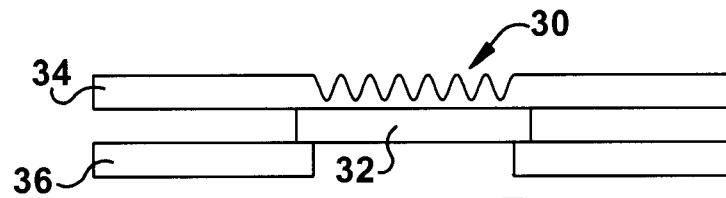


Figure 5B

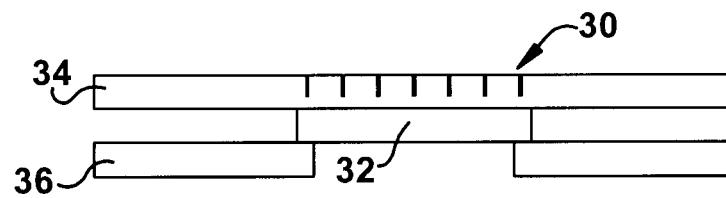


Figure 5C

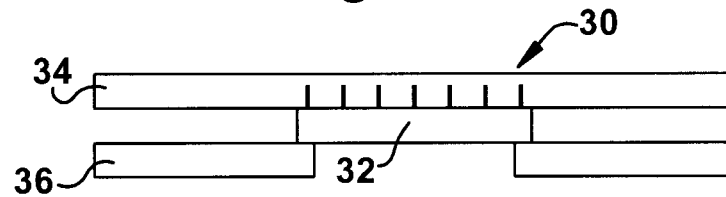


Figure 5D

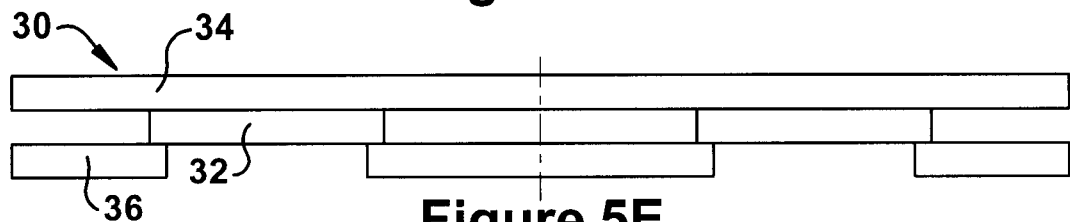


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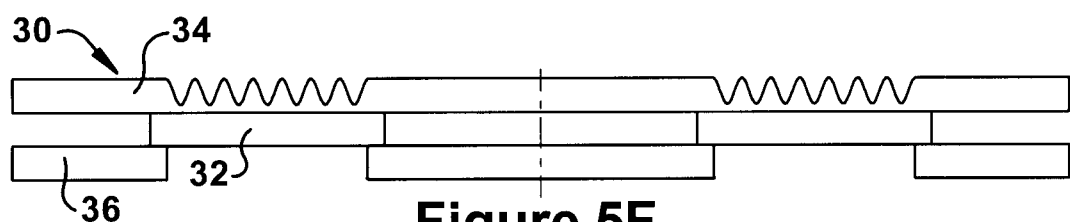


Figure 5F

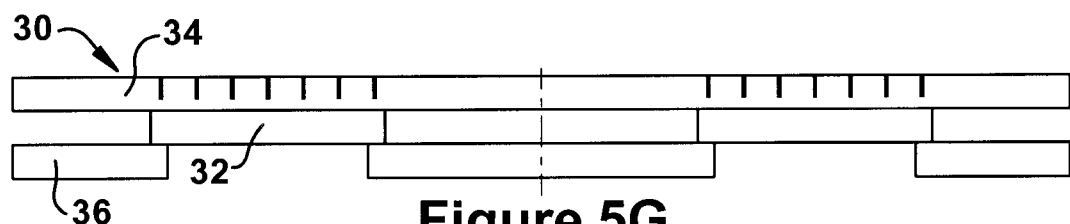


Figure 5G

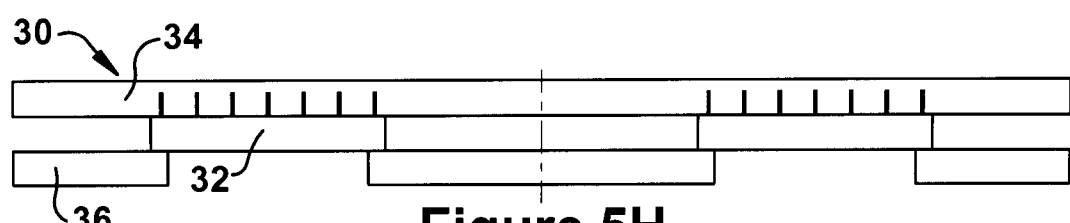
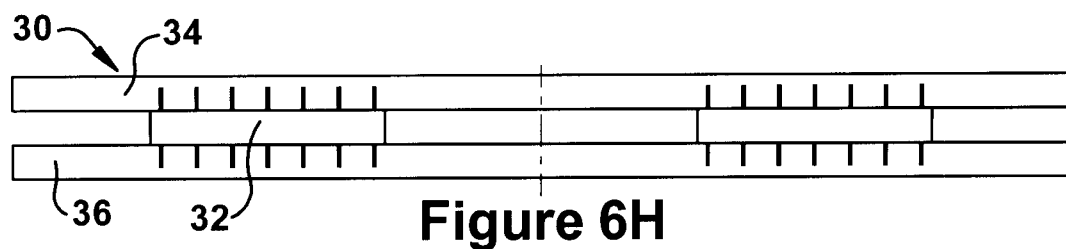
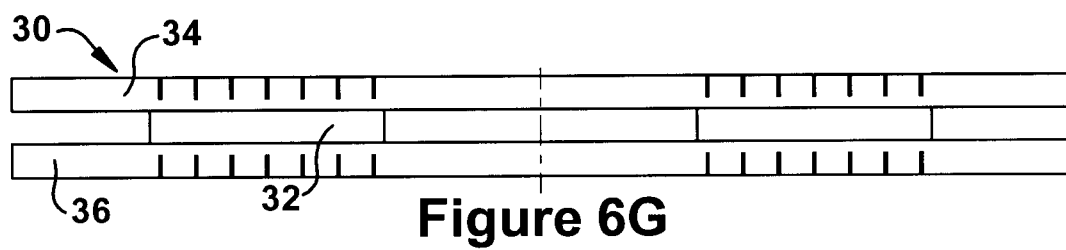
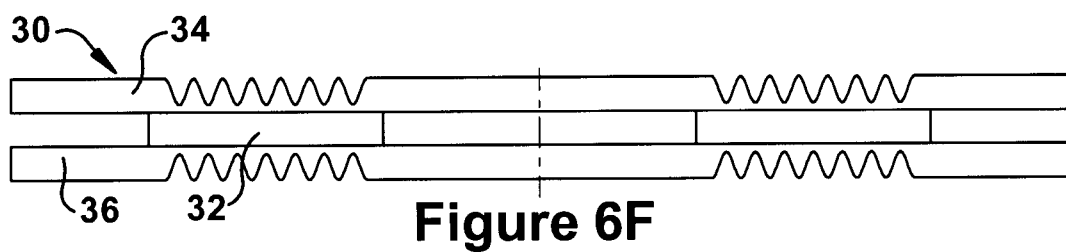
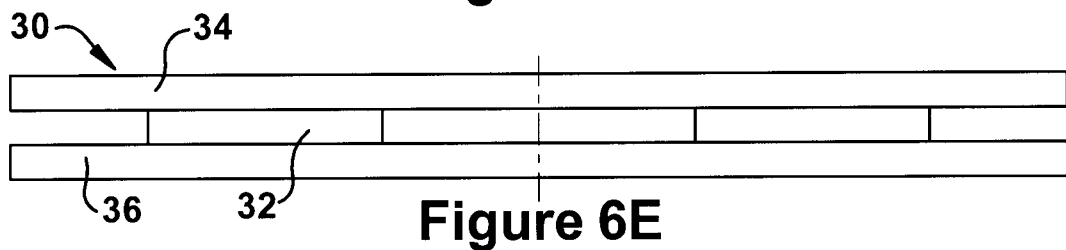
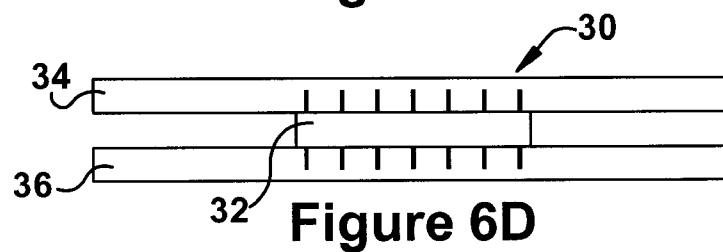
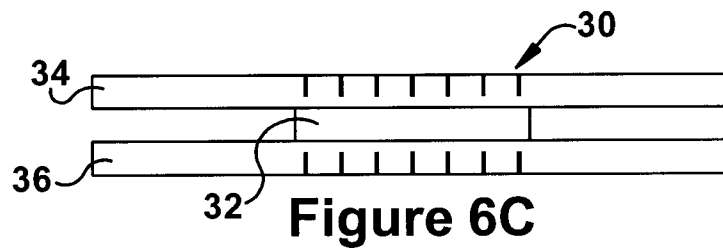
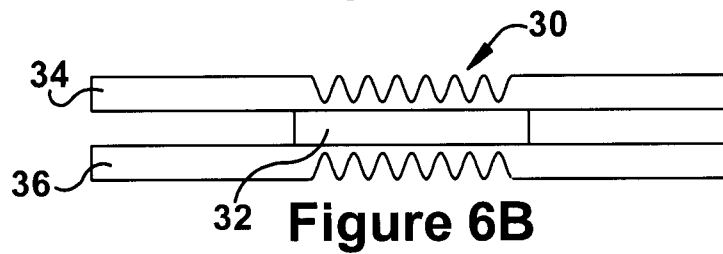
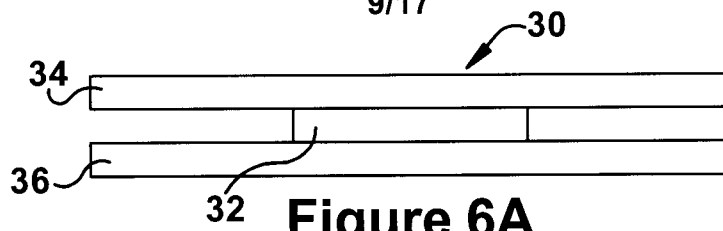


Figure 5H

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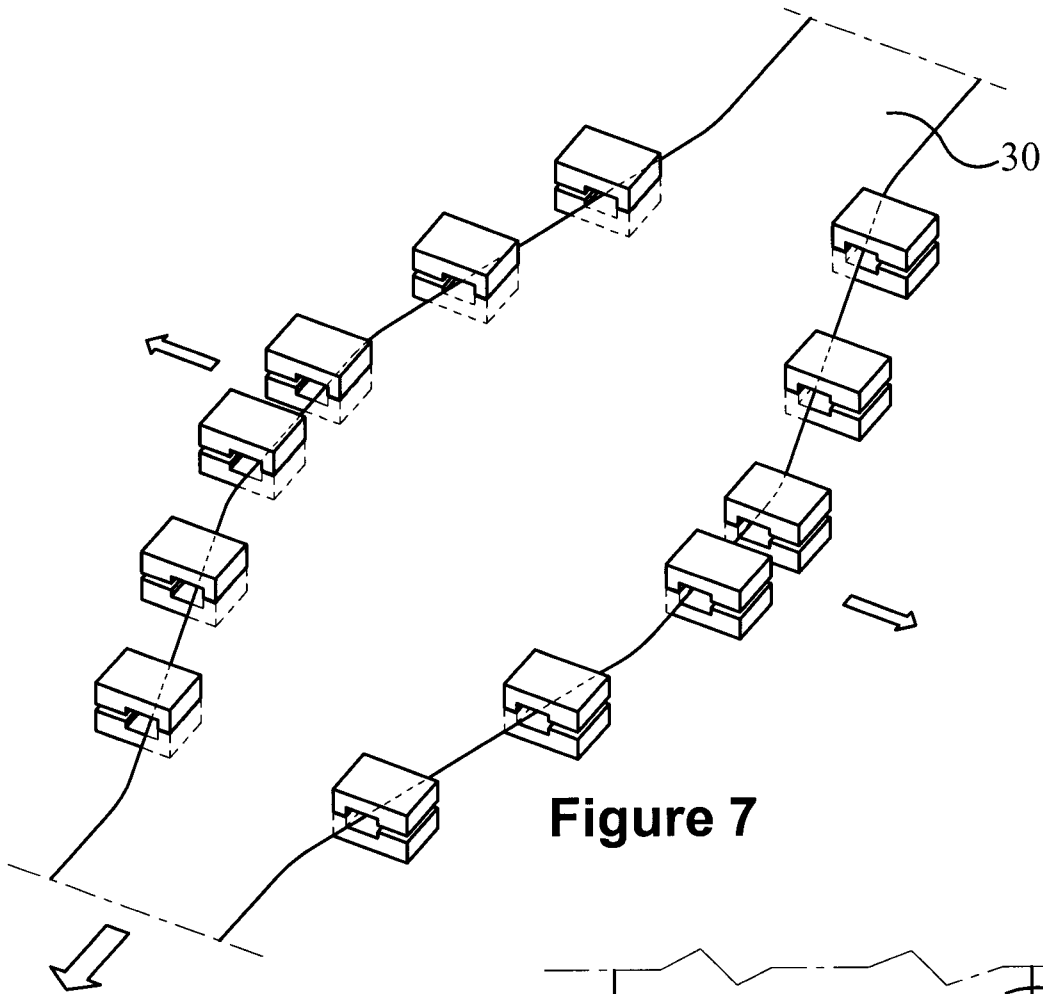


Figure 7

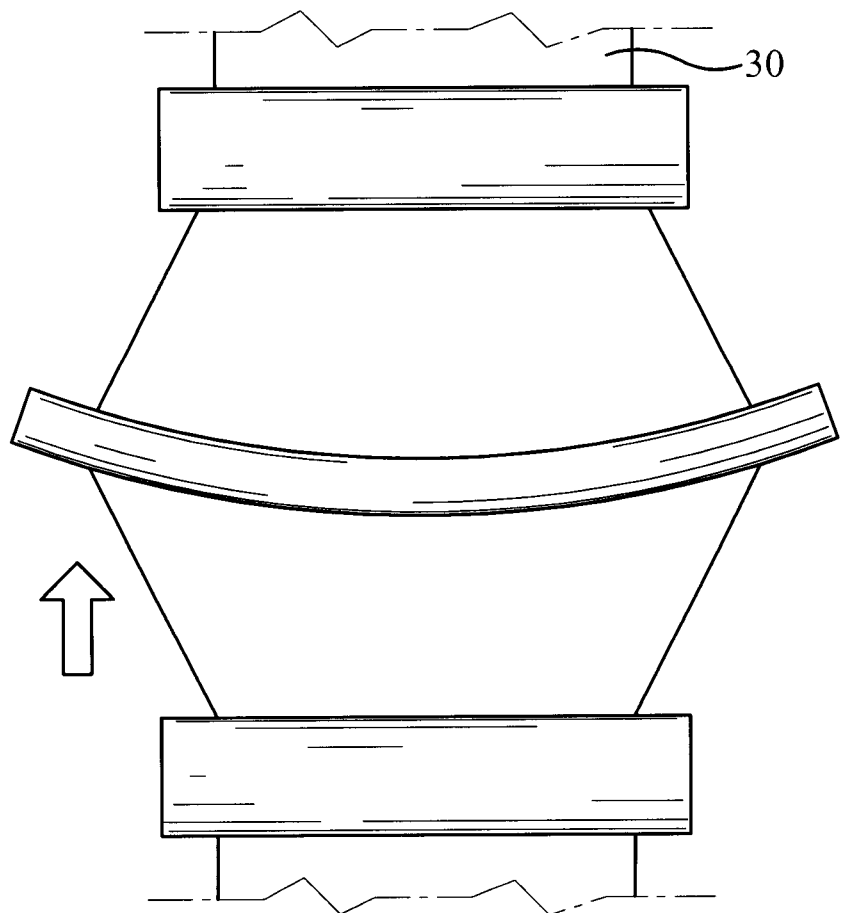


Figure 8

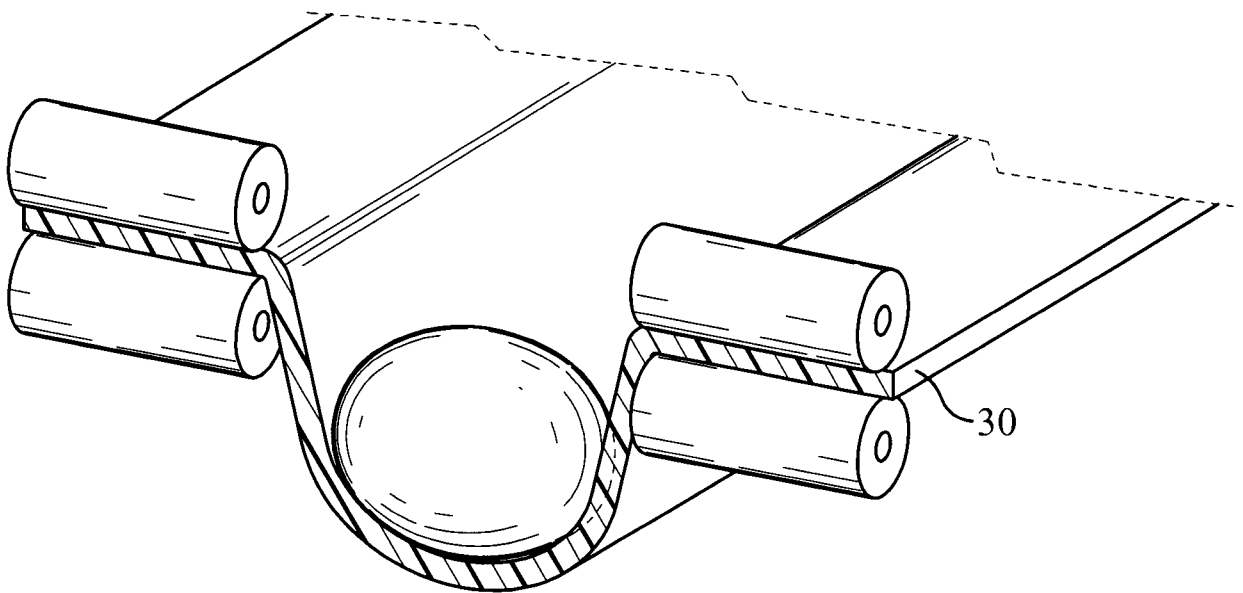
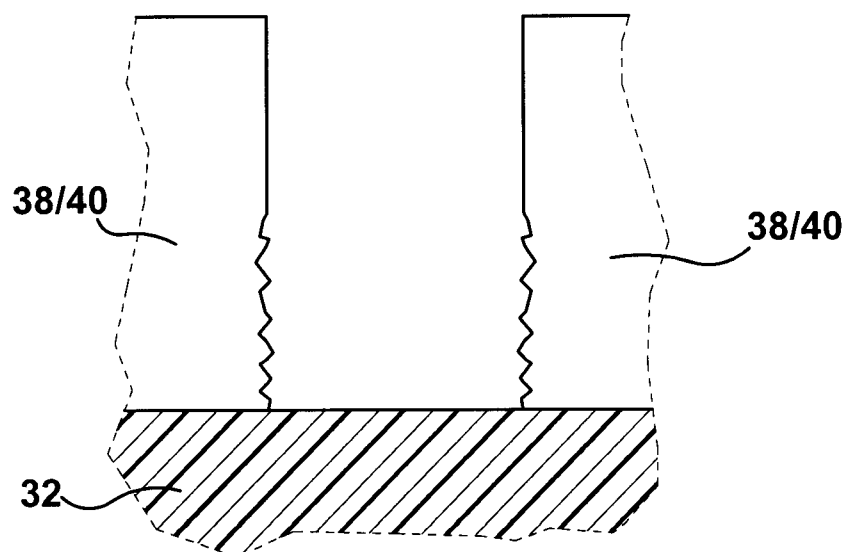
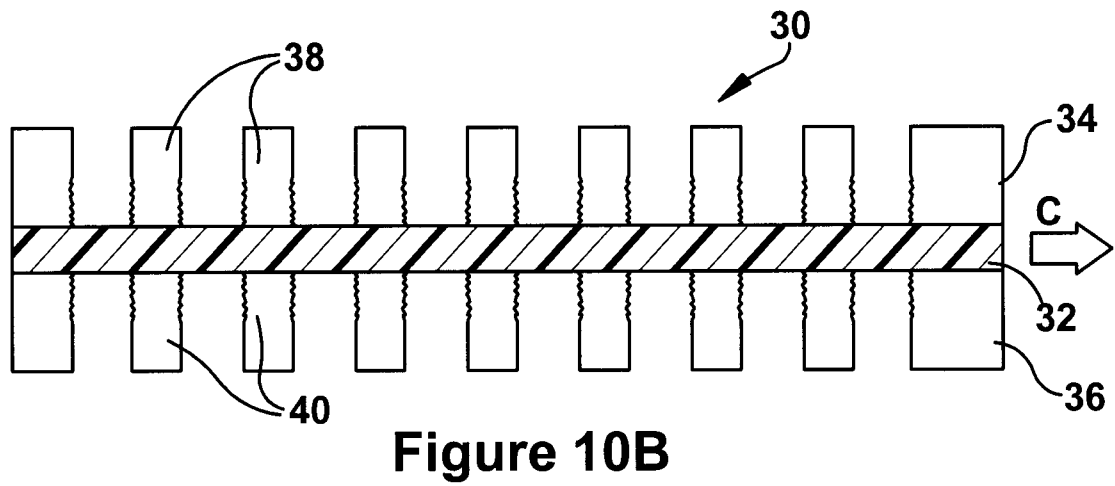
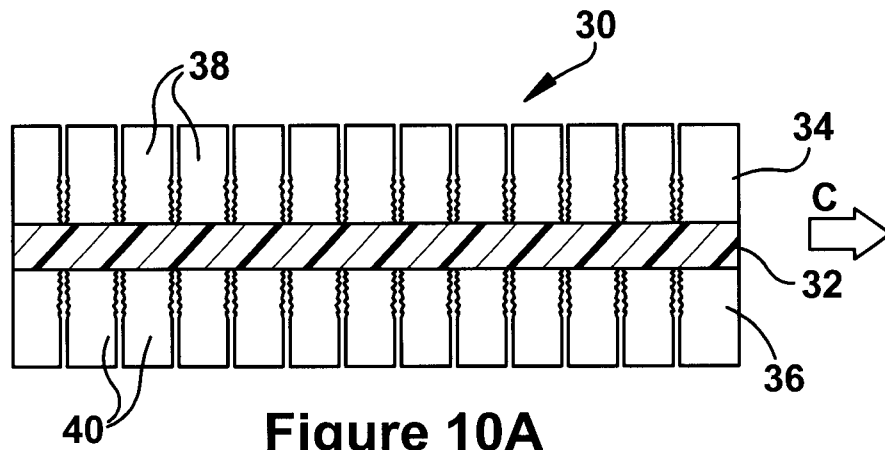


Figure 9



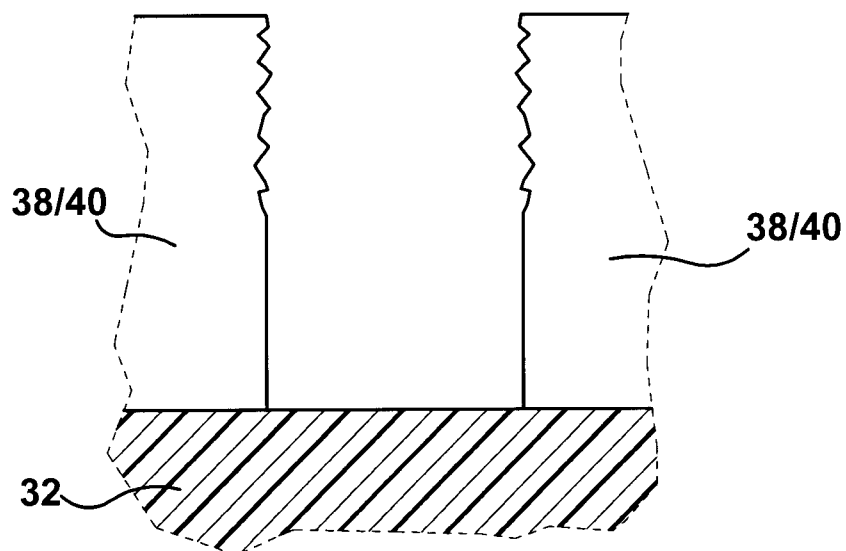
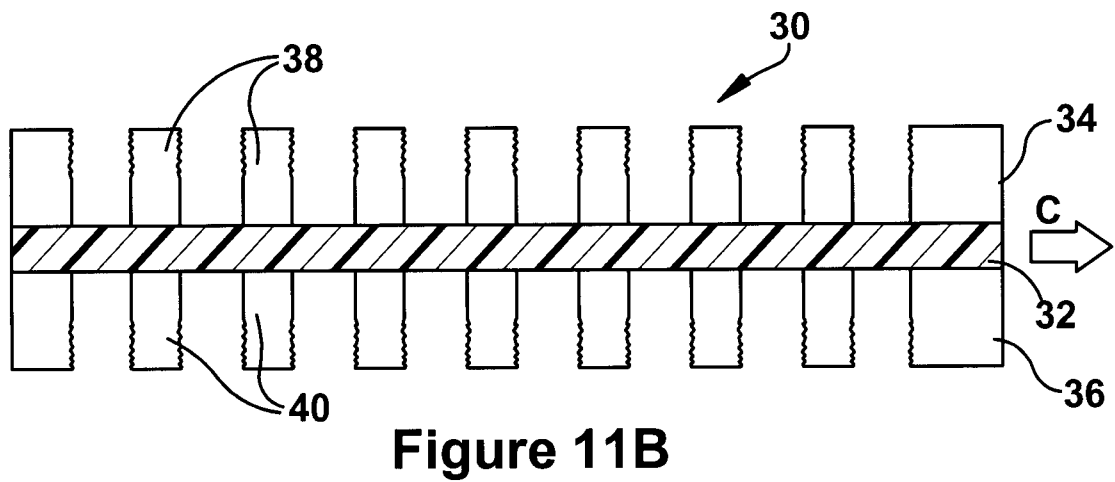
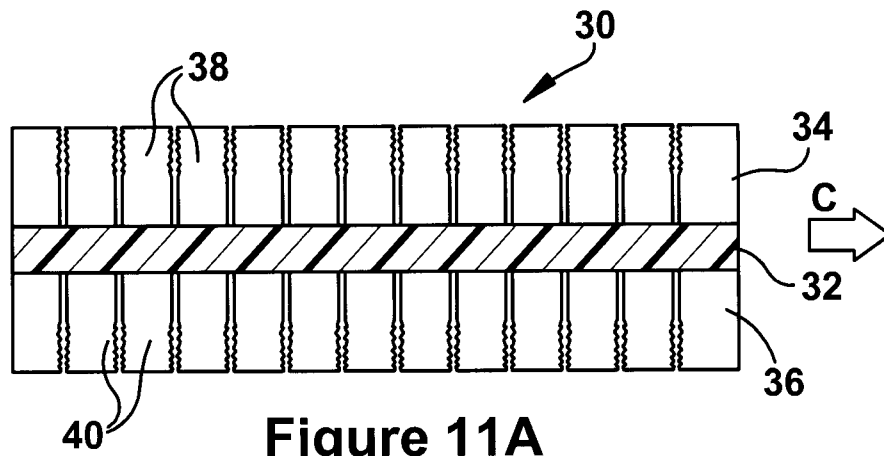


Figure 11C

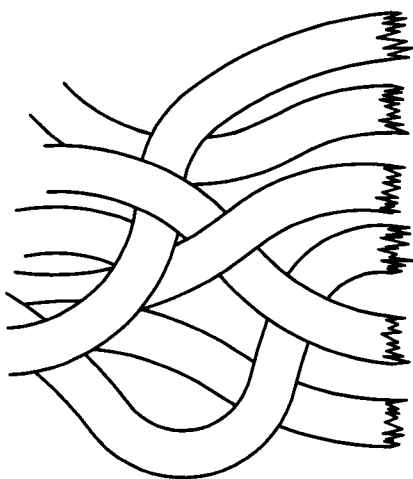


Figure 12A

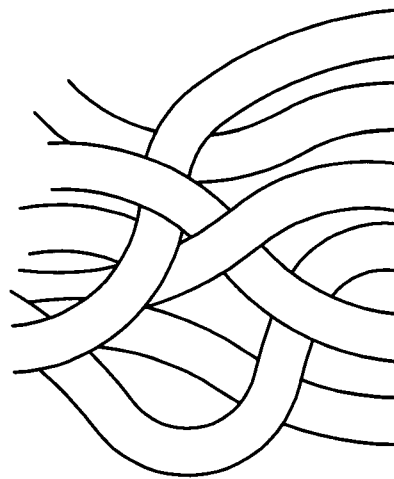
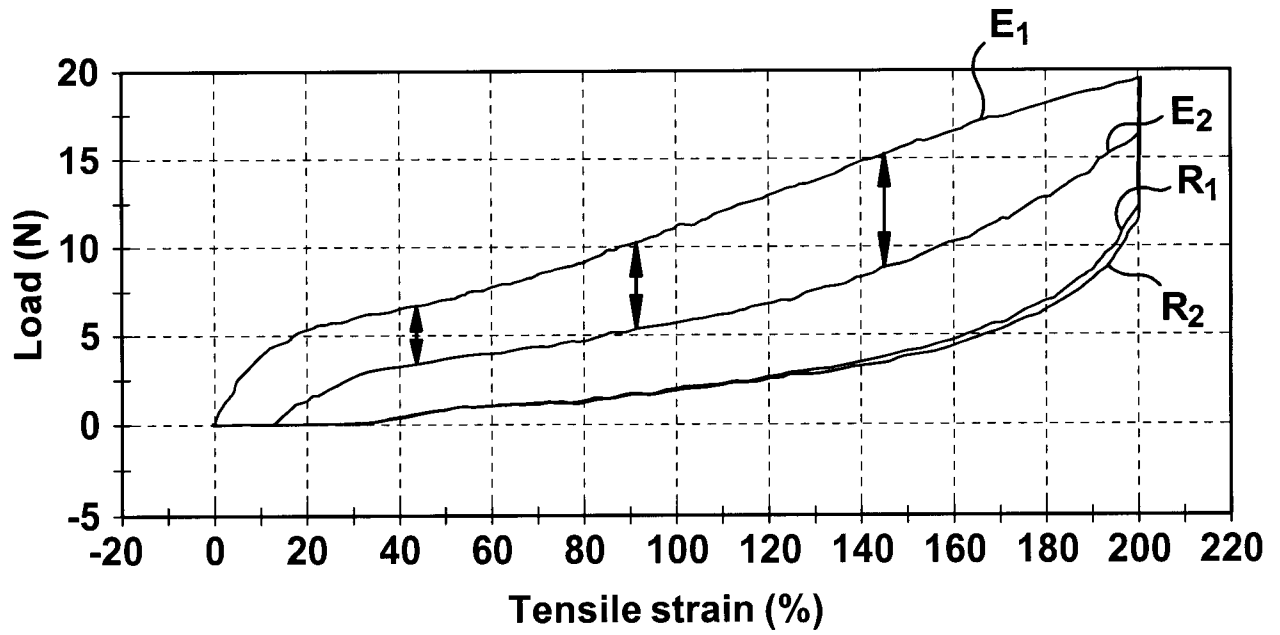
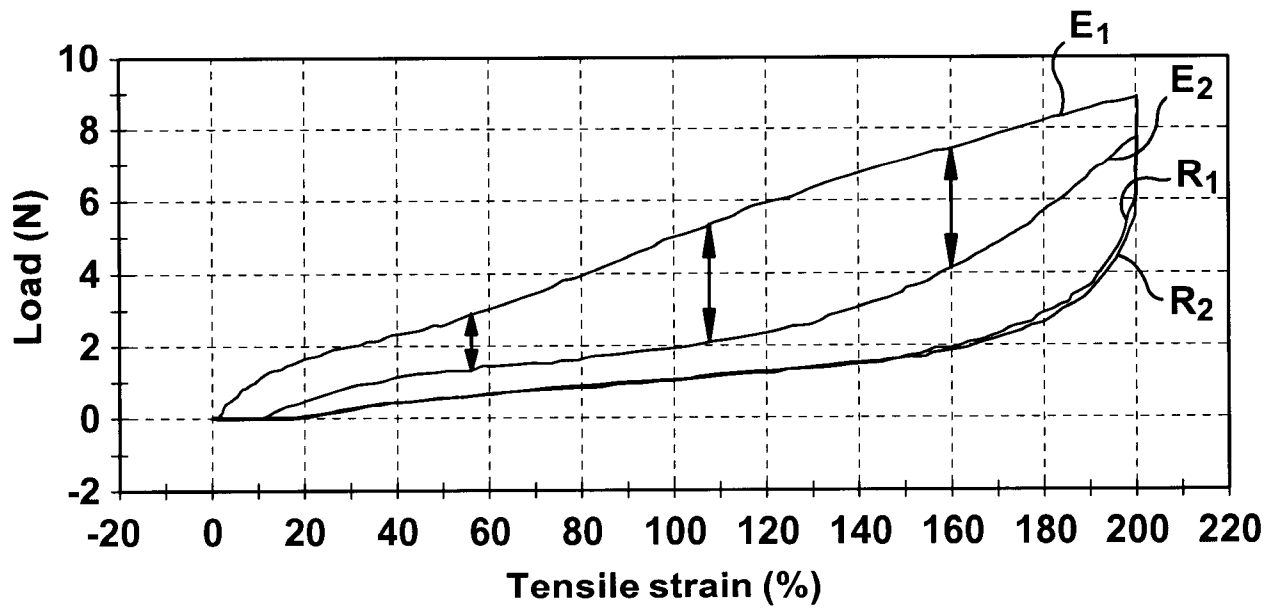
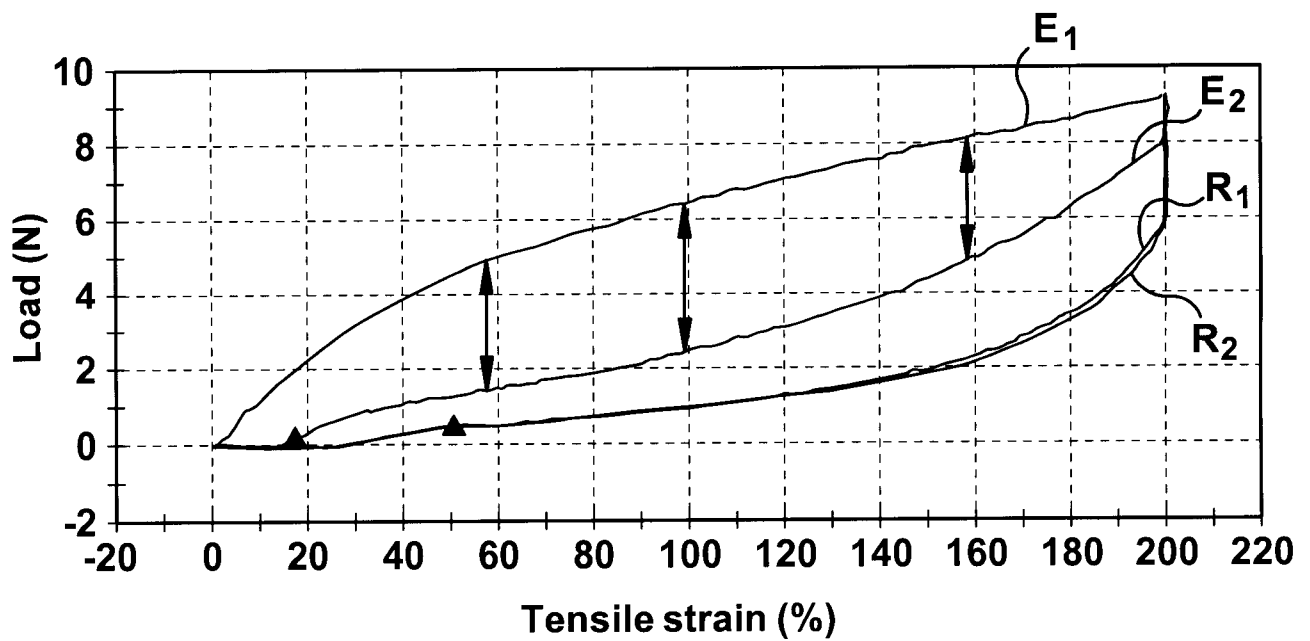
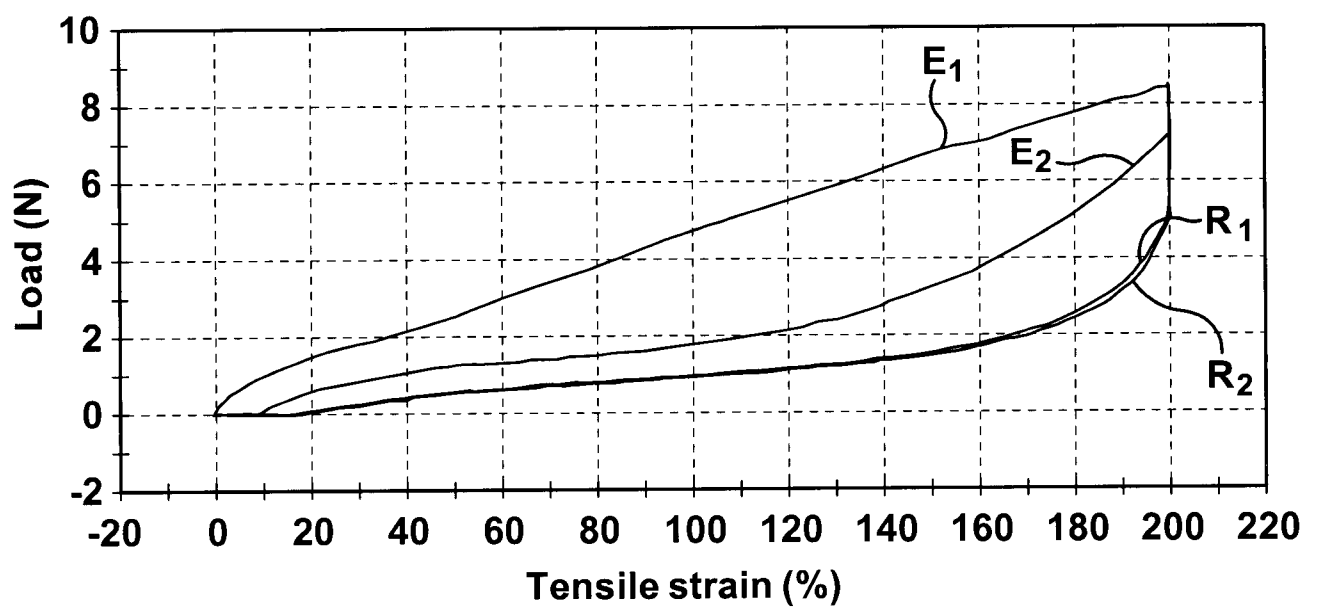
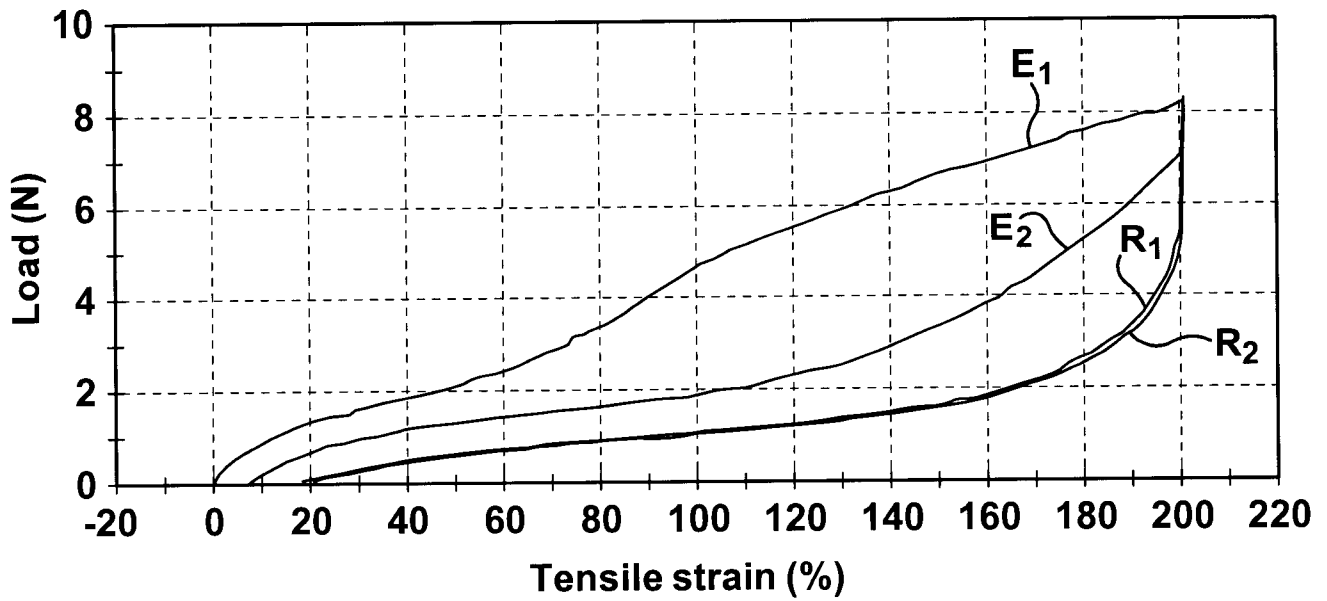
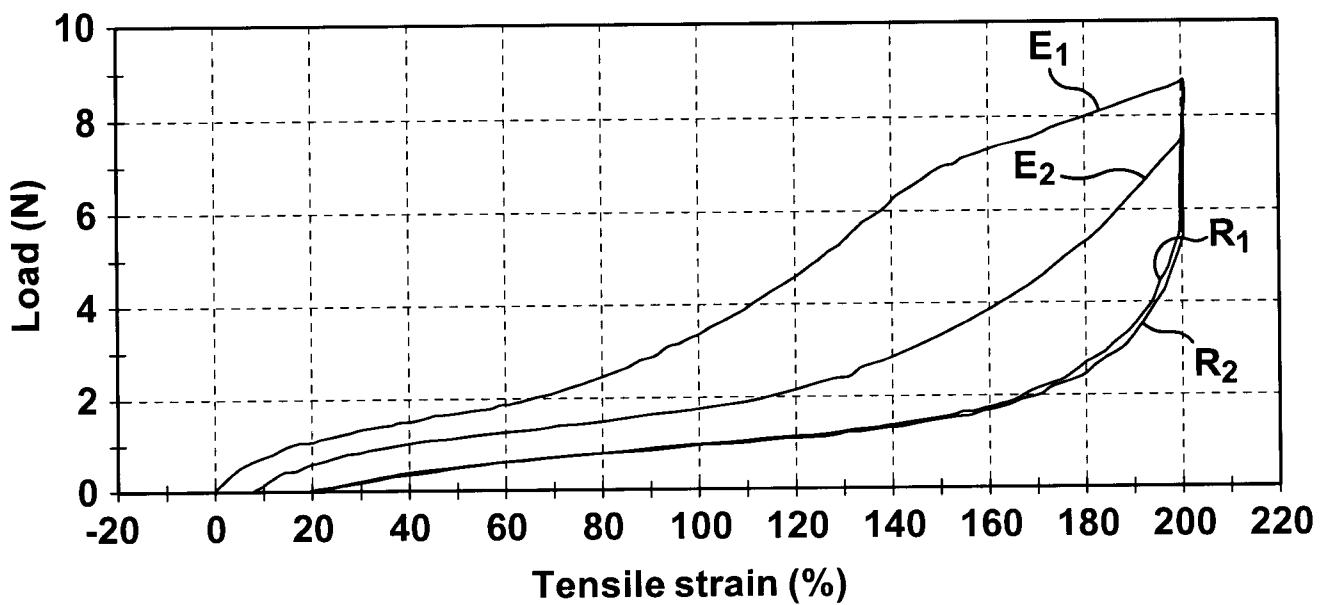


Figure 12B

**Figure 13****Figure 14**

**Figure 15****Figure 16**

**Figure 17****Figure 18**