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División de Nuevas Creaciones

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ENTRADA EN FASE NACIONAL

(21) EXPEDIENTE No 03-49576

(54) TITULO MATERIAL BIAXIALMENTE EXTENDIBLE

(51) CLASIFICACION INTERNACIONAL B23B 3/28

(71) SOLICITANTE KIMBERLY - CLARK WORLDWIDE INC

DOMICILIO NEENAH WISCONSIN ESTADOS UNIDOS DE AMERICA

(74) APODERADO MARIO CASTRO DUQUE

(22) SANTAFE DE BOGOTA, D C

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FORMULARIO ÚNICO DE SOLICITUD DE PATENTE

PCT

ENTRADA EN FASE NACIONAL

1 SOLICITUD DE:

☒ Patente de Invención. ☐ Patente de Modelo de Utilidad.

☐ Capítulo I. ☒ Capítulo II.

2 SOLICITANTE (71)	Nombre: KIMBERLY – CLARK WORLDWIDE, INC. Dirección: 401 North Lake Street, Neenah, Wisconsin 54957-0349 Nacionalidad o Domicilio: Estados Unidos Lugar de Constitución: Estados Unidos Teléfono: Fax: E-mail	**IDENTIFICACION** C.C. ☐ NIT ☐ C.E. ☐ Otro ☐ Cual____ Número ____
3 REPRESENTANTE O APODERADO	Nombre: RAMIRO CASTRO DUQUE Dirección: Cra. 7 No. 16-56 Piso 9 Teléfono: 380-2200 Fax: 380-2700 E-mail:	**IDENTIFICACION** C.C. ☒ NIT ☐ C.E. ☐ Otro ☐ Cual____ Número 170.322 TP 1003
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9 Comprobante de pago No. 03-36.611 **Fecha** 11-06-2003

Instrucciones para el diligenciamiento del presente formulario, ver reverso de esta página.

10 **ANEXOS**

2

- [x] Comprobante de pago de la tasa de presentación de la solicitud. $400.000
- [ ] Documento que acredita la existencia y representación legal cuando el solicitante sea persona jurídica.
- [x] Poderes, si fuere el caso. Protocolo No. 17397
- [ ] Documento de cesión del inventor al solicitante o a su causante.
- [ ] Declaraciones
- [x] Copia de la solicitud internacional. (Resumen, descripción, reivindicaciones, dibujos)
- [x] Traducción de la solicitud internacional al castellano. (Resumen, descripción, reivindicaciones, dibujos)
- [ ] Copia del examen preliminar efectuado por la IPEA.
- [ ] Traducción del examen preliminar efectuado por la IPEA.
- [ ] De ser el caso, copia del contrato de acceso.
- [ ] De ser el caso, documento que acredite la licencia o autorización de uso de conocimientos tradicionales de las comunidades indígenas.
- [ ] De ser el caso, certificado de depósito del material biológico.
- [ ] Arte final 12x12.
- [ ] De ser el caso, información sobre otras solicitudes de patente o títulos obtenidos en el extranjero por el mismo titular o su causante, relacionadas parcial o totalmente con la invención de esta solicitud.
- [ ] Otros

11 FIGURA CARACTERÍSTICA:

12 Solicito la concesión de la patente.

NOMBRE: RAMIRO CASTRO DUQUE

FIRMA

C.C. 170.322 de Bogotá T.P. 1003 del C.S.J.

Instrucciones para la presentación de los anexos, ver reverso de esta página.

3

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RECIBO OFICIAL DE CAJA : 03 - 36,611
FECHA : MAYO 26 DE 2003

***** C O N S I G N A C I O N *****

DEPOSITANTE	TIPO PAGO	BANCO	CUENTA	No. PAGO	FECHA PGO	Vr. PAGO
BRIGARD & CASTRO LTDA	CONSIGNACION	BANCO POPULAR	050-00110-6	7320826	26/05/2003	24,340,000.00
BRIGARD & CASTRO LTDA	CONSIGNACION	BANCO POPULAR	050-00110-6	7320828	26/05/2003	1,120,000.00

***** C O N C E P T O *****

CANT.	RENTISTICO	CONCEPTO	TOTAL CONCEPTO
1	50005-01-01 SOLICITUDES	1 TRAMITES DE SOL. DE PATENTE DE IN	400,000.00
		TOTAL : $	400,000.00

SON: CUATROCIENTOS MIL PESOS

RESPONSABLE : _____

RECIBO DE CAJA APLICADO AL EXPEDIENTE No._____

MATERIAL BIAXIALMENTE EXTENDIBLE

CAMPO DE LA INVENCIÓN

Esta invención está dirigida a un material que es extendible en todas las direcciones de plano x/y.

ANTECEDENTES DE LA INVENCIÓN

Un número de varios atributos de material son deseables para un material usado para hacer cubiertas exteriores de artículos absorbentes. Por ejemplo, en las prendas de tipo de calzón, la extensión en la dirección de la máquina es deseable debido a que la conformación longitudinal permite a una región de entrepierna de la prenda el combarse y pandearse cuando está cargada sin jalar la pretina del producto hacia abajo. En forma similar, la extensión en la dirección transversal es deseable debido a que la conformación lateral mantiene un entalle holgado pero cómodo alrededor de las caderas del usuario. Además, la extensión en todas las direcciones en el plano x/y contribuye a un producto de entalle de forma de todo alrededor.

Algunos materiales tales como los laminados unidos y estirados y estrechados (NSBL), unidos con hilado estrechados/crepados sujetados elastoméricos etc., tienen un estiramiento en todas las direcciones, por ejemplo alargamiento

con fuerza de recuperación. Estos materiales son relativamente costosos debido a la inclusión de materiales elastoméricos relativamente costosos. Sin embargo, las altas fuerzas de recuperación no siempre son deseables en los materiales de cubierta exterior. Las fuerzas de recuperación baja permiten a las prendas el permanecer en una forma conformada sobre el usuario sin ejercer una cantidad considerable de presión de retracción y sin restringir los movimientos del usuario. Además, cuando las prendas son llenadas por el usuario, las fuerzas de recuperación bajas permiten al peso de los contenidos de prenda el jalar los contenidos de prenda hacia fuera del cuerpo del usuario sin jalar el resto de la prenda hacia abajo del cuerpo del usuario, manteniendo por tanto un contacto estrecho entre el usuario y la prenda y el área de cintura y alrededor de las aberturas de pierna para evitar el filtrado de cualesquier contenidos de la prenda desde dicha prenda.

La capacidad para respirar es un atributo de material particularmente deseable en los artículos absorbentes.

Las películas con capacidad para respirar y los laminados típicamente bloquean el paso de la materia en partículas, el agua y otros líquidos mientras que dejan al vapor de agua y/o al aire el pasar a través del material. Por tanto, los materiales con capacidad para respirar cuando se usan en pañales o prendas absorbentes similares, reducen la

humedad relativa y la temperatura dentro de la prenda en comparación a tales prendas hechas de películas sin capacidad para respirar y laminados.

Una barrera al líquido es un material inherentemente deseable atribuible de un artículo absorbente. La barrera al líquido actúa para evitar que los líquidos permeen a través de una superficie de la prenda y sobre la ropa y los alrededores de un usuario.

Son conocidos en el arte varios tipos de material con atributos combinados. Por ejemplo, los laminados estirados y unidos (SBL) entregan un compuesto con capacidad para respirar extendible en la dirección de la máquina, pero no tienen una barrera al líquido y muy poca extensión en la dirección transversal. Los laminados estrechados y unidos más recientes entregan una barrera al líquido extendible en la dirección transversal, pero son extendibles en la dirección de la máquina. Otros compuestos funcionan como barreras con capacidad para respirar de tipo de paño, pero éstos tienen muy poca o ninguna extensión en cualesquier dirección de la máquina o en la dirección transversal.

La patente de los Estados Unidos de América No. 5.114.781 otorgada a Morman el 19 de Mayo de 1992, describe un laminado que puede extenderse en por lo menos dos direcciones.

87

El laminado incluye un material no tejido estrechado reversiblemente y una hoja elástica.

La patente de los Estados Unidos de América No. 5.116.662 otorgada a Morman el 26 de Mayo de 1992 describe un laminado que puede extenderse en por lo menos dos direcciones. El laminado incluye un material no tejido estrechado y una hoja elástica.

La patente de los Estados Unidos de América No. 5.883.028 otorgada a Morman y otros el 16 de Marzo de 1999 describe un laminado que puede extenderse en por lo menos dos direcciones. El laminado es formado mediante el sujetar un material no tejido que es estrechado en la dirección transversal a una película elastomérica soluble al vapor de agua que es estirada en la dirección de la máquina y que tiene de retracción en la dirección de la máquina.

Hay una necesidad o deseo de un material que entregue una multitud de propiedades en un compuesto único, a saber propiedades de barrera de líquido, de capacidad para respirar, de fuerza de recuperación baja, de extensión biaxial y que sea relativamente barato.

48

SÍNTESIS DE LA INVENCIÓN

La presente invención está dirigida a un material de cubierta exterior extensible (EOC) que puede extenderse en todas las direcciones del plano x/y. En una incorporación, el material de cubierta exterior extensible es un laminado que incluye una tela no tejida estrechada y una película microporosa, con capacidad para respirar, estriada que tiene rugosidades estriadas en la dirección de la máquina. Las rugosidades estriadas permiten a la película y a la tela no tejida estrechada el extenderse en la dirección transversal. El material de ésta incorporación se hace mediante el estirar la película llenada en la dirección de la máquina para provocar la capacidad para respirar, laminando la película estirada a la tela no tejida, estirando el laminado en la dirección de la máquina para estrechar la tela no tejida y formar las estrías en la película, y después crepar el laminado para crear extensión en la dirección de la máquina. Una laminación eslastomérica y/o adhesivo crepado puede ser usado para producir un laminado con una fuerza de retracción menor.

En otra incorporación de la invención, el material de cubierta exterior extendible es un laminado que incluye una película extendible en la dirección transversal de capa única hecha de un polímero extendible que permite a la película, junto con la tela no tejida estrechada unida a la película, el extenderse en la dirección transversal. El

material de ésta incorporación se hace mediante el estirar la película llenada en la dirección de la máquina para provocar una capacidad para respirar, estirar separadamente una tela no tejida para provocar el estrechado, laminar la película estirada y la tela no tejida estrechada juntas, y después crepar el laminado para crear la extensión en la dirección de la máquina. Como en la incorporación previa, una laminación elastomérica y/o adhesivo de crepado pueden usarse para producir un laminado con una fuerza de retracción menor.

El nivel de agregado adhesivo y el patrón de unión afectan grandemente las propiedades de material. Por tanto, el material resultante de la invención puede tener una fuerza de retracción alta en una dirección y baja o ninguna fuerza de retracción en otra. La fuerza de retracción adicional puede ser impartida en una o en ambas direcciones a través de la adición de la película elastomérica, de las fibras, de las espumas, de los lienzos, u otros elementos.

Con lo anterior en mente, es una característica y una ventaja de la invención el proporcionar un laminado con capacidad para respirar biaxialmente extendible que tiene propiedades de barrera al líquido y una fuerza de recuperación baja.

También es una característica y una ventaja de la invención el proporcionar un laminado con capacidad para

H10

respirar biaxialmente extendible y mejorado útil en una amplia variedad de cubiertas exterior para pañales, otros productos para el cuidado personal, batas quirúrgicas, y otras aplicaciones con capacidad para respirar.

Las anteriores y otras características y ventajas de la invención serán evidentes de la siguiente descripción detallada de las incorporaciones actualmente preferidas, leídas en conjunción con los ejemplos y los dibujos.

Breve Descripción de las Figuras

La Figura 1 es una vista superior de un laminado con capacidad para respirar biaxialmente extendible de la presente invención.

La Figura 2 es una vista en sección transversal de un laminado con capacidad para respirar biaxialmente extendible tomado a lo largo de la línea 2-2 de la figura 1.

La Figura 3 es una vista superior de una capa de película que tiene rugosidades estriadas; y

La Figura 4 es una vista superior de una capa no tejida que tiene un patrón de unión de tejido de alambre.

DEFINICIONES

Dentro del contexto de ésta descripción, cada término o frase abajo incluirá el siguiente significado o significados.

"Biaxialmente extendible" se refiere a un material que tiene extensión por lo menos por 25% de sus dimensiones iniciales (sin ruptura, rasgado o pérdida de propiedades de barrera) en dos direcciones perpendiculares una a otra, por ejemplo extendiéndose en una dirección de la máquina y en una dirección transversal, o en una dirección longitudinal (frente a espalda) y en una dirección lateral (lado a lado).

"Unido" se refiere a la unión, adhesión, conexión, sujeción, o similares, de dos elementos. Los dos elementos serán considerados que están unidos juntos cuando éstos están unidos directamente uno a otro o indirectamente uno la otro, tal como cuando cada uno está unido directamente a elementos intermedios.

"Crepado" o "crepé" se refiere a un material arrugado o compuesto que tiene áreas unidas o no unidas. El material crepado puede ser regresado a aproximadamente su longitud original mediante el aplicar una tensión mecánica, alisando por tanto las partes arrugadas.

"Dirección transversal" se refiere al ancho de una tela en una dirección generalmente perpendicular a la dirección en la cual ésta es producida, en oposición a la "dirección de la máquina" la cual se refiere a la longitud de una tela en la dirección en la cual ésta es producida.

"Elastomérico" se refiere a un material o compuesto el cual puede ser alargado por lo menos por 50% de su longitud relajada y el cual se recuperará, con la liberación de la fuerza aplicada, a por lo menos 40% de su alargamiento. Se prefiere generalmente que el material o compuesto elastomérico sea capaz de ser alargado por lo menos por 100%, más preferiblemente por lo menos por 300%, de su longitud relajada, y recuperarse, con la liberación de una fuerza aplicada, por lo menos 50% de su alargamiento.

"Extendible" significa un material el cual, con la aplicación de una fuerza estiradora, puede extenderse en una dirección particular, a una dimensión estirada (por ejemplo, ancho) la cual es por lo menos 25% mayor que una dimensión no estirada original. Cuando la fuerza estiradora es removida después de un período de retención de 1 minuto, el material no se retrae, o se retrae por no más de 30% de la diferencia entre la dimensión estirada y la dimensión original y puede retraerse más solamente si se ayuda por un adhesivo elástico u otro componente elástico unido al material. Por tanto, un material que tiene un ancho de un metro, el cual es extendible en la

14/13

dirección transversal, puede ser estirado a un ancho de por lo menos de 1,25 metros. Cuando la fuerza estiradora es liberada, después de retener el ancho extendido por un minuto, un material estirado a un ancho de 1,25 metros no se retraerá, o se retraerá a un ancho de no menos de 1,175 metros. Los materiales extendibles son diferentes de los materiales elásticos, los últimos tendiendo a retraerse casi del todo de su dimensión original cuando es liberada la fuerza estiradora. La fuerza estiradora puede ser cualesquier fuerza razonable suficiente para extender el material a entre 125% de su dimensión original y una dimensión estirada máxima en la dirección seleccionada (por ejemplo la dirección transversal) sin romperlo.

"Película" se refiere a una película termoplástica hecha usando un proceso de espumado y/o de extrusión de película, tal como un proceso de recubrimiento, de película fraguada o de extrusión de película soplada. Para los propósitos de la presente invención, el término incluye películas microporosas con capacidad para respirar y películas inherentemente con capacidad para respirar que actúan como barreras al líquido.

"Inelástico" se refiere a ambos materiales que no se estiran por más de 25% o más y a materiales que se estiran por ésta cantidad pero no se retraen por más de 30%. Los materiales inelásticos incluyen los materiales extendibles, como se definió arriba así como los materiales extendibles,

como se definió arriba así como los materiales que no se extienden, por ejemplo los cuales se rasgan cuando se someten a una fuerza estiradora.

"Capa" cuando se usa en el singular puede tener el significado dual de un elemento único o de una pluralidad de elementos.

"Dirección de la máquina" se refiere a una longitud de una tela en la dirección en la cual ésta es producida, en oposición a la "dirección transversal" la cual se refiere al ancho de una tela en una dirección generalmente perpendicular a la dirección de la máquina.

"Fibra soplada con fusión" significa fibras formadas mediante el extruir un material termoplástico fundido a través de una pluralidad de vasos capilares de matriz finos, usualmente circulares, como hilos o filamentos fundidos en unas corrientes de gas (por ejemplo de aire), calentadas a alta velocidad y convergentes, las cuales atenúan los filamentos del material termoplástico fundido para reducir su diámetro, el cual puede ser a un diámetro de microfibra. Después, las fibras sopladas con fusión llevadas por la corriente de gas a alta velocidad son depositadas sobre una superficie recolectora para formar un tejido de fibras sopladas con fusión y dispersadas al azar. Tal proceso está descrito, por ejemplo, en la patente de los Estados Unidos de América No. 3.849.241 otorgada a Butin y

otros. Las fibras sopladas con fusión son microfibras las cuales pueden ser continuas o discontinuas, son generalmente más pequeñas de alrededor de 0,6 denier, y son generalmente autounidas cuando se depositan sobre una superficie recolectora. Las fibras sopladas con fusión usadas en la presente invención son preferiblemente y esencialmente continuas en longitud.

"Estrechado" "estrechado y estirado" son términos intercambiables y se refieren a un método para alargar una tela no tejida, generalmente en la dirección longitudinal o de la máquina, para reducir su ancho en una manera controlada a una cantidad deseada. El estiramiento controlado puede tener lugar bajo temperaturas mayores o una temperatura ambiente bajo enfriamiento se limita a un aumento en la dimensión global en la dirección en que está siendo estirado hasta el alargamiento requerido para romper la tela, el cual en la mayoría de los casos es de alrededor de 1,2 a 1,4 veces. Cuando está relajada, la tela se retrae a sus dimensiones originales. Tal proceso está descrito, por ejemplo, en las patentes de los Estados Unidos de América Nos. 4.443.513 otorgada a Meitner y Notheis, 4.965.122, 4.981.747 y 5.114.781 otorgada a Morman y 5.244.482 otorgada a Hassenboehler Jr., y otros.

"No tejido" y "tela no tejida" se refiere a materiales fibrosos y tejidos de material fibroso los cuales son formados sin la ayuda de un proceso de tramado o de tejido textil.

"Polímeros" incluyen, pero no se limitan a homopolímeros, copolímeros tales como, por ejemplo, los copolímeros de bloque, de injerto, al azar, y alternantes, los terpolímeros, etc., y las mezclas y modificaciones de los mismos. Además, a menos que se limite específicamente de otra manera, el término "polímero" no incluirá todas las configuraciones geométricas posibles de las moléculas. Estas configuraciones incluyen, pero no se limitan a las simetrías isotáctica, sindiotáctica y atáctica.

"Rugosidades" se refiere a arrugas acanaladas o ranuradas estrechas y delgadas en una capa de película inelástica.

"Fibra unida con hilado" se refiere a fibras de diámetro pequeño las cuales son formadas mediante el extruir el material termoplástico fundido como filamentos desde una pluralidad de vasos capilares finos de un órgano hilandero que tiene una configuración circular u otra, con el diámetro de los filamentos extruidos entonces siendo rápidamente reducidos como se describió, por ejemplo, en las patentes de los Estados Unidos de América Nos. 4.340.563 otorgada a Appel y otros, y 3.692.618 otorgada a Dorschner y otros, 3.802,817 otorgada a Matsuki y otros, 3.338.992 y 3.341.394 otorgadas a Kinney, 3.502.763 otorgada a Hartmann, 3.502.538 otorgada a Petersen, y 3.542.615 otorgada a Dobo y otros, cada una de las cuales es incorporada aquí en su totalidad por referencia. Las fibras unidas con

hilado son enfriadas y generalmente no son pegajosas cuando éstas son depositadas sobre la superficie recolectora. Las fibras unidas con hilado son generalmente continuas y frecuentemente tienen deniers promedio mayores de alrededor de 0,3, más particularmente dentro de alrededor de 0,6 y 10.

Estos términos pueden ser definidos con un lenguaje adicional en las partes restantes de la descripción.

DESCRIPCIÓN DETALLADA DE LAS INCORPORACIONES ACTUALMENTE PREFERIDAS

La presente invención está dirigida a un laminado con capacidad para respirar que puede ser extendido en todas las direcciones en le plano x/y. El material de la presente invención es particularmente adecuado para usarse como una cubierta exterior para los artículos absorbentes desechables. Los ejemplos de tales artículos incluyen los pañales, los calzoncillos de aprendizaje, los productos para incontinencia, la ropa para nadar, otras prendas para el cuidado personal o para el cuidado de la salud, o similares.

Refiriéndonos ahora a las figuras 1 y 2, ahí se muestra una vista superior y una vista en sección transversal, respectivamente, de un laminado con capacidad para respirar que se extiende biaxialmente 20. El laminado 20 está hecho de una capa de película 22 y de una capa de tela no tejida 24. La capa

de tela no tejida 24 es estrechada y estirada en la dirección de la máquina para impartir una extensión en la dirección transversal. La capa de película 22 es extensible en la dirección transversal. Ambas la capa no tejida 24 y la capa de película 22 son crepadas para impartir extensión en la dirección de la máquina.

Adecuadamente, la película 22 puede ser ya sea hecha de un polímero extensible que es extensible en la dirección transversal o puede ser hecho en una película estriada e inelástica que tiene rugosidades estriadas en la dirección de la máquina las cuales permitan a la película 22 el extenderse en la dirección transversal. En cualesquier caso, la película 22 es adecuadamente una película con capacidad para respirar inherentemente o microporosa y con capacidad para respirar. La capa de película 22 sola tiene rugosidades extriadas 26 y se muestra en la figura 3.

El término "dirección transversal" como se usó aquí, se refiere al ancho del material en una dirección generalmente perpendicular a la dirección en la cual éste es producido, en oposición a "dirección de la máquina" el cual se refiere a la longitud de un material en la dirección en la cual éste es fabricado. Por referencia, la flecha 49 muestra la dirección de la máquina en las figuras 1 y 3, mientras que la flecha 48 muestra la dirección transversal en las figuras 1-3.

La dirección de la máquina en la figura 2 se extiende hacia adentro y hacia fuera de la página.

La capacidad para respirar del laminado no estirado 20, expresado como tasa de transmisión de vapor de agua (WVTR) es esencialmente igual a la capacidad para respirar de la capa de película 22 cuando la película 22 y la tela no tejida 24 son unidas inicialmente. La capa no tejida 24 es típicamente abierta y porosa y no afecta significativamente la capacidad para respirar del laminado 20. La tasa de transmisión de vapor de agua es una función de ambos el grosor de la película y la composición de la película. La capa de película 22 adecuadamente puede entregar una capacidad para respirar moderada, expresada como tasa de transmisión de vapor de agua, en un rango de alrededor de 500 a 30.000 gramos/metro cuadrado-24 horas usando el procedimiento de prueba de tasa de transmisión de vapor de agua Mocon descrito abajo. Adecuadamente, la tasa de transmisión de vapor de agua moderada de la capa de película 22 es de por lo menos de alrededor de 500 gramos/metro cuadrado-24 horas. Aún más adecuadamente, por lo menos alrededor de 750 gramos/metro cuiadrado-24 horas, más adecuadamente por lo menos alrededor de 1.000 gramos/metro cuadrado-24 horas.

En una incorporación incluida en una película estriada e inelástica 22, la película estriada inelástica 22 puede incluir un compuesto rellenador extruido dentro de un

componente de polímero. El componente de rellenador inicia la formación de huecos rodeando las partículas de rellenador con el estiramiento de la película 22 en la dirección de la máquina. Los huecos imparten capacidad para respirar a la película 22 mediante el crear una trayectoria tortuosa de las membranas delgadas a través de las cuales puede pasar el vapor de agua pero no el agua líquida.

Como se usó aquí, un "rellenador" se quiere que incluya partículas y/u otras formas de materiales las cuales pueden ser agregadas a la mezcla de polímero antes de la extrusión de película, y las cuales no interferirán químicamente con o afectan adversamente la película extruida 22 y además, las cuales serán dispersadas uniformemente a través de la película 22. Generalmente el componente rellenador estará en forma particulada con tamaños de partículas promedio en el rango de alrededor de 0,1 a alrededor de 7 micrómetros, deseablemente de desde alrededor de 0,1 a alrededor de 4 micrómetros. Como se usó aquí el término "tamaño de partícula" describe la dimensión más larga o la longitud del componente de rellenador. Ambos rellenadores orgánico e inorgánico están contemplados para usarse con la presente invención siempre que éstos no interfieran con el proceso formador de película y/o el proceso de laminación subsecuente. Los ejemplos de los rellenadores incluyen carbonato de calcio ($CaCO_3$), varias arcillas, sílice (SiO_2), alúmina, sulfato de bario, talco, sulfato de magnesio, dióxido de titanio, zeolitas, sulfato de aluminio, polvos

celulósicos, tierra diatomacea, yeso, carbonato de magnesio, carbonato de bario, caolina, mica, carbón, óxido de magnesio, hidróxido de aluminio, polvo de pulpa, polvo de madera, derivados de celulosa, partículas poliméricas, quitina y derivados de quitina. Las partículas rellenadoras opcionalmente pueden ser recubiertas con un ácido graso, tal como ácido esteárico, o ácido behénico, y/u otro material a fin de facilitar el flujo libre de las partículas (en volumen) y su facilidad de dispersión adentro del polímero. Por ejemplo, usando rellenador de carbonato de calcio con una densidad de alrededor de 2,8 gramos por centímetro cúbico, la película llenada 22 usualmente contendrá por lo menos alrededor de 15% de rellenador basada sobre el volumen total de la capa de película 22, más deseablemente de desde alrededor de 20% a alrededor de 65% por volumen.

Los polímeros adecuados para el componente de polímero incluidos pero no limitados a los polímeros extruibles no elásticos tal como poliolefina o una mezcla de poliolefinas, de hidrato de celulosa (celofán), y alcohol de vinilo etileno. Más particularmente, las poliolefinas útiles incluyen polipropileno y polietileno. Otros polímeros útiles incluyen aquellos descritos en la patente de los Estados Unidos de América No. 4.777.073 otorgada a Sheth, cedida a Exxon Chemical Patents, Inc., tal como un copolímero de polipropileno y polietileno de baja densidad o polietileno de baja densidad lineal.

Otros polímeros adecuados incluyen aquellos mencionados como los polímeros catalizados de sitio único tal como "polímeros de metaloceno" producidos de acuerdo a un proceso de metaloceno y los cuales tienen propiedades elásticas limitadas. El término "polímeros catalizados por metaloceno" como se usó aquí incluye aquellos materiales de polímero que son producidos por la polimerización de por lo menos etileno usando metalocenos o catalizadores de geometría constriñida, una clase de complejos organometálicos, como catalizadores. Por ejemplo, un metaloceno común es ferroceno, un complejo de un metal entre dos ligandos ciclopentadienilo (Cp). Los catalizadores de proceso de metaloceno incluyen bis(n-butilciclopentadienilo)dicloruro de titanio, bis(n-butilciclopentadienilo)dicloruro de zirconio, bis(ciclopentadienilo)cloruro de escandio, bis(indenilo)dicloruro de zirconio, bis(metilciclopentadienilo)dicloruro de titanio, bis(metilciclopentadienilo)dicloruro de zirconio, cobaltoceno, tricloruro de ciclopentadieniltitanio, ferroceno, dicloruro de hafnoceno, dicloruro de isopropilo(ciclopentadienilo,-1-fluoroenilo)zirconio, dicloruro de molibdoceno, niqueloceno, dicloruro de nioboceno, rutenoceno, dicloruro de titanoceno, hidruro de cloruro de zirconoceno, dicloruro de zirconoceno, entre otros. Una lista más exhaustiva de tales compuestos está incluida en la patente de los Estados Unidos de América No. 5.374.996 otorgada a Rosen y otros y cedida a Dow Chemical

Company. Tales compuestos también están discutidos en la patente de los Estados Unidos de América No. 5.064.802 otorgada a Stevens y otros y también cedida a Dow.

Tales polímeros de metaloceno están disponibles de Exxon-Mobil Chemical Company de Baytown, Texas bajo el nombre de comercio EXXPOL® para los polímeros a base de polipropileno y EXACT® para los polímeros a base de polietileno. Dow Chemical Company de Midland, Michigan tiene polímeros comercialmente disponibles bajo el nombre ENGAGE®. Preferiblemente, los polímeros de metaloceno son seleccionados de copolímeros de etileno y 1-buteno, copolímeros de etileno y 1-hexeno, copolímeros de etileno y 1-octeno y combinaciones de los mismos. En general, los polímeros a base de etileno derivados de metaloceno de la presente invención tienen una densidad de por lo menos de 0,900 gramos gramos por centímetro cúbico.

La película estriada e inelástica 22 puede ser una capa de película de capas múltiples la cual puede incluir una capa de núcleo y una o más capas de piel sobre cualesquier lado de la capa de núcleo. Cuando más de una capa de piel está presente, no es un requerimiento el de que las capas de piel sean las mismas. Cualesquiera de los polímeros discutidos arriba son adecuados para usarse como una capa de núcleo de una película de capas múltiples. Cualesquiera de los rellenadores

discutidos arriba son adecuados para usarse en cualesquier capa de película.

La capa de piel típicamente incluye los polímeros termoplásticos extruibles y/o los aditivos los cuales proporcionan propiedades especializadas a la capa de película inelástica y estriada 22. Por tanto, la capa de piel puede hacerse de polímeros los cuales proporcionan tales propiedades como antimicrobiales, barrera, transmisión de vapor de agua, adhesión y/o propiedades de antibloqueo. Los polímeros son por tanto escogidos para los atributos particulares deseados. Los ejemplos de los polímeros posibles que pueden ser usados solos o en combinación incluyen los homopolímeros, copolímeros y mezclas de poliolefinas así como etileno-vinil acetato (EVA), etileno-etil acrilato (EEA), ácido acrílico etileno (EAA), etileno metil acrilato (EMA), etileno butil acrilato (EBA), poliéster (PET), nilón (PA), alcohol de vinil etileno (EVOH), poliestireno (PS), poliuretano (PU), y elastómeros termoplásticos olefínicos los cuales son productos de reactor de pasos múltiples en donde un copolímero al azar de etileno propileno amorfo es dispersado molecularmente en una matriz continua de monómero de etileno bajo/monómero de polipropileno alto semicristalina predominantemente. La capa de piel puede ser formada de cualesquier polímero semicristalino o amorfo, incluyendo uno que es ligeramente elástico y que sufrirá una deformación permanente en el porcentaje de estiramiento que el laminado sufrirá. Sin embargo, la capa de piel es generalmente una poliolefina tal

como polietileno, polipropileno, polibutileno, o un copolímero de etileno-propileno, pero también puede ser completamente o parcialmente un poliuretano, una poliamida tal como nilón, un poliéster tal como tereftalato de polietileno, un fluoruro de polivinilideno, un poliacrilato tal como poli(metil metacrilato) (sólo en mezclas) y similares, y mezclas de los mismos.

Esta película estriada e inelástica 22 puede ser unida a la tela no tejida 24. La tela no tejida 24 es permeable al aire y puede ser formada de cualesquier proceso adecuado, incluyendo los procesos de tejido cardado y unido, los procesos de soplado con fusión y los procesos de unión con hilado. El peso base de las telas no tejidas es usualmente expresado en onzas de material por yarda cuadrada (osy) o gramos por metro cuadrado (gsm) y los diámetros de fibra son usualmente expresados en micras. (Nótese que para convertir de onzas por yarda cuadrada a gramos por metro cuadrado, debe multiplicarse onzas por yarda cuadrada por 33,91). La tela no tejida de la presente invención adecuadamente tiene un peso base de 10 a 90 gramos por metro cuadrado, más adecuadamente de 20 a 60 gramos por metro cuadrado.

La tela no tejida 24 es formada adecuadamente de por lo menos un miembro seleccionado de fibras y filamentos de polímeros inelásticos. Tales polímeros incluyen poliésteres, por ejemplo, tereftalato de polietileno, poliolefinas, por ejemplo, polietileno y polipropileno, poliamidas, por ejemplo,

nilón 6 y nilón 66. Estas fibras o filamentos son usadas solas o en combinación de dos o más de las mismas.

Las fibras adecuadas para la formación de la tela no tejida 24 incluyen fibras naturales y sintéticas así como fibras de bicomponente, de componentes múltiples y de polímero conformado. Una pluralidad de materiales estrechados también pueden ser usados. Los ejemplos de tales materiales pueden incluir, por ejemplo, los compuestos unidos con hilado/soplado con fusión y los compuestos de unido con hilado/soplado con fusión/unido con hilado como se enseñan en la patente de los Estados Unidos de América No. 4.041.203 otorgada a Brock y otros, la cual se incorpora aquí por referencia.

La tela no tejida 24 puede ser unida como para impartir un patrón de unión discreto con un área de superficie unida prescrita. Se conoce esto como la unión de punto térmico. La unión de punto térmico involucra el pasar un tejido de fibras que van a ser unidas entre un rodillo con patrón o calandrado calentado y un rodillo de yunque. El rodillo de calandrado tiene un patrón de manera que la tela no tejida completa no esté unida a través de su superficie completa. Si está presente demasiada área de unión sobre la tela no tejida, ésta se romperá antes de que se estreche. Si no hay suficiente área unida, entonces la tela no tejida se separará. Típicamente, el por ciento de área de unión útil en la presente invención varía de desde alrededor de 5% a alrededor de 40% del área de la tela no

tejida. Muchos patrones para los rodillos de calandrado han sido desarrollados. Como se entenderá por aquellos expertos en el arte, los porcentajes de área de unión son, de necesidad, descritos en rangos o aproximaciones ya que los pernos de unión son normalmente ahusados y se desgastan con el tiempo. Hay un número de patrones de unión discretos los cuales pueden ser usados. Un ejemplo de un patrón de unión es un patrón de "tejido de alambre", mostrado en la figura 4. El patrón de unión de tejido de alambre 28 incluye elementos de patrón de tela no tejida de forma cuadrada. Cada elemento de patrón puede ser definido por cuatro uniones de punto de forma elíptica 30. La longitud lateral de cada elemento de patrón (representando la distancia de centro a centro entre las uniones adyacentes) puede ser de alrededor de 0,057 pulgadas. Cada unión 30 puede tener una longitud de alrededor de 0,031 pulgadas y un ancho de alrededor de 0,016 pulgadas. El patrón de unión 28 puede ser aplicado ya sea parejamente o disparejamente a la tela no tejida 24. Un patrón de unión aplicado parejamente 28 contribuye a propiedades de material más consistentes a través de la superficie del laminado resultante, mientras que un patrón de unión aplicado disparejamente 28 puede afectar las propiedades materiales tales como el nivel de la fuerza de retracción. La tela no tejida adecuadamente tiene un peso base de estrechamiento posterior de alrededor de 10-30 gramos por metro cuadrado (gsm).

Como se mencionó, la capa no tejida 24 es estrechada y estirada en la dirección de la máquina, impartiendo por tanto una extensión en la dirección transversal al material. El proceso de estrechamiento está descrito en la patente de los Estados Unidos de América No. 5.226.992 otorgada a Morman, e incorporada aquí por referencia.

La laminación de la capa de película 22 a la capa no tejida 24 puede llevarse a cabo por los métodos típicos conocidos en el arte, incluyendo la unión de adhesivo, la unió de punto y la soldadura sónica. El uso de adhesivos inelásticos y/o elásticos para la unión de adhesivo es adecuada para ésta invención. Un ejemplo del adhesivo adecuado es un adehsivo soplado con fusión que contiene 54,5-57,5% por peso de resinas de hidrocarburo de petróleo; 18,5-21,5% por peso de una mezcla de varios aceites minerales; 22,5-27,5% por peso de copolímeros de bloque de estireno-butadieno-estireno; 0,1-0,9% por peso de polietileno y/o etileno vinil acetato; y 0,2-1,8% por peso de antioxidantes y estabilizadores. Otro ejemplo específico de un adhesivo adecuado es NS34-5610, disponible de National Starch & Chemical Company. El adhesivo puede ser aplicado fundido a ya sea la película 22 o al tejido 24 usando un proceso de soplado con fusión, a un nivel agregado de alrededor de 2 a 5 gramos por metro cuadrado. La cobertura de adhesivo resultante es intermitente y ocupa alrededor de 5 a 40% de la entercara entre la película 22 y la tela no tejida 24.

Cuando la capa de película 22 y la capa no tejida 24 son unidas a través del uso de calor y/o presión, puede ser usado un dispositivo laminador, tal como los rodillos laminadores. Los rodillos laminadores pueden ser calentados y puede ser usada la unión de punto. La temperatura a la cual son calentados los rodillos laminadores dependerá de las propiedades de la película 22 y/o del no tejido 24, pero usualmente estará en el rango de 200 a 275° F (de 93 a 135° C). Los rodillos laminadores pueden cada uno ser lisos o con patrón o un rodillo puede ser liso mientras que el otro rodillo tiene un patrón. Si uno de los rodillos tiene un patrón éste creará un patrón de unión discreto con un área de superficie unida prescrita para el laminado resultante 20.

Para hacer el laminado 20 incluyendo la película estriada e inelástica 22 y la tela no tejida 24, la película 22 es primero estirada en la dirección de la máquina a 2-5 veces su longitud no estirada original usando dos o más pares con punto de presión de rodillos de jalado calentados, con cada par subsecuente dando vueltas más rápido que cada par precedente. El estiramiento es llevado a cabo para impartir capacidad para respirar a la película 22. Uno o ambos de los rodillos de jalado en cada par puede ser calentado, de manera que la película 22 experimenta una temperatura de estiramiento de 150-200° F (F). La película estirada 22 tiene un grosor de menos de 50 milésimas de pulgada.

La película estirada 22 es entonces laminada a la tela no tejida 24 con la dirección de la máquina de la película 22 esencialmente alineada con la dirección de la máquina del tejido 24. Cuando se une adhesivamente la película 22 a la tela no tejida 24, se aplica un adhesivo fundido a cualesquiera la película 22 o el tejido 24, y la película 22 y el tejido 24 se ponen juntos bajo una presión ligera (menos de 50 libras/pulgada lineal) usando un par de rodillos de punto de presión lisos no calentados, para formar el laminado 20. En ése punto, el adhesivo aún está suficientemente tibio para efectuar la unión entre la película 22 y el tejido 24.

El laminado 20 es entonces estirado en la dirección de la máquina de la película 22 y el tejido 24, mediante el pasarlo a través de un par de rodillos de punto de presión estirados y no calentados que dan vuelta a velocidades mayores que las de los rodillos de punto de presión laminadores. Un horno puesto a 200-280° F puede ser colocado entre los pares de rodillos de punto de presión, para ayudar en el estrechamiento y asentamiento por calor del laminado 20. El laminado 20 es estirado en ésta manera a alrededor de 1,15-1,20 veces su longitud inmediatamente después de la laminación. Esto provoca el estrechamiento de la tela no tejida 24 a 60-75% de su ancho inicial. Esto también provoca un estiramiento adicional de la película 22, a alrededor de 2,5-7 veces su longitud original ocurriendo antes del estiramiento de prelaminación. También, debido a que la película 22 es laminada al tejido 24,

el estiramiento adicional hace que la película 22 se pliegue en la dirección transversal, resultando en la formación de rugosidades estriadas 26 (arrugas canalizadas o ranuradas estrechas y delgadas) en la película 22 (figura 3). El peso base del laminado 20 aumenta como un resultado del estiramiento.

Una vez que el laminado 20 está formado, el laminado 20 es entonces crepado con el adhesivo de crepado para lograr la extensión en la dirección de la máquina. Los adhesivos de crepado adecuados incluyen sin limitación adhesivos de butadieno estireno de base acuosa, neopreno, cloruro de polivinilo, copolímeros de vinilo, poliamidas y terpolímeros de etileno y vinilo. El material adhesivo actualmente preferido es una emulsión de polímero acrílico vendida por B. F. Goodrich Company bajo el nombre de comercio HYCAR®. El uso de un adhesivo de crepado elastomérico puede impartir alguna fuerza de retracción al laminado 20. Cualesquier método adecuado de crepado puede ser usado. Por ejemplo, la capa de tela no tejida 24 puede ser recubierta por lo menos parcialmente con un adhesivo de crepado elastomérico sobre un lado opuesto de la capa de película 22 de manera que alrededor de 5-100% (preferiblemente 10-70%) del área de superficie total sobre ése lado es recubierto, y álrededor de 0-95% (preferiblemente 30-90% del área está sin recubrimiento. El adhesivo de crepado puede ser aplicado ya sea parejamente o disparejamente a través de la capa no tejida 24. Un adhesivo de crepado aplicado parejamente contribuye a propiedades de material más consistentes a través

de la superficie de laminado resultante 20, mientras que un adhesivo de crepado aplicado disparejamente puede afectar las propiedades del material tal como el nivel de fuerza de retracción.

La tela no tejida 24 posee la unión de entre filamentos en la forma del patrón de unión 28 el cual es impartido durante la fabricación de la tela no tejida 24 (figura 4). El adhesivo de crepado elastomérico penetra en la tela no tejida 24 en alguna extensión en las áreas recubiertas, provocando una unión de entre filamentos incrementado en ésas áreas. El por lo menos un lado parcialmente recubierto de la tela no tejida 24 puede entonces ser colocado en contra de una superficie crepadora, tal como un tambor de crepado, y puede ser unido pelablemente a la superficie de crepado.

La superficie crepadora es preferiblemente calentada y es movida (por ejemplo girada) en una dirección de la máquina. La velocidad de la rotación de la superficie crepadora depende de la composición del material que está siendo crepado, pero para las incorporaciones descritas aquí, un rango de rotación adecuado es de aproximadamente de 175 a 250 pies por minuto. Adecuadamente, la superficie crepadora se mueve lo suficientemente rápido para disminuir la longitud en la dirección de la máquina del laminado 20 por aproximadamente una mitad para producir un laminado con 100% de alargamiento en la dirección de la máquina. Al moverse la superficie crepadora, la

orilla delantera del laminado 20 unida a la superficie puede ser crepada usando una cuchilla de doctor. La cuchilla de doctor penetra en el recubrimiento adhesivo debajo del tejido y levanta el laminado fuera del tambor, resultando en un doblado de laminado en la dirección transversal. Alternativamente, el adhesivo crepador puede ser aplicado a una superficie de la película 22 opuesta a la capa no tejida 24. Otros ejemplos de crepado se enseñan en la patente de los Estados Unidos de América No. 4.810.556 otorgada a Kobayashi y otros; en la solicitud de patente de los Estados Unidos de América serie No. 962.992 presentada el 31 de Octubre de 1997 a nombre de Varona e intitulada "Materiales No Tejidos Crepados"; y en la solicitud de patente de los Estados Unidos de América serie No. 040.707 presentada el 18 de Marzo de 1998 a nombre de Varona e intitulada "Forro No Tejido Crepado con una Estructura Capilar de Gradiente"; cada una de las cuales se incorpora aquí por referencia. Mediante el crepar sólo un lado del laminado 20, el grosor completo del laminado 20, incluyendo ambas la capa de película 22 y la capa no tejida 24 pueden ser crepadas.

El material resultante 20 de ésta incorporación, por tanto, incluye una capa no tejida plana 24 laminada a una capa de película inelástica 22 que tiene rugosidades estriadas 26 en la dirección de la máquina, con ambas la capa no tejida 24 y la capa de película 22 juntas teniendo ondulaciones en la dirección transversal, de manera que se extiende un "valle" en la ondulación a través del material 20 en la dirección

transversal. Por tanto, el material laminado resultante 20 puede extenderse en todas las direcciones en el plano x/y.

El material laminado 20 de ésta incorporación tiene capacidad para respirar respecto del vapor de agua debido al estiramiento en la dirección de la máquina de la película 22 que causa que se formen huecos alrededor de las partículas de carbonato de calcio. Cuando se midió usando el método de prueba INDA IST-70.4-99 (la prueba "Mocon") el laminado preestirado 20 tiene una tasa de transmisión de vapor de agua (WVTR) de más de 1.000 gramos/metro cuadrado-24 horas, y frecuentemente mayor de 2.000 gramos/metro cuadrado-24 horas. Sin embargo ambas la película 22 y el laminado 20 son esencialmente impermeables al agua líquida.

En otra incorporación de la invención, la película 22 puede ser una película extendible en la dirección transversal de capa única más bien que la película estriada e inelástica de la incorporación previa. En ésta incorporación, la película 22 puede hacerse de un polímero extendible. El polímero extendible permite a la película 22 (junto con la tela no tejida estrechada 24) el extenderse en la dirección transversal.

La película extendible 22 puede incluir una capa de núcleo microporosa única o con capacidad para respirar inherentemente, o una o más capas de piel en adición a la capa

de núcleo, como se describió en la incorporación previa. Como en la película estriada e inelástica, la película microporosa extendible también incluye un componente de rellenador extruido dentro de un polímero, pero en ésta incorporación el polímero es extendible. El componente de rellenador descrito en la incorporación previa es adecuado para usarse en ésta incorporación también.

El polímero extendible usado en ésta incorporación puede ser formado de cualesquier polímero termoplástico formador de película extendible. Los ejemplos de los polímeros adecuados incluyen sin limitación ciertas poliolefinas flexibles, por ejemplo polímeros a base de propileno que tienen ambos grupos de propileno atáctico e isotáctico en la cadena de polipropileno principal. Las poliolefinas flexibles (FPO) son vendidas por Rexene Corporation. También incluidos están los copolímeros de propileno-etileno heterofásicos vendidos como "catalloy" por Himont Corporation. Los polímeros heterofásicos son mezclas de reactor formadas mediante el agregar diferentes niveles de propileno y etileno en diferentes fases en el reactor. Los polímeros heterofásicos típicamente incluyen alrededor de 10-90% por peso de un primer segmento A de polímero, alrededor de 10-90% por peso de un segundo segmento B de polímero, y 0-20% por peso de un tercer segmento C de polímero. El segmento de polímero A es por lo menos de alrededor de 80% cristalino e incluye alrededor de 90-100% por peso de propileno como un

homopolímero o un copolímero al azar con hasta 10% por peso de etileno. El segmento de polímero B es de menos de alrededor de 50% cristalino, e incluye alrededor de 30-70% por peso de propileno copolimerizado al azar con alrededor de 30-70% por peso de etileno. El segmento de polímero opcional C contiene alrededor de 80-100% por peso de etileno y 0-20% de propileno copolimerizado al azar.

Otros polímeros extendibles incluyen polietileno de muy baja densidad (VLDPE), el cual es un copolímero alfa olefina-etileno que tiene una densidad de menos de 0,900 gramos por centímetro cúbico, preferiblemente de alrededor de 0,870-0,890 gramos por centímetro cúbico. Los polietilenos de muy baja densidad son catalizados de sitio único. Otros polímeros extendibles incluyen los copolímeros de alfa olefina-propileno que contienen más de 10% por peso de un comonómero de C_2 o C_4-C_{12}, preferiblemente de alrededor de 15-85% por peso del comonómero, con el etileno siendo un comonómero preferido.

El polímero extendible puede ser de un tipo y de una cantidad que haga que la película 22 tenga una extensión en la dirección transversal de por lo menos de alrededor de 25% de su ancho no estirado inicial cuando la fuerza estiradora es aplicada. Cuando la fuerza de estiramiento es relajada, la película 22 no debe por sí misma hacer que el laminado se retraiga por más de 30% de la diferencia entre el ancho estirado y el ancho no estirado inicial. Cualesquier reacción adicional

del laminado que contiene la película 22 puede causarse por un componente elastomérico y/o adhesivo elastomérico formando parte del laminado 20. Preferiblemente, la película 22 debe tener una extensión en la dirección transversal de por lo menos de alrededor de 35% (por ejemplo de 35-300%) del ancho inicial, más preferiblemente de por lo menos de alrededor de 50% (por ejemplo de 50-200%). El polímero extendible puede ser mezclado con un polímero no extendible siempre que la película 22 tenga la extensión necesaria. Los polímeros preferidos para la película 22 son copolímeros de etileno catalizados de sitio único y las poliolefinas flexibles (FPOs) como se describió arriba.

La composición de polímero, contenido de rellenador, grado y tamaño de partícula de rellenador del estiramiento son factores los cuales ayudan a determinar la capacidad para respirar y la barrera del líquido de la barrera de la película extendible 22 en el laminado 20. Generalmente, la película extendible 22 será de menos de alrededor de 50 micras de grosor, preferiblemente de menos de alrededor de 30 micras de grosor, más preferiblemente de menos de alrededor de 20 micras de grosor. La película 22 puede ser estirada uniaxialmente a alrededor de 1,1-7,0 veces su longitud original para provocar una capacidad para respirar, preferiblemente alrededor de 1,5-6,0 veces su longitud original; más preferiblemente alrededor de 2,5-5,0 veces su longitud original. La película 22 puede alternativamente ser estirada biaxialmente

usando técnicas convencionales familiares a las personas expertas en el arte. Preferiblemente, la película 22 es estirada en su dirección de la máquina, y es laminada a la tela no tejida 24 con la dirección de la máquina de la película 22 alineada con la dirección de la máquina del tejido 24. Las temperaturas de estiramiento pueden variar de desde 38-150° C dependiendo de los polímeros específicos empleados, y son preferiblemente de alrededor de 70-95° C. La película extendible y con capacidad para respirar 24 puede ser preparada mediante coextrusión de película soplada o fraguada de las capas, mediante recubrimiento por extrusión, o por medio de cualesquier proceso de colocación en capas convencional.

El material laminado 20 de ésta incorporación incluye la película extendible 22 de una tela no tejida 24, unidas juntas y crepadas. La tela no tejida 24, el estrachamiento de la tela no tejida 24, el proceso de unión, los materiales de unión, y el proceso de crepado pueden adecuadamente ser los mismos que en la incorporación previa.

El material resultante 20 de ésta incorporación por tanto incluye una capa no tejida plana 24 laminada a una capa de película extendible en la dirección transversal 22 con ambas la capa no tejida 24 y la capa de película 22 juntas teniendo ondulaciones en la dirección transversal. Por tanto, el material laminado resultante 20 puede extenderse en todas las direcciones en el plano x/y.

En una incorporación alterna de la invención, la tela no tejida 24 puede ser crepada antes de la unión de la capa de película 22 a la capa no tejida 24 más bien que el crepar el material laminado 20. En éste caso, la película debe ser extendible en la dirección de la máquina.

Cuando se usó para hacer la cubierta exterior de una prenda absorbente, las partes del laminado 20 (por ejemplo correspondiendo a las regiones de cintura frontal y posterior en la prenda de tipo de calzón) pueden extenderse por 30-200% en la dirección transversal. El estiramiento en la dirección transversal hace que la tela no tejida estrechada 24 regrese a su configuración no estrechada original, y haga que la película 22 se extienda en la dirección transversal por 30-200% (a 130-300%) de su ancho inicial. El laminado 20 puede ser extendido fácilmente en la dirección transversal a mano, debido a que la película 22 se hace de una composición de polímero extendible.

En general, el material laminado 20 de la invención puede ser extendido adecuadamente por alrededor de 30 a 200% en la dirección transversal, más adecuadamente por alrededor de 40 a 170%, más adecuadamente por alrededor de 50 a 150%. En forma similar, el crepado del laminado 20 permite al material laminado 20 de la invención el ser extendido por alrededor de 30 a 200% en la dirección de la máquina, más

adecuadamente por alrededor de 40 a 170%, más adecuadamente por alrededor de 50 a 150%.

La película extendible 22 y el laminado 20 de ésta incorporación tienen una capacidad para respirar variable al vapor de agua, como se midió por el método de prueba INDA IST-70,4-99. Antes de que el laminado 20 sea estirado en la dirección transversal, éste típicamente tiene una tasa de transmisión de vapor de agua de menos de 1.000 gramos/metro cuadrado por 24 horas. Después de un estiramiento de 25% en la dirección transversal, las partes del laminado afectadas por el estiramiento típicamente tienen una tasa de transmisión de vapor de agua muy superior, de por lo menos de 4.000 gramos/metro cuadrado-24 horas, ya sea que estén estirados o no en la dirección transversal la película 22 y el laminado 20 son esencialmente impermeables al agua líquida.

Sin importar si el laminado EOC 20 es hecho usando una película extendible o una película estriada e inelástica, la película 22 puede retraerse por 2-30% de su longitud estirada en la dirección de la máquina, después de haberse unido a la tela no tejida 24. Esta retracción puede hacer que la tela 24 tenga una topografía de superficie tridimensional caracterizada por rizos o cojines. En cada laminado EOC 20, la película con capacidad para respirar 22 tiene un grosor en un rango de alrededor de 0,2 a 4,0 milésimas de pulgada.

41

Como se mencionó, el laminado resultante 20 de la invención tiene una fuerza de retracción baja. El término "fuerza de retracción baja" se refiere a fuerzas de retracción que no son suficientemente fuertes para retraer el laminado por más de alrededor de 30% de una extensión de alrededor de 30% a alrededor 200%.

Para lograr una fuerza de retracción mayor en el laminado 20 que se proporciona por el adhesivo crepado, un componente elastomérico puede alternativamente ser sujetado a ya sea la capa de película 22 o a la capa no tejida 24 o entre la capa de película 22 y la capa no tejida 24. El componente elasromérico puede estar en la forma de, por ejemplo, películas, fibras, o rejillas de poliuretano, poliéster, polieteramida, o copolímeros de bloque de estireno-isopreno-estireno. El componente elastomérico puede ser aplicado en un patrón, tal como en hileras o columnas, de manera que el laminado 20 pueda tener una fuerza de retracción alta en una dirección y muy poca o ninguna fuerza de retracción en alguna otra dirección. Cualesquiera de éstos componentes elastoméricos pueden ser unidos al laminado 20 usando medios convencionales, incluyendo la unión de adhesivo, la unión térmica o la unión ultrasónica.

EJEMPLOS

Se prepararon dos muestras de la presente invención, junto con dos muestras de control. Una primera muestra ("inelástico 50/50") incluyó una película estriada e inelástica, a saber un laminado térmico-estirado con capacidad para respirar de 20 pulgadas disponible bajo la designación de comercio XP-1.885, conteniendo un rellenador, tal como carbonato de calcio, que fue estirado 3,6 veces en la dirección de la máquina para hacerla microporosa y con capacidad para respirar, y unirla adhesivamente a un material unido con hilado de polipropileno de tejido de alambre de 0,4 onzas por yarda cuadrada usando adhesivo H2525A en un agregado de 3 gramos por metro cuadrado. La velocidad de desenrollado fue de 50 pies por minuto (FPM), mientras que la velocidad de laminación fue de 184 pies por minuto. El laminado completo fue entonces estirado 1,12 veces en la dirección de la máquina que hizo que el laminado se estrechara a 65% de su ancho original. La capa de película total resultante en el laminado fue de 4. El estiramiento en la dirección de la máquina causó que el unido con hilado se estrechara lo cual forzó a la película sujetada al unido con hilado formar rugosidades estriadas en la dirección de la máquina. Este laminado fue entonces crepado usando una temperatura de tambor de 240° F con un adhesivo de crepado A-Flob 15, disponible de Air Products and Chemicals, Inc., de Allentown, Pennsylvania. La velocidad de toma del tambor de crepado fue de aproximadamente de una mitad de la velocidad de

tambor (125 pies por minuto en contra de 225 pies por minuto). La tasa de agregado del adhesivo de crepado fue de alrededor de 0,6%, pero lo que realmente terminó sobre el material fue mucho menos, cerca de alrededor de 0,1% o menos. Una muestra de control ("control inelástico") fue la misma que la muestra inelástica de 50/50 pero sin el crepado, por tanto el peso base del inelástico 50/50 fue de aproximadamente del doble del peso base del control inelástico.

Una segunda muestra ("extendible 50/502) de un laminado con capacidad para respirar extendible en la dirección transversal se produjo mediante el laminar adhesivamente una tela unida con hilado y estrechada a una película extendible en la dirección transversal. El unido con hilado se había estrechado lo suficiente para dar al laminado la cantidad deseada de extensión en la dirección transversal. La película fue una película de poliolefina que fue llenada con carbonato de calcio y fue estirada antes de la laminación lo suficiente para dar al laminado la capacidad para respirar deseada.

Otra muestra de control ("control extendible") fue aproximadamente la misma que la muestra extendible 50/50 pero sin el crepado, por tanto el peso base de la capa extendible 50/50 fue de aproximadamente del doble del peso base del control extendible. Más particularmente, el control extendible fue hecho comercialmente de 0,4 onzas por yarda cuadrada de unido con hilado con un patrón de unión térmico de

tejido de alambre estrechado a alrededor de dos tercios de su ancho original y laminado a una película estirada con capacidad para respirar producida comercialmente. La película estirada con capacidad para respirar fue una película fraguada de tres capas A-B-A vendida por Huntsman tipo 1.885, disponible de Huntsman Packaging Corporation, de 199 Edison Drive, de Washington, Georgia 30763. La película tuvo una capa de núcleo que contiene 42% por peso (69% por volumen) de un polietileno de baja densidad lineal catalizado Ziegler-Natta. El polietileno tuvo un comonómero octeno y una densidad de 0,918 gramos por centímetro cúbico. La capa de núcleo también contuvo 58% por peso (31% por volumen) de partículas de carbonato de calcio recubiertas con ácido esteárico teniendo un diámetro medio de alrededor de 1 micra y un corte superior de 7 micras. La película tuvo dos capas, cada una conteniendo una mezcla de 50,4% por peso de etileno vinil acetato (28% por peso de contenido de vinil acetato), 45,1% por peso de una combinación heterofásica de copolímeros de propileno-etileno comercialmente conocidos como catalloy Montell KS-357P, 4% por peso de tierra diatomacea SUPER FLOSS hecha por McCullough and Benton, y 0,5% por peso de antioxidante B-900 hecho por Ciba Specialties Company. Las capas de piel constituyeron alrededor de 3% del grosor de película total. La película estirada con capacidad para respirar fue preestirada cuatro veces antes de ser laminada al material unido con hilado y estrechado usando alrededor de 1 gramo por metro cuadrado de un adhesivo de base de estireno-isopreno-estireno Findley 2525® disponible de Ato Findley

Adhesives, Inc., de Wauwatosa, Wisconsin, Estados Unidos de América.

Todas las cuatro muestras sometidas a la siguiente prueba:

Prueba de Tensión: La prueba de tensión midió la resistencia y alargamiento de tensión de una tela cuando se sometió a un esfuerzo unidireccional de acuerdo a la prueba estándar ASTM D 5034-95, así como al estándar de métodos de prueba federal No. 191 método 5102-78. Esta prueba midió la resistencia en libras y el por ciento de estiramiento mientras que se alargó la muestra hasta que ésta se rompió. Los números superiores indican una tela más fuerte y/o más estirable, respectivamente. El término "carga pico" significa la fuerza o carga máxima, expresada en libras, requerida para alargar una muestra al rompimiento o ruptura en una prueba de tensión. El término "tensión" o "por ciento de estiramiento" significa el aumento en longitud de una muestra durante una prueba de tensión expresada como un porcentaje. Los valores para la carga pico y tensión a carga pico fueron obtenidos usando un ancho de tela de 3 por 6 pulgadas (76 por 152 milímetros), un ancho de abrazadera de 3 pulgadas (76 milímetros), una longitud medida de 3 pulgadas (76 milímetros) y una tasa de extensión constante de 12 pulgadas/minuto (305 milímetros/minuto), en donde el ancho de muestra completo fue agarrado en las abrazaderas. La muestra fue agarrada por ejemplo, en un aparato INSTRON 1.130 disponible

de Instron Corporation, o un aparato INTELLECT II de Thwing-Albert, disponible de Thwing-Albert Instrument Company, de 10.960 Dutton Road, Philadelphia, Pennsylvania 19154, y la unidad se puso a cero, se balanceó y se calibró de acuerdo al procedimiento estándar.

Las propiedades del material y los resultados de la prueba de tensión para las cuatro muestras se dan en la Tabla 1 dada abajo. Debido a que las muestras de prueba, inelásticas 50/50 y extendibles 50/50 tienen aproximadamente el doble del peso base que las muestras de control respectivas debido al crepado, la Tabla 2 muestra los resultados de la prueba de tensión normalizada por los pesos base de las muestras. La diferencia en peso base entre las muestras de prueba y las muestras de control afecta las propiedades de material que están siendo probadas en la dirección transversal y no afecta apreciablemente las propiedades de material que están siendo probadas en la dirección de la máquina ya que la diferencia de peso base es causada mediante el crepado en la dirección de la máquina.

Como puede verse en las Tablas 1 y 2, el inelástico 50/50 y el extendible 50/50 ambos tienen un módulo considerablemente bajo en ambas la dirección de la máquina y la dirección transversal en comparación a las muestras de control respectivas. La carga pico en la dirección transversal de ambos el inelástico 50/50 y el extendible 50/50 fue aproximadamente

igual a las muestras de control respectivas una vez normalizadas por el peso base, como se mostró en la Tabla 2. Sin embargo, la carga pico en la dirección de la máquina de ambos el inelástico 50/50 y el extendible 50/50 fue notablemente más bajo que las muestras de control respectivas en ambas la Tabla 1 y la Tabla 2. Comparando los valores normalizados, la tensión pico en la dirección transversal de ambos el inelástico 50/50 y el extendible 50/50 fueron de aproximadamente el doble de tanto como la tensión pico en la dirección transversal de las muestras de control, como se mostró en la Tabla 2. La tensión pico en la dirección de la máquina de ambos el inelástico 50/50 y el extendible 50/50 fue notablemente superior que la tensión pico en la dirección de la máquina de las muestras de control respectivas en ambas la Tabla 1 y la Tabla 2. Como puede verse en la Tabla 1 y en la Tabla 2, la tensión pico fue representada en términos de por ciento de alargamiento. El por ciento de alargamiento fue determinado mediante el dividir la diferencia entre la longitud final y la longitud inicial por la longitud inicial, y multiplicando el cociente por 100.

Tabla 1: Propiedades de Material

Muestra	Peso Base (gsm)	Módulos MD (psi)	Módulos CD (psi)	Carga Pico MD (gramos)	Carga Pico CD (gramos)	Tensión Pico MD (% de alargamiento)	Tensión Pico CD (% de alargamiento)
Control Inelástico	51,9	4727	519,8	16815	3069	50,7	114,7
Inelástico 50/50	97,2	284	138,1	12275	6082	170,4	120,4
Control Extendible	34,2	16897	1896	15141	2555	30,2	136,9
Extendible 50/50	77,6	395	423	11584	5816	169,8	146

Tabla 2: Propiedades de Material Normalizado por Peso Base

Muestra	Peso Base (gsm)	Módulos MD (psi)	Módulos CD (psi)	Carga Pico MD (gramos)	Carga Pico CD (gramos)	Tensión Pico MD (% de alargamiento)	Tensión Pico CD (% de alargamiento)
Control Inelástico	51,9	91,1	10,0	324,0	59,1	1,0	2,2
Inelástico 50/50	97,2	2,9	1,4	126,3	62,6	1,8	1,2
Control Extendible	34,2	494,1	55,4	442,7	74,7	0,9	4,0
Extendible 50/50	77,6	5,1	5,5	149,3	74,9	2,2	1,9

Durante la prueba de tensión dada arriba, los puntos de datos de fuerza individuales (medidos en gramos) fueron tomados a alargamientos específicos en ambas la dirección de la máquina y en la dirección transversal y e muestran abajo en las Tablas 3 y 4. La Tabla 5 es normalizada por los pesos base de las muestras y está en gramos/gramo por metro cuadrado.

Tabla 3: Alargamiento en la Dirección de la Máquina

% Alargamiento MD	Control Inelástico	Inelástico 50/50	Control Extendible	Extendible 50/50
1%	635	178	992	268
2%	1216	354	2492	487
3%	1747	526	3924	688
4%	2297	684	5204	859
5%	2915	849	6347	1024
10%	7040	1579	10177	1544
30%	14785	3159	14692	2413
50%	14742	3740		2837
75%		4316		3426
100%		5809		5215
170%		12275		11584

Como puede verse de la Tabla 3, las fuerzas requeridas para alargar las muestras de la presente invención fueron considerablemente más bajas que aquellas requeridas para extender los controles. Además, los controles se rompieron a

una extensión mucho más baja que la de las muestras inventivas, como puede verse también en la Tabla 1.

Tabla 4: Alargamiento en la Dirección Transversal

% Alargamiento MD	Control Inelástico	Inelástico 50/50	Control Extendible	Extendible 50/50
1%	40	24	65	38
2%	68	64	187	149
3%	87	111	318	326
4%	106	171	448	598
5%	125	226	525	819
10%	173	438	680	1414
30%	345	1079	807	1777
50%	1114	1798	887	1978
75%	2156	3746	1210	2764
100%	2839	5324	1896	4150

Tabla 5: Alargamiento en la Dirección Transversal Normalizado

% Alargamiento MD	Control Inelástico	Inelástico 50/50	Control Extendible	Extendible 50/50
1%	0,9	0,2	1,9	0,5
2%	1,3	0,7	5,5	1,9
3%	1,7	1,1	9,3	4,2
4%	2,0	1,8	13,1	7,7
5%	2,4	2,3	15,4	10,6
10%	3,3	4,5	19,9	18,2
30%	6,6	11,1	23,6	22,9
50%	21,5	18,5	25,9	25,5
75%	2156	3746	1210	2764
100%	2839	5324	1896	4150

Como se explicó arriba, la diferencia en pesos base entre las muestras de prueba y las muestras de control afectan las propiedades en la dirección transversal que está siendo probada. Por tanto, los valores en la Tabla 4 se han normalizado por los pesos base de las muestras, listadas en la Tabla 1, y los valores normalizados aparecen en la Tabla 5. Como puede verse en la Tabla 5, la extensión de las muestras de

la invención no se cambió significativamente debido al proceso de crepado.

Se apreciará que los detalles de las incorporaciones anteriores dados para propósitos de ilustración, no deben considerarse como limitantes del alcance de ésta invención. Aún cuando sólo unas cuantas incorporaciones de ejemplo de ésta invención se han descrito en detalle arriba, aquellos expertos en el arte apreciarán fácilmente que son posibles muchas modificaciones en las incorporaciones de ejemplo sin materialmente departir de las enseñanzas novedosas y de las ventajas de ésta invención. Por tanto, todas ésas modificaciones se intenta que sean incluidas dentro del alcance de ésta invención, la cual se define en las siguientes reivindicaciones y en todos los equivalentes de las mismas. Además, se reconoce que pueden concebirse muchas incorporaciones que no logran todas las ventajas de éstas incorporaciones, particularmente de las incorporaciones preferidas, pero que la ausencia de una ventaja particular no deberá considerarse como que significa necesariamente que tal incorporación está fuera del alcance de la presente invención.

Tasa de Transmisión de Vapor de Agua para Procedimiento de Prueba (WVTR)

Una técnica adecuada para determinar el vapor WVTR (tasa de transmisión de vapor de agua) de un material

laminado o película de la invención es el procedimiento de prueba estandarizado por INDA (Asociación de la Industria de Telas No Tejidas), No. IST-70,4-99, intitilada "MÉTODO DE PRUEBA ESTÁNDAR PARA TASA DE TRANSMISIÓN DE VAPOR DE AGUA A TRAVÉS DE UN NO TEJIDO Y PELÍCULA PLÁSTICA USANDO UNA PELÍCULA DE PROTECCIÓN Y SENSOR DE PRESIÓN DE VAPOR" el cual se incorpora aquí por referencia. El procedimiento de la Asociación de la Industria de Telas No Tejidas proporciona la determinación de la tasa de transmisión de vapor de agua, la permeación de la película al vapor de agua y, para los materiales homogéneos, el coeficiente de permeabilidad de vapor de agua.

El método de prueba de la Asociación de la Industria de Telas No Tejidas es muy conocido y no se establecerá aquí en detalle. Sin embargo, el procedimiento de prueba se resume como sigue. Una cámara seca es separada de una cámara húmeda de temperatura y humedad conocidas por una película de protección permanente y el material de muestra que va a ser probado. El propósito de la película de protección es el de definir una separación de aire definida y para acallar o aquietar el aire en la separación de aire mientras que la separación de aire está caracterizada. La cámara seca, la película de protección, y la cámara húmeda constituyen una celda de difusión en la cual es sellada la película de prueba. El soporte de muestra es conocido como Permatran-W modelo 100K fabricado por Mocon/Modern Controls, Inc., de Minneapolis, Minnesota. Se hace una primera prueba de la tasa de transmisión

de vapor de agua de la película de protección y de la separación de aire entre el conjunto evaporador que genera 100% de humedad relativa. El vapor de agua se difunde a través de la separación de aire y la película de protección y entonces se mezcla con un flujo de gas seco el cual es proporcional a la concentración de vapor de agua. Un sensor genera una señal proporcional al contenido de vapor de la corriente de gas. La señal eléctrica es dirigida a una computadora para el procesamiento. La computadora calcula la tasa de transmisión de la separación de aire y de la película de protección y almacena el valor para el uso adicional.

La tasa de transmisión de la película de protección y de la separación de aire se almacena en la computadora como CalC. El material de muestra es entonces sellado en la celda de prueba. De nuevo, el vapor de agua se difunde a través de la separación de aire a la película de protección y el material de prueba y entonces se mezcla con el flujo de gas seco que barre el material de prueba. También de nuevo, ésta mezcla es llevada al sensor de vapor. La computadora entonces calcula la tasa de transmisión de la combinación de la separación de aire, de la película de protección y del material de prueba. Esta información es entonces usada para calcular la tasa de transmisión a la cual la humedad es transmitida a través del material de prueba de acuerdo a la ecuación:

TR^{-1} material de prueba = TR^{-1} material de prueba, película de protección, separación de aire $-TR^{-1}$ película de protección, separación de aire

Cálculos:

Tasa de transmisión de vapor de agua: El cálculo de la tasa de transmisión de vapor de agua usa la fórmula:

$$WVTR = Fp_{sat}(T)RH/Ap_{sat}(T)(1-RH)$$

en donde:

F = El flujo del vapor de agua en centímetros cúbicos por minuto,

$p_{sat}(T)$ = La densidad del agua en aire saturado a la temperatura T,

RH = Humedad relativa en lugares especificados en la celda,

A = Área en sección transversal de la celda, y

$p_{sat}(T)$ = La presión de vapor de saturación del vapor de agua a la temperatura T.

54

REIVINDICACIONES

1. Un material laminado extendible en una primera dirección y en una segunda dirección mutuamente perpendicular, que comprende:

una película que tiene rugosidades estriadas en la primera dirección y ondulaciones en la segunda dirección mutuamente perpendicular; y

una tela no tejida unida a la película, la tela no tejida tiene ondulaciones en la segunda dirección mutuamente perpendicular.

2. El material laminado tal y como se reivindica en la cláusula 1, caracterizado porque la película comprende una película inelástica.

3. El material laminado tal y como se reivindica en la cláusula 1, caracterizado porque la película comprende una película microporosa con capacidad para respirar.

4. El material laminado tal y como se reivindica en la cláusula 1, caracterizado porque la tela no tejida comprende un tejido unido con hilado.

55

5. El material laminado tal y como se reivindica en la cláusula 1, caracterizado porque la tela no tejida es unida adhesivamente a la película.

6. El material laminado tal y como se reivindica en la cláusula 1, caracterizado porque la tela no tejida es térmicamente unida a la película.

7. Un material laminado extendible en una primera dirección y en una segunda dirección mutuamente perpendicular, que comprende:

una película que tiene ondulaciones en la segunda dirección y extensión en la segunda dirección; y

una tela no tejida unida a la película, la tela no tejida tiene ondulaciones en la segunda dirección.

8. El material laminado tal y como se reivindica en la cláusula 7, caracterizado porque la película comprende un polímero extendible que es extendible en la segunda dirección.

9. El material laminado tal y como se reivindica en la cláusula 7, caracterizado porque la tela no tejida comprende un tejido unido con hilado.

10. El material laminado tal y como se reivindica en la cláusula 7, caracterizado porque la tela no tejida es unida adhesivamente a la película.

11. El material laminado tal y como se reivindica en la cláusula 7, caracterizado porque la tela no tejida es térmicamente unida a la película.

12. Un material laminado que se extiende en una primera dirección y en una segunda dirección mutuamente perpendicular, que comprende:

una película extendible en la segunda dirección;

una tela no tejida unida estrechada y estirada en la primera dirección y crepada en la primera dirección; y

un adhesivo que une la película a la tela no tejida.

13. El material laminado tal y como se reivindica en la cláusula 12, caracterizado porque la película comprende una película microporosa con capacidad para respirar.

14. El material laminado tal y como se reivindica en la cláusula 12, caracterizado porque la película comprende

57

una película inelástica crepada en la primera dirección y que tiene rugosidades en la segunda dirección.

15. El material laminado tal y como se reivindica en la cláusula 12, caracterizado porque la película comprende un polímero extendible que es extendible en la segunda dirección.

16. El material laminado tal y como se reivindica en la cláusula 12, caracterizado porque la primera dirección comprende una dirección de la máquina y la segunda dirección comprende una dirección transversal.

17. El material laminado tal y como se reivindica en la cláusula 12, caracterizado porque un adhesivo crepado elastomérico es aplicado disparejamente a por lo menos una de la película y de la tela no tejida.

18. El material laminado tal y como se reivindica en la cláusula 12, caracterizado porque un patrón de unión es aplicado disparejamente a la tela no tejida.

19. El material laminado tal y como se reivindica en la cláusula 12, caracterizado porque comprende una película elastomérica unida a por lo menos una de la película extendible y de la tela no tejida.

20. El material laminado tal y como se reivindica en la cláusula 12, caracterizado además porque comprende una pluralidad de fibras elastoméricas unidas a por lo menos una de la película extendible y de la tela no tejida.

21. El material laminado tal y como se reivindica en la cláusula 12, caracterizado además porque comprende una espuma elastomérica unida a por lo menos una de la película extendible y de la tela no tejida.

22. El material laminado tal y como se reivindica en la cláusula 12, caracterizado además porque comprende un lienzo elastomérico unido a por lo menos una de la película extendible y de la tela no tejida.

23. El material laminado tal y como se reivindica en la cláusula 12, caracterizado porque el material laminado puede ser extendido por alrededor de 30% a alrededor de 200% en la primera dirección.

24. El material laminado tal y como se reivindica en la cláusula 12, caracterizado porque el material laminado puede ser extendido por alrededor de 40% a alrededor de 170% en la primera dirección.

25. El material laminado tal y como se reivindica en la cláusula 12, caracterizado porque el material laminado

puede ser extendido por alrededor de 50% a alrededor de 150% en la primera dirección.

26. El material laminado tal y como se reivindica en la cláusula 12, caracterizado porque el material laminado puede ser extendido por alrededor de 30% a alrededor de 200% en la segunda dirección.

27. El material laminado tal y como se reivindica en la cláusula 12, caracterizado porque el material laminado puede ser extendido por alrededor de 40% a alrededor de 170% en la segunda dirección.

28. El material laminado tal y como se reivindica en la cláusula 12, caracterizado porque el material laminado puede ser extendido por alrededor de 50% a alrededor de 150% en la segunda dirección.

29. Una cubierta exterior para artículo absorbente que comprende el material laminado tal y como se reivindica en la cláusula 12.

30. Un material laminado extendible en una primera dirección y en una segunda dirección mutuamente perpendicular, que comprende:

una película inelástica crepada en la primera dirección y que tiene rugosidades en la segunda dirección;

una tela no tejida estrechada y estirada en la primera dirección, crepada en la primera dirección, y laminada a la película; y

un adhesivo de crepado elastomérico aplicado a una superficie de por lo menos uno de la película y del tejido.

31. El material laminado tal y como se reivindica en la cláusula 30, caracterizado porque la película comprende una película microporosa y con capacidad para respirar.

32. El material laminado tal y como se reivindica en la cláusula 30, caracterizado porque el adhesivo de crepado elastomérico es aplicado disparejamente a por lo menos una de la película y de la tela no tejida.

33. El material laminado tal y como se reivindica en la cláusula 30, caracterizado porque un patrón de unión es aplicado disparejamente a la tela no tejida.

34. El material laminado tal y como se reivindica en la cláusula 30, caracterizado además porque comprende una película elastomérica unida a por lo menos una de la película inelástica y de la tela no tejida.

61

35. El material laminado tal y como se reivindica en la cláusula 30, caracterizado además porque comprende una pluralidad de fibras elastoméricas unidas a por lo menos una de la película inelástica y de la tela no tejida.

36. El material laminado tal y como se reivindica en la cláusula 30, caracterizado además porque comprende una espuma elastomérica unida a por lo menos una de la película inelástica y de la tela no tejida.

37. El material laminado tal y como se reivindica en la cláusula 36, caracterizado además porque comprende un lienzo elastomérico unido a por lo menos una de la película inelástica y de la tela no tejida.

38. El material laminado tal y como se reivindica en la cláusula 30, caracterizado porque el material laminado puede ser extendido por alrededor de 30% a alrededor de 200% en la primera dirección.

39. El material laminado tal y como se reivindica en la cláusula 30, caracterizado porque el material laminado puede ser extendido por alrededor de 40% a alrededor de 170% en la primera dirección.

62

40. El material laminado tal y como se reivindica en la cláusula 30, caracterizado porque el material laminado puede ser extendido por alrededor de 50% a alrededor de 150% en la primera dirección.

41. El material laminado tal y como se reivindica en la cláusula 30, caracterizado porque el material laminado puede ser extendido por alrededor de 30% a alrededor de 200% en la segunda dirección.

42. El material laminado tal y como se reivindica en la cláusula 30, caracterizado porque el material laminado puede ser extendido por alrededor de 40% a alrededor de 170% en la segunda dirección.

43. El material laminado tal y como se reivindica en la cláusula 30, caracterizado porque el material laminado puede ser extendido por alrededor de 50% a alrededor de 150% en la segunda dirección.

44. Una cubierta exterior para artículo absorbente que comprende el material laminado tal y como se reivindica en la cláusula 30.

45. Un material laminado extendible y recuperable en una primera dirección y en una segunda dirección mutuamente perpendicular, que comprende:

una película inelástica crepada en la primera dirección y que tiene rugosidades en la segunda dirección;

una tela no tejida estrechada y estirada en la primera dirección, crepada en la primera dirección, y laminada a la película; y

un componente elastomérico unido a por lo menos uno de la película y del tejido.

46. El material laminado tal y como se reivindica en la cláusula 45, caracterizado porque la película comprende una película microporosa y con capacidad para respirar.

47. El material laminado tal y como se reivindica en la cláusula 45, caracterizado porque el adhesivo de crepado elastomérico es aplicado disparejamente a por lo menos una de la película y de la tela no tejida.

48. El material laminado tal y como se reivindica en la cláusula 45, caracterizado porque un patrón de unión es aplicado disparejamente a la tela no tejida.

49. El material laminado tal y como se reivindica en la cláusula 45, caracterizado porque el componente elastomérico comprende una película elastomérica.

64

50. El material laminado tal y como se reivindica en la cláusula 45, caracterizado porque el componente elastomérico comprende una pluralidad de fibras elastoméricas.

51. El material laminado tal y como se reivindica en la cláusula 45, caracterizado porque el componente elastomérico comprende una espuma elastomérica.

52. El material laminado tal y como se reivindica en la cláusula 45, caracterizado porque el componente elastomérico comprende un lienzo elastomérico.

53. El material laminado tal y como se reivindica en la cláusula 45, caracterizado porque el material laminado puede ser extendido por alrededor de 30% a alrededor de 200% en la primera dirección.

54. El material laminado tal y como se reivindica en la cláusula 45, caracterizado porque el material laminado puede ser extendido por alrededor de 40% a alrededor de 170% en la primera dirección.

55. El material laminado tal y como se reivindica en la cláusula 45, caracterizado porque el material laminado puede ser extendido por alrededor de 50% a alrededor de 150% en la primera dirección.

56. El material laminado tal y como se reivindica en la cláusula 45, caracterizado porque el material laminado puede ser extendido por alrededor de 30% a alrededor de 200% en la segunda dirección.

57. El material laminado tal y como se reivindica en la cláusula 45, caracterizado porque el material laminado puede ser extendido por alrededor de 40% a alrededor de 170% en la segunda dirección.

58. El material laminado tal y como se reivindica en la cláusula 45, caracterizado porque el material laminado puede ser extendido por alrededor de 50% a alrededor de 150% en la segunda dirección.

59. Una cubierta exterior para artículo absorbente que comprende el material laminado tal y como se reivindica en la cláusula 45.

57/66

RESUMEN

Un laminado con capacidad para respirar extendible biaxialmente que tiene propiedades de barrera al líquido y una fuerza de retracción baja. El laminado incluye una tela no tejida estrechada y estirada en una primera dirección para impartir extensión del tejido en una segunda dirección mutuamente perpendicular con la primera dirección,. y una película que es extendible en una segunda dirección. La película puede ser una película microporosa y con capacidad para respirar, y puede ser ya sea una película inelástica estirada para formar rugosidades en la segunda dirección, o puede hacerse de un polímero extendible que es extendible en la segunda dirección. Usando una laminación elastomérica apropiada y/o adhesivo de crepado, el laminado es crepado para producir extensión en la primera dirección con alguna fuerza de retracción. El laminado extendible biaxialmente es particularmente útil como una cubierta exterior para pañales y otros productos para el cuidado personal.

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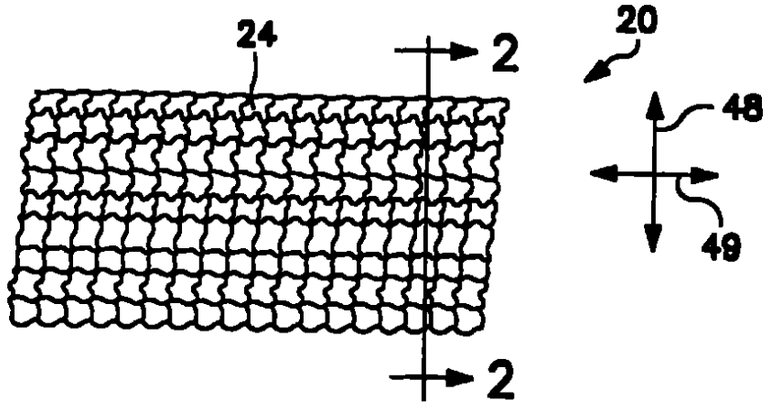
(54) Title: BIAXIALLY EXTENDIBLE MATERIAL



(57) Abstract: A biaxially extendible, breathable laminate having liquid barrier properties and low retractive force. The laminate includes a nonwoven web neck-stretched in a first direction to impart extendibility of the web in a second direction mutually perpendicular with the first direction, and a film that is extendible in the second direction. The film can be a breathable, microporous film, and either be an inelastic film stretched to form rugosities in the second direction, or can be made of an extendible polymer that is extendible in the second direction. Using an appropriate elastomeric lamination and/or creping adhesive, the laminate is creped to produce extendibility in the first direction with some retractive force. The biaxial extendible laminate is particularly useful as an outer cover for diapers and other personal care products.

WO 02/051627 A2

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

68

BIAXIALLY EXTENDIBLE MATERIAL

FIELD OF THE INVENTION

This invention is directed to a material that is extendible in all x/y plane directions.

BACKGROUND OF THE INVENTION

A number of various material attributes are desirable for material used to make outer covers of absorbent articles. For example, in pant-like garments, machine direction extendibility is desirable because longitudinal conformability allows a crotch region of the garment to sag and bulge when loaded without pulling the waistband of the product down. Similarly, cross direction extendibility is desirable because lateral conformability maintains a snug, yet comfortable fit about a wearer's hips. Furthermore, extendibility in all directions in the x/y plane contributes to an all-around form-fitting product.

Some materials, such as necked stretch-bonded laminates (NSBL), necked/creped spunbond attached to elastomerics, etc., have all-direction stretch, i.e., elongation with power recovery. These materials are relatively expensive because of the inclusion of relatively expensive elastomeric materials. However, high recovery forces are not always desirable in outer cover materials. Low recovery forces allow the garments to remain in a conforming shape on the wearer without exerting a considerable amount of retractive pressure and without restricting a wearer's movements. Furthermore, when the garments are filled up by the wearer, low recovery forces allow the weight of the garment contents to pull the garment contents away from the wearer's body without pulling the rest of the garment down on the wearer's body, thereby maintaining close contact between the wearer and the garment in the waist area and around the leg openings to prevent leakage of any garment contents from the garment.

Breathability is a material attribute particularly desirable in absorbent articles. Breathable films and laminates typically block the passage of particulate matter, water and other liquids while allowing water vapor and/or air to pass through the material. Thus, breathable materials, when used in diapers or similar absorbent garments, reduce the relative

humidity and temperature within the garment in comparison to such garments made of non-breathable films and laminates.

A liquid barrier is an inherently desirable material attribute of an absorbent article. The liquid barrier acts to prevent liquids from permeating through a surface of the garment and onto a wearer's clothing or surroundings.

Various types of material with combined attributes are known in the art. For example, stretch-bonded laminates (SBL) deliver a machine direction extendible, breathable composite, but have no liquid barrier and little extendibility in a cross direction. More recent neck-bonded laminates deliver a cross direction extendible liquid barrier, but are not extendible in the machine direction. Other composites function as cloth-like, breathable barriers, but they have little or no extendibility in either a machine direction or a cross direction.

U.S. Patent No. 5,114,781 issued to Morman on May 19, 1992, discloses a laminate that can extend in at least two directions. The laminate includes a reversibly necked nonwoven material and an elastic sheet.

U.S. Patent No. 5,116,662 issued to Morman on May 26, 1992, discloses a laminate that can extend in at least two directions. The laminate includes a necked nonwoven material and an elastic sheet.

U.S. Patent No. 5,883,028 issued to Morman, et al., on March 16, 1999, discloses a laminate that can extend in at least two directions. The laminate is formed by attaching a nonwoven material that is necked in the cross direction to a water vapor-soluble elastomeric film that is stretched in the machine direction and has retraction in the machine direction.

There is a need or desire for a material that delivers a multitude of properties in a single composite, namely biaxial extendibility, low recovery force, breathability, liquid barrier properties, and is relatively inexpensive.

SUMMARY OF THE INVENTION

The present invention is directed to an extendible outer cover (EOC) material that can extend in all x/y plane directions. In one embodiment, the EOC is a laminate including a necked nonwoven web and a striated, breathable, microporous film having

striated rugosities in the machine direction. The striated rugosities allow the film and the necked nonwoven web to extend in the cross direction. The material of this embodiment is made by stretching the filled film in the machine direction to cause breathability, laminating the stretched film to the nonwoven web, stretching the laminate in the machine direction to neck the nonwoven web and form the striations in the film, then creping the laminate to create machine direction extendibility. An elastomeric lamination and/or creping adhesive can be used to produce a laminate with minor retractive force.

In another embodiment of the invention, the EOC is a laminate including a single-layer cross-direction extendible film made from an extendible polymer that permits the film, along with a necked nonwoven web bonded to the film, to extend in the cross direction. The material of this embodiment is made by stretching the filled film in the machine direction to cause breathability, separately stretching a nonwoven web to cause necking, laminating the stretched film and the necked nonwoven web together, then creping the laminate to create machine direction extendibility. As in the previous embodiment, an elastomeric lamination and/or creping adhesive can be used to produce a laminate with minor retractive force.

The adhesive add-on level and bond pattern greatly affect material properties. Thus, the resulting material of the invention can have a high retractive force in one direction and low or no retractive force in another. Further retractive force can be imparted in one or both directions through the addition of elastomeric film, fibers, foams, scrims, or other elements.

With the foregoing in mind, it is a feature and advantage of the invention to provide a biaxially extendible, breathable laminate having liquid barrier properties and low recovery force.

It is also a feature and advantage of the invention to provide an improved biaxially extendible, breathable laminate useful in a wide variety of diaper outer covers, other personal care products, surgical gowns, and other breathable applications.

The foregoing and other features and advantages of the invention will become further apparent from the following detailed description of the presently preferred embodiments, read in conjunction with the examples and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a top view of a biaxially extendible, breathable laminate of the present invention;

Fig. 2 is a cross-sectional view of a biaxially extendible, breathable laminate, taken along line 2-2 of Fig. 1;

Fig. 3 is a top view of a film layer having striated rugosities; and

Fig. 4 is a top view of a nonwoven layer having a wire weave bond pattern.

DEFINITIONS

Within the context of this specification, each term or phrase below will include the following meaning or meanings.

"Biaxially extendible" refers to a material having extendibility by at least 25% of its initial dimensions (without rupture, tear or loss of barrier properties) in two directions perpendicular to one another, e.g. extendibility in a machine direction and in a cross direction, or in a longitudinal direction (front to back) and a lateral direction (side to side).

"Bonded" refers to the joining, adhering, connecting, attaching, or the like, of two elements. Two elements will be considered to be bonded together when they are bonded directly to one another or indirectly to one another, such as when each is directly bonded to intermediate elements.

"Creped" or "Crepe" refers to a crinkled material or composite having bonded and unbonded areas. The creped material can be returned to approximately its original length by applying a mechanical stress, thus smoothing out the crinkled portions.

"Cross direction" refers to the width of a fabric in a direction generally perpendicular to the direction in which it is produced, as opposed to "machine direction" which refers to the length of a fabric in the direction in which it is produced.

" Elastomeric" refers to a material or composite which can be elongated by at least 50 percent of its relaxed length and which will recover, upon release of the applied force, at least 40 percent of its elongation. It is generally preferred that the elastomeric material or composite be capable of being elongated by at least 100 percent, more preferably by at least 300 percent, of its relaxed length and recover, upon release of an applied force, at least 50 percent of its elongation.

"Extendible" means a material which, upon application of a stretching force, can be extended in a particular direction, to a stretched dimension (e.g., width) which is at least 25% greater than an original, unstretched dimension. When the stretching force is removed after a one-minute holding period, the material does not retract, or retracts by not more than 30% of the difference between the stretched dimension and the original dimension, and may retract more only if aided by an elastic adhesive or other elastic component bonded to the material. Thus, a material having a width of one meter, which is extendible in the cross direction, can be stretched to a width of at least 1.25 meters. When the stretching force is released, after holding the extended width for one minute, a material stretched to a width of 1.25 meters will not retract, or will retract to a width of not less than 1.175 meters. Extendible materials are different from elastic materials, the latter tending to retract most of the way to their original dimension when a stretching force is released. The stretching force can be any reasonable force sufficient to extend the material to between 125% of its original dimension, and its maximum stretched dimension in the selected direction (e.g., the cross direction) without rupturing it.

"Film" refers to a thermoplastic film made using a film extrusion and/or foaming process, such as a coating, cast film or blown film extrusion process. For the purposes of the present invention, the term includes breathable microporous and inherently breathable films that act as liquid barriers.

"Inelastic" refers both to materials that do not stretch by 25% or more and to materials that stretch by that amount but do not retract by more than 30%. Inelastic materials include extendible materials, as defined above, as well as materials that do not extend, e.g., which tear when subjected to a stretching force.

"Layer" when used in the singular can have the dual meaning of a single element or a plurality of elements.

"Machine direction" refers to the length of a fabric in the direction in which it is produced, as opposed to "cross direction" which refers to the width of a fabric in a direction generally perpendicular to the machine direction.

"Meltblown fiber" means fibers formed by extruding a molten thermoplastic material through a plurality of fine, usually circular, die capillaries as molten threads or

filaments into converging high velocity heated gas (e.g., air) streams which attenuate the filaments of molten thermoplastic material to reduce their diameter, which may be to microfiber diameter. Thereafter the meltblown fibers carried by the high velocity gas stream are deposited on a collecting surface to form a web of randomly dispersed meltblown fibers. Such a process is disclosed for example, in U.S. Patent 3,849,241 to Butin et al. Meltblown fibers are microfibers which may be continuous or discontinuous, are generally smaller than about 0.6 denier, and are generally self bonding when deposited onto a collecting surface. Meltblown fibers used in the present invention are preferably substantially continuous in length.

"Necked" or "neck stretched" are interchangeable terms and refer to a method of elongating a nonwoven fabric, generally in the longitudinal, or machine direction, to reduce its width in a controlled manner to a desired amount. The controlled stretching may take place under cool, room temperature or greater temperatures and is limited to an increase in overall dimension in the direction being stretched up to the elongation required to break the fabric, which in most cases is about 1.2 to 1.4 times. When relaxed, the web retracts toward its original dimensions. Such a process is disclosed, for example, in U.S. Patent Nos. 4,443,513 to Meitner and Notheis, 4,965,122, 4,981,747 and 5,114,781 to Morman and 5,244,482 to Hassenboehler Jr. et al.

"Nonwoven" and "nonwoven web" refer to fibrous materials and webs of fibrous material which are formed without the aid of a textile weaving or knitting process.

"Polymers" include, but are not limited to, homopolymers, copolymers, such as for example, block, graft, random and alternating copolymers, terpolymers, etc. and blends and modifications thereof. Furthermore, unless otherwise specifically limited, the term "polymer" shall include all possible geometrical configurations of the molecules. These configurations include, but are not limited to isotactic, syndiotactic and atactic symmetries.

"Rugosities" refers to thin, narrow grooved or channeled wrinkles in an inelastic film layer.

"Spunbonded fiber" refers to small diameter fibers which are formed by extruding molten thermoplastic material as filaments from a plurality of fine capillaries of a spinnerette having a circular or other configuration, with the diameter of the extruded

filaments then being rapidly reduced as described, for example, in U.S. Patent 4,340,563 to Appel et al., and U.S. Patent 3,692,618 to Dorschner et al., U.S. Patent 3,802,817 to Matsuki et al., U.S. Patents 3,338,992 and 3,341,394 to Kinney, U.S. Patent 3,502,763 to Hartmann, U.S. Patent 3,502,538 to Petersen, and U.S. Patent 3,542,615 to Dobo et al., each of which is incorporated herein in its entirety by reference. Spunbond fibers are quenched and generally are not tacky when they are deposited onto a collecting surface. Spunbond fibers are generally continuous and often have average deniers larger than about 0.3, more particularly, between about 0.6 and 10.

These terms may be defined with additional language in the remaining portions of the specification.

DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENTS

The present invention is directed to a breathable laminate that can extend in all directions in an x/y plane. The material of the present invention is particularly suitable for use as an outer cover for disposable absorbent articles. Examples of such suitable articles include diapers, training pants, incontinence products, swim wear, other personal care or health care garments, or the like.

Referring to Figs. 1 and 2, there is shown a top view and a cross-sectional view, respectively, of a biaxially extendible, breathable laminate 20. The laminate 20 is made up of a film layer 22 and a nonwoven web layer 24. The nonwoven web layer 24 is neck-stretched in the machine direction to impart cross direction extendibility. The film layer 22 is extendible in a cross direction. Both the nonwoven layer 24 and the film layer 22 are creped to impart machine direction extendibility.

Suitably, the film 22 can either be made of an extendible polymer that is extendible in the cross direction or can be an inelastic, striated film having striated rugosities in the machine direction which permit the film 22 to extend in the cross direction. In either case, the film 22 is suitably a breathable, microporous or inherently breathable film. The film layer 22 alone having striated rugosities 26 is shown in Fig. 3.

The term "cross direction," as used herein, refers to the width of a material in a direction generally perpendicular to the direction in which it is produced, as opposed to "machine direction," which refers to the length of a material in the direction in which it is

produced. For reference, arrow 49 depicts the machine direction in Figs. 1 and 3, while arrow 48 depicts the cross direction in Figs. 1-3. The machine direction in Fig. 2 extends into and out of the page.

The breathability of the unstretched laminate 20, expressed as water vapor transmission rate (WVTR), is essentially equal to the breathability of the film layer 22 when the film 22 and the nonwoven web 24 are initially bonded. The nonwoven layer 24 is typically open and porous and does not significantly affect the breathability of the laminate 20. The WVTR is a function of both film thickness and film composition. The film layer 22 suitably can deliver moderate breathability, expressed as WVTR, in a range of about 500 to 30,000 grams/m^2-24 hours using the Mocon WVTR test procedure described below. Suitably, the moderate WVTR of the film layer 22 is at least about 500 grams/m^2-24 hours, even more suitably at least about 750 grams/m^2-24 hours, most suitably at least about 1000 grams/m^2-24 hours.

In an embodiment including an inelastic, striated film 22, the inelastic, striated film 22 can include a filler component extruded within a polymer component. The filler component initiates the formation of voids surrounding the filler particles upon stretching of the film 22 in the machine direction. The voids impart breathability to the film 22 by creating a tortuous path of thin membranes through which water vapor, but not liquid water, can pass.

As used herein, a "filler" is meant to include particulates and/or other forms of materials which can be added to the polymer blend prior to film extrusion, and which will not chemically interfere with or adversely affect the extruded film 22 and, further, which can be uniformly dispersed throughout the film 22. Generally the filler component will be in particulate form with average particle sizes in the range of about 0.1 to about 7 micrometers, desirably from about 0.1 to about 4 micrometers. As used herein the term "particle size" describes the largest dimension or length of the filler component. Both organic and inorganic fillers are contemplated for use with the present invention provided they do not interfere with the film forming process and/or subsequent laminating processes. Examples of fillers include calcium carbonate ($CaCO_3$), various clays, silica (SiO_2), alumina, barium sulfate, talc, magnesium sulfate, titanium dioxide, zeolites, aluminum sulfate, cellulosic powders,

diatomaceous earth, gypsum, magnesium carbonate, barium carbonate, kaolin, mica, carbon, magnesium oxide, aluminum hydroxide, pulp powder, wood powder, cellulose derivatives, polymeric particles, chitin and chitin derivatives. The filler particles optionally may be coated with a fatty acid, such as stearic acid or behenic acid, and/or other material in order to facilitate the free flow of the particles (in bulk) and their ease of dispersion into the polymer. For example, using calcium carbonate filler with a density of about 2.8 grams per cubic centimeter, the filled film 22 will usually contain at least about 15% filler based upon the total volume of the film layer 22, more desirably from about 20% to about 65% by volume.

Suitable polymers for the polymer component include, but are not limited to, non-elastic extrudable polymers such as polyolefin or a blend of polyolefins, cellulose hydrate (cellophane), and ethylene vinyl alcohol. More particularly, useful polyolefins include polypropylene and polyethylene. Other useful polymers include those described in U.S. Patent No. 4,777,073 to Sheth, assigned to Exxon Chemical Patents Inc., such as a copolymer of polypropylene and low density polyethylene or linear low density polyethylene.

Other suitable polymers include those referred to as single site catalyzed polymers such as "metallocene" polymers produced according to a metallocene process and which have limited elastic properties. The term "metallocene-catalyzed polymers" as used herein includes those polymer materials that are produced by the polymerization of at least ethylene using metallocenes or constrained geometry catalysts, a class of organometallic complexes, as catalysts. For example, a common metallocene is ferrocene, a complex of a metal between two cyclopentadienyl (Cp) ligands. Metallocene process catalysts include bis(n-butylcyclopentadienyl)titanium dichloride, bis(n-butylcyclopentadienyl)zirconium dichloride, bis(cyclopentadienyl)scandium chloride, bis(indenyl)zirconium dichloride, bis(methylcyclopentadienyl)titanium dichloride, bis(methylcyclopentadienyl)zirconium dichloride, cobaltocene, cyclopentadienyltitanium trichloride, ferrocene, hafnocene dichloride, isopropyl(cyclopentadienyl,-1-fluorenyl)zirconium dichloride, molybdocene dichloride, nickelocene, niobocene dichloride, ruthenocene, titanocene dichloride, zirconocene chloride hydride, zirconocene dichloride, among others. A more exhaustive list

of such compounds is included in U.S. Patent 5,374,696 to Rosen et al. and assigned to the Dow Chemical Company. Such compounds are also discussed in U.S. Patent 5,064,802 to Stevens et al. and also assigned to Dow.

Such metallocene polymers are available from Exxon-Mobil Chemical Company of Baytown, Texas under the trade name EXXPOL® for polypropylene based polymers and EXACT® for polyethylene based polymers. Dow Chemical Company of Midland, Michigan has polymers commercially available under the name ENGAGE®. Preferably, the metallocene polymers are selected from copolymers of ethylene and 1-butene, copolymers of ethylene and 1-hexene, copolymers of ethylene and 1-octene and combinations thereof. In general, the metallocene-derived ethylene-based polymers of the present invention have a density of at least 0.900 g/cc.

The inelastic, striated film 22 may be a multi-layered film layer which may include a core layer and one or more skin layers on either side of the core layer. When more than one skin layer is present, it is not a requirement that the skin layers be the same. Any of the polymers discussed above are suitable for use as a core layer of a multi-layered film. Any of the fillers discussed above are suitable for use in any film layer.

The skin layer typically includes extrudable thermoplastic polymers and/or additives which provide specialized properties to the striated, inelastic film layer 22. Thus, the skin layer may be made from polymers which provide such properties as antimicrobial, barrier, water vapor transmission, adhesion and/or antiblocking properties. The polymers are thus chosen for the particular attributes desired. Examples of possible polymers that may be used alone or in combination include homopolymers, copolymers and blends of polyolefins as well as ethylene vinyl acetate (EVA), ethylene ethyl acrylate (EEA), ethylene acrylic acid (EAA), ethylene methyl acrylate (EMA), ethylene butyl acrylate (EBA), polyester (PET), nylon (PA), ethylene vinyl alcohol (EVOH), polystyrene (PS), polyurethane (PU), and olefinic thermoplastic elastomers which are multistep reactor products wherein an amorphous ethylene propylene random copolymer is molecularly dispersed in a predominately semicrystalline high polypropylene monomer/low ethylene monomer continuous matrix. The skin layer can be formed of any semicrystalline or amorphous polymer, including one that is slightly elastic and that will undergo permanent deformation

73

at the stretch percentage that the laminate will undergo. However, the skin layer is generally a polyolefin such as polyethylene, polypropylene, polybutylene or an ethylene-propylene copolymer, but may also be wholly or partly a polyurethane, a polyamide such as nylon, a polyester such as polyethylene terephthalate, a polyvinylidene fluoride, a polyacrylate such as poly(methyl methacrylate)(only in blends) and the like, and blends thereof.

This inelastic, striated film 22 can be bonded to the nonwoven web 24. The nonwoven web 24 is air-permeable and can be formed from any suitable process, including bonded carded web processes, meltblowing processes and spunbonding processes. The basis weight of nonwoven fabrics is usually expressed in ounces of material per square yard (osy) or grams per square meter (gsm) and the fiber diameters are usually expressed in microns. (Note that to convert from osy to gsm, multiply osy by 33.91). The nonwoven web of the present invention suitably has a basis weight of 10 to 90 gsm, more suitably 20 to 60 gsm.

The nonwoven web 24 is suitably formed from at least one member selected from fibers and filaments of inelastic polymers. Such polymers include polyesters, for example, polyethylene terephthalate, polyolefins, for example, polyethylene and polypropylene, polyamides, for example, nylon 6 and nylon 66. These fibers or filaments are used alone or in a mixture of two or more thereof.

Suitable fibers for forming the nonwoven web 24 include natural and synthetic fibers as well as bicomponent, multi-component, and shaped polymer fibers. A plurality of neckable materials may also be used. Examples of such materials can include, for example, spunbond/meltblown composites and spunbond/meltblown/spunbond composites such as are taught in U.S. Patent No. 4,041,203 issued to Brock et al., which is herein incorporated by reference.

The nonwoven web 24 can be bonded so as to impart a discrete bond pattern with a prescribed bond surface area. This is known as thermal point bonding. Thermal point bonding involves passing a web of fibers to be bonded between a heated calender or patterned roll and an anvil roll. The calender roll is patterned so that the entire nonwoven web is not bonded across its entire surface. If too much bond area is present on the nonwoven web, it will break before it necks. If there is not enough bond area, then the nonwoven web will pull apart. Typically, the percent bonding area useful in the present

invention ranges from around 5% to around 40% of the area of the nonwoven web. Many patterns for calender rolls have been developed. As will be understood by those skilled in the art, bond area percentages are, of necessity, described in approximations or ranges since bond pins are normally tapered and wear down over time. There are a number of discrete bond patterns which may be used. An example of one bond pattern is a "wire weave" pattern, shown in Fig. 4. The wire weave bond pattern 28 includes square-shaped nonwoven web pattern elements. Each pattern element can be defined by four elliptical-shaped point bonds 30. The side length of each pattern element (representing the center-to-center distance between adjacent bonds) can be about 0.057 inch. Each bond 30 may have a length of about 0.031 inch and a width of about 0.016 inch. The bond pattern 28 can be applied either evenly or unevenly to the nonwoven web 24. An evenly applied bond pattern 28 contributes to more consistent material properties across the surface of the resulting laminate 20, while an unevenly applied bond pattern 28 can affect material properties such as the level of retractive force. The nonwoven web suitably has a post-necked basis weight of about 10-30 grams per square meter (gsm).

As mentioned, the nonwoven layer 24 is neck-stretched in the machine direction, thereby imparting cross directional extendibility to the material. The process of necking is described in U.S. Patent 5,226,992 issued to Morman, hereby incorporated by reference.

Laminating the film layer 22 to the nonwoven layer 24 may be carried out by typical methods known in the art, including adhesive bonding, point bonding and sonic welding. The use of inelastic and/or elastic adhesives for the adhesive bonding is suitable for this invention. An example of a suitable adhesive is a meltblown adhesive containing 54.5-57.5% by weight petroleum hydrocarbon resins; 18.5-21.5% by weight of a mixture of several mineral oils; 22.5-27.5% by weight of styrene-butadiene-styrene block copolymers; 0.1-0.9% by weight polyethylene and/or ethylene vinyl acetate; and 0.2-1.8% by weight antioxidants and stabilizers. Another specific example of a suitable adhesive is NS34-5610, available from National Starch & Chemical Co. The adhesive can be applied molten to either the film 22 or the web 24 using a melt blowing process, at an add-on level of about 2

74

to 5 gsm. The resulting adhesive coverage is intermittent, and occupies about 5 to 40% of the interface between the film 22 and nonwoven web 24.

When the film layer 22 and nonwoven layer 24 are bonded through the use of heat and/or pressure, a laminating device, such as laminating rollers, can be used. The laminating rollers may be heated and point bonding may be used. The temperature at which the laminating rollers are heated depends on the properties of the film 22 and/or the nonwoven 24, but is usually in the range of 200 to 275° F (93 to 135° C). The laminating rollers may each be smooth or patterned or one roll may be smooth while the other roll is patterned. If one of the rolls is patterned it will create a discrete bond pattern with a prescribed bond surface area for the resultant laminate 20.

To make the laminate 20 including the inelastic, striated film 22 and nonwoven web 24, the film 22 is first stretched in the machine direction to 2-5 times its original, unstretched length using two or more nipped pairs of heated draw rollers, with each subsequent pair turning faster than each preceding pair. The stretching is carried out to impart breathability to the film 22. One or both draw rollers in each pair may be heated, so that the film 22 experiences a stretching temperature of 150-200° Fahrenheit (F). The stretched film 22 has a thickness of less than 50 mils.

The stretched film 22 is then laminated to the nonwoven web 24 with the machine direction of the film 22 substantially aligned with the machine direction of the web 24. When adhesively bonding the film 22 to the nonwoven web 24, a molten adhesive is applied to either the film 22 or the web 24, and the film 22 and web 24 are brought together under light pressure (less than 50 lb/linear inch) using a pair of unheated smooth nip rollers, to form the laminate 20. At that point, the adhesive is still warm enough to effect bonding between the film 22 and web 24.

The laminate 20 is then stretched in the machine direction of the film 22 and the web 24, by passing it through a pair of unheated stretch nip rollers that turn at greater speeds than the laminating nip rollers. An oven set at 200-280° F may be positioned between the pairs of nip rollers, to aid in necking and heat setting the laminate 20. The laminate 20 is stretched in this manner to about 1.15-1.20 times its length immediately after lamination. This causes necking of the nonwoven web 24 to 60-75% of its initial width. This also causes

further stretching of the film 22, to about 2.5-7 times its original length occurring before the pre-lamination stretching. Also, because the film 22 is laminated to the web 24, the further stretching causes the film 22 to gather in the cross direction, resulting in the formation of striated rugosities 26 (thin, narrow grooved or channeled wrinkles) in the film 22 (Fig. 3). The basis weight of the laminate 20 increases as a result of the stretching.

Once the laminate 20 is formed, the laminate 20 is then creped with a creping adhesive to achieve machine direction extendibility. Suitable creping adhesives include without limitation aqueous-based styrene butadiene adhesives, neoprene, polyvinyl chloride, vinyl copolymers, polyamides, and ethylene vinyl terpolymers. The presently preferred adhesive material is an acrylic polymer emulsion sold by the B.F. Goodrich Company under the trade name HYCAR®. The use of an elastomeric creping adhesive may impart some retractive force to the laminate 20. Any suitable method of creping can be used. For example, the nonwoven web layer 24 can be at least partially coated with an elastomeric creping adhesive on a side opposite the film layer 22, so that about 5-100% (preferably 10-70%) of the total surface area on that side is coated, and about 0-95% (preferably 30-90%) of the area is uncoated. The creping adhesive can be applied either evenly or unevenly across the nonwoven layer 24. An evenly applied creping adhesive contributes to more consistent material properties across the surface of the resulting laminate 20, while an unevenly applied creping adhesive can affect material properties such as the level of retractive force.

The nonwoven web 24 possesses interfilament bonding, in the form of the bond pattern 28 which is imparted during manufacture of the nonwoven web 24 (Fig. 4). The elastomeric creping adhesive penetrates the nonwoven web 24 to some extent in the coated areas, causing increased interfilament bonding in those areas. The at least partially coated side of the nonwoven web 24 can then be placed against a creping surface, such as a creping drum, and can be peelably bonded to the creping surface.

The creping surface is preferably heated, and is moved (e.g. rotated) in a machine direction. The speed of the rotation of the creping surface depends on the composition of the material being creped, but for the embodiments described herein, a suitable range of rotation speed is roughly 175 to 250 feet per minute. Suitably, the creping surface moves fast enough to decrease the machine direction length of the laminate 20 by

roughly one-half to produce a laminate with 100% machine direction elongation. As the creping surface moves, the leading edge of the laminate 20 bonded to the surface can be creped off using a doctor blade. The doctor blade penetrates the adhesive coating underneath the web and lifts the laminate off the drum, resulting in laminate bending in the cross direction. Alternatively, the creping adhesive can be applied to a surface of the film 22 opposite the nonwoven layer 24. Other examples of creping are taught in U.S. Patent 4,810,556, issued to Kobayashi et al.; U.S. Patent application Serial No. 962,992 filed on 31 October 1997 in the name of Varona and entitled "Creped Nonwoven Materials;" and U.S. Patent application Serial No. 040,707 filed on 18 March 1998 in the name of Varona and entitled "Creped Nonwoven Liner With Gradient Capillary Structure;" each of which is hereby incorporated by reference. By creping just one side of the laminate 20, the entire thickness of the laminate 20, including both the film layer 22 and the nonwoven layer 24, can be creped.

The resulting material 20 of this embodiment, therefore, includes a flat nonwoven layer 24 laminated to an inelastic film layer 22 having striated rugosities 26 in the machine direction, with both the nonwoven layer 24 and the film layer 22 together having undulations in the cross direction, such that a "valley" in the undulation extends across the material 20 in the cross direction. Thus, the resulting laminated material 20 can extend in all directions in an x/y plane.

The laminated material 20 of this embodiment is breathable to water vapor because the machine direction stretching of the film 22 causes voids to form around the calcium carbonate particles. When measured using INDA Test Method IST-70.4-99 (the "Mocon" test), the pre-stretched laminate 20 has a water vapor transmission rate (WVTR) of greater than 1000 grams/m^2-24 hours, and often greater than 2000 grams/m^{2}24 hours. Yet both the film 22 and laminate 20 are substantially impermeable to liquid water.

In another embodiment of the invention, the film 22 can be a single-layer cross-direction extendible film rather than the inelastic, striated film of the previous embodiment. In this embodiment, the film 22 can be made from an extendible polymer. The extendible polymer permits the film 22 (along with the necked nonwoven web 24) to extend in the cross direction.

The extendible film 22 can include a single microporous or inherently breathable core layer, or one or more skin layers in addition to the core layer, as described in the previous embodiment. As in the inelastic, striated film, the extendible microporous film also includes a filler component extruded within a polymer, but in this embodiment the polymer is extendible. The filler component described in the previous embodiment is suitable for use in this embodiment as well.

The extendible polymer used in this embodiment can be formed from any extendible film-forming thermoplastic polymer. Examples of suitable polymers include without limitation certain flexible polyolefins, for example propylene-based polymers having both atactic and isotactic propylene groups in the main polypropylene chain. Flexible polyolefins (FPO's) are sold by the Rexene Corporation. Also included are heterophasic propylene-ethylene copolymers sold as "catalloys" by the Himont Corporation. Heterophasic polymers are reactor blends formed by adding different levels of propylene and ethylene at different stages in the reactor. Heterophasic polymers typically include about 10-90% by weight of a first polymer segment A, about 10-90% by weight of a second polymer segment B, and 0-20% by weight of a third polymer segment C. Polymer segment A is at least about 80% crystalline and includes about 90-100% by weight propylene, as a homopolymer or random copolymer with up to 10% by weight ethylene. Polymer segment B is less than about 50% crystalline, and includes about 30-70% by weight propylene randomly copolymerized with about 30-70% by weight ethylene. Optional polymer segment C contains about 80-100% by weight ethylene and 0-20% of randomly copolymerized propylene.

Other extendible polymers include very low density polyethylene (VLDPE), which is an ethylene-alpha olefin copolymer having a density less than 0.900 grams/cm^3, preferably about 0.870-0.890 grams/cm^3. Preferred VLDPE's are single-site catalyzed. Other extendible polymers include random propylene-alpha olefin copolymers containing more than 10% by weight of a C_2 or C_4-C_{12} comonomer, preferably about 15-85% by weight of the comonomer, with ethylene being a preferred comonomer.

The extendible polymer should be of a type and amount that causes the film 22 to have cross-directional extendibility of at least about 25% of an initial, unstretched

width when a stretching force is applied. When the stretching force is relaxed, the film 22 should not by itself cause the laminate to retract by more than 30% of the difference between the stretched width and the initial, unstretched width. Any further retraction of a laminate containing the film 22 may be caused by an elastomeric adhesive and/or elastomeric component forming part of the laminate 20. Preferably, the film 22 should have cross-directional extendibility of at least about 35% (e.g., 35-300%) of the initial width, more preferably at least about 50% (e.g., 50-200%). The extendible polymer may be blended with a non-extendible polymer so long as the film 22 has the needed extendibility. Preferred polymers for the film 22 are single-site catalyzed ethylene copolymers and flexible polyolefins (FPOs) as described above.

The polymer composition, filler content, filler particle size and degree of stretching are factors which help determine the breathability and liquid barrier of the extendible film 22 in the laminate 20. Generally, the extendible film 22 will be less than about 50 microns thick, preferably less than about 30 microns thick, most preferably less than about 20 microns thick. The film 22 may be uniaxially stretched to about 1.1-7.0 times its original length to cause breathability, preferably to about 1.5-6.0 times its original length, most preferably to about 2.5-5.0 times its original length. The film 22 may alternatively be biaxially stretched using conventional techniques familiar to persons skilled in the art. Preferably, the film 22 is uniaxially stretched in its machine direction, and is laminated to the nonwoven web 24 with the machine direction of the film 22 aligned with the machine direction of the web 24. Stretching temperatures may range from about 38-150°C depending on the specific polymers employed, and are preferably about 70-95°C. The breathable extendible film 22 can be prepared by cast or blown film coextrusion of the layers, by extrusion coating, or by any conventional layering process.

The laminated material 20 of this embodiment includes the extendible film 22 and a nonwoven web 24, bonded together and creped. The nonwoven web 24, necking of the nonwoven web 24, bonding process, bonding materials, and creping process can suitably be the same as in the previous embodiment.

The resulting material 20 of this embodiment, therefore, includes a flat nonwoven layer 24 laminated to a cross-direction extendible film layer 22, with both the

nonwoven layer 24 and the film layer 22 together having undulations in the cross direction. Thus, the resulting laminated material 20 can extend in all directions in an x/y plane.

In an alternative embodiment of the invention, the nonwoven web 24 can be creped prior to bonding the film layer 22 to the nonwoven layer 24 rather than creping the laminated material 20. In this case, the film must also be extendible in the machine direction.

When used to make an outer cover of an absorbent garment, portions of the laminate 20 (i.e., corresponding to the front and back waist regions in a pant-like garment) may be extended by 30-200% in the cross direction. The cross-directional stretching causes the necked nonwoven web 24 to return toward its original, un-necked configuration, and causes the film 22 to extend in the cross direction by 30-200% (to 130-300%) of its initial width. The laminate 20 can be readily extended in the cross direction, by hand, because the film 22 is made from an extendible polymer composition.

In general, the laminated material 20 of the invention can suitably be extended by about 30 to 200% in the cross direction, more suitably by about 40 to 170%, most suitably by about 50 to 150%. Similarly, the creping of the laminate 20 enables the laminated material 20 of the invention to be extended by about 30 to 200% in the machine direction, more suitably by about 40 to 170%, most suitably by about 50 to 150%.

The extendible film 22 and laminate 20 of this embodiment have variable breathability to water vapor, as measured by INDA Test Method IST-70.4-99. Before the laminate 20 is stretched in the cross direction, it typically has a WVTR of less than 1000 grams/m^2-24 hours. Following a 25% stretch in the cross direction, the portions of the laminate affected by the stretch typically have a much higher WVTR, of at least 4,000 grams/m^2-24 hours. Whether or not stretched in the cross direction, the film 22 and laminate 20 are substantially impermeable to liquid water.

Regardless of whether the EOC laminate 20 is made using an inelastic, striated film or an extendible film, the film 22 may retract by 2-30% of its stretched length in the machine direction, after being bonded to the nonwoven web 24. This retraction may cause the web 24 to have a three-dimensional surface topography characterized by loops or pillows. In each EOC laminate 20, the breathable film 22 has a thickness in a range of about 0.2 to 4.0 mil.

77

As mentioned, the resulting laminate 20 of the invention has low retractive force. The term "low retractive force" refers to retractive forces that are not strong enough to retract the laminate more than about 30% from an extension of about 30% to about 200%.

To achieve greater retractive force in the laminate 20 than is provided by the creping adhesive, an elastomeric component can alternatively be attached to either the film layer 22 or the nonwoven layer 24 or between the film layer 22 and the nonwoven layer 24. The elastomeric component can be in the form of, for example, films, fibers, or scrims of polyurethane, polyetherester, polyetheramide, or styrene-isoprene-styrene block copolymers. The elastomeric component can be applied in a pattern, such as in rows or columns, such that the laminate 20 can have high retractive force in one direction and little or no retractive force in another direction. Any of these elastomeric components can be bonded to the laminate 20 using conventional means, including adhesive bonding, thermal bonding, or ultrasonic bonding.

EXAMPLES

Two samples of the present invention were prepared, along with two control samples. A first sample ("Inelastic 50/50") included an inelastic, striated film, namely a 20-inch breathable stretch-thermal laminate available under the trade designation XP-1885, containing a filler, such as calcium carbonate, that was stretched 3.6 times in the machine direction to make it microporous and breathable, and adhesively bonded to a 0.4 osy wire-weave polypropylene spunbond using H2525A adhesive, resulting in 3 gsm add-on. The unwind speed was 50 feet per minute (FPM), while the lamination speed was 184 FPM. The entire laminate was then stretched 1.12 times in the machine direction that caused the laminate to neck to 65% of its original width. The resulting total film draw in the laminate was four. The machine direction stretching caused the spunbond to narrow which forced the film attached to the spunbond to form machine-direction striated rugosities. This laminate was then creped using a drum temperature of 240 degrees Fahrenheit with A-Flob 15 creping adhesive, available from Air Products and Chemicals, Inc., of Allentown, Pennsylvania. The take-off speed from the creping drum was roughly one-half the speed of the drum (125 feet per minute versus 225 feet per minute). The add-on rate of the creping adhesive was about 0.6%, but what actually ended up on the material was much less, closer to about 0.1% or less.

A control sample ("Inelastic Control") was the same as the Inelastic 50/50 sample but without the creping, thus the basis weight of the Inelastic 50/50 was approximately twice the basis weight of the Inelastic Control.

A second sample ("Extendible 50/50") of cross-direction extendible, breathable laminate was produced by adhesively laminating a necked spunbond web to a cross-direction extendible film. The spunbond had been necked enough to give the laminate the desired amount of cross-direction extendibility. The film was a polyolefin film that was calcium carbonate filled and was stretched before lamination enough to give the laminate the desired breathability.

Another control sample ("Extendible Control") was roughly the same as the Extendible 50/50 sample but without the creping, thus the basis weight of the Extendible 50/50 was approximately twice the basis weight of the Extendible Control. More particularly, the Extendible Control was a commercially made 0.4 osy spunbond with a wire weave thermal bonding pattern necked to about two-thirds of its original width and laminated to a commercially produced breathable stretched film. The breathable stretched film was a three-layer A-B-A cast film sold as Huntsman Type 1885, available from Huntsman Packaging Corp., 199 Edison Drive, Washington, Georgia 30763. The film had a core layer containing 42% by weight (69% by volume) Ziegler-Natta catalyzed linear low density polyethylene. The polyethylene had an octene comonomer, and a density of 0.918 grams/cm^3. The core layer also contained 58% by weight (31% by volume) of stearic acid-coated calcium carbonate particles having a mean diameter of about 1 micron and a top cut of 7 microns. The film had two skin layers, each containing a mixture of 50.4% by weight ethylene vinyl acetate (28% by weight vinyl acetate content), 45.1% by weight of a heterophasic combination of propylene-ethylene copolymers commercially known as Montell KS-357P catalloy, 4% by weight SUPER FLOSS diatomaceous earth made by McCullough and Benton, and 0.5% by weight B-900 antioxidant made by Ciba Specialties Company. The skin layers constituted about 3% of the total film thickness. The breathable stretched film was prestretched four times before being laminated to the necked spunbond using about one gram per square meter of Findley 2525A styrene-isoprene-styrene based adhesive, available from Ato-Findley Adhesives, Inc., of Wauwatosa, Wisconsin, U.S.A.

78

All four samples were subjected to the following test:

Tensile Test: The tensile test measured strength and elongation or strain of a fabric when subjected to unidirectional stress according to ASTM Standard Test D 5034-95, as well as Federal Test Methods Standard No. 191A Method 5102-78. This test measured the strength in pounds and percent stretch while elongating the sample until it broke. Higher numbers indicate a stronger and/or more stretchable fabric, respectively. The term "peak load" means the maximum load or force, expressed in pounds, required to elongate a sample to break or rupture in a tensile test. The term "strain" or "percent stretch" means the increase in length of a sample during a tensile test expressed as a percentage. Values for peak load and strain at peak load were obtained using a width of fabric of 3 x 6 in. (76 x 152 mm), a 3 in. (76 mm) clamp width, a gauge length of 3 in. (76 mm), and a constant rate of extension of 12 inches/min. (305 mm/min.), where the entire sample width was gripped in the clamps. The specimen was clamped, for example, in an 1130 Instron, available from the Instron Corporation, or a Thwing-Albert Model INTELLECT II available from the Thwing-Albert Instrument Co., 10960 Dutton Rd., Philadelphia, Pennsylvania 19154, and the unit was zeroed, balanced and calibrated according to the standard procedure.

Material properties and results from the tensile test for the four samples are shown in Table 1 below. Because the test samples, Inelastic 50/50 and Extendible 50/50, have roughly twice the basis weight as the respective control samples due to creping, Table 2 shows the results from the tensile test normalized by the basis weights of the samples. The difference in basis weight between the test samples and control samples affects the material properties being tested in the CD and does not appreciably affect the material properties being tested in the MD since the basis weight difference is caused by creping in the MD.

As can be seen in Tables 1 and 2, Inelastic 50/50 and Extendible 50/50 both have a considerably low modulus in both the MD and the CD compared to the respective control samples. The peak load in the CD of both Inelastic 50/50 and Extendible 50/50 was roughly equal to the respective control samples once normalized by the basis weight, as shown in Table 2. However, the peak load in the MD of both Inelastic 50/50 and Extendible 50/50 was noticeably lower than the respective control samples in both Table 1 and Table 2. Comparing the normalized values, the peak strain in the CD of both Inelastic 50/50 and

Extendible 50/50 was roughly twice as much as the peak strain in the CD of the control samples, as shown in Table 2. The peak strain in the MD of both Inelastic 50/50 and Extendible 50/50 was noticeably higher than the peak strain in the MD of the respective control samples in both Table 1 and Table 2. As can be seen in Table 1 and Table 2, the peak strain was represented in terms of percent elongation. The percent elongation was determined by dividing the difference between the final length and the initial length by the initial length, and multiplying the quotient by 100.

Table 1: Material Properties

Sample	Basis Weight (gsm)	Modulus MD (psi)	Modulus CD (psi)	Peak Load MD (grams)	Peak Load CD (grams)	Peak Strain MD (% elonga-tion)	Peak Strain CD (% elonga-tion)
Inelastic Control	51.9	4727	519.8	16815	3069	50.7	114.7
Inelastic 50/50	97.2	284	138.1	12275	6082	170.4	120.4
Extendible Control	34.2	16897	1896	15141	2555	30.2	136.9
Extendible 50/50	77.6	395	423	11584	5816	169.8	146

Table 2: Material Properties Normalized by Basis Weight

Sample	Basis Weight (gsm)	Modulus MD (psi/gsm)	Modulus CD (psi/gsm)	Peak Load MD (grams/ gsm)	Peak Load CD (grams/ gsm)	Peak Strain MD (% elonga-tion)	Peak Strain CD (% elonga-tion)
Inelastic Control	51.9	91.1	10.0	324.0	59.1	1.0	2.2
Inelastic 50/50	97.2	2.9	1.4	126.3	62.6	1.8	1.2
Extendible Control	34.2	494.1	55.4	442.7	74.7	0.9	4.0
Extendible 50/50	77.6	5.1	5.5	149.3	74.9	2.2	1.9

79

During the above tensile testing, individual force data points (measured in grams) were taken at specified elongations in both the machine direction and the cross direction and are shown below in Tables 3 and 4. Table 5 is normalized by the basis weights of the samples and is in grams/gsm.

Table 3: Machine Direction Elongation

% Elongation MD	Inelastic Control	Inelastic 50/50	Extendible Control	Extendible 50/50
1%	635	178	992	268
2%	1216	354	2492	487
3%	1747	526	3924	688
4%	2297	684	5204	859
5%	2915	849	6347	1024
10%	7040	1579	10177	1544
30%	14785	3159	14692	2413
50%	14742	3740		2837
75%		4316		3426
100%		5809		5215
170%		12275		11584

As can be seen in Table 3, the forces required to elongate the samples of the present invention were considerably lower than those required to extend the controls. Further, the controls broke at a much lower extension than the inventive samples, as also can be seen in Table 1.

Table 4: Cross Direction Elongation

% Elongation CD	Inelastic Control	Inelastic 50/50	Extendible Control	Extendible 50/50
1%	47	24	65	38
2%	68	64	187	149
3%	87	111	318	326
4%	106	171	448	598
5%	125	226	525	819
10%	173	438	680	1414
30%	345	1079	807	1777
50%	1114	1798	887	1978
75%	2156	3746	1210	2764
100%	2839	5324	1896	4150

Table 5: Normalized Cross Direction Elongation

% Elongation CD	Inelastic Control	Inelastic 50/50	Extendible Control	Extendible 50/50
1%	0.9	0.2	1.9	0.5
2%	1.3	0.7	5.5	1.9
3%	1.7	1.1	9.3	4.2
4%	2.0	1.8	13.1	7.7
5%	2.4	2.3	15.4	10.6
10%	3.3	4.5	19.9	18.2
30%	6.6	11.1	23.6	22.9
50%	21.5	18.5	25.9	25.5
75%	2156	3746	1210	2764
100%	2839	5324	1896	4150

As explained above, the difference in basis weights between the test samples and the control samples affects the CD properties being tested. Therefore, the values in Table 4 have been normalized by the basis weights of the samples, listed in Table 1, and the normalized values appear in Table 5. As can be seen in Table 5, the extendibility of the inventive samples was not significantly changed due to the creping process.

It will be appreciated that details of the foregoing embodiments, given for purposes of illustration, are not to be construed as limiting the scope of this invention. Although only a few exemplary embodiments of this invention have been described in detail above, those skilled in the art will readily appreciate that many modifications are possible in the exemplary embodiments without materially departing from the novel teachings and advantages of this invention. Accordingly, all such modifications are intended to be included within the scope of this invention, which is defined in the following claims and all equivalents thereto. Further, it is recognized that many embodiments may be conceived that do not achieve all of the advantages of some embodiments, particularly of the preferred embodiments, yet the absence of a particular advantage shall not be construed to necessarily mean that such an embodiment is outside the scope of the present invention.

Test Procedure For Water Vapor Transmission Rate (WVTR)

A suitable technique for determining the WVTR (water vapor transmission rate) value of a film or laminate material of the invention is the test procedure standardized by INDA (Association of the Nonwoven Fabrics Industry), number IST-70.4-99, entitled "STANDARD TEST METHOD FOR WATER VAPOR TRANSMISSION RATE THROUGH NONWOVEN AND PLASTIC FILM USING A GUARD FILM AND VAPOR PRESSURE SENSOR" which is incorporated by reference herein. The INDA procedure provides for the determination of WVTR, the permeance of the film to water vapor and, for homogeneous materials, water vapor permeability coefficient.

The INDA test method is well known and will not be set forth in detail herein. However, the test procedure is summarized as follows. A dry chamber is separated from a wet chamber of known temperature and humidity by a permanent guard film and the sample material to be tested. The purpose of the guard film is to define a definite air gap and to quiet

or still the air in the air gap while the air gap is characterized. The dry chamber, guard film, and the wet chamber make up a diffusion cell in which the test film is sealed. The sample holder is known as the Permatran-W Model 100K manufactured by Mocon/Modern Controls, Inc., Minneapolis, Minnesota. A first test is made of the WVTR of the guard film and the air gap between an evaporator assembly that generates 100% relative humidity. Water vapor diffuses through the air gap and the guard film and then mixes with a dry gas flow which is proportional to water vapor concentration. A sensor generates a signal proportional to the vapor content of the gas stream. The electrical signal is routed to a computer for processing. The computer calculates the transmission rate of the air gap and the guard film and stores the value for further use.

The transmission rate of the guard film and air gap is stored in the computer as CalC. The sample material is then sealed in the test cell. Again, water vapor diffuses through the air gap to the guard film and the test material and then mixes with a dry gas flow that sweeps the test material. Also, again, this mixture is carried to the vapor sensor. The computer than calculates the transmission rate of the combination of the air gap, the guard film, and the test material. This information is then used to calculate the transmission rate at which moisture is transmitted through the test material according to the equation:

$$TR^{-1}_{\text{test material}} = TR^{-1}_{\text{test material, guardfilm, airgap}} - TR^{-1}_{\text{guardfilm, airgap}}$$

Calculations:

WVTR: The calculation of the WVTR uses the formula:

$$WVTR = Fp_{sat}(T)RH/Ap_{sat}(T)(1-RH))$$

where:

F = The flow of water vapor in cc/min.,

$p_{sat}(T)$ = The density of water in saturated air at temperature T,

RH = The relative humidity at specified locations in the cell,

A = The cross sectional area of the cell, and,

$p_{sat}(T)$ = The saturation vapor pressure of water vapor at temperature T.

WE CLAIM:

1. A laminated material extendible in a first direction and in a second mutually perpendicular direction, comprising:

a film having striated rugosities in the first direction and undulations in the second mutually perpendicular direction; and

a nonwoven web bonded to the film, the nonwoven web having undulations in the second mutually perpendicular direction.

2. The laminated material of Claim 1, wherein the film comprises an inelastic film.

3. The laminated material of Claim 1, wherein the film comprises a breathable, microporous film.

4. The laminated material of Claim 1, wherein the nonwoven web comprises a spunbond web.

5. The laminated material of Claim 1, wherein the nonwoven web is adhesively bonded to the film.

6. The laminated material of Claim 1, wherein the nonwoven web is thermally bonded to the film.

7. A laminated material extendible in a first direction and in a second mutually perpendicular direction, comprising:

a film having undulations in the second direction and extendibility in the second direction; and

a nonwoven web bonded to the film, the nonwoven web having undulations in the second direction.

8. The laminated material of Claim 7, wherein the film comprises an extendible polymer that is extendible in the second direction.

9. The laminated material of Claim 7, wherein the nonwoven web comprises a spunbond web.

10. The laminated material of Claim 7, wherein the nonwoven web is adhesively bonded to the film.

11. The laminated material of Claim 7, wherein the nonwoven web is thermally bonded to the film.

12. A laminated material extendible in a first direction and in a second mutually perpendicular direction, comprising:

a film extendible in the second direction;

a nonwoven web neck-stretched in the first direction and creped in the first direction; and

an adhesive bonding the film to the nonwoven web.

13. The laminated material of Claim 12, wherein the film comprises a breathable, microporous film.

14. The laminated material of Claim 12, wherein the film comprises an inelastic film creped in the first direction and having rugosities in the second direction.

15. The laminated material of Claim 12, wherein the film comprises an extendible polymer that is extendible in the second direction.

16. The laminated material of Claim 12, wherein the first direction comprises a machine direction and the second direction comprises a cross direction.

82

17. The laminated material of Claim 12, wherein an elastomeric creping adhesive is unevenly applied to at least one of the film and the nonwoven web.

18. The laminated material of Claim 12, wherein a bond pattern is unevenly applied to the nonwoven web.

19. The laminated material of Claim 12, further comprising an elastomeric film bonded to at least one of the extendible film and the nonwoven web.

20. The laminated material of Claim 12, further comprising a plurality of elastomeric fibers bonded to at least one of the extendible film and the nonwoven web.

21. The laminated material of Claim 12, further comprising an elastomeric foam bonded to at least one of the extendible film and the nonwoven web.

22. The laminated material of Claim 12, further comprising an elastomeric scrim bonded to at least one of the extendible film and the nonwoven web.

23. The laminated material of Claim 12, wherein the laminated material can be extended by about 30% to about 200% in the first direction.

24. The laminated material of Claim 12, wherein the laminated material can be extended by about 40% to about 170% in the first direction.

25. The laminated material of Claim 12, wherein the laminated material can be extended by about 50% to about 150% in the first direction.

26. The laminated material of Claim 12, wherein the laminated material can be extended by about 30% to about 200% in the second direction.

27. The laminated material of Claim 12, wherein the laminated material can be extended by about 40% to about 170% in the second direction.

28. The laminated material of Claim 12, wherein the laminated material can be extended by about 50% to about 150% in the second direction.

29. An absorbent article outer cover comprising the laminated material of Claim 12.

30. A laminated material extendible in a first direction and in a second mutually perpendicular direction, comprising:

an inelastic film creped in the first direction and having rugosities in the second direction;

a nonwoven web neck-stretched in the first direction, creped in the first direction, and laminated to the film; and

an elastomeric creping adhesive applied to a surface of at least one of the film and web.

31. The laminated material of Claim 30, wherein the film comprises a breathable, microporous film.

32. The laminated material of Claim 30, wherein the elastomeric creping adhesive is applied unevenly to at least one of the film and the nonwoven web.

33. The laminated material of Claim 30, wherein a bond pattern is unevenly applied to the nonwoven web.

34. The laminated material of Claim 30, further comprising an elastomeric film bonded to at least one of the inelastic film and the nonwoven web.

83

35. The laminated material of Claim 30, further comprising a plurality of elastomeric fibers bonded to at least one of the inelastic film and the nonwoven web.

36. The laminated material of Claim 30, further comprising an elastomeric foam bonded to at least one of the inelastic film and the nonwoven web.

37. The laminated material of Claim 36, further comprising an elastomeric scrim bonded to at least one of the inelastic film and the nonwoven web.

38. The laminated material of Claim 30, wherein the laminated material can be extended by about 30% to about 200% in the first direction.

39. The laminated material of Claim 30, wherein the laminated material can be extended by about 40% to about 170% in the first direction.

40. The laminated material of Claim 30, wherein the laminated material can be extended by about 50% to about 150% in the first direction.

41. The laminated material of Claim 30, wherein the laminated material can be extended by about 30% to about 200% in the second direction.

42. The laminated material of Claim 30, wherein the laminated material can be extended by about 40% to about 170% in the second direction.

43. The laminated material of Claim 30, wherein the laminated material can be extended by about 50% to about 150% in the second direction.

44. An absorbent article outer cover comprising the laminated material of Claim 30.

45. A laminated material extendible and recoverable in a first direction and in a second mutually perpendicular direction, comprising:

an inelastic film creped in the first direction and having rugosities in the second direction;

a nonwoven web neck-stretched in the first direction, creped in the first direction, and laminated to the film; and

an elastomeric component attached to at least one of the film and the web.

46. The laminated material of Claim 45, wherein the film comprises a breathable, microporous film.

47. The laminated material of Claim 45, wherein an elastomeric creping adhesive is unevenly applied to at least one of the film and the nonwoven web.

48. The laminated material of Claim 45, wherein a bond pattern is unevenly applied to the nonwoven web.

49. The laminated material of Claim 45, wherein the elastomeric component comprises an elastomeric film.

50. The laminated material of Claim 45, wherein the elastomeric component comprises a plurality of elastomeric fibers.

51. The laminated material of Claim 45, wherein the elastomeric component comprises an elastomeric foam.

52. The laminated material of Claim 45, wherein the elastomeric component comprises an elastomeric scrim.

84

53. The laminated material of Claim 45, wherein the laminated material can be extended by about 30% to about 200% in the first direction.

54. The laminated material of Claim 45, wherein the laminated material can be extended by about 40% to about 170% in the first direction.

55. The laminated material of Claim 45, wherein the laminated material can be extended by about 50% to about 150% in the first direction.

56. The laminated material of Claim 45, wherein the laminated material can be extended by about 30% to about 200% in the second direction.

57. The laminated material of Claim 45, wherein the laminated material can be extended by about 40% to about 170% in the second direction.

58. The laminated material of Claim 45, wherein the laminated material can be extended by about 50% to about 150% in the second direction.

59. An absorbent article outer cover comprising the laminated material of Claim 45.

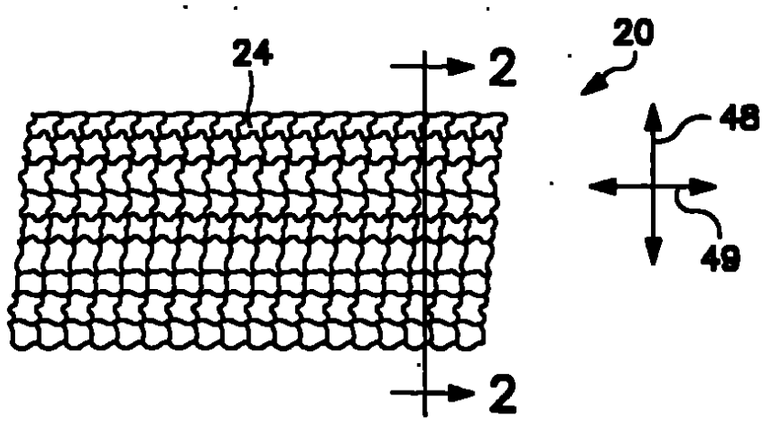


FIG. 1

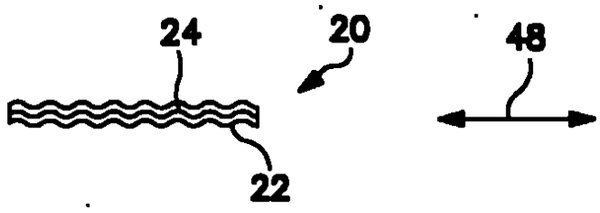


FIG. 2

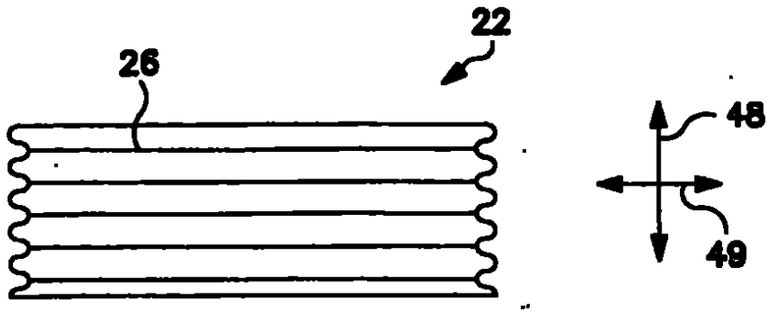


FIG. 3

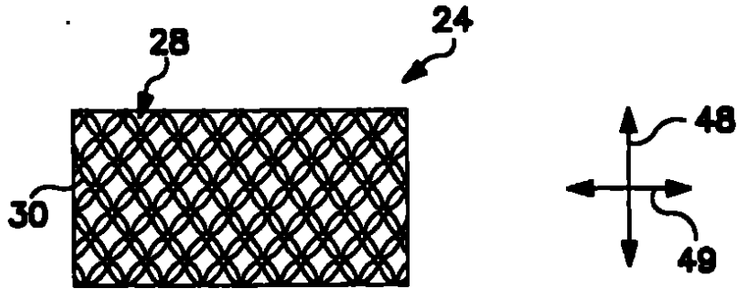


FIG. 4

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Declarations under Rule 4.17:
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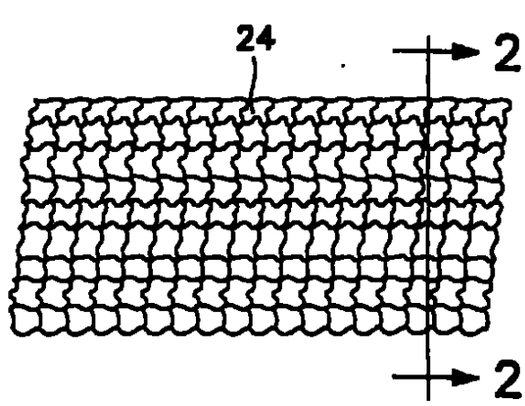

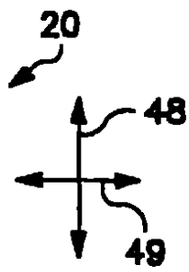

(57) Abstract: A biaxially extendible, breathable laminate having liquid barrier properties and low retractive force. The laminate includes a nonwoven web neck-stretched in a first direction to impart extendibility of the web in a second direction mutually perpendicular with the first direction, and a film that is extendible in the second direction. The film can be a breathable, microporous film, and either be an inelastic film stretched to form rugosities in the second direction, or can be made of an extendible polymer that is extendible in the second direction. Using an appropriate elastomeric lamination and/or creping adhesive, the laminate (20) is creped to produce extendibility in the first direction with some retractive force. The biaxial extendible laminate (20) is particularly useful as an outer cover for diapers and other personal care products.

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B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B32B A61F

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, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3 719 540 A (HALL J) 6 March 1973 (1973-03-06) claims 1,3 column 1, line 65 -column 2, line 54 column 2, line 65 -column 3, line 15 column 3, line 43 -column 4, line 12	1-59
A	US 6 159 584 A (EATON BRADLEY W ET AL) 12 December 2000 (2000-12-12) claims 1,26 column 2, line 59 -column 3, line 14 column 5, line 19 - line 48 column 10, line 33 -column 11, line 11 column 11, line 32 - line 65	1-59

-/--

[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

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"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
21 August 2002	29/08/2002

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	Girard, S

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

[illegible]—patent family members

International Application No
PCT/US 01/48328

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
US 3719540	A	06-03-1973	CA	951860 A1	30-07-1974
			DE	2121966 A1	25-11-1971
			FR	2088330 A5	07-01-1972
			GB	1333474 A	10-10-1973
US 6159584	A	12-12-2000	AU	745499 B2	21-03-2002
			AU	9214598 A	18-10-1999
			BR	9815770 A	21-11-2000
			CA	2326512 A1	30-09-1999
			CN	1291089 T	11-04-2001
			EP	1066008 A1	10-01-2001
			JP	2002507495 T	12-03-2002
			TW	442391 B	23-06-2001
			WO	9948455 A1	30-09-1999
			ZA	9902317 A	10-10-2000
WO 9702133	A	23-01-1997	AU	6389096 A	05-02-1997
			BR	9609747 A	16-07-2002
			CA	2222444 A1	23-01-1997
			CN	1200074 A	25-11-1998
			EP	0846056 A2	10-06-1998
			WO	9702133 A2	23-01-1997
US 5883028	A	16-03-1999	AU	736963 B2	09-08-2001
			AU	7595398 A	30-12-1998
			BR	9809520 A	20-06-2000
			CN	1258327 T	28-06-2000
			EP	0986665 A1	22-03-2000
			WO	9854389 A1	03-12-1998
			ZA	9804072 A	24-11-1998
WO 9522951	A	31-08-1995	US	5554145 A	10-09-1996
			AU	700813 B2	14-01-1999
			AU	1746395 A	11-09-1995
			BR	9506912 A	16-09-1997
			CA	2182873 A1	31-08-1995
			CN	1144472 A	05-03-1997
			CZ	9602469 A3	15-01-1997
			DE	69510923 D1	26-08-1999
			DE	69510923 T2	20-01-2000
			DK	748197 T3	29-11-1999
			EG	20605 A	30-09-1999
			EP	0748197 A1	18-12-1996
			ES	2133741 T3	16-09-1999
			FI	963355 A	28-08-1996
			GR	3030842 T3	30-11-1999
			HK	1012934 A1	23-06-2000
			HU	77402 A2	28-04-1998
			JP	9509350 T	22-09-1997
			NO	963555 A	25-10-1996
			SG	44635 A1	19-12-1997
			TR	28798 A	25-03-1997
			WO	9522951 A1	31-08-1995
			US	6325787 B1	04-12-2001
			US	5556394 A	17-09-1996
			US	5554143 A	10-09-1996
			US	5569232 A	29-10-1996
			US	5554144 A	10-09-1996

Form PCT/ISA/210 (patent family annex) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No.
PCT/US 01/48328

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9522951 A		US 5947948 A	07-09-1999
		US 5749866 A	12-05-1998
		ZA 9501648 A	13-11-1996

84

PCT

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving Office use only

International Application No.

International Filing Date

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference *(if desired) (12 characters maximum)* KCC-1130-PCT

Box No. I TITLE OF INVENTION

BIAXIALLY EXTENDIBLE MATERIAL

Box No. II APPLICANT ☐ This person is also inventor.

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

KIMBERLY-CLARK WORLDWIDE, INC.
401 North Lake Street
Neenah, Wisconsin 54956
United States of America

Telephone No.

Facsimile No.

Teleprinter No.

Applicant's registration No. with the Office

State *(that is, country)* of nationality: **US**

State *(that is, country)* of residence: **US**

This person is applicant for the purposes of: ☒ all designated States ☐ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

MORMAN, Michael Tod
555 Kings Peak
Alpharetta, Georgia 30022
United States of America

This person is:
☐ applicant only
☐ applicant and inventor
☒ inventor only *(If this check-box is marked, do not fill in below.)*

Applicant's registration No. with the Office

State *(that is, country)* of nationality:

State *(that is, country)* of residence:

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

☒ Further applicants and/or (further) inventors are indicated on a continuation sheet.

Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: ☒ agent ☐ common representative

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

RAUCH, Melanie I.
Pauley Petersen Kinne & Erickson
2800 West Higgins Road, Suite 365
Hoffman Estates, Illinois 60195
United States of America

(Please see continuation sheet)

Telephone No.
(847) 490 1400

Facsimile No.
(847) 490 1403

Teleprinter No.

Agent's registration No. with the Office
40,924

☐ **Address for correspondence:** Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

41

Continuation of Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

If none of the following sub-boxes is used, this sheet should not be included in the request.

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

EDELMAN, Lon M.
10380 Summer Creek Drive
Alpharetta, Georgia 30022
United States of America

This person is:
- ☐ applicant only
- ☐ applicant and inventor
- ☒ inventor only *(If this check-box is marked, do not fill in below)*

Applicant's Registration No. with the Office

State *(that is, country)* of nationality:

State *(that is, country)* of residence:

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

---

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

SMITH, Reginald
11250 Hembree Springs Drive
Roswell, Georgia 30076
United States of America

This person is:
- ☐ applicant only
- ☐ applicant and inventor
- ☒ inventor only *(If this check-box is marked, do not fill in below)*

Applicant's Registration No. with the Office

State *(that is, country)* of nationality:

State *(that is, country)* of residence:

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

---

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

This person is:
- ☐ applicant only
- ☐ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below)*

Applicant's Registration No. with the Office

State *(that is, country)* of nationality:

State *(that is, country)* of residence:

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

---

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

This person is:
- ☐ applicant only
- ☐ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below)*

Applicant's Registration No. with the Office

State *(that is, country)* of nationality:

State *(that is, country)* of residence:

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

---

☐ Further applicants and/or (further) inventors are indicated on a continuation sheet.

92

Continuation of Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

Name and address: (Family names followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)

BENDEL, Michael J.	Reg. No. 39,805	all at the address of:
CHARLIER, Patricia A.	Reg. No. 38,840	
CONNELLY, Thomas J.	Reg. No. 28,404	Kimberly-Clark Worldwide, Inc.
CROFT, Gregory E.	Reg. No. 27,542	401 North Lake Street
DEAN, Ralph H.	Reg. No. 41,550	Neenah, Wisconsin 54956
DUDKOWSKI, Alyssa A.	Reg. No. 40,596	United States of America
FIELDHACK, Randall W.	Reg. No. 43,811	
FLACK, Steven D.	Reg. No. 40,808	
GAGE, Thomas M.	Reg. No. 33,385	
GARRISON, Scott B.	Reg. No. 39,198	
HARPS, Joseph P.	Reg. No. 28,854	
HERRICK, William D.	Reg. No. 25,468	
KAPPES, Kyle K.	Reg. No. 34,848	
KIRBY, John P., Jr.	Reg. No. 25,348	
KLEMBUS, Nancy M.	Reg. No. 40,051	
KYRIAKOU, Christos S.	Reg. No. 42,776	
LEACH, Nicholas N.	Reg. No. 31,776	
LETSON, William W.	Reg. No. 42,797	
MIELKE Thomas J.	Reg. No. 31,399	
MILLER, Douglas L.	Reg. No. 30,406	
PARKER, Thomas M.	Reg. No. 42,063	
PUGLIESE, Sebastian C., III	Reg. No. 42,091	
ROBINSON, James B.	Reg. No. 34,912	
SIDOR, Karl V.	Reg. No. 32,597	
TULLEY, Douglas H.	Reg. No. 34,743	
WATSON, Sue C.	Reg. No. 39,885	
WILSON, Patrick C.	Reg. No. 31,893	
YEE, Paul Y.	Reg. No. 29,460	

SPECKMAN, Thomas W.	Reg. No. 22,617	all at the address of:
PAULEY, Douglas H.	Reg. No. 33,295	
PETERSEN, Maxwell J.	Reg. No. 32,772	Pauley Petersen Kinne & Erickson
KINNE, Charles C.	Reg. No. 31,831	2800 West Higgins Road
KOTTIS, Nick C.	Reg. No. 31,974	Suite 365
ERICKSON, Kevin D.	Reg. No. 36,736	Hoffman Estates, Illinois 60195
NORRIS, Roland W.	Reg. No. 32,799	United States of America
KRISCHKE, Eric T.	Reg. No. 42,769	
CROSBY, Margaret M.	Reg. No. 40,969	

Box No. V **DESIGNATION OF STATES** *Mark the applicable check-boxes; at least one must be marked.*

The following designations are hereby made under Rule 4.9(a):

Regional Patent

- ☒ **AP** **ARIPO Patent:** GH Ghana, GM Gambia, KE Kenya, LS Lesotho, MW Malawi, MZ Mozambique, SD Sudan, SL Sierra Leone, SZ Swaziland, TZ United Republic of Tanzania, UG Uganda, ZM Zambia, ZW Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT
- ☒ **EA** **Eurasian Patent:** AM Armenia, AZ Azerbaijan, BY Belarus, KG Kyrgyzstan, KZ Kazakhstan, MD Republic of Moldova, RU Russian Federation, TJ Tajikistan, TM Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT
- ☒ **EP** **European Patent:** AT Austria, BE Belgium, CH & LI Switzerland and Liechtenstein, CY Cyprus, DE Germany, DK Denmark, ES Spain, FI Finland, FR France, GB United Kingdom, GR Greece, IE Ireland, IT Italy, LU Luxembourg, MC Monaco, NL Netherlands, PT Portugal, SE Sweden, TR Turkey, and any other State which is a Contracting State of the European Patent Convention and of the PCT
- ☒ **OA** **OAPI Patent:** BF Burkina Faso, BJ Benin, CF Central African Republic, CG Congo, CI Côte d'Ivoire, CM Cameroon, GA Gabon, GN Guinea, GQ Equatorial Guinea, GW Guinea-Bissau, ML Mali, MR Mauritania, NE Niger, SN Senegal, TD Chad, TG Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT *(if other kind of protection or treatment desired, specify on dotted line)* .....

National Patent *(if other kind of protection or treatment desired, specify on dotted line)*:

☒ AE United Arab Emirates	☒ GH Ghana	☒ MX Mexico .....
☒ AG Antigua and Barbuda	☒ GM Gambia	☒ MZ Mozambique
☒ AL Albania.....	☒ HR Croatia.....	☒ NO Norway
☒ AM Armenia.....	☒ HU Hungary.....	☒ NZ New Zealand .....
☒ AT Austria.....	☒ ID Indonesia	☒ PL Poland .....
☒ AU Australia	☒ IL Israel	☒ PT Portugal .....
☒ AZ Azerbaijan	☒ IN India.....	☒ RO Romania
☒ BA Bosnia and Herzegovina.....	☒ IS Iceland	☒ RU Russian Federation .....
☒ BB Barbados	☒ JP Japan	.....
☒ BG Bulgaria.....	☒ KE Kenya	☒ SD Sudan
☒ BR Brazil	☒ KG Kyrgyzstan	☒ SE Sweden
☒ BY Belarus	☒ KP Democratic People's Republic	☒ SG Singapore
☒ BZ Belize.....	of Korea.....	☒ SI Slovenia.....
☒ CA Canada	☒ KR Republic of Korea.....	☒ SK Slovakia .....
☒ CH & LI Switzerland and Liechtenstein	☒ KZ Kazakhstan	☒ SL Sierra Leone .....
☒ CN China	☒ LC Saint Lucia	☒ TJ Tajikistan.....
☒ CO Colombia	☒ LK Sri Lanka	☒ TM Turkmenistan.....
☒ CR Costa Rica	☒ LR Liberia	☒ TR Turkey .....
☒ CU Cuba	☒ LS Lesotho	☒ TT Trinidad and Tobago .....
☒ CZ Czech Republic.....	☒ LT Lithuania	.....
☒ DE Germany	☒ LU Luxembourg	☒ TZ United Republic of Tanzania
☒ DK Denmark.....	☒ LV Latvia	☒ UA Ukraine .....
☒ DM Dominica	☒ MA Morocco	☒ UG Uganda .....
☒ DZ Algeria.....	☒ MD Republic of Moldova.....	☐ US United States of America .....
☒ EC Ecuador	.....	.....
☒ EE Estonia	☒ MG Madagascar	☒ UZ Uzbekistan .....
☒ ES Spain	☒ MK The former Yugoslav Republic of	☒ VN Viet Nam .....
☒ FI Finland	Macedonia.....	☒ YU Yugoslavia .....
☒ GB United Kingdom	☒ MN Mongolia	☒ ZA South Africa .....
☒ GD Grenada	☒ MW Malawi	☒ ZW Zimbabwe .....
☒ GE Georgia.....		

Check-boxes below reserved for designating States which have become party to the PCT after issuance of this sheet:

☒ PH Philippines.....	☒ OM Oman.....	☒ ZM Zambia.....
☒ TN Tunisia.....	☐	☐ .....

Precautionary Designation Statement: In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. *(Confirmation (including fee) must reach the receiving Office within the 15-month time limit.)*

Box No. VI PRIORITY CLAIM

The priority of the following earlier application(s) is hereby claimed:

	Filing date of earlier application *(day/month/year)*	Number of earlier application	Where earlier application is: national application: country	regional application: * regional Office	international application: receiving Office
item (1)	27 December 2000 (27.12.00)	09/749,141	US		
item (2)					
item (3)					
item (4)					
item (5)					

☐ Further Priority claims are indicated in the Supplemental Box.

The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) *(only if the earlier application was filed with the Office which for the purpose of this international application is the receiving Office)* identified above as:

☒ all items ☐ items (1) ☐ item (2) ☐ item (3) ☐ item (4) ☐ item (5) ☐ other, see Supplemental Box

** Where the earlier application is an ARIPO application, indicate at least one country party to the Paris Convention for the Protection of Industrial Property or one Member of the World Trade Organization for which that earlier application was filed (Rule 4.10 (b)(ii)):* .....

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) *(if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used)*:

ISA / . . EP .....

Request to use results of earlier search; reference to that search *(if an earlier search has been carried out by or requested from the International Searching Authority)*:

Date *(day/month/year)* Number Country *(or regional Office)*

Box No. VIII DECLARATIONS

The following declarations are contained in Boxes Nos. VIII (i) to (v) *(mark the applicable check-boxes below and indicate in the right column the number of each type of declaration)*:

			Number of declarations
☐	Box No. VIII (i)	Declaration as to the identity of the inventor :	
☒	Box No. VIII (ii)	Declaration as to the applicant's entitlement, as at the international filing date, to apply for and be granted a patent :	1
☒	Box No. VIII (iii)	Declaration as to the applicant's entitlement, as at the international filing date, to claim priority of the earlier application :	1
☐	Box No. VIII (iv)	Declaration of inventorship (only for the purposes of the designation of the United States of America) :	
☐	Box No. VIII (v)	Declaration as to non-prejudicial disclosures or exceptions to lack of novelty :	

95

Box No. VIII (ii) DECLARATION: ENTITLEMENT TO APPLY FOR AND BE GRANTED A PATENT

The declaration must conform to the standardized wording provided for in Section 212; see Notes to Boxes Nos. VIII, VIII (i) to (v) (in general) and the specific Notes to Box No. VIII (ii). If this Box is not used, this sheet should not be included in the request.

Declaration as to the applicant's entitlement, as at the international filing date, to apply for and be granted a patent (Rules 4.17(ii) and 51*bis*.1(a)(ii)), in a case where the declaration under Rule 4.17(iv) is not appropriate:

in relation to this international application,

KIMBERLY-CLARK WORLDWIDE, INC. is entitled to apply for and be granted a patent by virtue of the following:

an assignment from

Michael Tod MORMAN, 555 Kings Peak, Alpharetta, Georgia 30022, United States of America

Lon M. EDELMAN, 10380 Summer Creek Drive, Alpharetta, Georgia 30022, United States of America

Reginald SMITH, 11250 Hembree Springs Drive, Roswell, Georgia 30076, United States of America

to KIMBERLY-CLARK WORLDWIDE, INC., dated 05 March 2001.

This declaration is made for the purposes of all designations.

☐ This declaration is continued on the following sheet, "Continuation of Box No. VIII (ii)".

2
96

Box No. VIII (iii) DECLARATION: ENTITLEMENT TO CLAIM PRIORITY

The declaration must conform to the standardized wording provided for in Section 213; see Notes to Boxes Nos. VIII, VIII (i) to (v) (in general) and the specific Notes to Box No. VIII (iii). If this Box is not used, this sheet should not be included in the request.

Declaration as to the applicant's entitlement, as at the international filing date, to claim the priority of the earlier application specified below, where the applicant is not the applicant who filed the earlier application or where the applicant's name has changed since the filing of the earlier application (Rules 4.17(ii) and 51*bis*.1(a)(iii)):

in relation to this international application,

KIMBERLY-CLARK WORLDWIDE, INC. is entitled to claim priority of earlier application

No. 09/749,141 filed in US on 27 December 2000 (27.12.00)

by virtue of the following:

an assignment from

Michael Tod MORMAN, 555 Kings Peak, Alpharetta, Georgia 30022, United States of America

Lon M. EDELMAN, 10380 Summer Creek Drive, Alpharetta, Georgia 30022, United States of America

Reginald SMITH, 11250 Hembree Springs Drive, Roswell, Georgia 30076, United States of America

to KIMBERLY-CLARK WORLDWIDE, INC., dated 05 March 2001.

This declaration is made for the purposes of all designations.

☐ This declaration is continued on the following sheet, "Continuation of Box No. VIII (iii)".

Box No. IX CHECK LIST; LANGUAGE OF FILING

This international application contains:			This international application is accompanied by the following item(s) (*mark the applicable check-boxes below and indicate in right column the number of each item*):	Number of items
(a) the following number of sheets in paper form:				
request (including declaration sheets)	:	8	1. ☒ fee calculation sheet :	1
description (excluding sequence listing part)	:	28	2. ☐ original separate power of attorney :	
claims	:	7	3. ☐ original general power of attorney :	
abstract	:	1	4. ☒ copy of general power of attorney; reference number, if any: :	1
drawings	:	2	5. ☐ statement explaining lack of signature :	
Sub-total number of sheets:		44	6. ☐ priority document(s) identified in Box. No. VI as item(s): :	
sequence listing part of description (*actual number of sheets if filed in paper form, whether or not also filed in computer readable*			7. ☐ translation of international appliction into (*language*): :	
Total number of sheets	:	44	8. ☐ separate indications concerning deposited microorganisms or other biological material :	
(b) sequence listing part of description file in computer readable form			9. ☐ sequence listing in computer readable form (indicate also type and number of carriers (diskette, CD-ROM, CD-R or other)) :	
(i) ☐ only (under Section 801 (a)(ii))			(i) ☐ copy submitted for purposes of international search under Rule 13ter only (and not as part of the internaltional application) :	
(ii) ☐ in addition to being filed in paper form (under Section 801 (a)(ii)			(ii) ☐ (*only where check-box (b)(i) or (b)(ii) is marked in left column*) additional copies including, where applicable, the copy for the purposes of international search under Rule 13*ter* :	
Type and number of carriers (diskette, CR-Rom, CD-R or other) on which the sequence listing part is consained (*additional copies to be indicated under item 9(ii), in right column*):			(iii) ☐ together with relevant statement as to the identity of the copy or copies with sequence listing part mentioned in left column :	
			10. ☒ other (*specify*)... Certificate of Mailing by Express Mail (2 pages)..... :	1
Figure of the drawings which should accompany the abstract:		1	Language of filing of the international application:	English

Box No. X SIGNATURE OF APPLICANT, AGENT OR COMMON REPRESENTATIVE

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

Melanie I. Rauch, Agent

For receiving Office use only

1. Date of actual receipt of the purported international application:	2. Drawings: ☐ received: ☐ not received:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:	
4. Date of timely receipt of the required corrections under PCT Article 11(2):	
5. International Searching Authority (if two or more are competent): ISA/	6. ☐ Transmittal of search copy delayed until search fee is paid.

For International Bureau use only

Date of receipt of the record copy by the International Bureau:

This sheet is not part of and does not count as a sheet of the international application.

R98

PCT

FEE CALCULATION SHEET

Annex to the Request

For receiving Office use only

International application No.

Date stamp of the receiving Office

Applicant's or agent's file reference: **KCC-1130-PCT**

Applicant: **KIMBERLY-CLARK WORLDWIDE, INC.**

CALCULATION OF PRESCRIBED FEES

1. TRANSMITTAL FEE . . . . . $ 240.00 [T]

2. SEARCH FEE . . . . . $ 846.00 [S]

International search to be carried out by ISA/EP

(If two of more International Searching Authorities are competent in relation to the international application, indicate the name of the Authority which is chosen to carry out the international search.)

3. INTERNATIONAL FEE

Basic Fee

The international application contains 44 sheets.

first 30 sheets . . . . . $ 382.00 [b1]

14 (remaining sheets) x $ 9.00 (additional amount) = $ 126.00 [b2]

Add amounts entered at b1 and b2 and enter total at B . . $ 508.00 [B]

Designation Fees

The international application contains 93 designations.

6 (number of designation fees payable *(maximum 4)*) x $ 82.00 (amount of designation fee) = $ 492.00 [D]

Add amounts entered at B and D and enter total at I . . . . . $ 1,000.00 [I]

(Applicants from certain States are entitled to a reduction of 75% of the international fee. Where the applicant is (or all applicants are) so entitled, the total to be entered at I is 25% of the sum of the amounts entered at B and D.)

4. FEE FOR PRIORITY DOCUMENT *(if applicable)* . . . . . $ 15.00 [P]

5. TOTAL FEES PAYABLE . . . . . $ 2,101.00

Add amounts entered at T, S, I and P, and enter total in the TOTAL box: TOTAL

☐ The designation fees are not paid at this time.

MODE OF PAYMENT

☐ authorization to charge deposit account (see below)	☐ bank draft	☐ coupons
☒ cheque	☐ cash	☐ other *(specify)*:
☐ postal money order	☐ revenue stamps	

DEPOSIT ACCOUNT AUTHORIZATION *(this mode of payment may not be available at all receiving Offices)*

The RO/ US

☐ is hereby authorized to charge the total fees indicated above to my deposit account.

(this check-box may be marked only if the conditions for deposit accounts of the receiving Office so permit)

☒ is hereby authorized to charge any deficiency or credit any overpayment in the total fees indicated above to my deposit account.

☐ is hereby authorized to charge the fee for preparation and transmittal of the priority document to the International Bureau of WIPO to my deposit account.

19-3550	11 December 2001	Melanie L. Rauch
Deposit Account No.	Date *(day/month/year)*	Signature Melanie L. Rauch, Reg. No. 40,924

Form PCT/RO/101 (Annex) (January 2000)

See Notes to the fee calculation sheet

99

The demand must be filed directly with the competent International Preliminary Examining Authority or, if two or more Authorities are competent, with the one chosen by the applicant. The full name or two-letter code of that Authority may be indicated by the applicant on the line below:

IPEA/ US

PCT

CHAPTER II

DEMAND

under Article 31 of the Patent Cooperation Treaty:
The undersigned requests that the international application specified below be the subject of international preliminary examination according to the Patent Cooperation Treaty and hereby elects all eligible States (except where otherwise indicated).

For International Preliminary Examining Authority use only	
Identification of IPEA	Date of receipt of DEMAND

Box No. I IDENTIFICATION OF THE INTERNATIONAL APPLICATION		Applicant's or agent's file reference KCC-1130-PCT
International application No. PCT/US01/48328	International filing date *(day/month/year)* 11 December 2001 (11.12.01)	(Earliest) Priority date *(day/month/year)* 27 December 2000 (27.12.00)

Title of invention: **BIAXIALLY EXTENDIBLE MATERIAL**

Box No. II APPLICANT(S)

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

KIMBERLY-CLARK WORLDWIDE, INC.
401 North Lake Street
Neenah, Wisconsin 54956
United States of America

Telephone No.

Facsimile No.

Teleprinter No.

Applicant's registration No. with the Office

State *(that is, country)* of nationality:	State *(that is, country)* of residence:
US	US

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

State *(that is, country)* of nationality:	State *(that is, country)* of residence:

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

State *(that is, country)* of nationality:	State *(that is, country)* of residence:

☐ Further applicants are indicated on a continuation sheet.

International Application No.
PCT/US01/48328

Box No. III AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The following person is ☒ agent ☐ common representative

and ☒ has been appointed earlier and represents the applicant(s) also for international preliminary examination.

☐ is hereby appointed and any earlier appointment of (an) agent(s)/common representative is hereby revoked.

☐ is hereby appointed, specifically for the procedure before the International Preliminary Examining Authority, in addition to the agent(s)/common representative appointed earlier.

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

Rauch, Melanie I.
Pauley Petersen Kinne & Erickson
2800 West Higgins Road, Suite 365
Hoffman Estates, Illinois 60195
United States of America

(Please see continuation sheet)

Telephone No.
847.490.1400

Facsimile No.
847.490.1403

Teleprinter No.

Agent's registration No. with the Office
Registration No. 40,924

☐ Address for correspondence: Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

Box No. IV BASIS FOR INTERNATIONAL PRELIMINARY EXAMINATION

Statement concerning amendments:*

1. The applicant wishes the international preliminary examination to start on the basis of:

☐ the international application as originally filed

the description ☐ as originally filed
☐ as amended under Article 34

the claims ☐ as originally filed
☐ as amended under Article 19 (together with any accompanying statement)
☐ as amended under Article 34

the drawings ☐ as originally filed
☐ as amended under Article 34

2. ☐ The applicant wishes any amendment to the claims under Article 19 to be considered as reversed.

3. ☒ The applicant wishes the start of the international preliminary examination to be postponed until the expiration of 20 months from the priority date unless the International Preliminary Examining Authority receives a copy of any amendments made under Article 19 or a notice from the applicant that he does not wish to make such amendments (Rule.69.1(d)). *(This check-box may be marked only where the time limit under Article 19 has not yet expired.)*

* Where no check-box is marked, international preliminary examination will start on the basis of the international application as originally filed or, where a copy of amendments to the claims under Article 19 and/or amendments of the international application under Article 34 are received by the International Preliminary Examining Authority before it has begun to draw up a written opinion or the international preliminary examination report, as so amended.

Language for the purposes of international preliminary examination: English

☒ which is the language in which the international application was filed.

☐ which is the language of a translation furnished for the purposes of international search.

☒ which is the language of publication of the international application.

☐ which is the language of the translation (to be) furnished for the purposes of international preliminary examination.

Box No. V ELECTION OF STATES

The applicant hereby elects all eligible States *(that is, all States which have been designated and which are bound by Chapter II of the PCT)* excluding the following States which the applicant wishes not to elect:

Continuation of Box No. III AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FORCORRESPONDENCE

101

Name and address: (Family names followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)

BENDEL, Michael J.	Reg. No. 39,605	all at the address of:
CHARLIER, Patricia A.	Reg. No. 38,840	
CONNELLY, Thomas J.	Reg. No. 28,404	Kimberly-Clark Worldwide, Inc.
CROFT, Gregory E.	Reg. No. 27,542	401 North Lake Street
DEAN, Ralph H.	Reg. No. 41,550	Neenah, Wisconsin 54956
DUDKOWSKI, Alyssa A.	Reg. No. 40,596	United States of America
FIELDHACK, Randall W.	Reg. No. 43,611	
FLACK, Steven D.	Reg. No. 40,608	
GAGE, Thomas M.	Reg. No. 33,385	
GARRISON, Scott B.	Reg. No. 39,198	
HARPS, Joseph P.	Reg. No. 28,854	
HERRICK, William D.	Reg. No. 25,468	
KAPPES, Kyle K.	Reg. No. 34,846	
KIRBY, John P., Jr.	Reg. No. 25,348	
KLEMBUS, Nancy M.	Reg. No. 40,051	
KYRIAKOU, Christos S.	Reg. No. 42,776	
LEACH, Nicholas N.	Reg. No. 31,776	
LETSON, William W.	Reg. No. 42,797	
MIELKE Thomas J.	Reg. No. 31,399	
MILLER, Douglas L.	Reg. No. 30,406	
PARKER, Thomas M.	Reg. No. 42,063	
PUGLIESE, Sebastian C., III	Reg. No. 42,091	
R BINSON, James B.	Reg. No. 34,912	
SIDOR, Karl V.	Reg. No. 32,597	
TULLEY, Douglas H.	Reg. No. 34,743	
WATSON, Sue C.	Reg. No. 38,885	
WILSON, Patrick C.	Reg. No. 31,893	
YEE, Paul Y.	Reg. No. 29,460	

SPECKMAN, Thomas W.	Reg. No. 22,617	all at the address of:
PAULEY, Douglas H.	Reg. No. 33,295	
PETERSEN, Maxwell J.	Reg. No. 32,772	Pauley Petersen Kinne & Erickson
KINNE, Charles C.	Reg. No. 31,631	2800 West Higgins Road
KOTTIS, Nick C.	Reg. No. 31,974	Suite 365
ERICKSON, Kevin D.	Reg. No. 38,736	Hoffman Estates, Illinois 60195
NORRIS, Roland W.	Reg. No. 32,799	United States of America
KRISCHKE, Eric T.	Reg. No. 42,769	
CROSBY, Margaret M.	Reg. No. 40,969	

Sheet No. 4

International Application No.
PCT/US01/48328

Box No. VI CHECK LIST

The demand is accompanied by the following elements, in the language referred to in Box No. IV, for the purposes of international preliminary examination:			For International Preliminary Examining Authority use only: received	not received
1. translation of international application	:	sheets	☐	☐
2. amendments under Article 34	:	sheets	☐	☐
3. copy (or, where required, translation) of amendments under Article 19	:	sheets	☐	☐
4. copy (or, where required, translation) of statement under Article 19	:	sheets	☐	☐
5. letter	:	sheets	☐	☐
6. Other *(specify)*	:	sheets	☐	☐

The demand is also accompanied by the item(s) marked below:

1. ☒ fee calculation sheet
2. ☐ original separate power of attorney
3. ☐ original general power of attorney
4. ☒ copy of general power of attorney; reference number, if any:
4. ☐ statement explaining lack of signature
5. ☐ sequence listing in computer readable form
6. ☐ other *(specify)*:

Box No. VII SIGNATURE OF APPLICANT, AGENT OR COMMON REPRESENTATIVE

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the demand).

Melanie I. Rauch, Agent

For International Preliminary Examining Authority use only

1. Date of actual receipt of DEMAND:

2. Adjusted date of receipt of demand due to CORRECTIONS under Rule 60.1(b):

3. ☐ The date of receipt of the demand is AFTER the expiration of 19 months from the priority date and item 4 or 5, below, does not apply. ☐ The applicant has been informed accordingly.

4. ☐ The date of receipt of the demand is WITHIN the period of 19 months from the priority date as extended by virtue of Rule 80.5.

5. ☐ Although the date of receipt of the demand is after the expiration of 19 months from the priority date, the delay in arrival is EXCUSED pursuant to Rule 82.

For International Bureau use only

Demand received from IPEA on:

CHAPTER II

PCT

FEE CALCULATION SHEET

Annex to the Demand

International application No.	PCT/US01/48328
Applicant's or agent's file reference	KCC-1130-PCT

For International Preliminary Examining Authority use only

Applicant

KIMBERLY-CLARK WORLDWIDE, INC.

Calculation of prescribed fees

1.	Preliminary examination fee.....	$ 750.00	P
2.	Handling fee *(Applicants from certain States are entitled to a reduction of 75% of the handling fee. Where the applicant is (or all applicants are) so entitled, the amount to be entered at H is 25% of the handling fee.)*.....	$ 146.00	H
3.	Total of prescribe fees Add the amounts entered at P and H and enter total in the TOTAL box.....	$ 896.00 TOTAL	

Mode of Payment

☐	authorization to charge deposit account with the IPEA (see below)	☐	cash
☒	cheque	☐	revenue stamps
☐	postal money order	☐	coupons
☐	bank draft	☐	other (specify):

AUTHORIZATION TO CHARGE (OR CREDIT) DEPOSIT ACCOUNT
(This mode of payment may not be available at all IPEAs)

IPEA/ US

☐ Authorization to charge the total fees indicated above.

☒ *(This check-box may be marked only if the conditions for deposit accounts or the IPEA so permit)* Authorization to charge any deficiency or credit any overpayment in the total fees indicated above.

Deposit Account No.: 19-3550

Date: 26 July 2002

Name: Melanie I. Rauch, Agent

Signature: [signature]

Form PCT/IPEA/401 (Annex) (March 2001)

See Notes to the fee calculation sheet

104

PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:
MELANIE I RAUCH
PAULEY PETERSEN KINNE & ERICKSON
2800 WEST HIGGINS ROAD, SUITE 365
HOFFMAN ESTATES, IL 60195

PCT

WRITTEN OPINION

(PCT Rule 66)

Date of Mailing (day/month/year)	06 MAY 2003
Applicant's or agent's file reference KCC-1130-PCT	REPLY DUE within 1 months/days from the above date of mailing

International application No.	International filing date (day/month/year)	Priority date (day/month/year)
PCT/US01/48328	11 December 2001 (11.12.2001)	27 December 2000 (27.12.2000)

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

IPC(7): B32B 3/30 and US Cl.: 428/152

Applicant

KIMBERLY-CLARK WORLDWIDE, INC.

1. This written opinion is the first (first, etc.,) drawn by this International Preliminary Examining Authority.

2. This opinion contains indications relating to the following items:

- I ☒ Basis of the opinion
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Rule 66.2 (a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

3. The applicant is hereby invited to reply to this opinion.

When? See the time limit indicated above. ~~The applicant may, before the expiration of that time limit, request this Authority to grant an extension. See rule 66.2(d).~~

How? By submitting a written reply, accompanied, where appropriate, by amendments, according to Rule 66.3. For the form and the language of the amendments, see Rules 66.8 and 66.9.

Also For an additional opportunity to submit amendments, see Rule 66.4. For the examiner's obligation to consider amendments and/or arguments, see Rule 66.4 *bis*. For an informal communication with the examiner, see Rule 66.6

If no reply is filed, the international preliminary examination report will be established on the basis of this opinion.

4. The final date by which the international preliminary examination report must be established according to Rule 69.2 is: 27 April 2003 (27.04.2003) .

Name and mailing address of the IPEA/US	Authorized officer
Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703)305-3230	William P. Watkins III Telephone No. 703-308-0651

Form PCT/IPEA/408 (cover sheet)(July 1998)

WRITTEN OPINION

International application No.
PCT/US01/48328

I. Basis of the opinion

1. With regard to the elements of the international application:*

☒ the international application as originally filed

☒ the description:
pages 1-26, as originally filed
pages NONE, filed with the demand
pages NONE, filed with the letter of _____.

☒ the claims:
pages 27-33, as originally filed
pages NONE, as amended (together with any statement) under Article 19
pages NONE, filed with the demand
pages NONE, filed with the letter of _____.

☒ the drawings:
pages 1/2-2/2, as originally filed
pages NONE, filed with the demand
pages NONE, filed with the letter of _____.

☐ the sequence listing part of the description:
pages NONE, as originally filed
pages NONE, filed with the demand
pages NONE, filed with the letter of _____.

2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.
These elements were available or furnished to this Authority in the following language _____ which is:

☐ the language of a translation furnished for the purposes of international search (under Rule23.1(b)).

☐ the language of publication of the international application (under Rule 48.3(b)).

☐ the language of the translation furnished for the purposes of international preliminary examination(under Rules 55.2 and/or 55.3).

3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the written opinion was drawn on the basis of the sequence listing:

☐ contained in the international application in printed form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. ☐ The amendments have resulted in the cancellation of:

☐ the description, pages NONE

☐ the claims, Nos. NONE

☐ the drawings, sheets/fig NONE

5. ☐ This opinion has been drawn as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

** Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this opinion as "originally filed."*

105

WRITTEN OPINION

International application No.
PCT/US01/48328

V. Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. STATEMENT

Novelty (N)	Claims	1-59	YES
	Claims	NONE	NO
Inventive Step (IS)	Claims	NONE	YES
	Claims	1-59	NO
Industrial Applicability (IA)	Claims	1-59	YES
	Claims	NONE	NO

2. CITATIONS AND EXPLANATIONS

Claims 1-44 lack an inventive step under PCT Article 33(3) as being obvious over MORMAN et al. (WO 00/389913) in view of BENSON et al. MORMAN et al. (WO 00/389913) teaches a necked non-woven with an inelastic layer with rugosities, which allow extension in the necked direction (abstract). BENSON et al. teaches the use of corrugations or creping in a direction perpendicular to the elongation direction of the necked material in order to allow extension in the elongation direction of a necked material (abstract, col.9, lines 15-30). The instant invention claims a necked non-woven with an inelastic layer with rugosities with creping in the direction of elongation (the direction of elongation being perpendicular to the necking direction). It would have been obvious to one of ordinary skill in the art to have creped the laminate of MORMAN (WO 00/389913) in order to allow for extension in both axis directions because of the teachings of BENSON et al. to crepe a necked laminate to allow for bi-directional extension.

Claims 45-59 lack an inventive step under PCT Article 33(3) as being obvious over the prior art as applied in the immediately preceding paragraph and further in view of MORMON et al. (WO 00/38911). MORMON et al. (WO 00/38911) teaches a necked composite with an elastic layer to allow for automatic drawback after extension in a given direction (abstract). The instant invention claims a necked creped composite with an elastic layer. It would have been obvious to one of ordinary skill in the art to have added an elastic layer to the laminate of MORMAN et al. (WO 00/38913) in view of BENSON et al. in order to allow for automatic drawback because of the teachings of MORMON et al. (WO 00/38911).

Claims 1-59 the criteria set out in PCT Article 33(2), because the prior art does not teach or fairly suggest all of the claimed features in a single reference. The base reference lacks a teaching of creping perpendicular to the elongation to allow extension in the elongation direction as noted above.

Claims 1-59 the criteria set out in PCT Article 33(4), and thus have industrial applicability because the subject matter claimed can be made or used in industry. The claimed articles have applications in the sanitary article field.

---------- NEW CITATIONS ----------

US 6,114,263 A (BENSON et al.) 5 SEPTEMBER 2000, see the abstract, col. 9, lines 15-30).

WO 00/38913 A (MORMAN et al.) 6 JULY 2000, see the abstract.

WO 00/38911 A (MORMAN et al.) 6 JULY 2000, see the abstract.

WRITTEN OPINION

International application No.
PCT/US01/48328

Supplemental Box
(To be used when the space in any of the preceding boxes is not sufficient)

TIME LIMIT:
The time limit set for response to a Written Opinion may not be extended. 37 CFR 1.484(d). Any response received after the expiration of the time limit set in the Written Opinion will not be considered in preparing the International Preliminary Examination Report.

US006114263A

United States Patent [19]

Benson et al.

[11] **Patent Number: 6,114,263**

[45] **Date of Patent: Sep. 5, 2000**

[54] **STABLE WEB HAVING ENHANCED EXTENSIBILITY AND METHOD FOR MAKING SAME**

[75] Inventors: **Douglas H. Benson**, West Harrison, Ind.; **John J. Curro**, Cincinnati, Ohio

[73] Assignee: **The Procter & Gamble Company**, Cincinnati, Ohio

[21] Appl. No.: **09/309,201**

[22] Filed: **May 10, 1999**

Related U.S. Application Data

[63] Continuation of application No. 08/832,875, Apr. 4, 1997, Pat. No. 5,914,084.

[51] Int. Cl.[7] B32B 27/12

[52] U.S. Cl. 442/394; 442/400; 442/401

[58] Field of Search 442/35, 400, 401, 442/394

[56] **References Cited**

U.S. PATENT DOCUMENTS

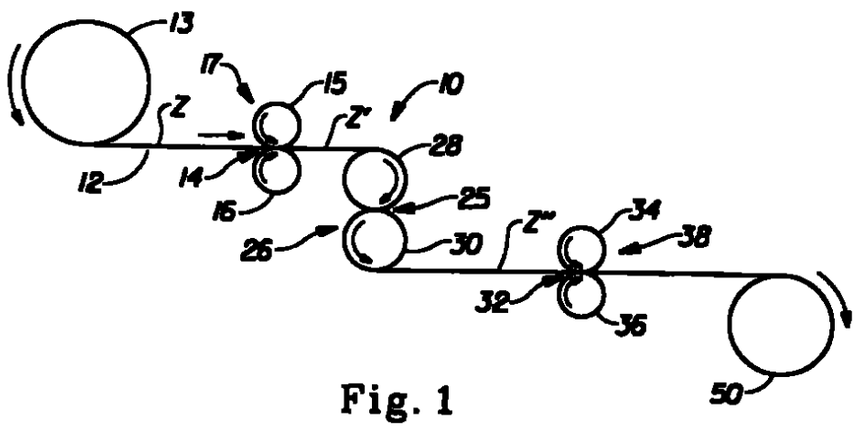
4,981,747	1/1991	Morman	428/198
5,167,897	12/1992	Weber et al.	264/288.8
5,244,482	9/1993	Hassenboehler, Jr. et al.	55/528
5,336,545	8/1994	Morman	428/152
5,628,741	5/1997	Buell et al.	604/385.2
5,789,065	8/1998	Haffner et al.	428/152

Primary Examiner—Blaine Copenheaver
Assistant Examiner—Ula C. Ruddock
Attorney, Agent, or Firm—Kevin C. Johnson; Roddy M. Bullock; David M. Weirich

[57] **ABSTRACT**

The present invention provides a stable nonwoven web having enhanced extensibility and a method for making the same. A neckable nonwoven web is fed in a first direction. The neckable nonwoven web is subjected to incremental stretching in a direction perpendicular to the first direction. A tensioning force is applied to the neckable nonwoven web to neck the nonwoven web. The necked nonwoven web is then subjected to mechanical stabilization to provide a stabilized extensible necked nonwoven web. The stabilized extensible necked nonwoven web is easily extended in a direction parallel to the direction necking.

16 Claims, 5 Drawing Sheets


13
17
15
10
Z
Z'
28
12
14
16
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Z''
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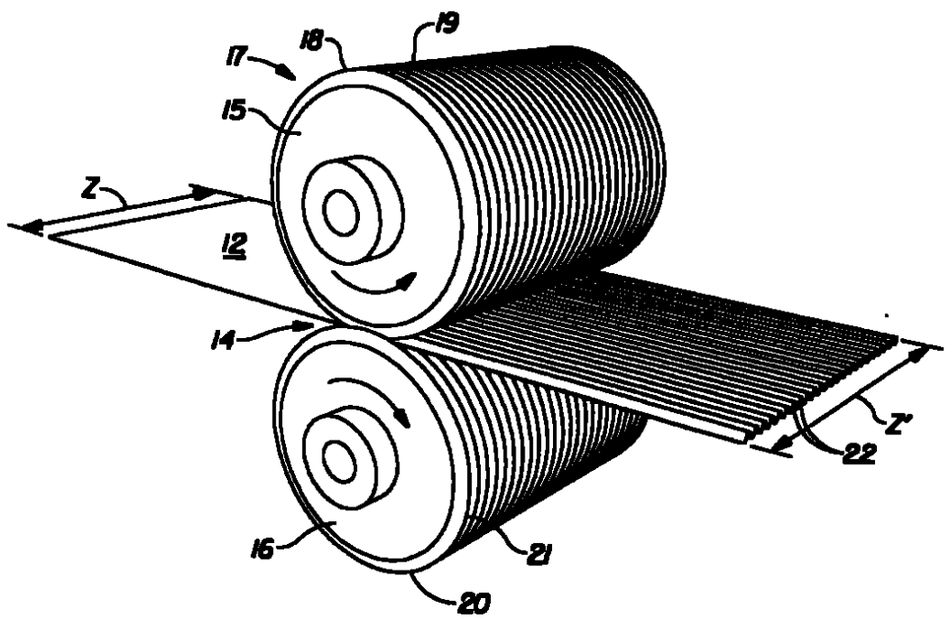
32
36
50

Fig. 1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18
17
15
Z
12
14
Z'
22
16
21
20

Fig. 2

109

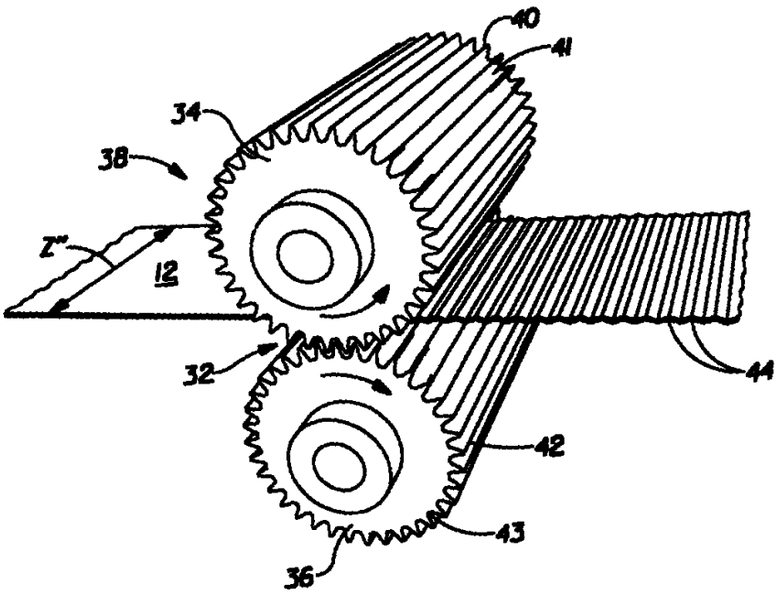

Fig. 3

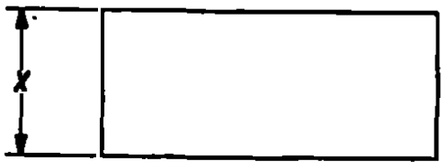

Fig. 4

Fig. 5

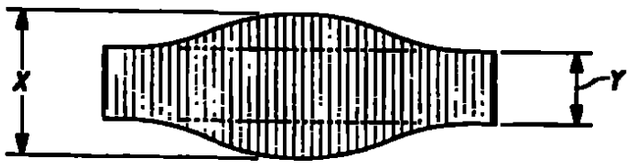

Fig. 6

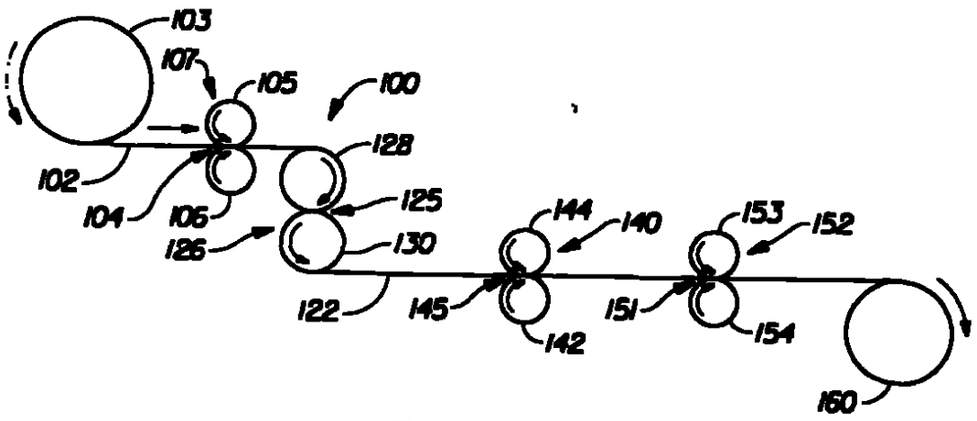

Fig. 7

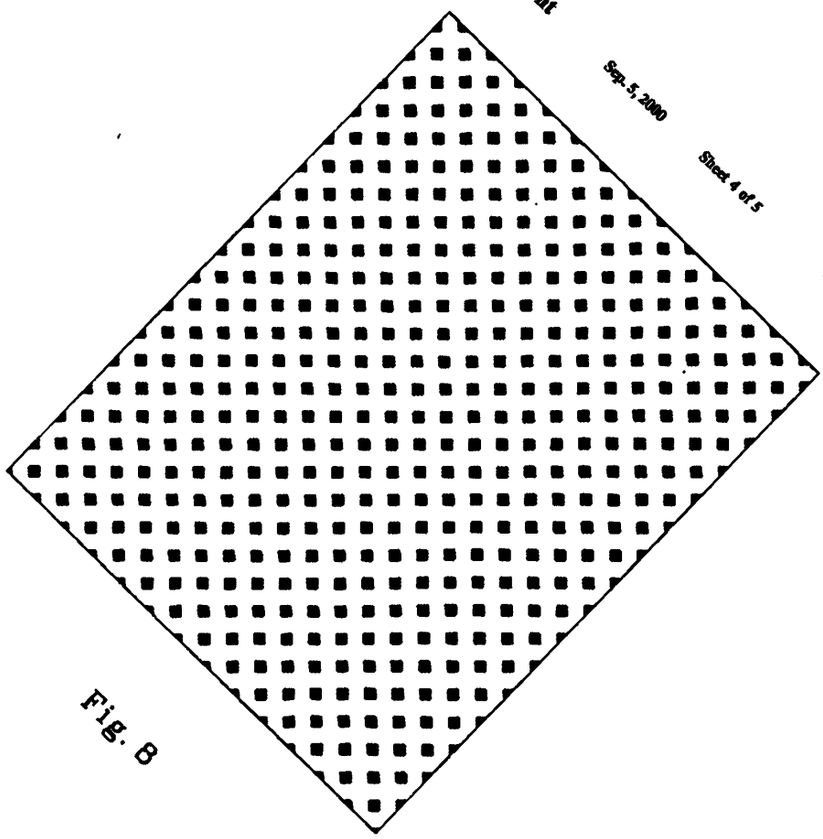

Fig. 8

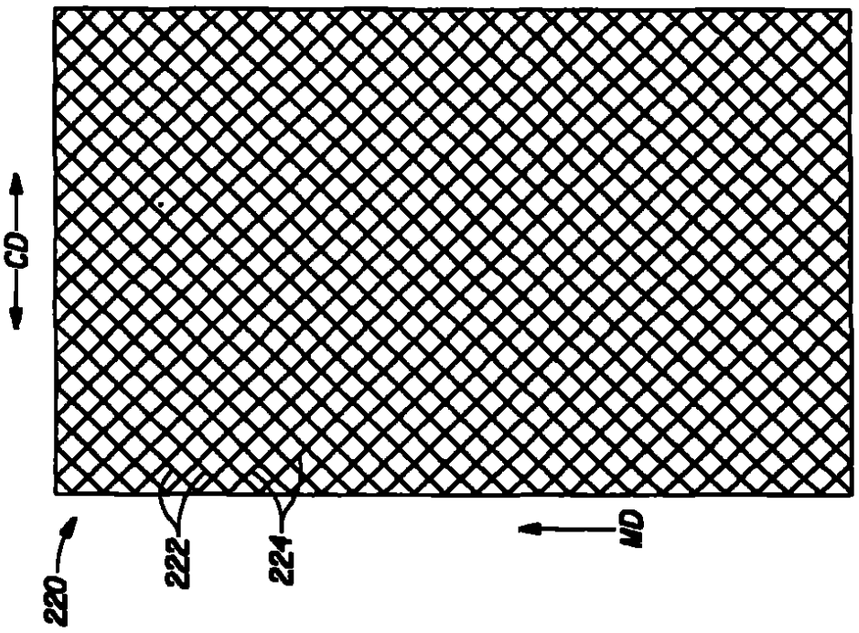

Fig. 10

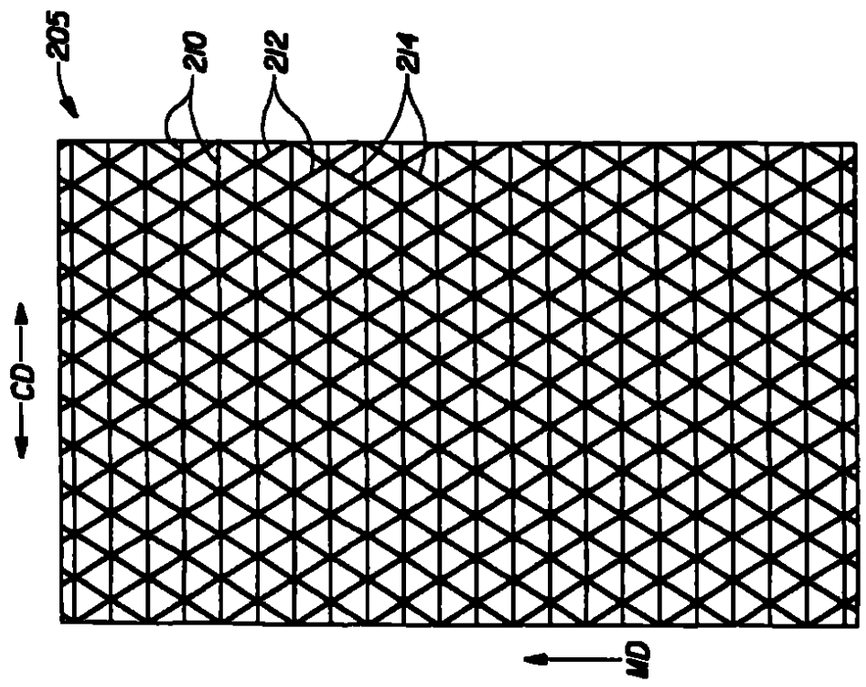

Fig. 9

STABLE WEB HAVING ENHANCED EXTENSIBILITY AND METHOD FOR MAKING SAME

This application is a Continuation of application Ser. No. 08/832,875, filed Apr. 4, 1997, now U.S. Pat. No. 5,914,084 which is hereby incorporated herein by reference.

FIELD OF THE INVENTION

The present invention relates to stable materials having enhanced extensibility and a mechanical post-processing method for making the same. High extension materials, such as nonwoven webs and film webs are particularly well suited for use in disposable absorbent articles such as diapers, incontinence briefs, training pants, feminine hygiene garments, and the like, as they are able to be used in portions of the article where high extensibility can aid in the article's fit to the body.

BACKGROUND OF THE INVENTION

Nonwoven webs may be manufactured into products and components of products so inexpensively that the product may be viewed as disposable after only one or a few uses. Representatives of such products include diapers, training pants, wipes, garments, incontinence briefs, feminine hygiene garments and the like.

Nonwoven webs may be treated to provide the nonwoven web with certain properties. For example, U.S. Pat. No. 5,244,482 issued to Hassenboehler, Jr. et al. on Sep. 14, 1993 discloses a method for treating a nonwoven web wherein the nonwoven web is heated at an elevated temperature and uniaxially drawn to consolidate and stabilize the nonwoven web. Such nonwoven webs are noted to exhibit an increased elasticity after processing. Such elasticity increase is recognized as being caused by the new "memory" instilled by the heating of the nonwoven web. For applications desiring enhanced extensibility rather than elasticity, such heating is therefore not desirable. Additionally, such drawing and setting of the nonwoven web by heating at an elevated temperature often causes fiber embrittlement and the nonwoven web to exhibit increased gloss. For many applications involving skin contact, e.g., such as in diaper coverstock, such attributes are contrary to the desired cloth-like properties of softness and non-plastic, (low gloss) appearance. Lastly, the requirement of heating the nonwoven web to consolidate and stabilize the web adds to the complexity and cost of the process.

U.S. Pat. No. 4,981,747 issued to Morman on Jan. 1, 1991, discloses a "reversibly necked" material. It is taught that the unstabilized necked material must be held under high tension on the re-wound roll until such time as the further heat setting step is performed to stabilize the material. Such a material will again suffer the deficits noted above with respect to preferred skin contact applications, and will enhance the elastic properties of the material rather than the extensible behavior of the material.

U.S. Pat. No. 5,226,992 issued to Morman on Jul. 13, 1993, discloses a method of producing a composite elastic necked-bonded material. A tensioning force is applied to at least one neckable material, such as a neckable nonwoven web, to neck or consolidate the material. Instead of heating the consolidated nonwoven web, this patent teaches superposing the tensioned consolidated nonwoven web on an elastic material and joining the tensioned consolidated nonwoven web to the elastic material while the tensioned consolidated nonwoven web is in a tensioned condition. By joining the tensioned consolidated nonwoven web to the elastic material while still in a tensioned condition, the nonwoven web is constrained to its' necked dimension. Such a procedure does not provide a means for producing a stabilized extensible web without the attachment of the nonwoven web to an additional elastic layer.

It is an object of the present invention to provide a stabilized extensible necked nonwoven web, capable of being wound into stable rollstock or festooned form, suitable for subsequent conversion or combining operations.

It is also an object of the present invention to provide a stabilized extensible necked nonwoven web, capable of very high speed extension via mechanical straining means.

It is also an object of the present invention to provide a post-processing method for producing a stabilized extensible necked nonwoven web.

It is also an object of the present invention to provide a post-processing method for producing a stabilized extensible necked nonwoven web that does not require heating of the neckable material to elevated temperatures, to enhance the extensible properties rather than the elastic properties and to substantially preserve the original properties of the neckable nonwoven web.

As used herein, the term "elastic", refers to any material which, upon application of a biasing force, is stretchable, that is, elongatable, to at least about 60 percent (i.e., to a stretched, biased length which is at least about 160 percent of its relaxed unbiased length), and which, will recover at least 55 percent of its elongation upon release of the *stretching, elongation force*.

As used herein, the term "extensible" refers to any material which, upon application of a biasing force, is stretchable, that is, elongatable, to at least about 60 percent without suffering catastrophic failure (i.e., to a stretched, biased length which is at least about 160 percent of its relaxed unbiased length), but does not recover more than 55 percent of its elongation upon release of the stretching, elongation force.

As used herein, the term "highly extensible" refers to any material which, upon application of a biasing force, is stretchable, that is, elongatable, to at least about 100 percent without suffering catastrophic failure (i.e., to a stretched, biased length which is at least about 200 percent of its relaxed unbiased length), but does not recover more than 55 percent of its elongation upon release of the stretching, elongation force.

As used herein, the term "stabilized" refers to a material of the present invention which is capable of being stored in a stable condition in any common or conventional web storage manner without the need for further heating or the addition of or joinder with other webs to stabilize the material. Such storage means would include for example, low tension rolls or festooned material in boxes.

As used herein, the term "nonwoven web", refers to a web that has a structure of individual fibers or threads which are interlaid, but not in any regular repeating manner. Nonwoven webs have been, in the past, formed by a variety of processes such as, for example, meltblowing processes, spunbonding process, and bonded carded web processes.

As used herein, the term "necked material", refers to any material which has been constricted in at least one dimension by applying a tensioning force in a direction that is perpendicular to the desired direction of neck-down.

As used herein, the term "neckable material", refers to any material which can be necked.

As used herein, the term "percent neckdown", refers to the ratio determined by measuring the difference between the un-necked dimension and the stabilized necked dimensions of the neckable material in the direction of necking, and then dividing that difference by the un-necked dimension of the neckable material, then multiplying by 100.

As used herein, the term "composite elastic material", refers to a material comprising an elastic member joined to a stabilized extensible necked material. The elastic member may be joined to the stabilized extensible necked material at intermittent points or may be continuously bonded thereto. The joining is accomplished while the elastic member and the stabilized extensible necked material are in juxtaposed configuration. The composite elastic material is elastic in a direction generally parallel to the direction of neckdown of the stabilized extensible necked material and may be stretched in that direction to the breaking point of the stabilized extensible necked material. A composite elastic material may include more than two layers.

As used herein, the term "polymer", generally includes, but is not limited to, homopolymers, copolymers, such as, for example, block, graft, random, and alternating copolymers, terpolymers, etc. and blends and modifications thereof. Furthermore, unless otherwise specifically limited, the term "polymer" shall include all possible molecular geometric configurations of the material. These configurations include, but are not limited to, isotactic, syndiotactic and random symmetries.

As used herein, the term "surface-pathlength" refers to a measurement along topographic surface of the material in question in a specified direction.

SUMMARY OF THE INVENTION

In accordance with the present invention there is provided a method of producing a stabilized extensible necked nonwoven web comprising the steps of:

providing a neckable nonwoven web;

feeding the neckable nonwoven web in a first direction;

subjecting the neckable nonwoven web to incremental stretching in a direction perpendicular to the first direction;

applying a tensioning force to the neckable nonwoven web in a direction parallel to the first direction to neck the nonwoven web in a direction perpendicular to the first direction; and

subjecting the necked nonwoven web to mechanical stabilization to provide a stabilized extensible necked nonwoven web.

The stabilized extensible necked nonwoven web is easily extended in a direction perpendicular to the first direction or parallel to the direction of necking. A preferred method for mechanically stabilizing the necked nonwoven web comprises subjecting the necked nonwoven web to incremental stretching in a direction parallel to the first direction.

The method may also comprise the additional step of winding the stabilized extensible necked nonwoven web onto a take-up roll or festooning the stabilized extensible necked nonwoven web into box.

The method may also comprise the additional step of joining the stabilized extensible necked nonwoven web to an elastic member to form a composite elastic material.

If the material is stretchable it may be necked by stretching in a direction generally perpendicular to the desired direction of neck-down. The neckable material may be any material that can be necked sufficiently at room temperature. Such neckable materials include knitted and loosely woven fabrics, bonded carded nonwoven webs, spunbonded nonwoven webs, or meltblown nonwoven webs. The neckable material may also have multiple layers such as, for example, multiple spunbonded layers and/or multiple meltblown layers or film layers. The neckable material may be made of polymers such as for example, polyolefins. Exemplary polyolefins include polypropylene, polyethylene, ethylene copolymers, propylene copolymers and blends thereof. The neckable nonwoven web may be a nonelastic nonwoven web such as for example a nonelastic nonwoven material.

BRIEF DESCRIPTION OF THE DRAWINGS

While the specification concludes with claims particularly pointing out and distinctly claiming the subject matter which is regarded as forming the present invention, it is believed that the invention will be better understood from the following description which is taken in conjunction with the accompanying drawings in which like designations are used to designate substantially identical elements, and in which:

FIG. 1 is schematic illustration of an exemplary process for forming a necked nonwoven web of the present invention;

FIG. 2 is an enlarged perspective illustration of the cross-machine direction web enhancement arrangement;

FIG. 3 is an enlarged perspective illustration of the stabilizing roller arrangement;

FIG. 4 is a plan view of an exemplary neckable nonwoven web before tensioning and necking;

FIG. 5 is a plan view of an exemplary necked nonwoven web;

FIG. 6 is a plan view of an exemplary composite elastic material while partially stretched;

FIG. 7 is a schematic illustration of another exemplary process for forming a necked nonwoven web of the present invention;

FIG. 8 is a plan view of a spaced-apart pattern of embossments which is not suitable for setting the necked nonwoven web;

FIG. 9 is a plan view of an embossment pattern of the present invention which is suitable for setting the necked nonwoven web; and

FIG. 10 is a plan view of another embossment pattern of the present invention which is suitable for setting the necked nonwoven web.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. 1 there is schematically illustrated at 10 a process for forming a stabilized extensible necked nonwoven web of the present invention.

According to the present invention, a neckable nonwoven web 12 is unwound from a supply roll 13 and travels in the direction indicated by the arrows associated therewith, i.e., in the machine direction or MD or first direction, as the supply roll 13 rotates in the direction indicated by the arrows associated therewith. From the supply roll 13 the neckable nonwoven web 12 passes through the nip 14 formed by the incremental stretching rollers 15 and 16 of the cross-machine direction web enhancement arrangement 17.

The neckable nonwoven web 12 may be formed by known nonwoven extrusion processes, such as, for example, known meltblowing processes or known spunbonding processes, and passed directly through the nip 14 without first being stored on a supply roll.

FIG. 2 is an enlarged perspective illustration of a preferred embodiment of the cross-machine direction web enhancement arrangement 17 employing opposed pressure applicators having three-dimensional surfaces which at least to a degree are complimentary to one another. The cross-machine direction web enhancement arrangement 17 shown in FIG. 2 comprises incremental stretching rollers 15 and 16. The neckable nonwoven web 12 passes through the nip 14 formed by incremental stretching rollers 15 and 16 as the incremental stretching rollers rotate in the direction indicated by the arrows associated therewith. Uppermost incremental stretching roller 15 comprises a plurality of teeth 18 and corresponding grooves 19 which extend about the entire circumference of roller 15. Lowermost incremental stretching roller 16 comprises a plurality of teeth 20 and corresponding grooves 21 which extend about the entire circumference of roller 16. The teeth 18 on roller 15 intermesh with or engage the grooves 21 on roller 16, while the teeth 20 on roller 16 intermesh with or engage the grooves 19 on roller 15.

The teeth 18 and 20 on rollers 15 and 16, respectively, extend in a direction substantially parallel to the travel direction of the neckable nonwoven web 12 or in a direction substantially perpendicular to the width of the neckable nonwoven web 12. That is, teeth 18 and 20 extend in a direction parallel to the machine, MD or first direction. The incremental stretching rollers 15 and 16 incrementally stretch the nonwoven web in a direction generally perpendicular to the first or machine direction thereby causing the fibers of the nonwoven web to be oriented, at least to a degree, in the cross-machine or CD direction or perpendicular to the first direction. In addition to orienting the individual fibers of the nonwoven web in CD direction the surface-pathlength of the nonwoven web as measured in the CD direction or perpendicular to the first direction increases. As the nonwoven web 12 exits the cross-machine direction web enhancement arrangement 17 the nonwoven web 12 includes a plurality of rugosities 22. The rugosities 22 provide the nonwoven web 12 with its increased surface-pathlength as compared to the surface-pathlength of the substantially flat nonwoven web 12 prior to entering the cross-machine direction web enhancement arrangement 17.

As can be seen in FIG. 2, prior to entering the nip 14 of the cross-machine direction web enhancement arrangement 17, the nonwoven web 12 has a CD surface-pathlength dimension Z. After being subjected to the incremental stretching rollers 15 and 16 the nonwoven web has a plurality of rugosities 22 which provide the nonwoven web 12 with a new CD surface-pathlength dimension Z' which is greater than CD surface-pathlength dimension Z. CD surface-pathlength dimension Z' is preferably at least about 10% greater than CD surface-pathlength dimension Z, more preferably at least about 20% greater than CD surface-pathlength dimension Z, and most preferably at least about 30% greater than CD surface-pathlength dimension Z. CD surface-pathlength dimension Z' may be as much as about 200% greater than dimension Z or more without subjecting the nonwoven web to catastrophic failure. For example, the nonwoven web 12 having a CD surface-pathlength dimension Z of 10 inches, may be expanded 50% to have a CD surface-pathlength dimension Z' of 15 inches.

The method for determining the surface-pathlength of the nonwoven web can be found in the Test Methods section set forth in subsequent portions of the present specification.

The incremental stretching rollers 15 and 16 may include any number of teeth and grooves as desired. In addition, the teeth and grooves may be nonlinear, such as for example, curved, sinusoidal, zig-zag, etc. The size and amount of engagement of teeth and grooves on incremental stretching rollers 15 and 16 may be of any desired dimension.

From the cross-machine direction web enhancement arrangement 17 the neckable nonwoven web 12 passes through a nip 25 of the S-roll arrangement 26 formed by the stack rollers 28 and 30. The neckable nonwoven web 12 passes through the nip 25 of the S-roll arrangement 26 in a reverse-S path as indicated by the rotation direction arrows associated with the stack rollers 28 and 30. From the S-roll arrangement 26 the neckable nonwoven web 12 passes through the nip 32 formed by the incremental stretching rollers 34 and 36 of the mechanical stabilization arrangement 38. Because the peripheral linear speed of the rollers of the S-roll arrangement 26 is controlled to be less than the peripheral linear speed of the rollers of the mechanical stabilization arrangement 38, the neckable nonwoven web 12 is tensioned between the S-roll arrangement 26 and the nip 32 of the incremental stretching rollers 34 and 36 of the mechanical stabilization arrangement 38. By adjusting the difference in the speeds of the rollers, the neckable nonwoven web 12 is tensioned so that it necks a desired amount and is maintained in such a tensioned, necked condition. The mechanical stabilization arrangement 38 provides a stabilized necked nonwoven web which may be joined to other materials.

As the nonwoven web 12 is tensioned between the S-roll arrangement 26 and the nip 32 of the incremental stretching rollers 34 and 36 tension is applied to the neckable nonwoven web in a direction parallel to the first direction or parallel to the machine or MD direction. The tensioning of the nonwoven web 12 in a direction parallel to the first direction causes the nonwoven web to neck in a direction perpendicular to the first direction or in a direction parallel to the CD or cross-machine direction.

Entering the S-roll arrangement 26, the nonwoven web 12 has a CD surface-pathlength dimension Z'. When tensioned between the S-roll arrangement 26 and the nip 32 of the incremental stretching rollers 34 and 36 of the mechanical stabilization arrangement 38 the nonwoven web 12 is necked such that its new CD surface-pathlength dimension Z" is less than the CD surface-pathlength dimension Z', and preferably less than the CD surface-pathlength dimension Z. CD surface-pathlength dimension Z" is preferably less than about 75% of CD surface-pathlength dimension Z, more preferably less than about 50% of CD surface-pathlength dimension Z, and most preferably less than about 30% of CD surface-pathlength dimension Z. For example, the nonwoven web 12 having a CD surface-pathlength dimension Z of 10 inches, may be expanded 50% to have a CD surface-pathlength dimension Z' of 15 inches, and then may be necked to have a CD surface-pathlength dimension Z" of 5 inches which is 50% of the CD surface-pathlength dimension Z of 10 inches.

Other methods of tensioning the neckable nonwoven web 12 may be used such as, for example, tenter frames.

The neckable nonwoven web 12 may be extensible, elastic, or nonelastic nonwoven material. The neckable nonwoven web 12 may be a spunbonded web, a meltblown web, or a bonded carded web. If the neckable nonwoven web is a web of meltblown fibers, it may include meltblown microfibers. The neckable nonwoven web 12 may be made of fiber forming polymers such as, for example, polyolefins. Exemplary polyolefins include one or more of polypropylene, polyethylene, ethylene copolymers, propylene copolymers, and butene copolymers.

In one embodiment of the present invention, the neckable nonwoven web 12 may be a multilayer material having, for example, at least one layer of a spunbonded web joined to at least one layer of a meltblown web, a bonded carded web or other suitable material. Alternatively, the neckable nonwoven web 12 may be a single layer of material such as, for example, a spunbonded web, a meltblown web, or a bonded carded web.

The neckable nonwoven web 12 may also be a composite material made of a mixture of two or more different fibers or a mixture of fibers and particles. Such mixtures may be formed by adding fibers and/or particulates to the gas stream in which the meltblown fibers are carried so that an intimate entangled commingling of meltblown fibers and other materials, e.g., wood pulp, staple fibers and particulates such as, for example, hydrocolloidal (hydrogel) particles commonly referred to as superabsorbent materials, occurs prior to collection of the meltblown fibers upon a collecting device to form a coherent web of randomly dispersed meltblown fibers and other materials.

The nonwoven web of fibers should be joined by bonding to form a coherent web structure which is able to withstand necking. Suitable bonding techniques include, but are not limited to, chemical bonding, thermobonding, such as point calendering, hydroentangling, and needling.

FIG. 3 is an enlarged perspective illustration of a preferred embodiment of the mechanical stabilization arrangement 38 employing opposed pressure applicators having three-dimensional surfaces which at least to a degree are complimentary to one another. The mechanical stabilization arrangement 38 shown in FIG. 3 comprises incremental stretching rollers 34 and 36. The neckable nonwoven web 12 passes through the nip 32 formed by incremental stretching rollers 34 and 36 as the incremental stretching rollers rotate in the direction indicated by the arrows associated therewith. Uppermost incremental stretching roller 34 comprises a plurality of teeth 40 and corresponding grooves 41 which extend about the entire circumference of roller 34. Lowermost incremental stretching roller 36 comprises a plurality of teeth 42 and corresponding grooves 43 which extend about the entire circumference of roller 36. The teeth 40 on roller 34 intermesh with or engage the grooves 43 on roller 36, while the teeth 42 on roller 36 intermesh with or engage the grooves 41 on roller 34.

The teeth 40 and 42 on rollers 34 and 36, respectively, extend in a direction substantially perpendicular to the first direction of the neckable nonwoven web 12 or in a direction substantially parallel to the width of the neckable nonwoven web 12. That is, teeth 40 and 42 extend in a direction parallel to the cross-machine or CD direction. The incremental stretching rollers 34 and 36 incrementally stretch the necked web in a direction generally perpendicular to the necked direction, i.e., in a direction parallel to the first direction, thereby stabilizing the necked nonwoven web 12 such that it remains in its necked condition after passing through the incremental stretching rollers 34 and 36 and the tension on the necked nonwoven web is released. By stabilizing the necked nonwoven web, the necked nonwoven web substantially maintains its necked dimension without returning to its precursor dimension.

After being stabilized by passing through the incremental stretching rollers 34 and 36, the stabilized necked nonwoven web 12 includes a plurality of stabilizing embossments 44. Stabilizing embossments 44 extend in a substantially linear direction parallel to one another across the entire width of the stabilized necked nonwoven web 12. The stabilizing embossments 44 are shown to be extending in a direction substantially parallel to the CD or cross-machine direction. As seen in FIG. 3, each stabilizing embossment extends across the stabilized necked nonwoven web 12 from one edge to the other edge. This is very important as this sets the fibers across the entire width of the web thereby stabilizing the web. If the stabilizing embossments 44 did not extend entirely across the neckable nonwoven web 12, the portion of the neckable nonwoven web that is not embossed would return to its precursor width. For example, a spaced apart pattern of embossments such as shown in FIG. 8, would not effectively set the nonwoven web. The portions of the nonwoven web between the individual embossments would not be set, and therefore, would allow the nonwoven web to return to its precursor dimension.

The incremental stretching rollers 34 and 36 may include any number of teeth and grooves to provide the desired stabilization in the nonwoven web. In addition, the teeth and grooves may be nonlinear, such as for example, curved, sinusoidal, zig-zag, etc. The size and amount of engagement of the teeth and grooves on the incremental stretching rollers 34 and 36 may be of any desired dimension. In addition, the teeth and grooves may extend in a direction other than perpendicular to the travel direction of the neckable web. For example, the teeth and grooves may extend at an angle to the CD direction, but preferably not parallel to the MD or machine direction, as this type of incremental stretching would tend to expand the width of the web, thus defeating the purpose of the necking operation.

Refarring now to FIG. 1, after the neckable nonwoven web 12 passes through the mechanical stabilization arrangement 38 it is wound up on take-up roll 50. Stabilizing the neckable nonwoven web in its necked condition allows it to be wound up on a take-up roll while in its necked condition and then later used for the desired end use. Once the neckable nonwoven web has been mechanically stabilized or set, it is suitable for handling on high speed conventional diaper converting equipment without the need for special handling equipment. Alternatively, the neckable nonwoven web 12 may be festooned into a box using conventional festooning equipment.

The stabilized necked nonwoven web is easily extended in a direction parallel to the direction of necking. That is, the stabilized necked nonwoven web is easily extended or elongated in the cross-machine direction. The stabilized extensible necked nonwoven web is elongatable upon application of a biasing force to at least about 60 percent without suffering catastrophic failure, (i.e., to a stretched, biased length which is at least about 160 percent of its relaxed unbiased length). Preferably, the stabilized extensible necked nonwoven web is elongatable upon application of a biasing force to at least about 100 percent without suffering catastrophic failure, (i.e., to a stretched, biased length which is at least about 200 percent of its relaxed unbiased length). Because the stabilized extensible necked nonwoven web is extensible and not elastic, the stabilized extensible necked nonwoven web does not recover more than 55 percent of its elongation upon release of the stretching, elongation force, and preferably no more than 25 percent of its elongation upon release of the stretching, elongation force.

The stabilized extensible necked nonwoven web is preferably elongatable to at least about 60 percent and more preferably to at least about 100 percent or more without suffering catastrophic failure upon the application of a relatively low biasing force. Being elongatable to at least about 60 percent and more preferably to at least about 100 percent or more upon the application of a relatively low

biasing force makes the stabilized extensible necked nonwoven web particularly well suited for use in disposable absorbent articles such as diapers, incontinence briefs, training pants, feminine hygiene garments, and the like, as they are able to be used in portions of the article where high extensibility can aid in the article's fit to the body.

The stabilized extensible necked nonwoven web is preferably elongatable to at least about 60 percent and more preferably to at least about 100 percent without suffering catastrophic failure upon the application of a biasing force of less than about 300 grams, more preferably upon the application of a biasing force of less than about 200 grams, and most preferably upon the application of a biasing force of less than about 100 grams.

Conventional drive means and other conventional devices which may be utilized in conjunction with the apparatus of FIG. 1 are well known and, for purposes of clarity, have not been illustrated in the schematic view of FIG. 1.

In addition to incremental stretching, there are other suitable methods for mechanically stabilizing the necked nonwoven web. These methods include crimping, and/or creping rollers. Another suitable method includes passing the necked nonwoven web through the nip of a pair of smooth rollers. The nip pressure and/or roller engagements of such stabilizing rollers are set to provide the desired degree of stabilization to the necked web.

FIG. 9 is a plan view of another suitable embossment pattern for stabilizing the neckable nonwoven web. The pattern includes a plurality of linear embossments 210 extending continuously across the entire width of the web 205 in a direction generally parallel to the cross-machine direction. The pattern also includes a plurality of linear embossments 212 extending continuously across the entire width of the web 205 at an angle to the cross-machine direction and at an angle to the embossments 210. The web 205 also includes a plurality of linear embossments 214 extending continuously across the entire width of the web 205 at an angle to the cross-machine direction and at an angle to the embossments 210 and 212. The embossments 212 and 214 may extend at any angle to one another and to the embossments 210.

FIG. 10 is a plan view of another embossment pattern for stabilizing the neckable nonwoven web. The pattern includes a plurality of linear embossments 222 extending continuously across the entire width of the web 220 at an angle to the cross-machine direction. The web 220 also includes a plurality of linear embossments 224 extending continuously across the entire width of the web 220 at an angle to the cross-machine direction and at an angle to the embossments 222. The embossments 222 and 224 are preferably aligned perpendicular to one another. However, other angles between the linear embossments 222 and 224 may also be employed.

The embossment pattern of FIGS. 9 and 10, is provided by feeding the necked nonwoven web through a nip formed by a pair of patterned compression rollers. Each roller comprises a series of raised surfaces, similar to the teeth 40 and 42 on rollers 34 and 36, respectively. The raised surfaces on each of the rollers are complimentary and engage one another and compress the necked nonwoven web providing the embossment pattern shown in FIGS. 9 and 10. The compression provided by the patterned compression rollers sets the individual fibers to stabilize the web in its necked condition.

Alternatively, the patterned compression rollers may comprise a pattern roller having a pattern of raised surfaces and an anvil roller having a smooth surface. The raised surfaces on the pattern roller compress the necked nonwoven web against the anvil roller to provide the embossment pattern shown in FIGS. 9 and 10.

The stabilized extensible necked nonwoven web may later be joined to an elastic member to form a composite elastic material. Preferably, the stabilized extensible necked material is joined with an elastic member while the elastic member is in a substantially untensioned condition. The stabilized extensible necked nonwoven web and the elastic member may be joined to one another either intermittently or substantially continuously along at least a portion of their coextensive surfaces while the elastic member is in either a tensioned or an untensioned condition. The stabilized extensible necked nonwoven web may be joined to an elastic member after having been removed from a roll, such as take-up roll 50, or may be joined to an elastic member after having been immediately subjected to mechanical stabilization.

The elastic member may be made from any suitable elastic material. Generally, any suitable elastomeric fiber forming resins or blends containing the same may be utilized for the nonwoven webs of elastomeric fibers and any suitable elastomeric film forming resins or blends containing the same may be utilized for the elastomeric films of the invention. For example, the elastic member may be an elastomeric film made from block copolymers having the general formula A-B-A' where A and A' are each a thermoplastic polymer endblock which contains a styrenic moiety such as a poly(vinyl arene) and where B is an elastomeric polymer midblock such as a conjugated diene or a lower alkene polymer. Other exemplary elastomeric films which may be used to form the elastic sheet include polyurethane elastomeric materials such as, for example, those available under the trademark ESTANE from B.F. Goodrich & Company, polyamide elastomeric materials such as, for example, those available under the trademark PEBAX from the Rilsan Company, and polyester elastomeric materials such as, for example, those available under the trade designation Hytrel from E. I. DuPont De Nemours & Company.

A polyolefin may also be blended with the elastomeric polymer to improve the processability of the composition. The polyolefin must be one which, when blended and subjected to an appropriate combination of elevated pressure and elevated temperature conditions, is extrudable, in blended form, with the elastomeric polymer. Useful blending polyolefin materials include, for example, polyethylene, polypropylene and polybutene, including ethylene copolymers, polypropylene copolymers, and butene copolymers.

The elastic member may also be a pressure sensitive elastomeric adhesive sheet. For example, the elastic material itself may be tacky or, alternatively, a compatible tackifying resin may be added to the extrudable elastomeric compositions described above to provide an elastomeric sheet that can act as a pressure sensitive adhesive, e.g., to bond the elastomeric sheet to a tensioned, necked nonelastic web. The elastic sheet may also be a multilayer material that may include two or more individual coherent webs or films. Additionally, the elastomeric sheet may be a multilayer material in which one or more of the layers contain a mixture of elastic and nonelastic fibers or particles.

Other suitable elastomeric materials for use as the elastic member include "live" synthetic or natural rubber including heat shrinkable elastomeric films, formed elastomeric scrim, elastomeric foams, or the like. In an especially preferred

embodiment, the elastic member comprises an elastomeric scrim available from Conwed Plastics.

The relation between the original dimensions of the neckable nonwoven web 12 to its dimensions after tensioning or necking determines the approximate limits of stretch of the composite elastic material. Because the neckable nonwoven web is able to stretch and return to its necked dimension in directions such as, for example, the machine direction or cross-machine direction, the composite elastic material will be stretchable in generally the same direction as the neckable nonwoven web 12.

For example, with reference to FIGS. 4, 5, and 6, if it is desired to prepare a composite elastic material stretchable to a 150% elongation, a width of neckable material shown schematically and not necessarily to scale in FIG. 4 having a width "X" such as, for example, 250 cm, is tensioned so that it necks down to a width "Y" of about 100 cm. The necked nonwoven web shown in FIG. 4 is mechanically stabilized to provide a stabilized extensible necked nonwoven web. The stabilized extensible necked nonwoven web is then joined to an elastic member having a width of approximately 100 cm and which is at least stretchable to a width of 250 cm. The resulting composite elastic material shown schematically and not necessarily to scale in FIG. 6 has a width "Y" of about 100 cm and is stretchable to at least the original 250 cm width "X" of the neckable material for an elongation of about 150%. As can be seen from the example, the elastic limit of the elastic member needs only be as great as the minimum desired elastic limit of the composite elastic material.

Referring now to FIG. 7, there is schematically illustrated another process 100 for forming a necked nonwoven web of the present invention.

A neckable nonwoven web 102 is unwound from a supply roll 103 and travels in the direction indicated by the arrows associated therewith, i.e., in the machine or first direction, as the supply roll 103 rotates in the direction indicated by the arrows associated therewith. From the supply roll 103 the neckable nonwoven web 102 passes through the nip 104 formed by the incremental stretching rollers 105 and 106 of the cross-machine direction web enhancement arrangement 107. The cross-machine direction web enhancement arrangement 107 employs opposed pressure applicators having three-dimensional surfaces which at least to a degree are complimentary to one another. The cross-machine direction web enhancement arrangement 107 comprises incremental stretching rollers 105 and 106. A more detailed description of the cross-machine direction web enhancement arrangement comprising incremental stretching rollers is shown in FIG. 2.

The neckable nonwoven web 102 may be formed by known nonwoven extrusion processes, such as, for example, known meltblowing processes or known spunbonding processes, and passed directly through the nip 104 without first being stored on a supply roll.

From the cross-machine direction web enhancement arrangement 107 the neckable nonwoven web 102 passes through the nip 125 of the S-roll arrangement 126 formed by the stack rollers 128 and 130. The neckable nonwoven web 102 passes through the nip 125 of the S-roll arrangement 126 in a reverse-S path as indicated by the rotation direction arrows associated with the stack rollers 128 and 130. From the S-roll arrangement 126, the neckable nonwoven web 102 passes through the pressure nip 145 formed by pressure roller arrangement 140 comprised of pressure rollers 142 and 144. Because the peripheral linear speed of the rollers of the S-roll arrangement 126 is controlled to be less than the peripheral linear speed of the rollers of the pressure roll arrangement 140, the neckable nonwoven web 102 is tensioned between the S-roll arrangement 126 and the pressure nip of the pressure roll arrangement 140. By adjusting the difference in the speeds of the rollers, the neckable nonwoven web 102 is tensioned so that it necks a desired amount and is maintained in such a tensioned, necked condition. From the pressure roller arrangement 140 the necked nonwoven web 102 passes through the nip 151 formed by the mechanical stabilization arrangement 152 comprised of incremental stretching rollers 153 and 154. Because the peripheral linear speed of the rollers of the pressure roll arrangement 140 is controlled to be less than or equal to the peripheral linear speed of the rollers of the mechanical stabilization arrangement 152, the nonwoven web is maintained in its tensioned and/or necked condition between the pressure roll arrangement 140 and the mechanical stabilization arrangement 152. After leaving mechanical stabilization arrangement 152 the stabilized necked nonwoven web 102 is wound up on take-up roll 160. Alternatively, the stabilized necked nonwoven web 102 may be festooned into a box using conventional equipment.

Conventional drive means and other conventional devices which may be utilized in conjunction with the apparatus of FIG. 7 are well known and, for purposes of clarity, have not been illustrated in the schematic view of FIG. 7.

Test Methods

Surface-pathlength measurements of nonwoven webs are to be determined by analyzing the nonwoven webs by means of microscopic image analysis methods.

The sample to be measured is cut and separated from nonwoven web. An unstrained sample length of one-half inch is to be "gauge marked" perpendicular to the "measured edge" while attached to the web, and then accurately cut and removed from the web.

Measurement samples are then mounted onto the long-edge of a microscopic glass slide. The "measured edge" is to extend slightly (approximately 1 mm) outward from the slide edge. A thin layer of pressure-sensitive adhesive is applied to the glass face-edge to provide a suitable sample support means. For a sample having deep ruggosities it may be necessary to gently extend the sample (without imposing significant force) to facilitate contact and attachment of the sample to the slide edge. This allows improved edge identification during image analysis and avoids possible "crumpled" edge portions that require additional interpretation analysis.

Images of each sample are to be obtained as "measured edge" views taken with the support slide "edge on" using suitable microscopic measuring means of sufficient quality and magnification. Data is obtained using the following equipment; Keyence VH-6100 (20xLens) video unit, with video-image prints made with a Sony Video printer Mavigraph unit. Video prints are image-scanned with a Hewlett Packard ScanJet IIP scanner. Image analysis is on a Macintosh IICi computer utilizing the software NIH MAC Image version 1.45.

Using this equipment, a calibration image initially taken of a grid scale length of 0.500" with 0.005" increment-marks to be used for calibration setting of the computer image analysis program. All samples to be measured are then video-imaged and video-image printed. Next, all video-prints are image-scanned at 100 dpi (256-level gray scale) into a suitable Mac image-file format. Finally, each image-file (including calibration file) is analyzed utilizing Mac

Image 1.45 computer program. All samples are measured with freehand line-measurement tool selected. Samples are measured on both side-edges and the lengths are recorded. Thin samples require only one side-edge to be measured. Thick samples are measured on both side-edges. Length measurement tracings are to be made along the full gauge length of a cut sample. In some cases multiple (partially overlapping) images may be required to cover the entire cut sample. In these cases, select characteristic features common to both overlapping-images and utilize as "markers" to permit image length readings to adjoin but not overlap.

The final determination of surface-pathlength is obtained by averaging the lengths of five (5) separate ½" gauge-samples of each region. Each gauge-sample "surface-pathlength" is to be the average of both side-edge surface-pathlengths.

While the test method described above is useful for many of the webs of the present invention it is recognized that the test method may have to be modified to accommodate some webs.

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. An elastic laminate comprising:

an elongatable nonwoven web necked in a first direction which recovers less than about 55 percent of its elongation upon release of an elongation force applied to said web in a direction parallel to said first direction; and

an elastic member joined to the elongatable, necked nonwoven web while the nonwoven web is in a substantially untensioned condition.

2. The elastic laminate of claim 1 wherein the elastic member comprises an elastomeric film.

3. The elastic laminate of claim 2 wherein elastomeric film comprises a polymer selected from the group consisting of polyesters, polyurethanes and polyamides.

4. The elastic laminate of claim 1 wherein the elastic member comprises a pressure sensitive elastomeric adhesive.

5. The elastic laminate of claim 1 wherein the elastic member comprises an elastomeric scrim.

6. The elastic laminate of claim 1 wherein the elastic member comprises a polyolefin blended with an elastomeric polymer.

7. The elastic laminate of claim 1 wherein nonwoven web is a web selected from the group consisting of a bonded carded web of fibers, a web of spunbonded fibers, a web of meltblown fibers, and a multilayer material including at least one of said webs.

8. The elastic laminate of claim 7 wherein said fibers comprise a polymer selected from the group consisting of polyolefins, polyesters, and polyamides.

9. An elastic laminate comprising:

an incrementally stretched, elongatable, necked nonwoven web; and

an elastic member joined to the incrementally stretched, elongatable, necked nonwoven web, the nonwoven web and elastic member being joined while the elastic member is in a substantially untensioned condition.

10. The elastic laminate of claim 1 wherein the elastic member comprises an elastomeric film.

11. The elastic laminate of claim 10 wherein elastomeric film comprises a polymer selected from the group consisting of polyesters, polyurethanes and polyamides.

12. The elastic laminate of claim 9 wherein the elastic member comprises a pressure sensitive elastomeric adhesive.

13. The elastic laminate of claim 9 wherein the elastic member comprises an elastomeric scrim.

14. The elastic laminate of claim 9 wherein the elastic member comprises a polyolefin blended with an elastomeric polymer.

15. The elastic laminate of claim 9 wherein nonwoven web is a web selected from the group consisting of a bonded carded web of fibers, a web of spunbonded fibers, a web of meltblown fibers, and a multilayer material including at least one of said webs.

16. The elastic laminate of claim 15 wherein said fibers comprise a polymer selected from the group consisting of polyolefins, polyesters, and polyamides.

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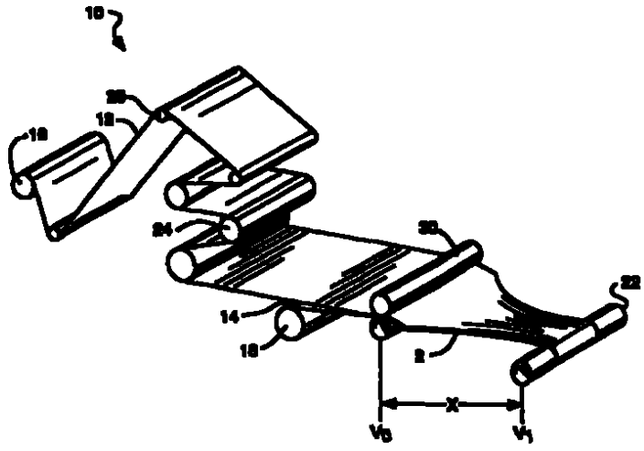

(57) Abstract

The present invention is directed to a necked laminate and a process for making the laminate. The necked laminate is formed from sheet layers of at least one non-elastic necktable material laminated to at least one non-elastic film defining a longitudinal and transverse dimension wherein the laminate is extensible and retractable in at least one dimension without significantly reducing the breathability and/or liquid barrier properties of the film layer. This laminate extensibility and retractability is the result of striated rugosities in, for instance, the longitudinal dimension of the film layer which enables the necked laminate to have an amount of extensibility and retractability in the transverse dimension. The laminate is made by first partially stretching the non-elastic film layer, attaching a non-elastic necktable layer to form a laminate and then stretching the laminate to neck the laminate and stretch the film to its desired fully stretched configuration.

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TRANSVERSELY EXTENSIBLE AND RETRACTABLE NECKED LAMINATE OF NON-ELASTIC SHEET LAYERS

Field of the Invention

The present invention is directed to a necked laminate and a process for making the laminate. The necked laminate is formed from sheet layers of at least one non-elastic neckable material laminated to at least one non-elastic film defining a longitudinal and transverse dimension wherein the laminate is extensible and retractable in at least one dimension without significantly reducing the breathability and/or liquid barrier properties of the film layer. This laminate extensibility and retractability is the result of striated rugosities in, for instance, the longitudinal dimension of the film layer which enables the necked laminate to have an amount of extensibility and retractability in the transverse dimension.

Background of the Invention

Laminates of film and nonwoven web layers are known to be useful in personal care absorbent articles such as diapers, training pants, incontinence garments, mattress pads, wipers, feminine care products (e.g. sanitary napkins), in medical applications such as surgical drapes and gowns, facemasks, and wound dressings and wraps, in articles of clothing or portions thereof including industrial workwear and lab coats, and the like.

These laminates are made such that the article can be produced with relatively low cost and are thus disposable after only one or a few uses. Much research and development continues, however, to achieve "cloth-like" visual and tactile qualities in these articles without sacrificing breathability and low cost, while also providing an article that is liquid-impermeable. In particular, one disadvantage of such articles is that the laminate used to make the article does not "give" like, for instance, a fabric made from cotton, which due to its fiber and yarn structure, has a natural ability to extend and retract. These properties are necessary to allow the article to conform to the user's body, thereby feeling and appearing to be more "cloth-like". One known solution to this problem has

been to incorporate elastomeric or elastic materials into the article. Unfortunately, incorporation of such materials generally results in increased costs due to the more expensive materials. If breathability is attained by stretching a filled film to form micropores, there are problems associated with maintaining breathability of filled elastic films since the recovery of the elastic material after stretching generally closes or partially closes the micropores which had been created for breathability.

Heretofore, to provide laminates with transverse extensibility and retractability, nonwoven web layers were necked (as defined below) prior to applying an elastomeric sheet made using an elastomeric polymer as described in, for instance, commonly assigned U.S. Patent No. 5,336,545 to Morman. Necking of the nonwoven web allowed it to extend in the transverse direction. Without the elastic sheet attached to the nonwoven web, however, the laminate would not have significant recovery force after the extension.

Prior art laminates made from non-elastic materials which were used as, for example, waistband components in articles such as diapers, have been made to be more conformable by first stretching an elastic waistband, then attaching the laminate to the stretched waistband such that when the waistband retracts, it draws in the laminate. A problem with this design is that the laminate is difficult to gather or bunch and the resulting product has minimal extensibility and retractability. Such bunched laminates are also very difficult to fabricate, have a cheap appearance and are uncomfortable when in contact with the body.

The present invention avoids these and other difficulties by providing an inexpensive, necked laminate which achieves transverse extensibility and retractability using non-elastic materials without compromising other properties such as breathability, liquid barrier properties and strength.

Summary of the Invention

The present invention is directed to a necked laminate and a process for making the laminate. The necked laminate is formed from sheet layers of at least one non-elastic

neckable material laminated to at least one non-elastic film defining a longitudinal and transverse dimension wherein the laminate is extensible and retractable in at least one dimension without significantly reducing the breathability and/or liquid barrier properties of the film layer. This laminate extensibility and retractability is the result of striated rugosities in, for instance, the longitudinal dimension of the film layer which enables the necked laminate to have an amount of extensibility and retractability in the transverse dimension. A breathable laminate may be made by first partially stretching the non-elastic film layer, attaching a non-elastic neckable layer to form a laminate and then stretching the laminate to neck the laminate and lengthen the film to its desired fully stretched configuration.

Brief Description of the Drawings

Figure 1 is a schematic representation of an exemplary process for forming the transversely extensible and retractable necked laminate of the present invention.

Figures 2 is a top plan view of the laminate of the present invention as it is being necked showing the striated rugosities in the longitudinal dimension.

Figure 3 is a perspective view of the process of Figure 1 showing the stretching of the non-elastic film layer, attachment of the non-elastic neckable material and the necking of the laminate.

Figure 4 is a partially cut-away top plan view of an exemplary personal care absorbent article, in this case a diaper, which may utilize the necked laminate according to the present invention.

Figure 5 is a plan view of an exemplary medical article, in this case a facemask, which may utilize the necked laminate according to the present invention.

Figure 6 is a top plan view of an optical photo micrograph (High Resolution Digital Image) of the non-elastic film layer side of a laminate of the present invention showing the striated rugosities.

Figure 6a is a top plan view of an optical photo micrograph of the enlarged section of Figure 6 showing the variation and randomness of the striated rugosities.

Figures 7, 8, and 9 are cross-sectional optical photo micrographs of the laminates of the present invention showing trapezoidal, pleated, and crenellated striations, respectively.

Figure 10 is an oblique view of an optical photo micrograph of a prior art laminate.

Figures 11a, 11b, 11c, 12a, 12b and 12c graphically illustrate load versus extension curves for various samples.

Figures 14-15 graphically illustrate enlarged curves of load versus extension for various samples.

Detailed Description of the Invention

The present invention is directed to a necked laminate and a process for making the laminate. The necked laminate is formed from sheet layers of at least one non-elastic neckable material laminated to at least one non-elastic film defining a longitudinal and transverse dimension, wherein the laminate is extensible and retractable in at least one dimension without significantly reducing the breathability and/or liquid barrier properties of the film layer. This laminate extensibility and retractability is the result of striated rugosities in, for instance, the longitudinal dimension of the film layer which enable the necked laminate to have an amount of extensibility and retractability in the transverse dimension. The necked laminate is made, for example, by first partially stretching the non-elastic film layer, attaching a non-elastic neckable layer to the film layer to form a laminate, and then stretching the laminate to neck the laminate and to complete the stretching/orientation of the film layer to its desired fully stretched configuration. When a laminate is "fully stretched" it exhibits properties completely sufficient for the intended use, for example, breathability and tensile strength. As used herein, the term "partially stretched" means that the film and/or laminate is not fully stretched.

As used herein, the term "neck" or "neck stretch" interchangeably means that the laminate is drawn such that it is extended under conditions reducing its width or its transverse dimension by drawing and elongating to increase the length of the fabric. The controlled drawing may take place under cool temperatures, room temperature or greater temperatures and is limited to an increase in overall dimension in the direction being drawn up to the elongation required to break the laminate, which in most cases is about 1.2 to 1.6 times. When relaxed, the laminate does not retract toward its original longitudinal dimension or extend to its original transverse dimension, but instead essentially maintains its necked dimension. The necking process typically involves unwinding a sheet from a supply roll and passing it through a brake nip roll assembly driven at a given linear speed. A take-up roll or nip, operating at a linear speed higher than the brake nip roll, draws the fabric and generates the tension needed to elongate and neck the fabric. U.S. Patent No. 4,965,122 issued to Morman, and commonly assigned to the assignee of the present invention, discloses a reversibly necked nonwoven material which may be formed by necking the material, then heating the necked material, followed by cooling and is incorporated herein by reference in its entirety. The heating of the necked material causes additional crystallization of the polymer giving it a partial heat set.

As used herein, the term "neckable material or layer" means any material which can be necked such as a nonwoven, woven, or knitted material. As used herein, the term "necked material" refers to any material which has been drawn in at least one dimension, (e.g. lengthwise), reducing the transverse dimension, (e.g. width), such that when the drawing force is removed, the material can be pulled back to its original width. The necked material has a higher basis weight per unit area than the un-necked material. When the necked material is pulled back to its original un-necked width, it should have about the same basis weight as the un-necked material. This differs from stretching/orienting the film layer, during which the film is thinned and the basis weight is reduced.

The term "laminate" as used herein means a combination made up of at least two sheet layers wherein at least one sheet layer is a film layer and at least one sheet layer is

a layer of neckable material. Also, the term "longitudinal direction" or "LD" means the length of a material in the direction in which the material is moving when it is produced. The "longitudinal dimension" therefore, is the dimension of the longitudinal direction. The term "transverse direction" or "TD" means the width of the material, i.e. a direction generally perpendicular to the longitudinal direction. Likewise, the "transverse dimension" therefore, is the dimension of the transverse direction.

Referring to Figure 1, there is schematically illustrated an exemplary process 10 for forming the transversely extensible and retractable necked laminate 2 of the present invention. For all of the figures, like reference numerals represent the same or equivalent structure or element. A non-elastic film layer 12 is unwound from a first supply roll 18 and fed into a stretching means 20 using guide rollers 26. Once in the stretching means 20, the non-elastic film layer 12 is partially stretched in a longitudinal direction by stretching rollers 24 which stretch and thin the film layer 12. Such stretching usually occurs with little or no necking of the film layer. If the distance between the rolls is too large, irreversible narrowing of the film layer can occur. After partially stretching the film layer 12 and prior to laminating to the neckable material 14, the tension of the film layer 12 is only that which is sufficient to keep the layer from sagging. In other words, it is not necessary to continue stretching film layer 12 between the stretching means 20 and laminating means 30. A non-elastic neckable material 14, likewise is unwound from second supply roll 18 which rotates in the direction of the arrows associated therewith. In an embodiment where partial film stretching is controlled to avoid film necking, matching the film width to the width of the neckable material is facilitated. It should be understood that the non-elastic neckable material and/or film layer may just as well be formed in-line rather than being pre-made and unwound. Adhesive sprayer 34 applies adhesive to the surface of the neckable material 14 which is then laminated to the film layer 12 using laminating means 30 (e.g. nip rolls). The laminate could also be formed by thermal point bonding, sonic welding, point bonding, or the like. The thus formed laminate 2 is then necked by a necking means 22 (e.g. take-up roll) which may be accomplished as shown in Figure 1

wherein the surface speed V_0 of laminating means 30 is less than the surface speed V_1 of necking means 22. As used herein, to say that the laminate has been drawn 1X means that surface speed V_0 is equal to surface speed V_1. The "necking draw", therefore, is the surface speed V_1 divided by surface speed V_0. Further, the distance x between laminating means 30 and necking means 22, must be sufficient to allow for necking of the laminate, such that the transverse dimension of the laminate is less than that of the un-necked laminate. As a general rule, the distance x should be at least two times the transverse dimension (width) of the laminate. Such necking provides striated rugosities in the film and/or laminate resulting in transverse extensibility and retractability to the necked laminate 2 and more "cloth-like" aesthetics (e.g. the necked laminate is softer than prior art laminates and looks more like a woven material because of the striated rugosities). Figure 3 is essentially the same as Figure 1 except that it is a perspective view showing the necking of the laminate.

It is known that stretching and orienting a filled film layer causes micropores to form in the film, but longitudinal striated rugosities do not typically form in the film layer when stretched. The film layer would instead become physically thinner and may narrow slightly. Further, to then attempt to elongate the oriented filled film layer in the TD could result in tearing when very little force is applied, which is likely due to tearing along the LD microslits which have formed from stretching and orienting the filled film layer. The polymer used to make the film, the amount of filler, and how much the film was totally drawn affects how much the film can be TD extended before it splits. By necking the laminate, the non-elastic neckable material, which is attached to the non-elastic film layer, will neck and bring the non-elastic film layer with it, thereby forming the longitudinal striated rugosities in the film which allow the film layer to extend and retract in the TD without adversely affecting the breathability and/or barrier properties of the film. In Figure 2, the striated rugosities 28 are shown figuratively in the longitudinal direction LD of laminate 2 which has been necked in the transverse direction TD. The un-necked transverse dimension 32 is the dimension the laminate would have but for the necking.

The double edged arrows indicate the extensibility and retractability of the laminate in the TD. As used herein, the term "striated rugosities", refers to thin, narrow grooved, or channeled wrinkles in the non-elastic film layer 12 of necked laminate . Referring to Figure 6, the striated rugosities can be shown generally at 28 in the surface of film layer 12' of sample 6 (in the Examples below). Figure 6a is an enlarged view of Figure 6. As can be seen in these figures, the striated rugosities have a variable and random pattern. Figures 7-9 are enlarged cross-sectional end views of the laminate 2 of Figure 6 at different points along the section showing the variable striations in film layer 12' which is attached to neckable material 14'. Figure 7 generally shows a trapezoidal striation 40; Figure 8 generally shows pleats 42; while Figure 9 generally shows crenellated striations 44. As used herein, the term "crenellated" is used as in crenellated molding which, according to Webster's Third New International Dictionary, unabridged, copyright 1986, is "a molding of ... [an] indented pattern common in medieval buildings". The striated rugosities actually occur predominantly in the non-elastic film layer, but can be seen through the necked material and give the entire laminate a more cloth-like appearance. If one were to delaminate the film layer from the neckable material after necking, the film layer would visually retain the striated rugosities while the neckable material would not. The separated film would extend and retract in the TD much like an accordion. A theory that may be ascribed to this phenomena is that the film actually crystallizes and/or plastically deforms to some degree when forming the striated rugosities, thereby setting a "memory" into the film which works to retract the laminate once it has been extended.

By the term "non-elastic", what is meant is that the sheet layers are made from polymers that are generally considered to be inelastic. In other words, use of such inelastic polymers to form the sheet layers would result in sheet layers which are not elastic. As used herein, the term "elastic" means any material which, upon application of a biasing force, is stretchable, that is, elongatable, at least about 60 percent (i.e., to a stretched, biased length which is at least about 160 percent of its relaxed unbiased length), and which will immediately recover at least 55 percent of its elongation upon

release of the stretching, elongating force. By "immediately" what is meant is that the elastic material will behave, for instance, as a rubber band to recover as soon as the elongating force is removed. A hypothetical example would be a one (1) inch sample of a material which is elongatable to at least 1.60 inches (4.06 cm) and which, upon being elongated to 1.60 inches (4.06 cm) and released, will immediately, i.e. within less than one second, recover to a length of not more than 1.27 inches (3.23 cm). Many elastic materials may be elongated by much more than 60 percent, for example, 100 percent or more, and many of these will recover to substantially their initial relaxed length, for example, to within 105 percent of their initial relaxed length upon release of the stretching force.

The terms "extensible and retractable" have been chosen to describe what the laminate made of non-elastic sheet layers of the present invention does upon application and removal of a biasing force. Those having skill in the art of elastic materials have conventionally used the phraseology "stretch and recover" to describe what an elastic material does upon application and removal of a biasing force as described above.

For purposes of the present invention, wherein the materials used to form the sheet layers are not elastic, the terminology chosen to describe the phenomena exhibited by the laminate upon application and removal of a biasing force is "extensible and retractable". The laminates of the present invention do not stretch as far as that of a highly elastic material, which can stretch in excess of 500%. In fact, the film portion of the laminate does not actually stretch; instead, the striated rugosities are essentially temporarily removed when a biasing force is applied in the transverse direction. If these striated rugosities are not permanently removed by, for instance, overextending the laminate in the transverse dimension or heating the extended laminate to impart a "new" memory, the laminate will eventually retract to close to its original dimension. Such a property has heretofore been unknown in laminates made solely from non-elastic neckable and film materials.

As used herein, the term "polymer" generally includes, but is not limited to, homopolymers, copolymers, for example, block, graft, random and alternating copolymers, terpolymers, etc. and blends and modifications thereof. Such blends include blends of inelastic polymers with elastic polymers as long as the elastic polymers are used in such a quantity and composition that the use of these would not render the polymeric film elastic. Unless otherwise specifically limited, the term "polymer" shall include all possible geometrical configurations of the molecule. These configurations include, but are not limited to, isotactic, syndiotactic and random symmetries.

The non-elastic film layer 12 can be made from either cast or blown film equipment, can be coextruded and can be embossed if so desired. The film layer may be made from any suitable non-elastic polymer composition.

Such polymers include but are not limited to non-elastic extrudable polymers such as polyolefin or a blend of polyolefins, nylon, polyester and ethylene vinyl alcohol. More particularly, useful polyolefins include polypropylene and polyethylene. Other useful polymers include those described in U.S. Patent No. 4,777,073 to Sheth, assigned to Exxon Chemical Patents Inc., such as a copolymer of polypropylene and low density polyethylene or linear low density polyethylene.

Other useful polymers include those referred to as single site catalyzed polymers such as "metallocene" polymers produced according to a metallocene process and which have limited elastic properties. The term "metallocene-catalyzed polymers" as used herein includes those polymer materials that are produced by the polymerization of at least ethylene using metallocenes or constrained geometry catalysts, a class of organometallic complexes, as catalysts. For example, a common metallocene is ferrocene, a complex of a metal between two cyclopentadienyl (Cp) ligands. Metallocene process catalysts include bis(n-butylcyclopentadienyl)titanium dichloride, bis(n-butylcyclopentadienyl)zirconium dichloride, bis(cyclopentadienyl)scandium chloride, bis(indenyl)zirconium dichloride, bis(methylcyclopentadienyl)titanium dichloride, bis(methylcyclopentadienyl)zirconium dichloride, cobaltocene, cyclopentadienyltitanium

trichloride, ferrocene, hafnocene dichloride, isopropyl(cyclopentadienyl,-1-flourenyl)zirconium dichloride, molybdocene dichloride, nickelocene, niobocene dichloride, ruthenocene, titanocene dichloride, zirconocene chloride hydride, zirconocene dichloride, among others. A more exhaustive list of such compounds is included in U.S. Patent 5,374,696 to Rosen et al. and assigned to the Dow Chemical Company. Such compounds are also discussed in U.S. Patent 5,064,802 to Stevens et al. and also assigned to Dow.

Such metallocene polymers are available from Exxon Chemical Company of Baytown, Texas under the trade name EXXPOL® for polypropylene based polymers and EXACT® for polyethylene based polymers. Dow Chemical Company of Midland, Michigan has polymers commercially available under the name ENGAGE®. Preferably, the metallocene polymers are selected from copolymers of ethylene and 1-butene, copolymers of ethylene and 1-hexene, copolymers of ethylene and 1-octene and combinations thereof. For a more detailed description of the metallocene polymers and the process for producing same which are useful in the present invention, see commonly assigned U.S. Patent application Serial Nos. 774,852 and 854,658 first filed on 27-December-1996 in the names of Gwaltney et al., which is incorporated herein by reference in its entirety. In general, the metallocene-derived ethylene-based polymers of the present invention have a density of at least 0.900 g/cc.

The non-elastic film layer may be a multi-layered film layer which may include a core layer, or "B" layer, and one or more skin layers, or "A" layers, on either side or both sides of the core layer. When more than one skin layer is present, is not a requirement that the skin layers be the same. For instance, there may be an A layer and an A' layer. Any of the polymers discussed above are suitable for use as a core layer of a multi-layered film. Any of the fillers disclosed herein are suitable for use in any film layer.

The skin layer will typically include extrudable thermoplastic polymers and/or additives which provide specialized properties to the non-elastic film layer. Thus, the skin layer may be made from polymers which provide such properties as antimicrobial, barrier, water vapor transmission, adhesion and/or antiblocking properties. The polymers are thus

chosen for the particular attributes desired. Examples of possible polymers that may be used alone or in combination include homopolymers, copolymers and blends of polyolefins as well as ethylene vinyl acetate (EVA), ethylene ethyl acrylate (EEA), ethylene acrylic acid (EAA), ethylene methyl acrylate (EMA), ethylene butyl acrylate (EBA), polyester (PET), nylon (PA), ethylene vinyl alcohol (EVOH), polystyrene (PS), polyurethane (PU), and olefinic thermoplastic elastomers which are multistep reactor products wherein an amorphous ethylene propylene random copolymer is molecularly dispersed in a predominately semicrystalline high polypropylene monomer/low ethylene monomer continuous matrix. The skin layer can be formed of any semicrystalline or amorphous polymer, including one that is elastic. However, the skin layer is generally a polyolefin such as polyethylene, polypropylene, polybutylene or a ethylene-propylene copolymer, but may also be wholly or partly polyamide such as nylon, polyester such as polyethylene terephthalate, polyvinylidene fluoride, polyacrylate such as poly(methyl methacrylate)(only in blends) and the like, and blends thereof.

The non-elastic film layers of the present invention can be made from breathable or non-breathable materials. The non-elastic film layer may contain such fillers as micropore developing fillers, e.g. calcium carbonate; opacifying agents, e.g. titanium dioxide; and antiblock additives, e.g. diatomaceous earth.

Fillers may be incorporated for developing micropores during orientation of the non-elastic film layer resulting in breathable films. Once the particle-filled film has been formed, it is then either stretched or crushed to create pathways through the film layer. Generally, to qualify as being "breathable" for the present invention, the resultant laminate should have a water vapor transmission rate (WVTR) of at least about 250 $g/m^2/24$ hours as may be measured by a test method as described below. Preferably, the laminate will have a WVTR of at least about 1000 $g/m^2/24$ hours.

As used herein, a "micropore developing filler" is meant to include particulates and other forms of materials which can be added to the polymer and which will not chemically interfere with or adversely affect the extruded film but are able to be uniformly

dispersed throughout the film layer. Generally, the micropore developing fillers will be in particulate form and usually will have somewhat of a spherical shape with average particle sizes in the range of about 0.5 to about 8 microns. The non-elastic film layer will usually contain at least about 20 volume percent, preferably about 20 to about 45 volume percent, of micropore developing filler based upon the total volume of the film layer. Both organic and inorganic micropore developing fillers are contemplated to be within the scope of the present invention provided that they do not interfere with the film formation process, the breathability of the resultant non-elastic film layer, the liquid barrier properties of the film layer or its ability to bond to another sheet layer.

Examples of micropore developing fillers include calcium carbonate ($CaCO_3$), various kinds of clay, silica (SiO_2), alumina, barium sulfate, sodium carbonate, talc, magnesium sulfate, titanium dioxide, zeolites, aluminum sulfate, cellulose-type powders, diatomaceous earth, magnesium sulfate, magnesium carbonate, barium carbonate, kaolin, mica, carbon, calcium oxide, magnesium oxide, aluminum hydroxide, pulp powder, wood powder, cellulose derivative, polymer particles, chitin and chitin derivatives. The micropore developing filler particles may optionally be coated with a fatty acid, such as stearic acid, or a larger chain fatty acid than starch such as behenic acid, which may facilitate the free flow of the particles (in bulk) and their ease of dispersion into the polymer matrix. Silica-containing fillers may also be present in an effective amount to provide antiblocking properties.

The non-elastic neckable material of the present invention is air-permeable. Such non-elastic neckable materials include nonwoven webs, woven materials and knitted materials. As used herein, the term "nonwoven fabric or web" means a web having a structure of individual fibers or threads which are interlaid, but not in an identifiable manner as in a knitted fabric. Nonwoven fabrics or webs have been formed from many processes, for example, bonded carded web processes, meltblowing processes and spunbonding processes. The basis weight of nonwoven fabrics is usually expressed in ounces of material per square yard (osy) or grams per square meter (gsm) and the fiber

diameters useful are usually expressed in microns. (Note that to convert from osy to gsm, multiply osy by 33.91). The non-elastic neckable material of the present invention has a basis weight of 5 to 90 gsm, preferably 10 to 90 gsm, more preferably 20 to 60 gsm.

The non-elastic neckable material is preferably formed from at least one member selected from fibers and filaments of inelastic polymers. Such polymers include polyesters, for example, polyethylene terephthalate, polyolefins, for example, polyethylene and polypropylene, polyamides, for example, nylon 6 and nylon 66. These fibers or filaments are used alone or in a mixture of two or more thereof.

Suitable fibers for forming the neckable material 14 include natural and synthetic fibers as well as bicomponent, multi-component, and shaped polymer fibers. A plurality of neckable materials may also be used according to the present invention. Examples of such materials can include, for example, spunbond/meltblown composites and spunbond/meltblown/spunbond composites such as are taught in Brock et al., U.S. Patent No. 4,041,203 which is incorporated herein by reference in its entirety. Neckable materials may also be formed from "coform" as described in commonly assigned U.S. Patent No. 4,100,324 to Anderson et al.

As used herein, the term "spunbonded fibers" refers to small diameter fibers which are formed by extruding through one or more extruders attached to one or more banks made up of at least transfer piping and spinplates to produce molten thermoplastic material as filaments from a plurality of fine, usually circular, capillaries in a spinneret with the diameter of the extruded filaments then being rapidly reduced as by, for example, in Appel et al., U.S. Patent No. 4,340,563; Matsuki, et al., U.S. Patent No. 3,802,817; Dorschner et al., U.S. Patent No. 3,692,618; Kinney, U.S. Patent Nos. 3,338,992 and 3,341,394; Hartman, U.S. Patent No. 3,502,763; and Dobo et al., U.S. Patent No. 3,542,615. Spunbond fibers are generally not tacky when they are deposited onto a collecting surface. Spunbond fibers are generally continuous and have average diameters (from a sample of at least 10) larger than 7 microns, more frequently, between about 10 and 40 microns. The resulting matt of fibers is then bonded to form a strong neckable

fabric. This bonding may be performed by ultrasonic bonding, chemical bonding, adhesive bonding, thermal bonding, needle punching, hydroentangling and the like.

As used herein the term "meltblown fibers" means fibers formed by extruding a molten thermoplastic material through a plurality of fine, usually circular, die capillaries as molten threads or filaments into converging high velocity, usually hot, gas (e.g. air) streams which attenuate the filaments of molten thermoplastic material to reduce their diameter, which may be to microfiber diameter. Thereafter, the meltblown fibers are carried by the high velocity gas stream and are deposited on a collecting surface to form a web of randomly dispersed meltblown fibers. Such a process is disclosed, for example, in U.S. Patent 3,849,241 to Butin et al. Meltblown fibers are microfibers which may be continuous or discontinuous, and are generally smaller than 20 microns in average diameter.

As used herein the term "microfibers" means small diameter fibers having an average diameter not greater than about 75 microns, for example, having an average diameter of from about 0.5 microns to about 50 microns, more particularly, about 2 microns to about 40 microns. Another frequently used expression of fiber diameter is denier, which is defined as grams per 9000 meters of a fiber and may be calculated as fiber diameter (in microns) squared, multiplied by the polymer density in grams/cc, multiplied by 0.00707. For the same polymer, a lower denier indicates a finer fiber and a higher denier indicates a thicker or heavier fiber. For example, the diameter of a polypropylene fiber given as 15 microns may be converted to denier by squaring, multiplying the result by 0.89 g/cc and multiplying by 0.00707. Thus, a 15 micron polypropylene fiber has a denier of about 1.42 (15^2 x 0.89 x 0.00707 = 1.415). Outside the United States the unit of measurement is more commonly the "tex", which is defined as the grams per kilometer of fiber. Tex may be calculated as denier/9.

Many polyolefins are available for fiber production according to the present invention, for example, fiber forming polypropylenes include Exxon Chemical Company's Escorene® PD 3445 polypropylene and Himont Chemical Company's PF-304.

Polyethylenes such as Dow Chemical's ASPUN® 6811A linear low density polyethylene, 2553 LLDPE and 25355 and 12350 high density polyethylene are also suitable polymers. The polyethylenes have melt flow rates of about 26, 40, 25 and 12, respectively. Many other polyolefins are commercially available.

The nonwoven web layer may be bonded to impart a discrete bond pattern with a prescribed bond surface area. This is known as thermal point bonding. "Thermal point bonding" involves passing a web of fibers to be bonded between a heated calender or patterned roll and an anvil roll. The calender roll is patterned so that the entire neckable material is not bonded across its entire surface. In fact, this feature is very important for necking of neckable materials as described herein. If too much bond area is present on the neckable material, it will break before it necks. If there is not enough bond area, then the neckable material will pull apart. Typically, the percent bonding area useful in the present invention ranges from around 5% to around 40% of the area of the neckable material. Many patterns for calender rolls have been developed. As will be understood by those skilled in the art, bond area percentages are, of necessity, described in approximations or ranges since bond pins are normally tapered and wear down over time. As those skilled in the art will also recognize, references to "pins/in.^{2}" and "bonds/in.^{2}" are somewhat interchangeable since the pins will create bonds in the substrate in essentially the same sizes and surface relationship as the pins on the roll. There are a number of discrete bond patterns which may be used. See, for example, Brock et al., U.S. Patent No. 4,041,203. One example of a pattern has points and is the Hansen Pennings or "H&P" pattern with about 200 bonds/square inch as taught in U.S. Patent 3,855,046 to Hansen and Pennings. The H&P pattern has square point or pin bonding areas wherein each pin may have a side dimension of 0.038 inches (0.965 mm), for example, resulting in a pattern having a bonded area of about 30%. Another typical point bonding pattern is the expanded Hansen and Pennings or "EHP" bond pattern which produces a bond area of about 15% to 18% which may have a square pin having a side dimension of 0.037 inches (0.94 mm), for example, and a pin density of about 100 pins/in^2. Another typical

point bonding pattern designated "714" has square pin bonding areas wherein each pin may have a side dimension of 0.023 inches, for example, for a bond area of 15% to 20% and about 270 pins/in^2. Other common patterns include a "Ramisch" diamond pattern with repeating diamonds having a bond area of 8% to 14% and 52 pins/in.^{2}, a HDD pattern, which comprises point bonds having about 460 pins/in.^{2} for a bond area of about 15% to about 23%, as well as a wire weave pattern looking as the name suggests, e.g. like a window screen and having a bond area of 15% to 20% and 302 bonds/in.^{2}. Another bond pattern for a spunbond facing web is a "S" weave pattern as described in commonly assigned U.S. Patent No. 5,964,742 to McCormack et al. which is incorporated herein by reference in its entirety.

Laminating the film layer to the neckable material to form the laminate of the present invention may occur by typical methods known in the art including adhesive bonding, point bonding, thermal point bonding, and sonic welding. The use of inelastic and/or elastic adhesives for the adhesive bonding is contemplated herein. As discussed in more detail below, the use of an elastic adhesive has not been found to impact ease of extensibility. When the film layer and neckable material are bonded through the use of heat and/or pressure, laminating means 30 (Figure 1) such as laminating rollers may be used. The laminating rollers may be heated and point bonding may be used. The temperature at which the laminating rollers are heated depends on the properties of the film and or neckable material but is usually in the range of 200 - 275°F (93 - 135°C). The laminating rollers may each be smooth or patterned or one roll may be smooth while the other roll is patterned. If one of the rolls is patterned it will create a discrete bond pattern with a prescribed bond surface area for the resultant necked laminate 2.

Also contemplated by the present invention is the attachment of a second neckable material, which may be simply unwound and laminated to the partially stretched film, the necked laminate, or the partially necked laminate as described above or formed directly in-line of the process. Such three layer laminates are particularly useful in medical and

industrial protective garment applications. Similarly, other film layers or partially stretched film layers may be combined.

As has been stated previously, the necked laminate 2 may be used in a wide variety of applications, including personal care absorbent articles or garments such as diapers, training pants, incontinence devices and feminine hygiene products such as sanitary napkins. The laminates resulting from the present invention are preferably more conformable to the body of the wearer resulting in better fit and comfort. An exemplary article 80, a diaper, is shown in Figure 4. Referring to Figure 4, most such personal care absorbent articles 80 include a liquid permeable top sheet or liner 82, a back sheet or outercover 84 and an absorbent core 86 disposed between and contained by the top sheet 82 and back sheet 84. Articles 80, such as diapers, may also include some type of fastening means 88 such as adhesive fastening tapes or mechanical hook and loop type fasteners to maintain the garment in place on the wearer.

The necked laminate 2 may be used to form various portions of the article including, but not limited to the back sheet 84. When using the necked laminate as back sheet 84, it is usually advantageous to place the nonwoven side facing out away from the wearer. In addition, in such embodiments it may be possible to utilize the nonwoven portion of the necked laminate as the loop portion of the hook and loop combination of fastening means 88.

As the necked laminate has TD extensibility and retractability, the elastic waistband 90 can be attached/incorporated in a non-stretched configuration during diaper production, significantly simplifying the converting process. The resulting waistband will also stretch, recover, and seal around the baby's waist much better. Necked laminates of the present invention are equally useful in articles used in medical applications. Referring to Figure 5, the necked laminate 2 has been utilized to form an exemplary article useful in medical applications, in this case a facemask 60.

Yet another exemplary article is a garment such as a lab coat or workwear. One particularly bothersome aspect of use of the prior art non-elastic laminate is the lack of

"give" as discussed above. This can be best understood in the context of bending a laminate-clad elbow. If the prior art laminate was used to create the garment, when the elbow bends, the material tightens around the elbow which may cause the material to tear or at the very least cause discomfort to the wearer. If the garment were to be made of a necked laminate of the present invention, however, the material will "give" when the elbow bends and afterwards tend to return to its prior form. The laminate would not recover with a strong force but very gently so comfort could be maintained.

One advantage of using necked laminate 2 in such applications is that the articles will be more "cloth-like" in both appearance and feel. Additionally, the transverse extensibility and retractability will allow the article to more closely conform to the body of the wearer.

The necked laminate of the present invention is able to maintain properties such as strength, hydrohead and breathability while getting improvements in "cloth-like" characteristics such as conformability and transverse extensibility and retractability. The advantages and other characteristics of the present invention are best illustrated by the following examples.

Examples

Samples of the present invention were prepared as described below. The samples were then subjected to the following tests:

Tensile Test: The tensile test measured strength and elongation or strain of a fabric when subjected to unidirectional stress according to ASTM Standard Test D 5034-95, as well as Federal Test Methods Standard No. 191A Method 5102-78. This test measured the strength in pounds and percent stretch while elongating the sample until it broke. Higher numbers indicate a stronger and/or more stretchable fabric, respectively. The term "peak load" means the maximum load or force, expressed in pounds, required to elongate a sample to break or rupture in a tensile test. The term "strain" or "percent stretch" means the increase in length of a sample during a tensile test expressed as a percentage. Values for peak load and strain at peak load were obtained using a width of

fabric of 3 x 6 in. (76 x 152 mm), a 3 in. (76 mm) clamp width, a gauge length of 3 in. (76 mm), and a constant rate of extension of 12 inches/min. (305 mm/min.), where the entire sample width was gripped in the clamps. The specimen was clamped, for example, in an 1130 Instron, available from the Instron Corporation, or a Thwing-Albert Model INTELLECT II available from the Thwing-Albert Instrument Co., 10960 Dutton Rd., Philadelphia, Pennsylvania 19154, and the unit was zeroed, balanced and calibrated according to the standard procedure.

Breathability Test: The water vapor transmission rate (WVTR) for the sample materials was calculated generally in accordance with the following test method in order to measure the breathability of the samples. The test procedure establishes a means to determine the normalized rate of water vapor transmission through solid and porous films, nonwoven materials, and other materials while under steady state conditions. The material to be evaluated is sealed to the top of a cup of water and placed in a temperature-controlled environment. Evaporation of water in the cup results in a relatively higher vapor pressure inside the cup than the vapor pressure of the environment outside of the cup. This difference in vapor pressure causes the vapor inside the cup to flow through the test material to the outside of the cup. The rate of this flow is dependent upon the permeability of the test material sealed to the top of the cup. The difference between the beginning and ending cup weights is used to calculate the water vapor transmission rate.

In particular, circular samples measuring three inches in diameter were cut from each of the test materials and a control which was a piece of CELGARD® 2500 film from Hoechst Celanese Corporation. CELGARD® 2500 film is a microporous polypropylene film. The test dish was a 68-1 Vapometer cup distributed by Thwing-Albert Instrument Company of Philadelphia, Pennsylvania. One hundred milliliters of water were poured into each Vapometer cup and individual samples of the test materials and control material were placed across the open tops of the individual cups. A rubber gasket and metal ring (fitted to the cup) were placed over the sample and clamped using metal clamps. The

sample test material and control material were exposed to room temperature over a 6.5 centimeter diameter circle, having an exposed area of approximately 33.17 square centimeters. The cups were placed in an oven at about 38 °C (100°F), long enough for the cups to reach thermal equilibrium. The cups were removed from the oven, weighed, and replaced in the oven. The oven was a constant temperature oven with external air circulating through it to prevent water vapor accumulation inside. A suitable forced air oven is, for example, a Blue M Power-O-Matic 60 oven distributed by Blue M. Electric Company of Blue Ispeak, Illinois. After 24 hours, the cups were removed from the oven and weighed again. The preliminary test water vapor transmission rate values were calculated with Equation (I) below:

(I) APP MVT = (grams weight loss over 24 hours) x 7571/24

expressed in $g/m^2/24$ hours

Approximate moisture vapor transfer is designated by "APP MVT". Under the predetermined set conditions of about 38 °C (100 °F) and ambient relative humidity, the WVTR for the CELGARD® 2500 control has been defined to be 5000 grams per square meter for 24 hours. Accordingly, the control sample was run with each test and the preliminary test values were corrected to set conditions using Equation (II) below:

(II) WVTR = (Test WVTR/control WVTR) x (5000 $g/m^2/24$ hours)

Hydrohead: A measure of the liquid barrier properties of a fabric is the hydrohead test. The hydrohead test determines the height of water (in centimeters) which the fabric will support before a predetermined amount of liquid passes through, usually 3 drops. A fabric with a higher hydrohead reading has a greater barrier to liquid penetration than a fabric with a lower hydrohead. The hydrohead test is performed according to Federal Test Standard 191A, Method 5514 using a Textest FX-3000 Hydrostatic Head Tester available from Marlo Industries, Inc., P.O. Box 1071, Concord, North Caroline. A circular head having an inner circumference of 26 cm was used to clamp down the sample.

% Theoretical Extensibility: The % Theoretical Extensibility is the amount of extensibility and retractability that can be expected for necked laminates of the present

invention, based upon how much the original width is reduced and assuming the original laminate has no inherent extensibility. In the following equations, original width is the un-necked width (transverse dimension) of the laminate, while necked width is the width of the laminate after necking. % Theoretical Extensibility can be determined as follows:

% Theoretical Extensibility = 100 X [(original width - necked width) ÷ necked width]

which can be rewritten as:

% Theoretical Extensibility = 100 X [(original width - necked width) - 1]

The % of the original width that the laminate is necked can be represented by the following equation:

% original width = 100 X (necked width ÷ original width)

which can be rewritten as:

(original width ÷ necked width) = 100 ÷ % original width

Substituting this equation into % Theoretical Extensibility above:

% Theoretical Extensibility = 100 X [(100 ÷ % original width) - 1]

So, for each sample below, the original width was measured, as was the necked width, and % Theoretical Extensibility was calculated as shown below in Table 3.

Permanent Set: The permanent set test measures the degree of retractability of a material after being stretched to a specific length. Generally, the greater the permanent set value, the less retractable the sample is. After the laminate was produced and wound onto a roll, indelible ink was used to mark a 2 in. (5.08 cm) wide strip of material in the transverse dimension. After the laminate was unwound, a sample area 3 in. (7.62 cm) (LD) x 4.5 in. (11.43 cm) (TD) was cut out of the laminate to include the marked-off area. Each sample was placed between two 3 in. (7.62 cm) wide jaws. The jaws were separated a distance of 2 in. (5.08 cm) apart and the jaws were clamped on the marks that were previously made on the material. The samples were then elongated a specified amount, 90% or 1.8 in. (4.57 cm), and allowed to retract. The elongation was recorded when the force during retraction reached 25 grams. The permanent set was calculated as follows:

Permanent set = distance between the jaws when the resistance of the laminate equaled 25 grams $_{force}$ - initial length = x (in.) - 2 (in.) = x (cm) - 5.08 (cm).

Three repetitions were performed and the average value is represented in the examples below.

Example 1

A necked laminate was prepared from a non-elastic film layer and a non-elastic nonwoven web layer. A 1.5 mil layer of blown film made of 48% by weight (25 volume percent) SUPERCOAT calcium carbonate as manufactured by English China Clay America, Inc. of Sylacauga, Alabama, 47% by weight (68 volume percent) linear low density polyethylene (LLDPE) available under the trade designation DOWLEX NG3347A as manufactured by the Dow Chemical Company ("Dow"), 5% by weight (7 volume percent) low density polyethylene (LDPE) available under the trade designation 640I as manufactured by Dow, and 2000 ppm antioxidant stabilizer available under the trade designation B900 as manufactured by Ciba Specialties Company of Tarrytown, New York. The film layer, made of the composition as described above, was pre-made and wound onto a roll. To make this film layer highly breathable, it should be stretched over about 4X (4 times its original length). The film layer was then unwound from a film unwind unit into a conventional machine direction orienter, such as that manufactured by the Marshall and Williams Company, where it was partially stretched as shown in Table 1 below (stretching draw) in the machine direction to form a partially stretched, breathable film layer. Likewise, a 0.4 osy basis weight standard polypropylene spunbond having a wireweave bond pattern, such as that available from the Kimberly-Clark Corporation of Dallas, Texas, was unwound and an adhesive of 3 gsm weight (at the application point) available as H2525A from Ato-Findley of Wauwatosa, WI was applied to one surface of the nonwoven web layer using an air assisted spraying device such as a meltblown device as described in Butin et al., supra. Such devices are generally described in, for example, commonly assigned U.S. Patent No. 4,949,668 to Heindel et al.; U.S. Patent No. 4,983,109 to Miller

et al., assigned to Nordson Corporation; and U.S. Patent No. 5,728,219 to Allen et al., assigned to J&M Laboratories, Inc.

The adhesive side of the nonwoven web layer was then laminated to the partially stretched film layer using laminating rollers at a pressure of 30 pli (5.4 kg/linear cm) of a smooth resilient (rubber coated) anvil roll on one side and a smooth, unheated steel roll.

The laminate was then stretched in the longitudinal dimension and necked in the transverse dimension by passing it through a stretch nip at a greater speed than the speed of the laminating rollers (see Table 1 below - the Laminate Necking Draw column). The necking draw caused contraction (necking) of the laminate in the transverse direction. The laminating rollers were spaced about 8 feet (2.4 m) from the stretch nip. "Total draw" in Table 1 is the necking draw multiplied by the stretching draw and was sufficient to insure enough orientation or stretching of the film layer to make it highly breathable. The thus formed transversely extensible and retractable necked laminate was then wound onto a roll. Samples were cut from the necked laminate and subjected to tests, the results of which are reported below in Table 1. Samples C1 and C2 are comparative (baseline) examples wherein the film layer was stretched as indicated, but the laminate was not necked. Figure 10 shows an oblique image of a prior art laminate of Sample C1, wherein the film layer 12 was fully stretched prior to lamination to the neckable material 14 to form the laminate, which was not subsequently necked. Sample 8 was a repeat of Sample 7. "Peak strain" is the strain at "peak load".

Table 1

Sample	Total Draw	Film Stretching Draw	Laminate Necking Draw	WVTR $g/m^2/24$ hr	Hydrohead mbar	LD Peak Strain %	LD Peak Load lb. (kg)	TD Peak Strain %	TD Peak Load lb. (kg)
C1	5.0X	5.0X	1.0X	2799	353	35.7	25.62 (11.62)	92.2	5.11 (2.32)
C2	3.6X	3.6X	1.0X	1759	265	66.4	23.36 (10.59)	100.8	6.16 (2.79)
3	3.9X	3.6X	1.1X	1004	316	65.6	26.33 (11.94)	100.0	6.15 (2.79)
4	4.3X	3.6X	1.2X	866	437	69.1	30.75 (13.95)	95.0	6.01 (2.73)
5	4.6X	3.6X	1.3X	1474	383	65.2	33.32 (15.11)	126.9	5.43 (2.46)
6	5.0X	3.6X	1.4X	1213	454	55.6	44.07 (19.99)	197.8	4.99 (2.26)
7	5.2X	3.6X	1.45X	-	383	48.8	35.01 (15.88)	144.3	5.46 (2.48)
8	5.2X	3.6X	1.45X	1140	387	56.0	40.20 (18.23)	141.2	4.70 (2.13)

Sample 6 had the highest TD peak strain. In this laminate, the film layer has been drawn a total of 5.0X, which is typical drawing for such articles. The laminate has additionally been necked by a 1.4X draw. The film layer of Sample C1 has also been drawn a total of 5.0X, but the laminate has not been necked at all. Even though the film layers have been drawn by the same amount, the example of the present invention, Sample 6, has a much greater TD peak strain than the comparative example, which is an indication of the improvement of the transverse extensibility and retractability of the present invention. Figures 11 and 12 graphically illustrate load versus extension curves for samples C1 and 6, while Figures 14-15 graphically illustrate enlarged curves of load versus extension curves for these samples.

Table 3 below represents necked width in inches (cm) as a function of percent stretch and shows how readily the necked laminates elongated in the transverse direction for each of the samples of Table 1. From the tensile strength test above, the force in pounds (kilograms) was recorded below in Table 2 for each sample at 30%, 60%, 90%, 120%, 150%, and 180% to break. The laminates which had been necked to a narrower width (Samples 5, 6, 8; Table #3 "Laminated Necked Width" column) elongated at a much less force at the same % elongation than the control and to a much greater extent before breaking. If the sample broke either on or before the percent step change, it has been designated as "- -".

Table 2

Sample	30%	60%	90%	120%	150%	180%
C1	2.51 (1.14)	4.21 (1.91)	5.05 (2.29)	--		
C2	3.16 (1.43)	5.05 (2.29)	6.02 (2.73)	--		
3	2.74 (1.24)	4.88 (2.21)	5.88 (2.67)	--		
4	2.78 (1.26)	4.89 (2.22)	5.92 (2.69)	--		
5	1.30 (0.59)	2.84 (1.29)	4.41 (2.00)	5.27 (2.39)	--	
6	0.60 (0.27)	1.28 (0.58)	2.13 (0.97)	3.22 (1.46)	4.09 (1.86)	4.73 (2.15)
7	1.51 (0.68)	2.78 (1.26)	4.18 (1.90)	5.06 (2.30)	5.38 (2.44)	--
8	1.21 (0.55)	2.33 (1.06)	3.42 (1.55)	3.89 (1.76)	4.47 (2.03)	--

Table 3 additionally shows the calculated % Theoretical Extensibility as described above for each of the samples of Table 1.

Table 3

Sample	Laminate Necked Width In. (cm)	% Original Width	% Theoretical Extensibility
C1	12 3/8 (31.43)	100	0
C2	12 ¼ (31.12)	99	1
3	11 ½ (29.21)	93	7.5
4	10 3/4 (27.31)	87	15
5	8 3/4 (22.23)	71	41
6	7 ½ (19.05)	61	65
8	6 3/8 (16.19)	51	94

The breathability was measured by WVTR for the necked laminate when it was in the TD extended configuration, since this is the configuration it would have when in use as for instance in a diaper. Three repetitions of Sample 6 were extended 100% and 166% and tested for WVTR. The results were as follows in Table 4.

Table 4

Sample 6	WVTR $g/m^2/24$ hr
Unstretched (from Table 1 above)	1213
100% extended	3960
166% extended	4250

To better describe the TD extensibility of the film layer, for Samples C1 and 6 above, the film layer was delaminated from the spunbond layer for a further test. Prior to delamination, a length of 3 inches (7.62 cm) was marked on the film side of the laminate across the TD. The delamination was conducted by completely immersing and soaking the laminate in denatured ethyl alcohol (ethanol) which softened and partially dissolved the adhesive bonding between the film layer and spunbond layer, such that the striated rugosities of the film layer were not removed, damaged, or otherwise distorted. Once delaminated, the film layer was tested in a tensile tester as described above and the force was measured when the film layer had been extended by 0.3 inches (0.762 cm) (10% strain). The force required to extend Sample C1 (the average of three repetitions) was approximately 1000 grams per mil of the film layer thickness. The force required to extend Sample 6 (the average of three repetitions), on the other hand, was approximately 60 grams per mil of the film layer thickness, which was the thickness determined with the striated rugosities flattened out.

Example 2

Additional laminates were prepared as described above, except that a non-elastic adhesive was used in some samples and that some samples were heated while being

necked. The modifications were made to evaluate the impact of: 1) using a non-elastic adhesive as compared with the semi-elastic adhesive used above, and 2) heating the laminate during the necking process. For each sample, the non-elastic film layer was stretched to 4X its length prior to lamination to the spunbond layer. The laminates were necked as indicated in Table 5 and tested for permanent set as described above. The non-elastic adhesive used was Rextac 2730, available from Huntsman Polymers in Odessa, TX. Further, the samples that were heated after necking were contacted with heated rolls maintained at a temperature of about 170°F (76°C).

A 10 cm x 10 cm (3.94 in. x 3.94 in.) sample was measured while the laminate was still wound on a roll. Since the materials were wound under tension and some degree of relaxation tends to occur over time, the samples were re-measured after being cut from the roll. Samples C9 and C10 are comparative (baseline) materials wherein the film was stretched but the laminate was not necked.

Table 5

Sample	Laminate Necking Draw	Actual Draw	Adhesive Type	Heat Applied	Sample Size Measured cm (in.)	Sample Size After Relaxation cm (in.)	Permanent Set cm (in.)
C9	1.1X	1.03X	Non-elastic	No	10 x 10 (3.94 x 3.94)	10 x 10 (3.94 x 3.94)	-
C10	1.1X	1.03X	Semi-elastic	No	10 x 10 (3.94 x 3.94)	10 x 10 (3.94 x 3.94)	-
11	1.43X	1.32X	Non-elastic	No	10 x 10 (3.94 x 3.94)	10 x 12.2 (3.94 x 4.80)	3.45 (1.36)
12	1.4X	1.28X	Semi-elastic	No	10 x 10 (3.94 x 3.94)	9.6 x 11.6 (3.78 x 4.57)	3.63 (1.43)
13	1.45X	1.3X	Semi-elastic	No	10 x 10 (3.94 x 3.94)	9.5 x 11.8 (3.74 x 4.65)	3.63 (1.43)
14	1.5X	1.36X	Semi-elastic	Yes	10 x 10 (3.94 x 3.94)	10 x 10.5 (3.94 x 4.13)	3.56 (1.40)
15	1.45X	1.3X	Non-elastic	Yes	10 x 10 (3.94 x 3.94)	10 x 10.3 (3.94 x 4.06)	3.66 (1.44)
16	1.45X	1.3X	Non-elastic	No	10 x 10 (3.94 x 3.94)	10 x 11.25 (3.94 x 4.43)	3.66 (1.44)

The heat set materials, Samples 14 and 15, maintained their original dimensions better than the materials that were necked and not heat set, based on a comparison between the sample size before and after cutting from the roll. Further, all of the materials, regardless of use of elastic or inelastic adhesive, exhibited a high degree of permanent set, indicating that the materials retract upon release of a biasing force applied in the transverse dimension. There was little difference between the permanent set of the laminates made with the semi-elastic adhesive and those made with the inelastic adhesive, indicating that the small amount of elastic adhesive used does not bear on the overall extensibility and retractability of the nonwoven web laminate.

The samples were additionally tested for tensile properties in the transverse dimension (TD) and WVTR according to the test methods described above. The results are summarized in Table 6.

Table 6

Sample	Actual Draw	Adhesive Type	Heat Applied	TD Load at 50% Elongation lb. (kg)	TD Peak Strain %	TD Peak Load lb. (kg)	Unstretched WVTR $g/m^2/24$ hr
C9	1.03X	Non-elastic	No	5.73 (2.60)	62.5	6.24 (2.83)	1667
C10	1.03X	Elastic	No	4.85 (2.20)	89.7	6.15 (2.79)	2121
11	1.32X	Non-elastic	No	0.0904 (0.041)	175	4.56 (2.07)	1272
12	1.28X	Elastic	No	0.375 (0.170)	201	4.72 (2.14)	1222
13	1.3X	Elastic	No	0.817 (0.280)	212	4.78 (2.17)	903
14	1.36X	Elastic	Yes	0.419 (0.190)	192	3.57 (1.62)	1482
15	1.3X	Non-elastic	Yes	0.375 (0.170)	174	3.37 (1.53)	1400
16	1.3X	Non-elastic	No	0.190 (0.086)	174	4.52 (2.05)	N/A

When the samples were elongated 50%, the control (un-necked) materials, Samples C9 and C10, exhibited a significantly higher load than the necked materials, Sample 11-16, indicating that a much greater force was needed to extend the control samples in the transverse dimension.

Having thus described the invention in detail, it should be apparent that various modifications can be made in the present invention without departing from the spirit and scope of the following claims.

We claim:

1. A necked laminate comprising:

   a) at least one layer of a non-elastic neckable material;

   b) at least one layer of a non-elastic film; and

   c) a means of attaching said non-elastic neckable material to said non-elastic film to form a laminate,

   wherein said laminate is necked in a first dimension and wherein said film layer has striated rugosities in a dimension perpendicular to said first dimension.

2. The necked laminate of claim 1, wherein a biasing force applied to said first dimension of said laminate will cause said laminate to extend, and release of the biasing force will cause said laminate to retract.

3. The necked laminate of claim 1, wherein said striated rugosities comprise trapezoidal, crenellated, or pleated striations.

4. The necked laminate of claim 1, wherein said means of attaching comprises point bonding, thermal point bonding, adhesive bonding, or sonic welding.

5. The necked laminate of claim 4, wherein said means of attaching is adhesive bonding.

6. The necked laminate of claim 1, wherein said first dimension is defined by a transverse dimension and said perpendicular dimension is defined by a longitudinal dimension.

7. The necked laminate of claim 1, wherein said laminate is breathable.

8. The necked laminate of claim 1, wherein said non-elastic neckable material has a basis weight of from about 0.3 osy (10 gsm) to about 2.7 osy (90 gsm).

9. The necked laminate of claim 1, wherein said neckable material or said non-elastic film comprises a polyolefin.

10. The necked laminate of claim 1 or 9, wherein said neckable material comprises a spunbond nonwoven material.

11. A conformable laminate for use in a garment comprising:

a) at least one layer of a non-elastic neckable material;

b) at least one layer of a non-elastic film; and

c) a means of attaching said non-elastic neckable material to said non-elastic film to form a laminate,

wherein said laminate is necked in a first dimension and wherein said film layer has striated rugosities in a dimension perpendicular to said first dimension, such that a biasing force applied to said first dimension of said laminate will cause said laminate to extend and conform around the body of the wearer.

12. The conformable laminate of claim 11, wherein said striated rugosities comprise trapezoidal, crenellated, or pleated striations.

13. The conformable laminate of claim 11, wherein said means of attaching comprises thermal point bonding, point bonding, adhesive bonding, or sonic welding.

14. The conformable laminate of claim 13, wherein said means of attaching is adhesive bonding.

15. The conformable laminate of claim 11, wherein said first dimension is defined by a transverse dimension and said perpendicular dimension is defined by a longitudinal dimension.

16. The conformable laminate of claim 11, wherein said non-elastic neckable material has a basis weight of from about 0.3 osy (10 gsm) to about 2.7 osy (90 gsm).

17. The conformable laminate of claim 11, wherein said laminate is breathable.

18. The conformable laminate of claim 11, wherein said laminate forms at least a portion of a personal care absorbent article.

19. The conformable laminate of claim 11, 17 or 18, wherein said laminate forms at least a portion of an outer cover for a personal care absorbent article.

20. The conformable laminate of claim 11, wherein said laminate forms at least a portion of a protective garment.

21. The conformable laminate of claim 11 or 20, wherein said laminate forms at least a portion of a facemask.

22. The necked laminate of claim 11, wherein said neckable material or said non-elastic film comprises a polyolefin.

23. The necked laminate of claim 11 or 22, wherein said neckable material comprises a spunbond nonwoven material.

24. A method for making a necked laminate comprising:

a) providing a non-elastic neckable material;

b) providing a non-elastic film layer;

c) attaching said non-elastic neckable material to said non-elastic film to form a laminate; and

d) stretching said laminate in a first dimension to neck said laminate in a dimension perpendicular to said first dimension,

such that said striated rugosities are formed in said non-elastic film layer in said perpendicular dimension.

25. The method of claim 24, further comprising partially stretching said non-elastic film layer prior to formation of the laminate to render said film layer in the laminate breathable.

26. The method of claim 25, wherein said non-elastic film layer contains from about 20% to about 45% by volume of filler.

27. The method of claim 25, wherein said laminate has a WVTR of at least about 1000 $g/m^2/24$ hours.

28. The method of claim 24, further comprising heating said laminate.

29. The method of claim 24, wherein said step of attaching comprises adhesive bonding, thermal point bonding, point bonding, or sonic welding.

30. The method of claim 29, wherein said step of attaching is adhesive bonding.

31. The necked laminate of claim 24, wherein said laminate is stretched to about 1.2 to about 1.6 times its original length.

32. A breathable, conformable laminate for use in a garment, comprising:

a) at least one layer of a non-elastic neckable spunbond material having a basis weight of from about 0.3 osy (10 gsm) to about 0.7 osy (24 gsm);

b) at least one layer of a non-elastic film containing from about 20% to about 45% by volume of filler; and

c) a means of attaching said non-elastic neckable spunbond material to said non-elastic film to form a laminate with a WVTR of at least about 1000 $g/m^2/24$ hr,

wherein said laminate is necked in a first dimension to about 30% to about 80% of its original width, and wherein said film layer has striated rugosities in a dimension perpendicular to said first dimension, such that a biasing force applied to said first dimension of said laminate will cause said laminate to extend and conform around the body of the wearer.

33. A conformable laminate for use in a garment, comprising:

a) at least one layer of a non-elastic neckable spunbond material having a basis weight of from about 0.3 osy (10 gsm) to about 0.7 osy (24 gsm);

b) at least one layer of a non-elastic film;

c) a means of attaching said non-elastic neckable spunbond material to said non-elastic film to form a laminate,

wherein said laminate is necked in a first dimension to about 30% to about 80% of its original width, and wherein said film layer has striated rugosities in a dimension perpendicular to said first dimension, such that a biasing force applied to said first

dimension of said laminate will cause said laminate to extend and conform around the body of the wearer.

34. An extensible and retractable sheet layer comprising a non-elastic film layer, wherein said non-elastic film has striated rugosities in a first dimension such that said film will extend in a dimension perpendicular to said first dimension when a biasing force is applied in said perpendicular dimension and will retract upon release of the biasing force.

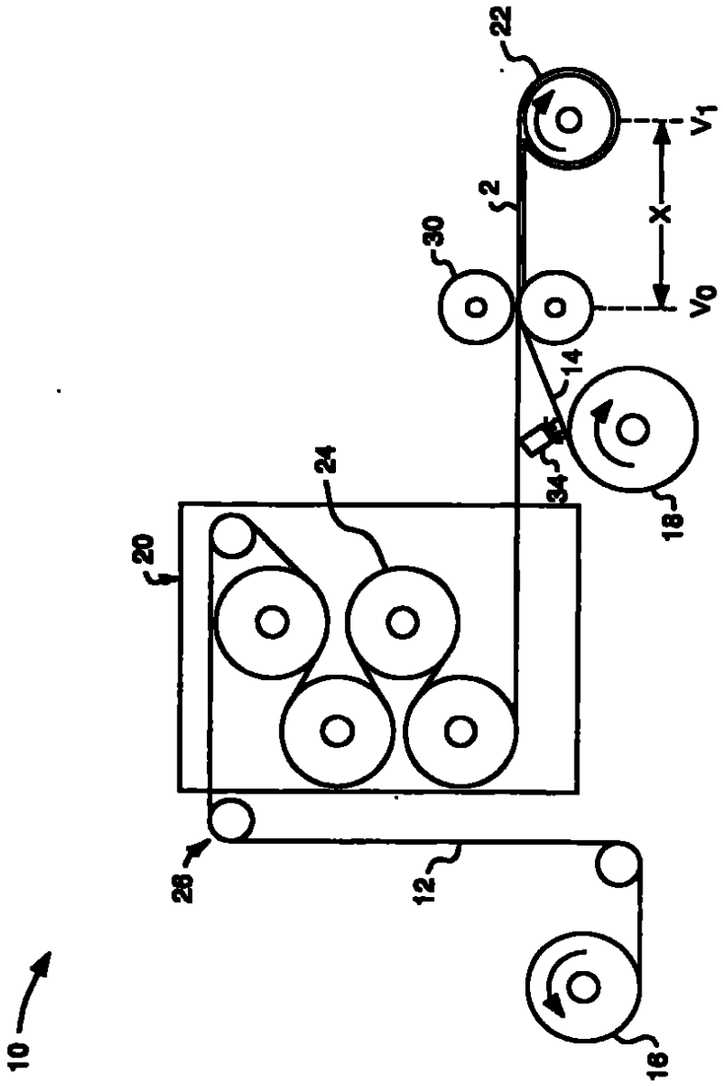


FIG. 1

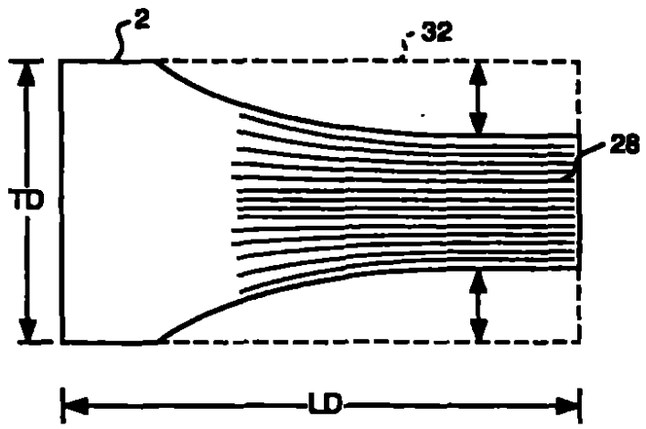


FIG. 2

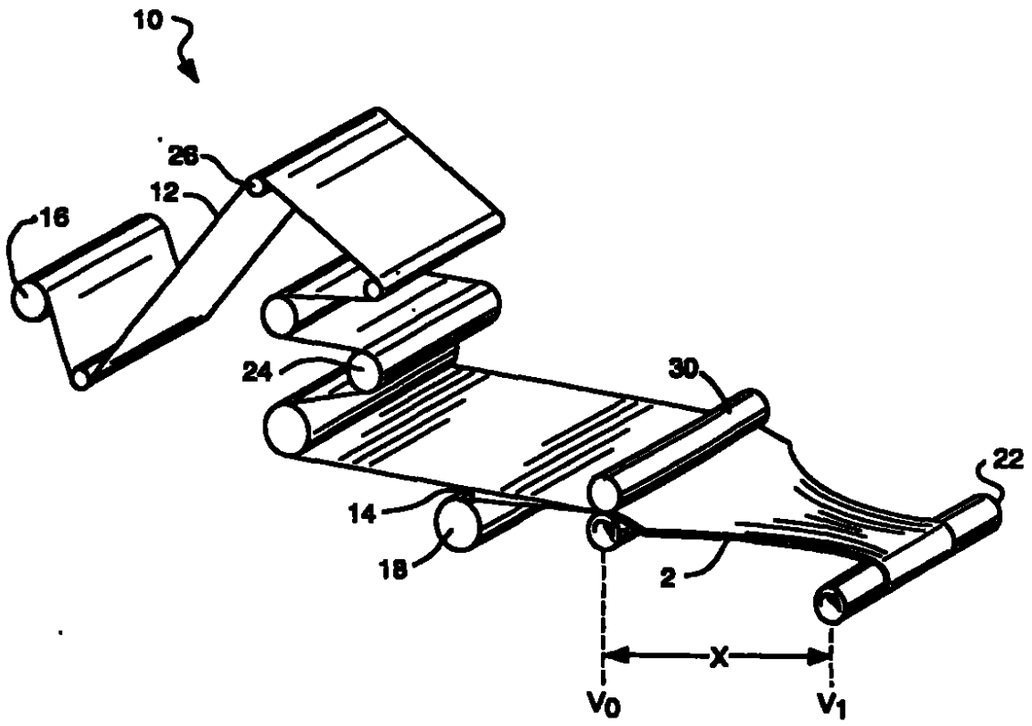


FIG. 3

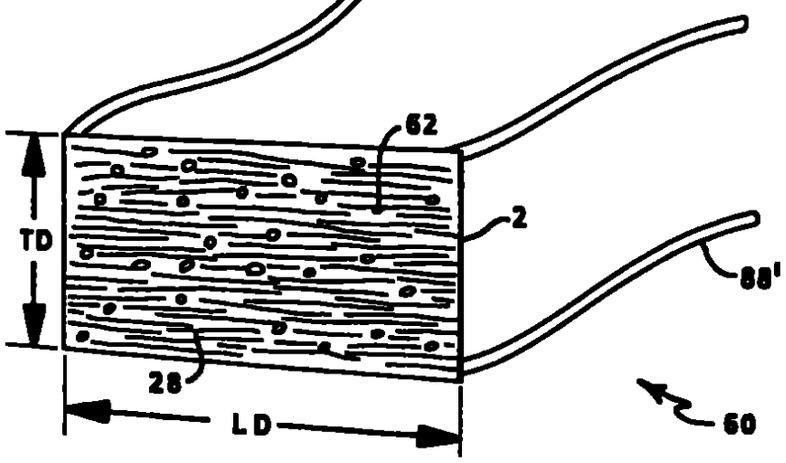


FIG. 5

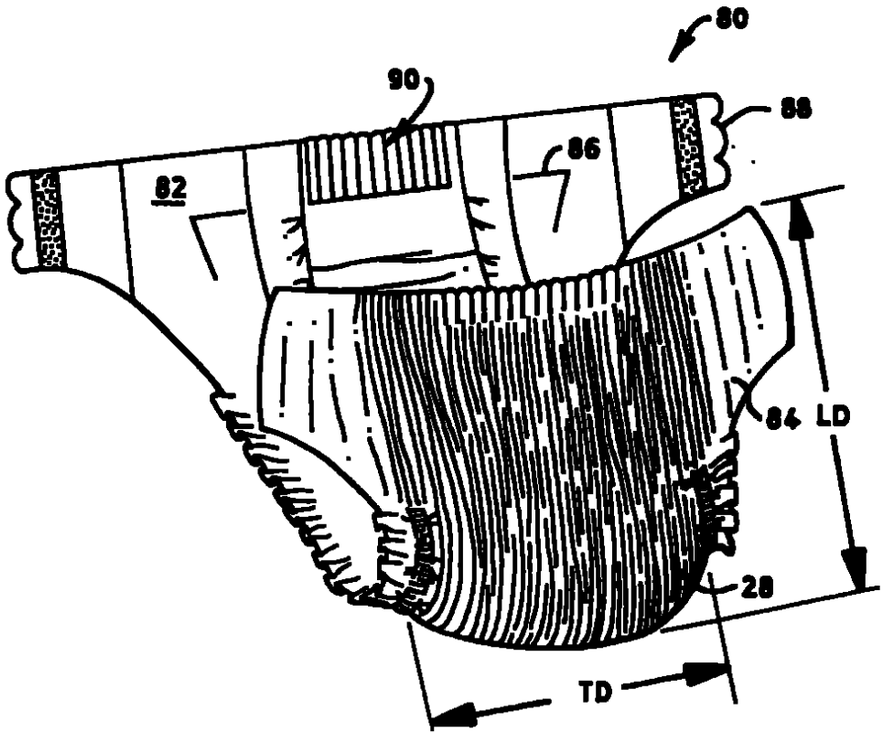


FIG. 4

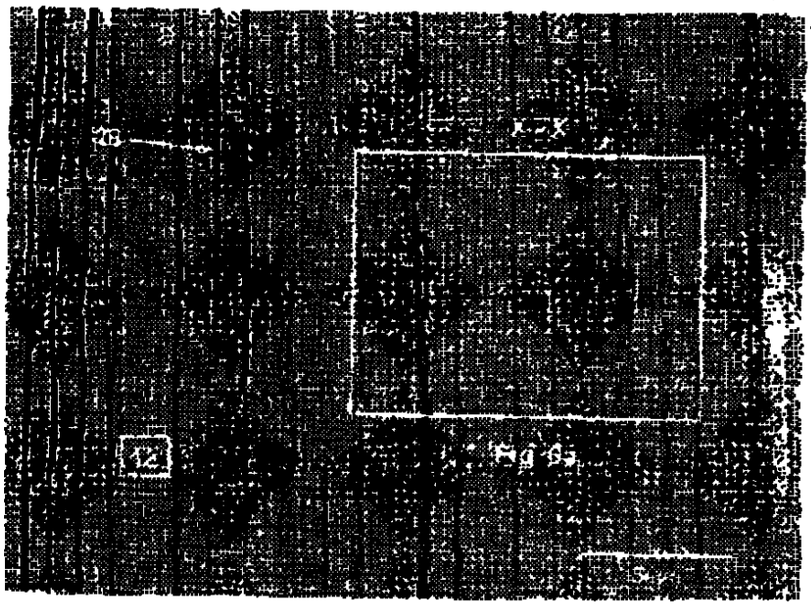


FIG. 6

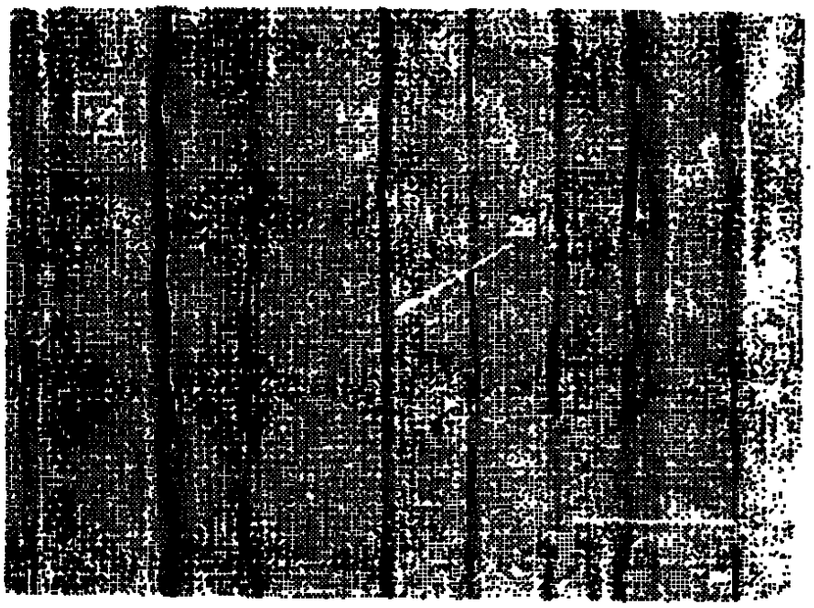


FIG. 6a

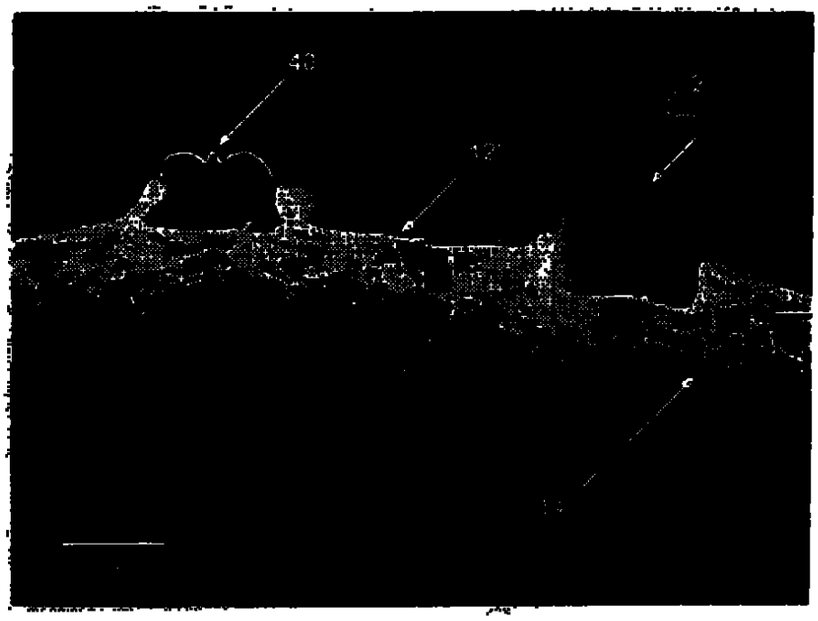


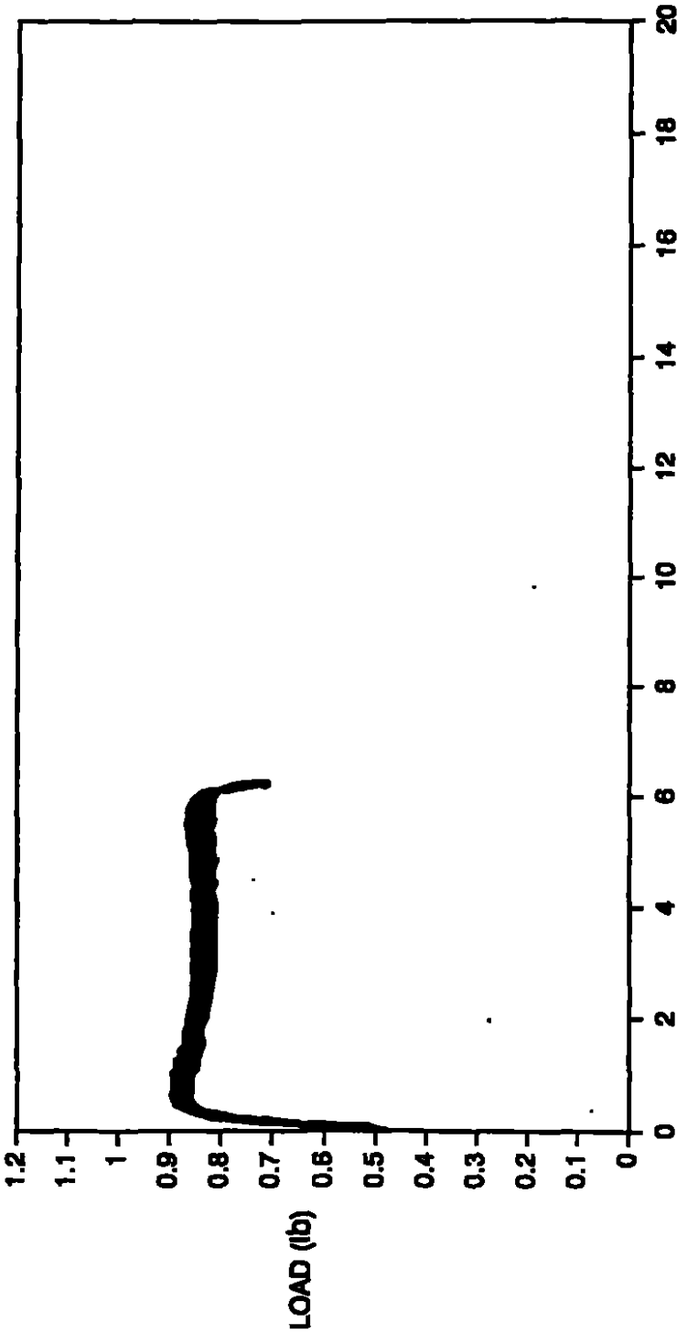
FIG. 7

FIG. 8

FIG. 9

FIG. 10

137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EXTENSION (in)

FIG. 11A

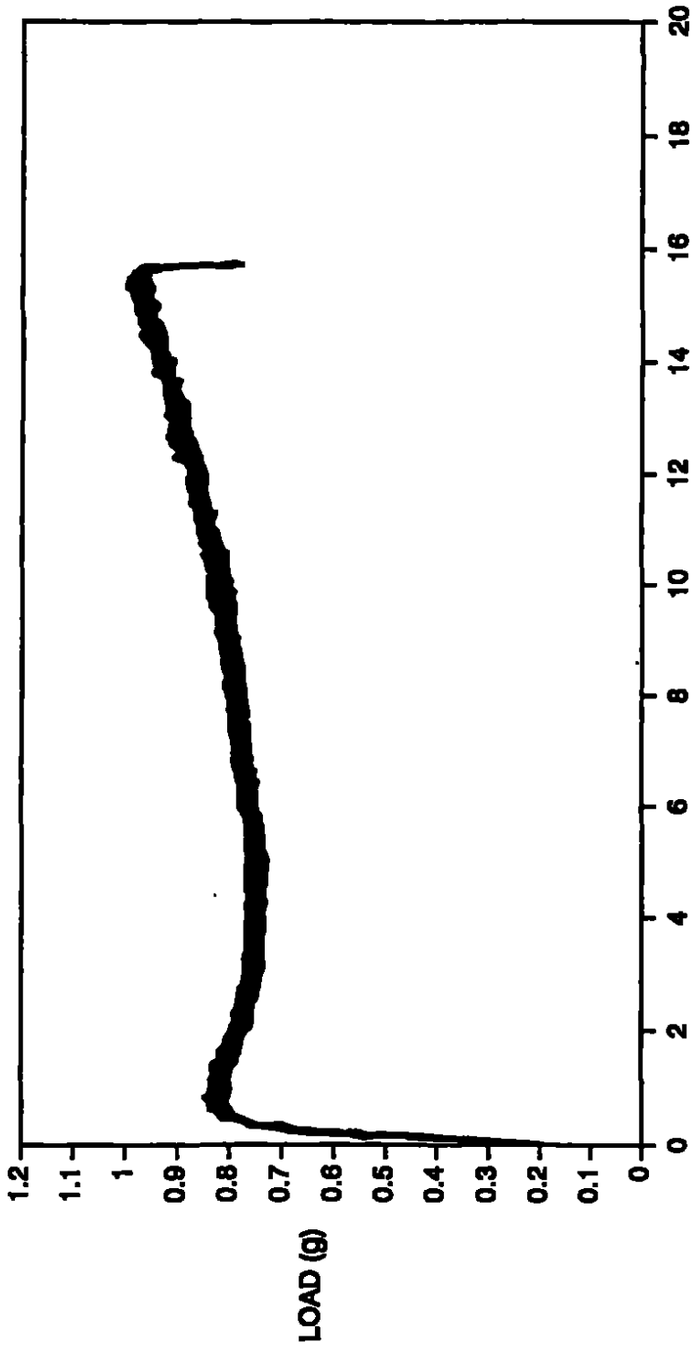
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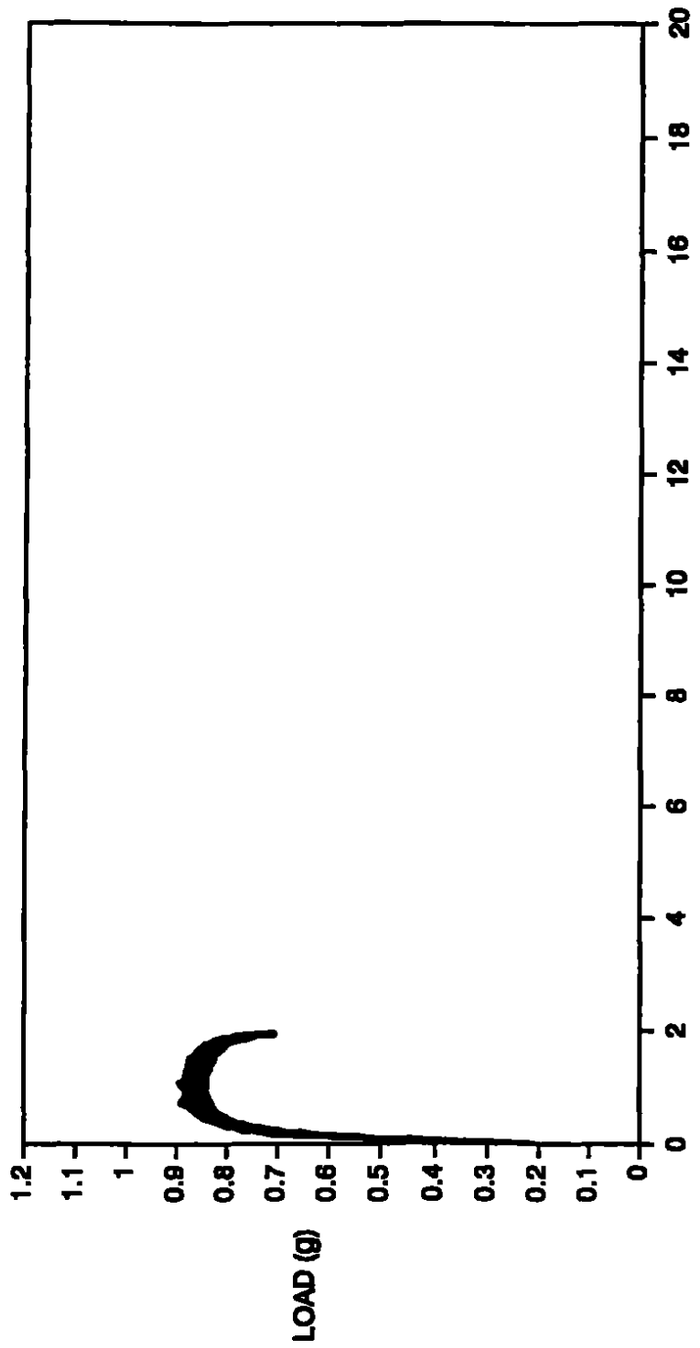
FIG. 11B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EXTENSION (in)

FIG. 11C

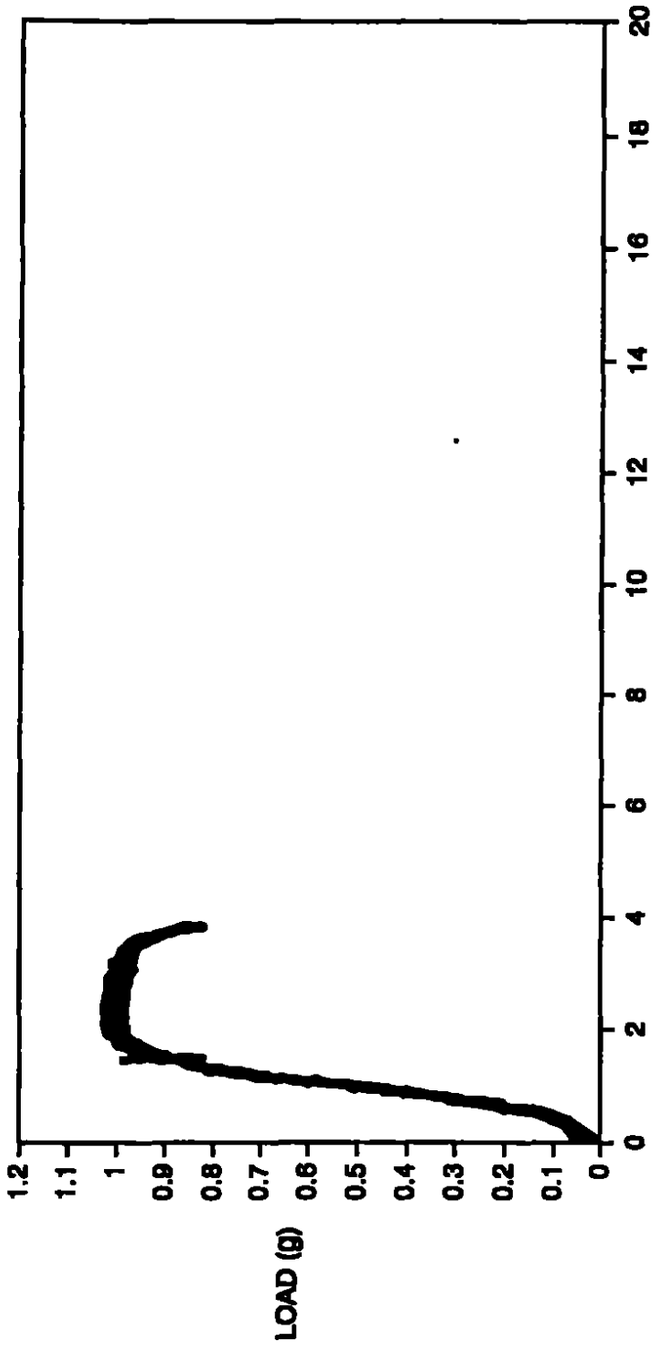
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FIG. 12A

139

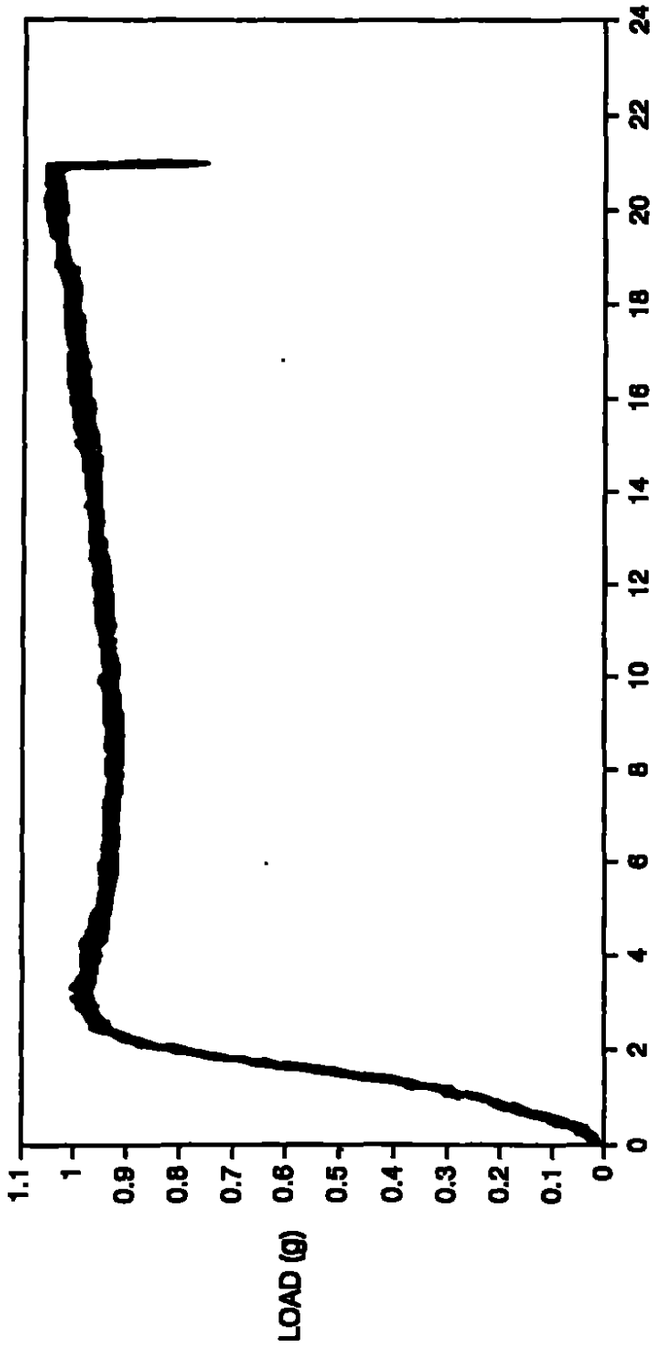
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FIG. 12B

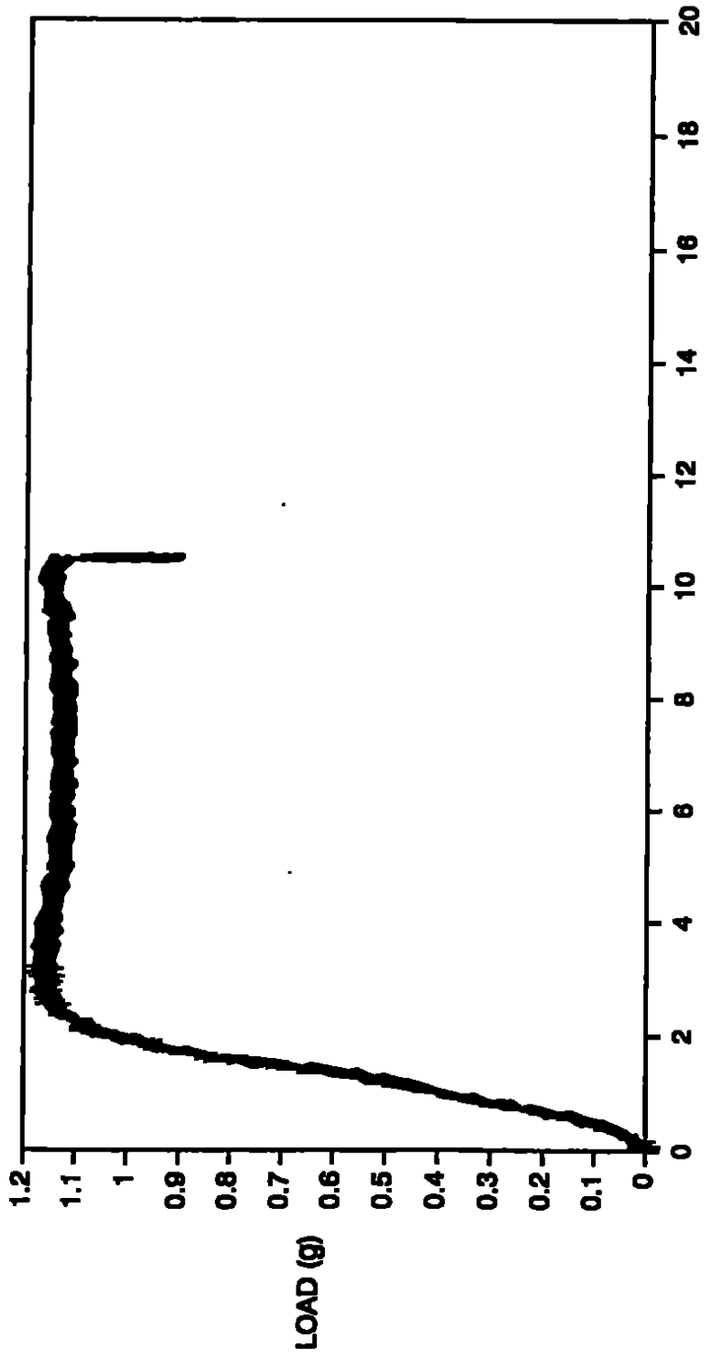
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FIG. 12C

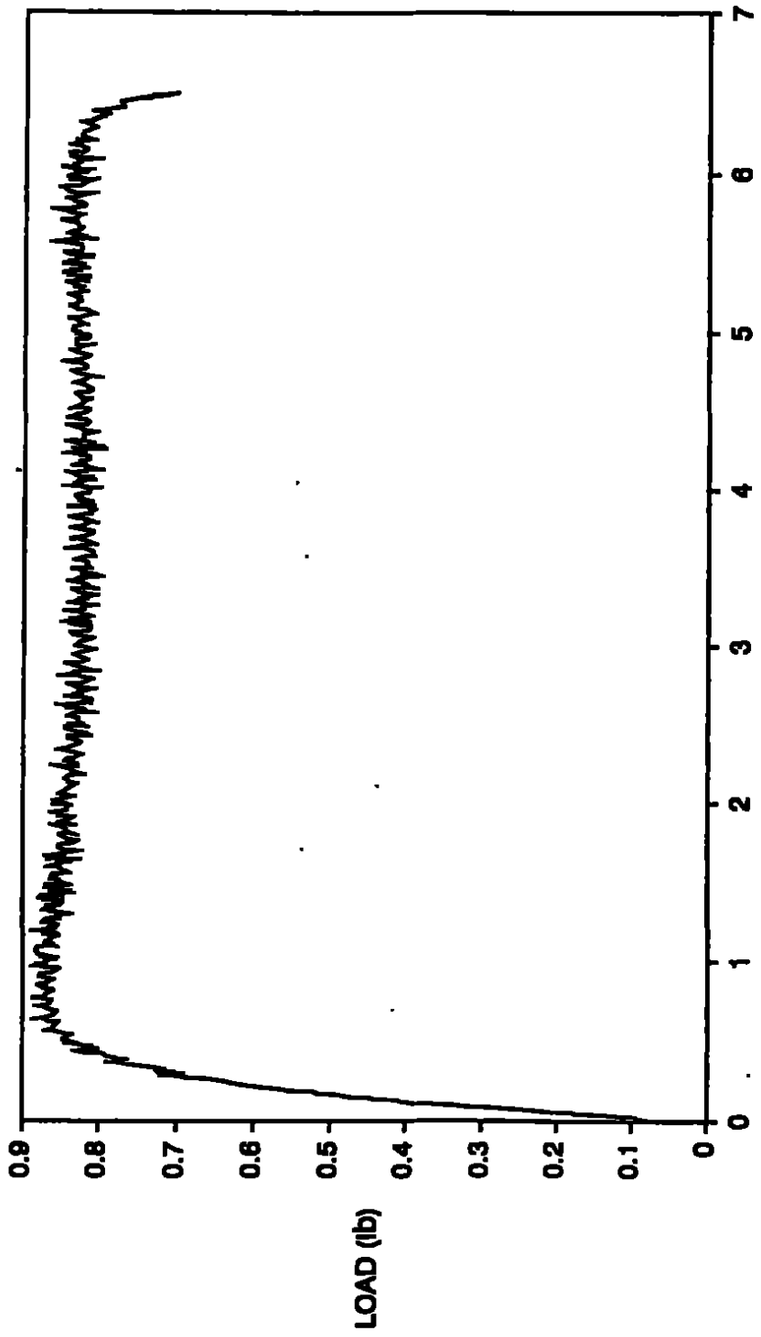

FIG. 14

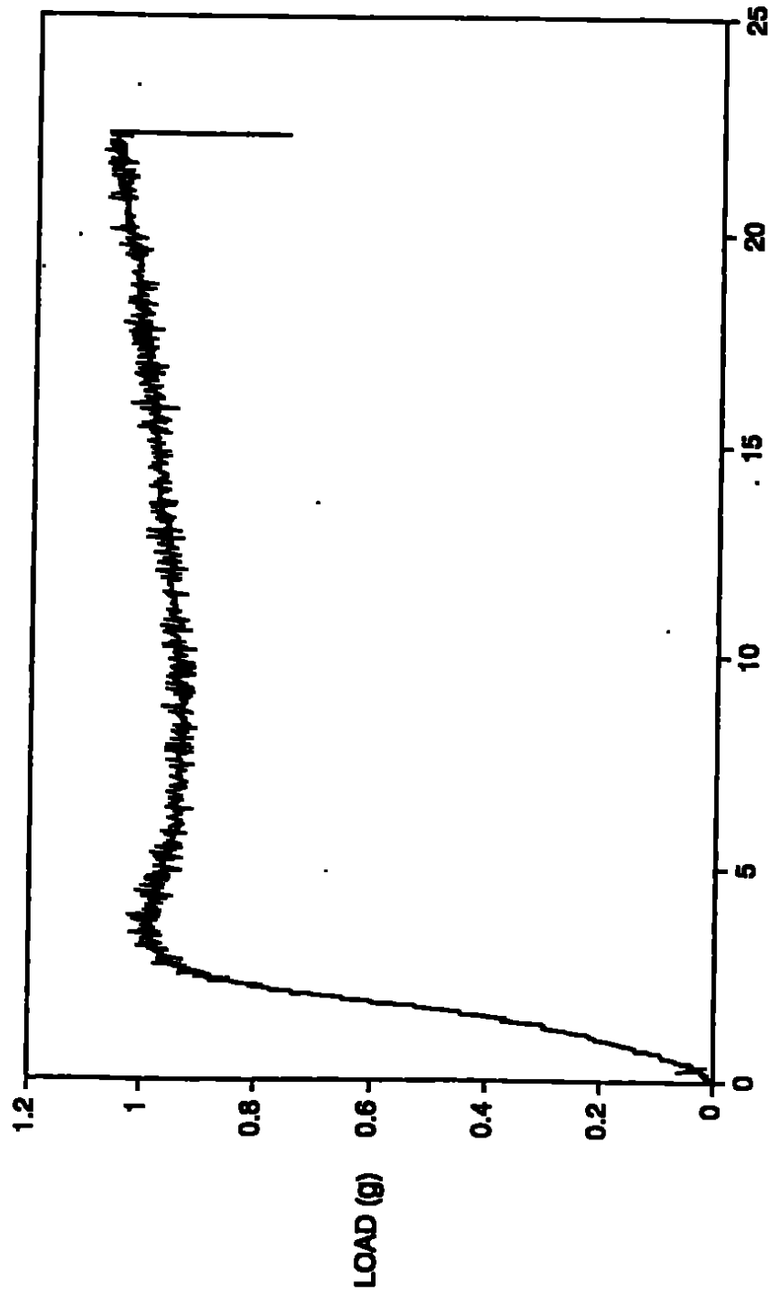

FIG. 15

141

INTERNATIONAL SEARCH REPORT

Intn. onal Application No
PCT/US 99/30729

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B32B5/04 B32B5/26 B29C55/02 B29C55/08 B32B3/30
B29C55/00 B29C55/18 A61F13/15 A41D13/00

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 B32B D04H B29C B29B A61F A41D

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)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 656 760 A (WISNESKI TONY J ET AL) 7 April 1987 (1987-04-07) column 6, line 55 -column 7, line 61; figure 2	34
A	WO 93 14928 A (RASMUSSEN O B ;JONES HELEN MARJORIE MEREDITH (GB)) 5 August 1993 (1993-08-05) claim 1	1,11,24, 32-34
A	WO 91 15365 A (MINNESOTA MINING & MFG) 17 October 1991 (1991-10-17) figure 3	1,11,24, 32-34
A	US 4 443 511 A (WORDEN DEXTER ET AL) 17 April 1984 (1984-04-17) figure 6A	1

-/—

[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
"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"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
9 May 2000	18/05/2000
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2

142

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144

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(57) Abstract

The present invention is directed to a composite material and a process for making the material. The composite material may be breathable and is formed from at least one layer of an elastic material and a necked laminate of sheet layers. The sheet layers include at least one non-elastic neckable material laminated to at least one non-elastic film defining a longitudinal and transverse dimension wherein the laminate is extensible and retractable in at least one dimension without significantly reducing the breathability and/or liquid barrier properties of the film layer. This laminate extensibility and retractability is the result of striated rugosities in, for instance, the longitudinal dimension of the film layer which enables the necked laminate to have an amount of extensibility and retractability in the transverse dimension. A breathable laminate may be made by first partially stretching a filled non-elastic film layer, attaching a non-elastic neckable layer to form a laminate and then stretching the laminate to neck the laminate and lengthen the film to its desired fully stretched configuration. Attachment of at least one layer of an elastic material to the necked laminate further provides stretch and recovery in at least one dimension.

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COMPOSITE MATERIAL HAVING STRETCH AND RECOVERY INCLUDING A LAYER OF AN ELASTIC MATERIAL AND A TRANSVERSELY EXTENSIBLE AND RETRACTABLE NECKED LAMINATE OF NON-ELASTIC SHEET LAYERS

Field of the Invention

The present invention is directed to a composite material and a process for making the composite material. The composite material may be breathable and is formed from at least one non-elastic film layer, at least one non-elastic neckable material, and at least one layer of an elastic material. Sheet layers of at least one non-elastic neckable material laminated to at least one non-elastic film are combined to form a necked laminate defining longitudinal and transverse dimensions wherein the necked laminate is extensible and retractable in at least one dimension without significantly reducing the breathability and/or liquid barrier properties of the film layer. The necked laminate extensibility and retractability is the result of striated rugosities in, for instance, the longitudinal dimension of the film layer which enables the necked laminate to have an amount of extensibility and retractability in the transverse dimension. Addition of at least one layer of an elastic material to the necked laminate to form a composite material provides stretch and recovery which was not present in the necked laminate while still maintaining breathability and barrier properties.

Background of the Invention

Composite materials of multiple sheet layers of, for instance, film and nonwoven web layers, are known to be useful in such articles as diapers, training pants, incontinence garments, mattress pads, wipers, feminine care products such as sanitary napkins, in medical applications such as surgical drapes, gowns and facemasks, articles of clothing or portions thereof including workwear and lab coats, and the like.

These composite materials are made such that the article can be produced with relatively low cost and are thus disposable after only one or a few uses. Much research and development continues, however, to achieve "cloth-like" visual and tactile qualities in these articles without sacrificing breathability and low cost, while also providing an article that is liquid-impermeable. In particular, one disadvantage of such articles is that the material used to make the article does not "give" like, for instance, a fabric made from cotton, which due to its fiber and yarn structure, has a natural ability to extend and retract.

These properties are necessary to allow the article to conform to the user's body, thereby feeling and appearing to be more "cloth-like". Even when the article "gives" it may quickly lose its shape if it does not exhibit stretch and recovery. One known solution to this problem has been to use an elastomeric or elastic material to form, for instance, the film layer of a film/nonwoven laminate. If breathability is attained by stretching a filled elastic film to form micropores, there are problems associated with maintaining breathability of filled elastic films since the recovery of the elastic material after stretching generally closes or partially closes the micropores which had been created for breathability.

Layers of a nonwoven web have been necked (as defined below) prior to applying an elastomeric sheet made using an elastomeric polymer as described in, for instance, commonly assigned U.S. Patent No. 5,336,545 to Morman. Necking of the nonwoven web allowed it to extend in the transverse direction, but it would not recover without attachment of the elastic sheet.

Prior art laminates made from non-elastic materials which were used as, for example, diaper outer cover would not stretch in all directions and still be breathable through a non-elastic microporous film. Further, the prior art laminates of non-elastic materials that have been used in waistband components in articles such as diapers, have been made to be more conformable by first stretching an elastic waistband, then attaching the laminate to the stretched waistband such that when the waistband retracts, it draws in the laminate. A problem with this design is that the laminate is difficult to gather or bunch and the resulting product has minimal extensibility and retractability. Such bunched laminates are also very difficult to fabricate, have a cheap appearance and are uncomfortable when in contact with the body.

The present invention avoids these and other difficulties by providing an inexpensive composite material of a non-elastic necked laminate and at one elastic material which achieves stretch and recovery without compromising other properties such as breathability, liquid barrier properties and strength.

Summary of the Invention

The present invention is directed to a composite material and a process for making the material. The composite material may be breathable and is formed from at least one layer of an elastic material and a necked laminate of sheet layers. The sheet layers include at least one non-elastic neckable material laminated to at least one non-elastic film defining a longitudinal and transverse dimension wherein the laminate is extensible and retractable in at least one dimension without significantly reducing the breathability

and/or liquid barrier properties of the film layer. This laminate extensibility and retractability is the result of striated rugosities in, for instance, the longitudinal dimension of the film layer which enables the necked laminate to have an amount of extensibility and retractability in the transverse dimension. A breathable laminate may be made by first partially stretching a filled non-elastic film layer, attaching a non-elastic neckable layer to form a laminate and then stretching the laminate to neck the laminate and lengthen the film to its desired fully stretched configuration. Attachment of at least one layer of an elastic material to the necked laminate further provides stretch and recovery in at least one dimension.

Brief Description of the Drawings

Figure 1 is a schematic representation of an exemplary process for forming the composite material of the present invention.

Figure 2 is a top plan view of the laminate that forms the composite material of the present invention as it is being necked showing the striated rugosities in the longitudinal dimension.

Figure 3 is a perspective view of the process of Figure 1 showing the stretching of the non-elastic film layer, attachment of the non-elastic neckable material, the necking of the laminate, and the attachment of the elastic material to form the composite material of the present invention.

Figure 4 is a partially cut-away top plan view of an exemplary personal care absorbent article, in this case a diaper, which may utilize the composite material according to the present invention.

Figure 5 is a plan view of an exemplary medical article, in this case a facemask, which may utilize the composite material according to the present invention.

Figure 6 is a top plan view of an optical photomicrograph (High Resolution Digital Image) of the non-elastic film layer side of the necked laminate that forms the composite material of the present invention showing the striated rugosities.

Figure 6a is a top plan view of an optical photomicrograph of the enlarged section of Figure 6 showing the variation and randomness of the striated rugosities.

Figures 7, 8, and 9 are cross-sectional optical photomicrographs of a laminate that forms the composite material of the present invention showing trapezoidal, pleated, and crenellated striations, respectively.

Figure 10 is an oblique view of an optical photomicrograph of a prior art laminate.

Figures 11a, b and c, and 12a, b and c graphically illustrate load versus extension curves for various samples.

Figure 13 is a schematic representation of an exemplary process for forming the composite material of the present invention having a stretched layer of elastomeric filaments.

Figures 14-15 graphically illustrate enlarged curves of load versus extension for various samples.

Figures 16-18 graphically illustrate results of cycling testing done on various samples.

Figure 19a and b depict sine wave and dot bonding patterns, respectively, used to join the necked laminate to the elastic material to form a composite material of the present invention.

Figure 20 is a top plan view of an image of the non-elastic neckable material side of the necked laminate which makes up the composite material of the present invention.

Figure 21 is the opposite side of Figure 20, showing the layer of elastomeric filaments which were stretched in the LD while being attached to the longitudinal dimension of the non-elastic film side of the necked laminate.

Figure 22 is a top plan view of an image of the non-elastic neckable material side of the necked laminate which makes up the composite material of the present invention, showing the layer of elastomeric filaments which were lengthwise attached to the TD of the non-elastic film side of the necked laminate.

Figure 23 is a cross-sectional optical photomicrograph of the composite material, in this case using an unstretched elastic meltblown nonwoven web to form the elastic material layer according to the present invention.

Figure 24 is a cross-sectional optical photomicrograph of the composite material, in this case using an unstretched elastic meltblown nonwoven web to form the elastic material layer according to the present invention.

Figure 25 is a cross-sectional optical photomicrograph of the composite material, in this case using an stretched elastic meltblown nonwoven web to form the elastic material layer according to the present invention.

Figures 26-28 graphically illustrate results of LD tensile testing load versus extension curves for various samples.

Figures 29-31 graphically illustrate results of TD tensile testing load versus extension curves for various samples.

147

Figures 32-34 graphically illustrate results of LD cycling testing done on various samples.

Figures 35-37 graphically illustrate results of TD cycling testing done on various samples.

Detailed Description of the Invention

The present invention is directed to a composite material which may be breathable and is formed from at least one non-elastic film layer, at least one non-elastic neckable material, and an elastic material. Sheet layers of at least one non-elastic neckable material laminated to at least one non-elastic film are combined to form a necked laminate, wherein the laminate defines longitudinal and transverse dimensions such that the laminate is extensible and retractable in at least one dimension without significantly reducing the breathability and/or liquid barrier properties of the film layer. This laminate extensibility and retractability is the result of striated rugosities in, for instance, the longitudinal dimension ("LD" as defined below) of the film layer which enable the necked laminate to have an amount of extensibility and retractability in the transverse dimension ("TD" as defined below). At least one layer of elastic material is attached to the necked laminate to form a composite material which is both stretchable and recoverable.

As contemplated herein, the elastic material may be present in the composite material in various forms. For instance, the elastic material may be in the form of an elastic non-neckable material, (such as a layer of an elastic meltblown nonwoven web), elastomeric filaments, (such as long, essentially continuous fibers as found in commonly assigned U.S. Patent No. 5,385,775 to Wright), and the like.

If the elastic material is present in the composite material of the present invention as a layer of elastomeric filaments, these filaments may or may not be stretched in the longitudinal direction before attaching it to a necked laminate having extensibility and retractability in the transverse direction. When the elastomeric filaments are longitudinally stretched and attached while being stretched to the necked laminate along the TD of the necked laminate, the composite material exhibits stretch and recovery in the LD and extensibility and retractability in the TD. Further, the layer of elastomeric filaments may be attached lengthwise in the transverse dimension of the necked laminate, thereby providing TD stretch and recovery.

If the elastic material is present as an unstretched elastic material, the resulting composite material will exhibit TD stretch and recovery. The TD stretch is, however, limited by the extensibility of the necked laminate, because the inelastic film portion of the

necked laminate does not actually stretch - instead the striated rugosities are essentially temporarily removed when a biasing force is applied in the transverse direction. If these striated rugosities are not permanently removed by, for instance, overextending the laminate in the transverse direction or heating the extended laminate to impart a "new" memory, then the laminate will tend to return to, or retract to, close to its original dimension.

If the elastic material is present as an elastic non-neckable material, it may be stretched and while being stretched, attached to the necked laminate to form a composite material which is both stretchable and recoverable in multiple directions. The elastic non-neckable material may, for instance, be stretched in the LD, and then attached to the necked laminate having extensibility and retractability in the TD. By addition of the longitudinally stretched elastic non-neckable material, LD stretch and recovery can be achieved which would complement the TD stretch and recovery found in the necked laminate and unstretched elastic non-neckable material. This composite material would not only stretch and recover in the LD and TD, but instead would have some stretch and recovery in all directions.

The necked laminate is made, for example, by first partially stretching the non-elastic film layer, attaching a non-elastic neckable layer to the film layer to form a laminate, and then stretching the laminate to neck the laminate and to complete the stretching/orientation of the film layer to its desired fully stretched configuration. A layer of elastomeric filaments may then be attached to the necked laminate to form the composite material. Alternatively, an elastic material may be stretched in the longitudinal direction and then attached to the necked laminate to form the composite material. As another alternative embodiment, an elastic material is attached, without first stretching, to the necked laminate to form the composite material. When a laminate is "fully stretched" it exhibits properties completely sufficient for the intended use, for example, breathability and tensile strength. As used herein, the term "partially stretched" means that the film and/or laminate is not fully stretched.

As used herein, the term "neck" or "neck stretch" interchangeably means that the laminate is drawn such that it is extended under conditions reducing its width or its transverse dimension by drawing and elongating to increase the length of the fabric. The controlled drawing may take place under cool temperatures, room temperature or greater temperatures and is limited to an increase in overall dimension in the direction being drawn up to the elongation required to break the laminate, which in many cases is about 1.2 to 1.6 times. When relaxed, the laminate does not retract toward its original longitudinal dimension

or extend to its original transverse dimension, but instead essentially maintains its necked dimension. The necking process typically involves unwinding a sheet from a supply roll and passing it through a brake nip roll assembly driven at a given linear speed. A take-up roll or nip, operating at a linear speed higher than the brake nip roll, draws the fabric and generates the tension needed to elongate and neck the fabric. U.S. Patent No. 4,965,122 issued to Morman, and commonly assigned to the assignee of the present invention, discloses a reversibly necked nonwoven material which may be formed by necking the material, then heating the necked material, followed by cooling and is incorporated herein by reference in its entirety. The heating of the necked material causes additional crystallization of the polymer giving it a partial heat set and some retraction.

As used herein, the term "neckable material or layer" means any material which can be necked such as a nonwoven, woven, or knitted material. As used herein, the term "necked material" refers to any material which has been drawn in at least one dimension, (e.g. lengthwise), reducing the opposite dimension, (e.g. width), such that when the drawing force is removed, the material can be pulled back to its original width. It should be understood that the term "neckable" describes the attribute of the material as being capable of being necked and does not require that the material actually be necked. The necked material has a higher basis weight per unit area than the un-necked material. When the necked material is pulled back to its original un-necked width, it should have about the same basis weight as the un-necked material. This differs from stretching/orienting the film layer, during which the film is thinned and the basis weight is reduced.

The term "laminate" as used herein means a combination made up of at least two sheet layers wherein at least one sheet layer is a non-elastic film layer and at least one sheet layer is a layer of non-elastic neckable material. Also, the term "longitudinal direction or LD" means the length of a material in the direction in which the material is moving when it is produced. The "longitudinal dimension" therefore, is the dimension of the longitudinal direction. The term "transverse direction or TD" means the width of the material, i.e. a direction generally perpendicular to the longitudinal direction. Likewise, the "transverse dimension" therefore, is the dimension of the transverse direction.

Referring to Figure 1, there is schematically illustrated an exemplary process 10 for forming a composite material 8 according to the present invention. For all of the figures, like reference numerals represent the same or equivalent structure or element. A non-elastic film layer 12 is unwound from a first supply roll 16 and fed into a stretching means 20 using guide rollers 26. Once in the stretching means 20, the non-elastic film layer 12 is partially stretched in a longitudinal direction by stretching rollers 24 which stretch and thin the film

layer 12. Such stretching usually occurs with little or no necking of the film layer. If the distance between the rolls is too large, irreversible narrowing of the film layer can occur. After partially stretching the film layer 12 and prior to laminating to the neckable material 14, the tension of the film layer 12 is only that which is sufficient to keep the layer from sagging or recovery. In other words, it is not necessary to continue stretching film layer 12 between the stretching means 20 and laminating means 30.

A non-elastic neckable material 14, likewise is unwound from second supply roll 18 which rotates in the direction of the arrows associated therewith. In an embodiment where partial film stretching is controlled to avoid film necking, matching the film width to the width of the neckable material is facilitated. It should be understood that the non-elastic neckable material and/or film layer may just as well be formed in-line rather than being pre-made and unwound.

Adhesive sprayer 34 applies adhesive to the surface of the neckable material 14 which is then laminated to the film layer 12 using laminating means 30 (e.g. nip rolls) to form the necked laminate. The laminate could also be formed by thermal point bonding, sonic welding, point bonding, or the like. The thus formed laminate 2 is then necked by a necking means 22 (e.g. take-up roll) which may be accomplished as shown in Figure 1 wherein the surface speed V_0 of laminating means 30 is less than the surface speed V_1 of necking means 22. As used herein, to say that the laminate has been drawn 1X means that surface speed V_0 is equal to surface speed V_1. The "necking draw", therefore, is the surface speed V_1 divided by surface speed V_0. Further, the distance x between laminating means 30 and necking means 22, must be sufficient to allow for necking of the laminate, such that the transverse dimension of the laminate is less than that of the un-necked laminate. As a general rule, the distance x should be at least two times the transverse dimension (width) of the laminate. Such necking provides striated rugosities in the film and/or laminate resulting in transverse extensibility and retractability to the necked laminate 2 and more "cloth-like" aesthetics (e.g. the necked laminate is softer than prior art laminates and looks more like a woven material because of the striated rugosities).

Additionally, an elastic material forming apparatus 48, such as an apparatus conventionally used to form an elastic meltblown nonwoven web, such as that found in commonly assigned U.S. Patent No. 4,663,220, to Wisneski et al., which is incorporated herein by reference in its entirety, is used to form the elastic material 50. The meltblown fibers are deposited onto the necked laminate 2 and may be sent through a pair of bonding rollers 52 and 52' to bond the layer of elastic material 50 to the necked laminate 2. Alternatively, a layer of long, essentially continuous elastomeric filaments 51 (which may be

seen in Figure 4), may be similarly attached to the necked laminate 2. As previously discussed, the elastic material may be attached in either a stretched or unstretched state, depending on the intended properties.

As shown in Figure 1, bonding rollers 52 and 52' rotate at speeds sufficient to perform the necking function as described above so that these have a dual function of bonding and necking in this illustration. Further, the composite material 8, is shown here as being wound onto the roll 52. Since the elastic material 50 may be sticky and therefore not easily unwound, the composite material 8 may just as easily be converted into an article in-line. Figure 3 is essentially the same as Figure 1 except that it is a perspective view and the upper bonding roller 52' has been removed since the bonding roller may not be necessary to bond the layer of elastic material 50 to necked laminate 2. In other words, the layer of elastic material 50 may be essentially melted onto the necked laminate 2.

Referring to Figure 13, an elastic material forming apparatus 48 in this case is used to form the substantially parallel rows of elastomeric filaments 51. The long, essentially continuous elastomeric filaments are deposited onto the forming wire 56. The layer of elastomeric filaments 51 is stretched while bonding to the necked laminate 2 by the same means as described above for the necking means. The surface speed V_0 of bonding rollers 52 is less than the surface speed V_1 of laminating means 30 such that the layer of elastomeric filaments 51 is being stretched while being laminated to necked material 2. The tension of the stretched elastomeric filaments 51 is, therefore, maintained while laminating to necked laminate 2. In this embodiment, the thus formed composite material 8 exhibits stretch and recovery in the LD and extensibility and retractability in the TD.

Now referring to Figure 20, a top plan view is shown of an image of the non-elastic neckable material 14' side of the necked laminate 2 which makes up the composite material 8 of the present invention. Striated rugosities can be seen in the LD at 28. Figure 21 is the opposite side of Figure 20, showing the layer of elastomeric filaments 51 which were stretched in the LD while being attached to the longitudinal dimension of the non-elastic film 12' side of the necked laminate 2. Figure 22 is a top plan view of an image of the non-elastic neckable material 14' side of the necked laminate 2 which makes up the composite material 8 of the present invention, showing the layer of elastomeric filaments 51 which were lengthwise attached to the TD of the non-elastic film 12' side of the necked laminate 2.

It is known that stretching and orienting a filled film layer causes micropores to form in the film, but longitudinal striated rugosities do not typically form in the film layer when stretched. The film layer would instead become physically thinner and may narrow slightly. Further, to then attempt to elongate the oriented filled film layer in the TD could

result in tearing when very little force is applied, which is likely due to tearing along the LD microslits which have formed from stretching and orienting the filled film layer. The polymer used to make the film, the amount of filler, and how much the film was totally drawn affects how much the film can be TD extended before it splits. By necking the laminate, the non-elastic neckable material, which is attached to the non-elastic film layer, will neck and bring the non-elastic film layer with it, thereby forming the longitudinal striated rugosities in the film which allow the film layer to extend and retract in the TD without adversely affecting the breathability and/or barrier properties of the film. In Figure 2, the striated rugosities 28 are shown figuratively in the longitudinal direction LD of laminate 2 which has been necked in the transverse direction TD. The un-necked transverse dimension 32 is the dimension the laminate would have but for the necking. The double edged arrows indicate the extensibility and retractability of the laminate in the TD. As used herein, the term "striated rugosities" refers to thin, narrow groved, or channeled wrinkles in the non-elastic film layer 12 of necked laminate 2. Referring to Figure 6, the striated rugosities can be shown generally at 28 in the surface of film layer 12' of sample 6 (in the Examples below). Figure 6a is an enlarged view of Figure 6. As can be seen in these figures, the striated rugosities have a variable and random pattern. Figures 7-9 are enlarged cross-sectional end views of the laminate 2 of Figure 6 at different points along the section showing the variable striations in film layer 12' which is attached to neckable material 14'. Figure 7 generally shows a trapezoidal striation 40; Figure 8 generally shows pleats 42; while Figure 9 generally shows crenellated striations 44. As used herein, the term "crenellated" is used as in crenellated molding which, according to Webster's Third New International Dictionary, unabridged, copyright 1986, is "a molding of...[an] indented pattern common in medieval buildings". The striated rugosities actually occur predominantly in the non-elastic film layer, but can be seen through the necked material and give the entire laminate a more cloth-like appearance. If one were to delaminate the film layer from the neckable material after necking, the film layer would visually retain the striated rugosities while the neckable material would not. The separated film would extend and retract in the TD much like an accordian. A theory that may be ascribed to this phenomena is that the film actually crystallizes and/or plastically deforms to some degree when forming the striated rugosities, thereby setting a "memory" into the film which works to retract the laminate once it has been extended.

By the term "non-elastic", what is meant is that the sheet layers are made from polymers that are generally considered to be inelastic. In other words, use of such inelastic polymers to form the sheet layers would result in sheet layers which are not

150

elastic. As used herein, the term "elastic" means any material which, upon application of a biasing force, is stretchable, that is, elongatable, at least about 60 percent (i.e., to a stretched, biased length which is at least about 160 percent of its relaxed unbiased length), and which will immediately recover at least 55 percent of its elongation upon release of the stretching, elongating force. By "immediately" what is meant is that the elastic material will behave, for instance, as a rubber band to recover as soon as the elongating force is removed. A hypothetical example would be a one (1) inch sample of a material which is elongatable to at least 1.60 inches (4.06 cm) and which upon being elongated to 1.60 inches (4.06 cm) and released, will immediately, i.e. within less than one second, recover to a length of not more than 1.27 inches (3.23 cm). Many elastic materials may be elongated by much more than 60 percent, for example, 100 percent or more, and many of these will recover to substantially their initial relaxed length, for example, to within 105 percent of their initial relaxed length upon release of the stretching force.

The terms "extensible and retractable" have been chosen to describe what the laminate made of non-elastic sheet layers of the present invention does upon application and removal of a biasing force. For the novel necked laminates described herein, the materials used to form the sheet layers are not elastic and so the terminology chosen to describe the phenomena exhibited by the laminate upon application and removal of a biasing force is "extensible and retractable". Those having skill in the art of elastic materials have conventionally used the phraseology "stretch and recover" to describe what an elastic material does upon application and removal of a biasing force as described above. As used herein, the terms "recover" and "recovery" refer to the immediate contraction of the stretched elastic material upon termination of the biasing force following stretching of the material by application of the biasing force.

As used herein, the term "polymer" generally includes, but is not limited to, homopolymers, copolymers, for example, block, graft, random and alternating copolymers, terpolymers, etc. and blends and modifications thereof. Such blends include blends of inelastic polymers with elastic polymers as long as the elastic polymers are used in such a quantity and composition that the use of these would not render the polymer elastic. Unless otherwise specifically limited, the term "polymer" shall include all possible geometrical configurations of the molecule. These configurations include, but are not limited to, isotactic, syndiotactic and random symmetries.

The non-elastic film layer 12 can be made from either cast or blown film equipment, can be coextruded and can be embossed if so desired. The film layer may be made from any suitable non-elastic polymer composition.

Such polymers include but are not limited to non-elastic extrudable polymers such as polyolefin or a blend of polyolefins, nylon, polyester, and ethylene vinyl alcohol. More particularly, useful polyolefins include polypropylene and polyethylene. Other useful polymers include those described in U.S. Patent No. 4,777,073 to Sheth, assigned to Exxon Chemical Patents Inc., such as a copolymer of polypropylene and low density polyethylene or linear low density polyethylene.

Other useful polymers include those referred to as single site catalyzed polymers such as "metallocene" polymers produced according to a metallocene process and which have limited elastic properties. The term "metallocene-catalyzed polymers" as used herein includes those polymer materials that are produced by the polymerization of at least ethylene using metallocenes or constrained geometry catalysts, a class of organometallic complexes, as catalysts. For example, a common metallocene is ferrocene, a complex metal between two cyclopentadienyl (Cp) ligands. Metallocene process catalysts include bis(n-butylcyclopentadienyl)titanium dichloride, bis(n-butylcyclopentadienyl)zirconium dichloride, bis(cyclopentadienyl)scandium chloride, bis(indenyl)zirconium dichloride, bis(methylcyclopentadienyl)titanium dichloride, bis(methylcyclopentadienyl)zirconium dichloride, cobaltocene, cyclopentadienyltitanium trichloride, ferrocene, hafnocene dichloride, isopropyl(cyclopentadienyl,-1-flourenyl)zirconium dichloride, molybdocene dichloride, nickelocene, niobocene dichloride, ruthenocene, titanocene dichloride, zirconocene chloride hydride, zirconocene dichloride, among others. A more exhaustive list of such compounds is included in U.S. Patent 5,374,696 to Rosen et al. and assigned to the Dow Chemical Company. Such compounds are also discussed in U.S. Patent 5,064,802 to Stevens et al. and also assigned to Dow.

Such metallocene polymers are available from Exxon Chemical Company of Baytown, Texas under the trade name EXXPOL® for polypropylene based polymers and EXACT® for polyethylene based polymers. Dow Chemical Company of Midland, Michigan has polymers commercially available under the name ENGAGE®. Preferably, the metallocene polymers are selected from copolymers of ethylene and 1-butene, copolymers of ethylene and 1-hexene, copolymers of ethylene and 1-octene and combinations thereof. For a more detailed description of the metallocene polymers and the process for producing same which are useful in the present invention, see commonly assigned U.S. Patent application Serial Nos. 774,852 and 854,658 first filed on 27-December-1996 in the names of Gwaltney et al., each of which is incorporated herein by reference in its entirety. In general, the metallocene-derived ethylene-based polymers of the present invention have a density of at least 0.900 g/cc.

The non-elastic film layer may be a multi-layered film layer which may include a core layer, or "B" layer, and one or more skin layers, or "A" layers, on either side or both sides of the core layer. When more than one skin layer is present, is not a requirement that the skin layers be the same. For instance, there may be an A layer and an A' layer. Any of the polymers discussed above are suitable for use as a core layer of a multi-layered film. Any of the fillers disclosed herein are suitable for use in any film layer.

The skin layer will typically include extrudable thermoplastic polymers and/or additives which provide specialized properties to the non-elastic film layer. Thus, the skin layer may be made from polymers which provide such properties as antimicrobial, barrier, water vapor transmission, adhesion and/or antiblocking properties. The polymers are thus chosen for the particular attributes desired. Examples of possible polymers that may be used alone or in combination include homopolymers, copolymers and blends of polyolefins as well as ethylene vinyl acetate (EVA), ethylene ethyl acrylate (EEA), ethylene acrylic acid (EAA), ethylene methyl acrylate (EMA), ethylene butyl acrylate (EBA), polyester (PET), nylon (PA), ethylene vinyl alcohol (EVOH), polystyrene (PS), polyurethane (PU), and olefinic thermoplastic elastomers which are multistep reactor products wherein an amorphous ethylene propylene random copolymer is molecularly dispersed in a predominately semicrystalline high polypropylene monomer/low ethylene monomer continuous matrix. The skin layer can be formed of any semicrystalline or amorphous polymer, including one that is elastic. However, the skin layer is generally a polyolefin such as polyethylene, polypropylene, polybutylene or a ethylene-propylene copolymer, but may also be wholly or partly polyamide such as nylon, polyester such as polyethylene terephthalate, polyvinylidene fluoride, polyacrylate such as poly(methyl methacrylate)(only in blends) and the like, and blends thereof.

The non-elastic film layers in the laminate of the present invention can be made from breathable or non-breathable materials and can be apertured. The non-elastic film layer may contain such fillers as micropore developing fillers, e.g. calcium carbonate; opacifying agents, e.g. titanium dioxide; and antiblock additives, e.g. diatomaceous earth.

Fillers may be incorporated for developing micropores during orientation of the non-elastic film layer resulting in breathable films. Once the particle-filled film has been formed, it is then either stretched or crushed to create pathways through the film layer. Generally, to qualify as being "breathable" for the present invention, the resultant laminate should have a water vapor transmission rate (WVTR) of at least about 250 g/m^2/24 hours as may be measured by a test method as described below. Preferably, the laminate will have a WVTR of at least about 1000 g/m^2/24 hours.

As used herein, a "micropore developing filler" is meant to include particulates and other forms of materials which can be added to the polymer and which will not chemically interfere with or adversely affect the extruded film but are able to be uniformly dispersed throughout the film layer. Generally, the micropore developing fillers will be in particulate form and usually will have somewhat of a spherical shape with average particle sizes in the range of about 0.5 to about 8 microns. The non-elastic film layer will usually contain at least about 20 volume percent, preferably about 20 to about 40 volume percent, of micropore developing filler based upon the total volume of the film layer. Both organic and inorganic micropore developing fillers are contemplated to be within the scope of the present invention provided that they do not interfere with the film formation process, the breathability of the resultant non-elastic film layer, the liquid barrier properties of the film layer or its ability to bond to another sheet layer.

Examples of micropore developing fillers include calcium carbonate ($CaCO_3$), various kinds of clay, silica (SiO_2), alumina, barium sulfate, sodium carbonate, talc, magnesium sulfate, titanium dioxide, zeolites, aluminum sulfate, cellulose-type powders, diatomaceous earth, magnesium sulfate, magnesium carbonate, barium carbonate, kaolin, mica, carbon, calcium oxide, magnesium oxide, aluminum hydroxide, pulp powder, wood powder, cellulose derivative, polymer particles, chitin and chitin derivatives. The micropore developing filler particles may optionally be coated with a fatty acid, such as stearic acid, or a larger chain fatty acid than starch such as behenic acid, which may facilitate the free flow of the particles (in bulk) and their ease of dispersion into the polymer matrix. Silica-containing fillers may also be present in an effective amount to provide antiblocking properties.

Also contemplated herein, is the attachment of an additional non-elastic neckable material which is not necked and which would most beneficially be attached to the unstretched elastic material, opposite of the necked laminate. Such an additional layer will provide a more pleasant appearance and feel to the other side of the composite material.

At least one layer of non-elastic neckable material is added to the composite material of the present invention. The non-elastic neckable material 14 (see, for instance, Figure 1) includes nonwoven webs, woven materials and knitted materials which are air permeable.

As used herein, the term "nonwoven fabric or web" means a web having a structure of individual fibers or threads which are interlaid, but not in an identifiable manner as in a knitted fabric. Nonwoven fabrics or webs have been formed from many processes

such as for example, bonded carded web processes, meltblowing processes and spunbonding processes. The basis weight of nonwoven fabrics is usually expressed in ounces of material per square yard (osy) or grams per square meter (gsm) and the fiber diameters useful are usually expressed in microns. (Note that to convert from osy to gsm, multiply osy by 33.91). The neckable material of the present invention has a basis weight of 5 to 90 gsm, preferably 10 to 90 gsm, more preferably 20 to 60 gsm.

Suitable fibers for forming the non-elastic neckable material include natural and synthetic fibers as well as bicomponent, multi-component, and shaped polymer fibers. A plurality of non-elastic neckable materials may also be used according to the present invention. Examples of such materials can include, for example, spunbond/meltblown composites and spunbond/meltblown/spunbond composites such as are taught in Brock et al., U.S. Patent No. 4,041,203 which is incorporated herein by reference in its entirety. The non-elastic neckable materials may also be formed from "coform" as described in commonly assigned U.S. Patent No. 4,100,324 to Anderson et al.

As used herein, the term "spunbonded fibers" refers to small diameter fibers which are formed by extruding through one or more extruders, attached to one or more banks made up of at least transfer piping and spinplates to produce molten thermoplastic material as filaments from a plurality of fine, usually circular, capillaries in a spinneret with the diameter of the extruded filaments then being rapidly reduced as by, for example, in Appel et al., U.S. Patent No. 4,340,563; Matsuki, et al., U.S. Patent No. 3,802,817; Dorschner et al., U.S. Patent No. 3,692,618; Kinney, U.S. Patent Nos. 3,338,992 and 3,341,394; Hartman, U.S. Patent No. 3,502,763; and Dobo et al., U.S. Patent No. 3,542,615. Spunbond fibers are generally not tacky when they are deposited onto a collecting surface. Spunbond fibers are generally continuous and have average diameters (from a sample of at least 10) larger than 7 microns, more frequently, between about 10 and 40 microns. The resulting matt of fibers is then bonded to form a strong neckable fabric. This bonding may be performed by ultrasonic bonding, chemical bonding, adhesive bonding, thermal bonding, needle punching, hydroentangling and the like.

As used herein the term "meltblown fibers" means fibers formed by extruding a molten thermoplastic material through a plurality of fine, usually circular, die capillaries as molten threads or filaments into converging high velocity, usually hot, gas (e.g. air) streams which attenuate the filaments of molten thermoplastic material to reduce their diameter, which may be to microfiber diameter. Thereafter, the meltblown fibers are carried by the high velocity gas stream and are deposited on a collecting surface to form a web of

randomly dispersed meltblown fibers. Such a process is disclosed, for example, in U.S. Patent 3,849,241 to Butin et al. Meltblown fibers are microfibers which may be continuous or discontinuous, and are generally smaller than 20 microns in average diameter.

As used herein the term "microfibers" means small diameter fibers having an average diameter not greater than about 75 microns, for example, having an average diameter of from about 0.5 microns to about 50 microns, more particularly, from about 2 microns to about 40 microns. Another frequently used expression of fiber diameter is denier, which is defined as grams per 9000 meters of a fiber and may be calculated as fiber diameter (in microns) squared, multiplied by the polymer density in grams/cc, multiplied by 0.00707. For the same polymer, a lower denier indicates a finer fiber and a higher denier indicates a thicker or heavier fiber. For example, the diameter of a polypropylene fiber given as 15 microns may be converted to denier by squaring, multiplying the result by 0.89 g/cc and multiplying by 0.00707. Thus, a 15 micron polypropylene fiber has a denier of about 1.42 (15^2 x 0.89 x 0.00707 = 1.415). Outside the United States the unit of measurement is more commonly the "tex", which is defined as the grams per kilometer of fiber. Tex may be calculated as denier/9.

The non-elastic neckable material is preferably formed from at least one member selected from fibers and filaments made of non-elastic polymers such as polyesters, for example, polyethylene terephthalate, polyolefins, for example, polyethylene and polypropylene, polyamides, for example, nylon 6 and nylon 66. These fibers or filaments are used alone or in a mixture of two or more thereof.

Many polyolefins are available for fiber production according to the present invention, for example, fiber forming polypropylenes include Exxon Chemical Company's Escorene® PD 3445 polypropylene and Himont Chemical Company's PF-304. Polyethylenes such as Dow Chemical's ASPUN® 6811A linear low density polyethylene, 2553 LLDPE and 25355 and 12350 high density polyethylene are also suitable polymers. The polyethylenes have melt flow rates of about 26, 40, 25 and 12 respectively. Many other polyolefins are commercially available.

If at least one layer of elastomeric filaments 51 is added to the composite material, these filaments may be formed by the method of forming substantially parallel rows of elastomeric filaments found in commonly assigned U.S. Patent No. 5,385,775 to Wright which is incorporated herein by reference in its entirety. The elastomeric filaments may have an average diameter of at least about 40 microns (μm), preferably ranging from at least about 40 to about 750 microns.

The layer of elastomeric filaments and/or the elastic material are preferably formed from at least one member selected from fibers and filaments made of elastic (or elastomeric) polymers which may be formed as described above for non-elastic neckable materials, for instance, into a nonwoven web of elastic fibers, e.g., meltblown elastic fibers. A useful layer of elastic material may have a basis weight ranging from about 5 gsm (grams per square meter) to about 300 gsm, for example, from about 5 gsm to about 150 gsm. Elastomeric thermoplastic polymers useful in the practice of this invention may be those made from block copolymers such as polyurethanes, copolyether esters, polyamide polyether block copolymers, ethylene vinyl acetates (EVA), block copolymers having the general formula A-B-A' or A-B like copoly(styrene/ethylene-butylene), styrene-poly(ethylene-propylene)-styrene, styrene-poly(ethylene-butylene)-styrene, (polystyrene/poly(ethylene-butylene)/polystyrene, poly(styrene/ethylene-butylene/styrene) and the like.

Useful elastomeric resins include block copolymers having the general formula A-B-A' or A-B, where A and A' are each a thermoplastic polymer endblock which contains a styrenic moiety such as a poly (vinyl arene) and where B is an elastomeric polymer midblock such as a conjugated diene or a lower alkene polymer. Block copolymers of the A-B-A' type can have different or the same thermoplastic block polymers for the A and A' blocks, and the present block copolymers are intended to embrace linear, branched and radial block copolymers. In this regard, the radial block copolymers may be designated $(A\text{-}B)_m\text{-}X$, wherein X is a polyfunctional atom or molecule and in which each $(A\text{-}B)_m$- radiates from X in a way that A is an endblock. In the radial block copolymer, X may be an organic or inorganic polyfunctional atom or molecule and m is an integer having the same value as the functional group originally present in X. It is usually at least 3, and is frequently 4 or 5, but not limited thereto. Thus, in the present invention, the expression "block copolymer", and particularly "A-B-A" and "A-B" block copolymer, is intended to embrace all block copolymers having such rubbery blocks and thermoplastic blocks as discussed above, which can be extruded (e.g., by meltblowing), and without limitation as to the number of blocks. The elastomeric nonwoven web may be formed from, for example, elastomeric (polystyrene/poly(ethylene-butylene)/ polystyrene) block copolymers. Commercial examples of such elastomeric copolymers are, for example, those known as KRATON® materials which are available from Shell Chemical Company of Houston, Texas. KRATON® block copolymers are available in several different formulations, a number of which are identified in U.S. Patents 4,663,220 and 5,304,599, hereby incorporated by reference.

Polymers composed of an elastomeric A-B-A-B tetrablock copolymer may also be used in the practice of this invention. Such polymers are discussed in U.S. Patent

5,332,613 to Taylor et al. In such polymers, A is a thermoplastic polymer block and B is an isoprene monomer unit hydrogenated to a poly(ethylene-propylene) monomer unit. An example of such a tetrablock copolymer is a styrene-poly(ethylene-propylene)-styrene-poly(ethylene-propylene) or SEPSEP elastomeric block copolymer available from the Shell Chemical Company of Houston, Texas under the trade designation KRATON® G-1657.

Other exemplary elastomeric materials which may be used include polyurethane elastomeric materials such as, for example, those available under the trademark ESTANE® from B. F. Goodrich & Co. or MORTHANE® from Morton Thiokol Corp., polyetherester elastomeric materials such as, for example, those available under the trade designation HYTREL® from E. I. du Pont de Nemours and Company, Inc., and those known as ARNITEL®, formerly available from Akzo Plastics of Arnhem, Holland and now available from DSM of Sittard, Holland.

Another suitable material is a polyether block amide copolymer having the formula:

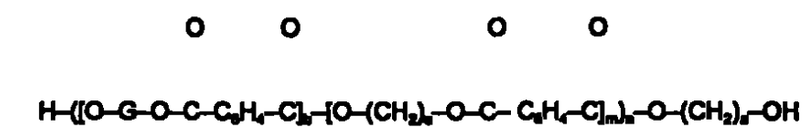
where n is a positive integer, PA represents a polyamide polymer segment and PE represents a polyether polymer segment. In particular, the polyether block amide copolymer has a melting point of from about 150°C to about 170° C, as measured in accordance with ASTM D-789; a melt index of from about 6 grams per 10 minutes to about 25 grams per 10 minutes, as measured in accordance with ASTM D-1238, condition Q (235 C/1Kg load); a modulus of elasticity in flexure of from about 20 Mpa to about 200 Mpa, as measured in accordance with ASTM D-790; a tensile strength at break of from about 29 Mpa to about 33 Mpa as measured in accordance with ASTM D-638 and an ultimate elongation at break of from about 500 percent to about 700 percent as measured by ASTM D-638. A particular embodiment of the polyether block amide copolymer has a melting point of about 152°C as measured in accordance with ASTM D-789; a melt index of about 7 grams per 10 minutes, as measured in accordance with ASTM D-1238, condition Q (235 C/1Kg load); a modulus of elasticity in flexure of about 29.50 Mpa, as measured in accordance with ASTM D-790; a tensile strength at break of about 29 Mpa, a measured in accordance with ASTM D-639; and an elongation at break of about 650 percent as measured in accordance with ASTM D-638. Such materials are available in various grades under the trade designation PEBAX® from Atochem Inc. Polymers Division (RILSAN®), of Glen Rock, New Jersey. Examples of the use of such polymers may be found in U.S. Patents 4,724,184, 4,820,572 and 4,923,742

154

hereby incorporated by reference, to Killian et al. and assigned to the same assignee as this invention.

Elastomeric polymers also include copolymers of ethylene and at least one vinyl monomer such as, for example, vinyl acetates, unsaturated aliphatic monocarboxylic acids, and esters of such monocarboxylic acids. The elastomeric copolymers and formation of elastomeric nonwoven webs from those elastomeric copolymers are disclosed in, for example, U.S. Patent 4,803,117.

The thermoplastic copolyester elastomers include copolyetheresters having the general formula:



where "G" is selected from the group consisting of poly(oxyethylene)-alpha,omega-diol, poly(oxypropylene)-alpha,omega-diol, poly(oxytetramethylene)-alpha,omega-diol and "a" and "b" are positive integers including 2, 4 and 6, "m" and "n" are positive integers including 1-20. Such materials generally have an elongation at break of from about 600 percent to 750 percent when measured in accordance with ASTM D-638 and a melt point of from about 350°F to about 400°F (176 to 205°C) when measured in accordance with ASTM D-2117.

Commercial examples of such copolyester materials are, for example, those known as ARNITEL®, formerly available from Akzo Plastics of Arnhem, Holland and now available from DSM of Sittard, Holland, or those known as HYTREL® which are available from E. I. du Pont de Nemours and Company, Inc., of Wilmington, Delaware. Formation of an elastomeric nonwoven web from polyester elastomeric materials is disclosed in, for example, U.S. Patent 4,741,949 to Morman et al. and US Patent 4,707,398 to Boggs, hereby incorporated by reference.

A nonwoven web layer may be bonded to impart a discrete bond pattern with a prescribed bond surface area. This is known as thermal point bonding. "Thermal point bonding" involves passing a web of fibers to be bonded between a heated calender or patterned roll and an anvil roll. The calender roll is patterned so that the entire neckable material is not bonded across its entire surface. In fact, this feature is very important for necking of neckable materials as described herein. If too much bond area is present on the neckable material, it will break before it necks. If there is not enough bond area, then the

neckable material will pull apart. Typically, the percent bonding area useful in the present invention ranges from around 5% to around 40% of the area of the neckable material. Many patterns for calender rolls have been developed. As will be understood by those skilled in the art, bond area percentages are, of necessity, described in approximations or ranges since bond pins are normally tapered and wear down over time. As those skilled in the art will also recognize, references to "pins/In.^{2}" and "bonds/In.^{2}" are somewhat interchangeable since the pins will create bonds in the substrate in essentially the same sizes and surface relationship as the pins on the roll. There are a number of discrete bond patterns which may be used. See, for example, Brock et al., U.S. Patent No. 4,041,203. One example of a pattern has points and is the Hansen Pennings or "H&P" pattern with about 200 bonds/square inch as taught in U.S. Patent 3,855,046 to Hansen and Pennings. The H&P pattern has square point or pin bonding areas wherein each pin may have a side dimension of 0.038 inches (0.965 mm), for example, resulting in a pattern having a bonded area of about 30%. Another typical point bonding pattern is the expanded Hansen and Pennings or "EHP" bond pattern which produces a bond area of about 15% to 18% which may have a square pin having a side dimension of 0.037 inches (0.94 mm), for example, and a pin density of about 100 pins/in^2. Another typical point bonding pattern designated "714" has square pin bonding areas wherein each pin may have a side dimension of 0.023 inches, for example, for a bond area of 15% to 20% and about 270 pins/in^2. Other common patterns include a "Ramisch" diamond pattern with repeating diamonds having a bond area of 8% to 14% and 52 pins/In.^{2}, a HDD pattern, which comprises point bonds having about 460 pins/In.^{2} for a bond area of about 15% to about 23%, as well as a wire weave pattern looking as the name suggests, e.g. like a window screen and having a bond area of 15% to 20% and 302 bonds/In.^{2}. Another bond pattern for a spunbond facing web is a "S" weave pattern as described in commonly assigned U.S. Patent No. 5,964,742 to McCormack et al., which is incorporated herein by reference in its entirety.

Laminating the non-elastic film layer to the non-elastic neckable material to form the necked laminate may occur by typical methods known in the art including adhesive bonding, point bonding, thermal point bonding and sonic welding. The use of inelastic and/or elastic adhesives for the adhesive bonding is also contemplated herein. As discussed in more detail below, the use of an elastic adhesive has not been found to significantly impact ease of extensibility. When the film layer and neckable material are bonded through the use of heat and/or pressure, laminating means 30 (Figure 1) such as laminating rollers may be used. The laminating rollers may be heated and point bonding may be used. The temperature at which the laminating rollers are heated depends on the properties of the film

and or neckable material but is usually in the range of 200 - 275°F (93 - 135°C). The laminating rollers may each be patterned or one roll may be smooth while the other roll is patterned. If one of the rolls is patterned it will create a discrete bond pattern with a prescribed bond surface area for the resultant necked laminate 2.

As has been stated previously, the composite material having stretch and recovery may be used in a wide variety of applications, including personal care absorbent articles such as diapers, training pants, incontinence devices and feminine hygiene products such as sanitary napkins. An exemplary article 80, a diaper, is shown in Figure 4. Referring to Figure 4, most such personal care absorbent articles 80 include a liquid permeable top sheet or liner 82, a back sheet or outercover 84 and an absorbent core 86 disposed between and contained by the top sheet 82 and back sheet 84. Articles 80, such as diapers, may also include some type of fastening means 88 such as adhesive fastening tapes or mechanical hook and loop type fasteners to maintain the garment in place on the user.

The composite material may be used to form various portions of the article including, but not limited to, the top sheet 82 and the back sheet 84. If the composite material is to be used as the top sheet 82, it will most likely be apertured or otherwise made to be liquid permeable. When using the composite material as back sheet 84, it is usually advantageous to place the nonwoven side, if only one side has a nonwoven, facing out away from the user. In addition, in such embodiments it may be possible to utilize the nonwoven portion of the composite material as the loop portion of the hook and loop combination of fastening means 88.

As the composite material has stretch and recovery, the elastic waistband 90 can be attached/incorporated in a non-stretched configuration during diaper production, significantly simplifying the converting process. The resulting waistband will stretch, recover, and seal around the baby's waist much better. Composite materials of the present invention are equally useful in articles used in medical applications. Referring to Figure 5, the composite material has been utilized to form an exemplary article useful in medical applications, in this case a facemask 60. The composite material is attached to fastening means 88' to tie the facemask 60 to the head of a user. In this application, the non-elastic film layer would most likely be apertured so that the wearer may breathe comfortably. Such apertures 62 will be sized and located such that breathing is not impaired but will not be too large or numerous such that the function of the facemask (e.g. to protect the wearer) is thwarted. One such embodiment may be to have the apertures on the TD edges of the facemask (not shown).

Yet another exemplary article is a protective garment such as a lab coat or workwear. One particularly bothersome aspect of use of the prior art non-elastic laminate is the lack of "give" as discussed above. This can be best understood in the context of bending a laminate-clad elbow. If the prior art laminate was used to create the garment, when the elbow bends, the material tightens around the elbow which may cause the material to tear or at the very least cause discomfort to the user. If the garment were to be made of the composite material of the present invention, however, the material will "give" when the elbow bends and afterwards tend to return to its prior form.

One advantage of using composite material in such applications is that the articles will be more "cloth-like" in both appearance and feel. Additionally, the stretch and recovery will allow the article to more closely conform to the body of the wearer.

The composite material of the present invention is able to maintain properties such as strength, hydrohead and breathability while getting improvements in "cloth-like" characteristics such as conformability and stretch and recovery. The advantages and other characteristics of the present invention are best illustrated by the following examples.

Examples

Samples of the present invention were prepared as described below. The samples were then subjected to the following tests:

Tensile Test: The tensile test measured strength and elongation or strain of a fabric when subjected to unidirectional stress according to ASTM Standard Test D 5034-95, as well as Federal Test Methods Standard No. 191A Method 5102-78. This test measured the strength in pounds and percent stretch while elongating the sample until it broke. Higher numbers indicate a stronger and/or more stretchable fabric, respectively. The term "peak load" means the maximum load or force, expressed in pounds, required to elongate a sample to break or rupture in a tensile test. The terms "elongation", "strain" or "percent stretch" means the increase in length of a sample during a tensile test expressed as a percentage. Values for peak load and strain at peak load were obtained using a width of fabric of 3 x 6 in. (76 x 152 mm), a 3 in. (76 mm) clamp width, a gauge length of 3 in. (76 mm), and a constant rate of extension of 12 inches/min. (305 mm/min.), where the entire sample width was gripped in the clamps. The specimen was clamped, for example, in an 1130 Instron, available from the Instron Corporation, or a Thwing-Albert Model INTELLECT II available from the Thwing-Albert Instrument Co., 10960 Dutton Rd., Philadelphia,

Pennsylvania 19154, and the unit was zeroed, balanced and calibrated according to the standard procedure.

Cycle Test: The samples were also cycled on the Instron tester with Microcon II using a 50 kg load cell. The sample sizes and tester were set up as described above except that the gage length was 2 inches (5.08 cm). Chart and crosshead speeds were set for 20 inches (50.8 cm) per minute. The maximum extension limit for the cycle length was set at a distance determined by calculating 50 percent of the "elongation to break" from the Tensile Test. The samples were cycled to the specified cycle length two times and then were taken to break on the third cycle. The test equipment was set to measure Peak Load in grams force for each cycle. On the third cycle (cycle to break), the Peak Elongation and Peak Load were measured.

% Permanent Set: The permanent set test measures the degree of retractability of a material after being stretched to a specific length. Generally, the greater the permanent set value, the less retractable the sample is. After the laminate was produced and wound onto a roll, indelible ink was used to mark a 2 in. (5.08 cm) wide strip of material in the transverse dimension. After the laminate was unwound, a sample area 3 in. (7.62 cm) (LD) x 4.5 in. (11.43 cm) (TD) was cut out of the laminate to include the marked-off area. Each sample was placed between two 3 in. (7.62 cm) wide jaws. The jaws were separated a distance of 2 in. (5.08 cm) apart and the jaws were clamped on the marks that were previously made on the material. The samples were then elongated a specified amount, (e.g. 90% or 1.8 in. (4.57 cm)), and allowed to retract. The elongation was recorded when the force during retraction reached 25 grams. The permanent set was calculated as follows:

% Permanent set = 100 x (distance x between the jaws when the resistance of the laminate drops to 25 grams $_{force}$ during the retraction cycle — initial length) ÷ total stretched length = [x (in.) — 2 (in.)] ÷ 1.8 = [x (cm) — 5.08 (cm)] ÷ 4.57

Three repetitions were performed and the average value is represented in the examples below.

Breathability Test: The water vapor transmission rate (WVTR) for the sample materials was calculated generally in accordance with the following test method in order to measure the breathability of the samples. The test procedure establishes a means to determine the normalized rate of water vapor transmission through solid and porous films, nonwoven materials, and other materials while under steady state conditions. The material to be evaluated is sealed to the top of a cup of water and placed in a temperature-controlled environment. Evaporation of water in the cup results in a relatively

higher vapor pressure inside the cup than the vapor pressure of the environment outside of the cup. This difference in vapor pressure causes the vapor inside the cup to flow through the test material to the outside of the cup. The rate of this flow is dependent upon the permeability of the test material sealed to the top of the cup. The difference between the beginning and ending cup weights is used to calculate the water vapor transmission rate.

In particular, circular samples measuring three inches in diameter were cut from each of the test materials and a control which was a piece of CELGARD® 2500 film from Hoechst Celanese Corporation. CELGARD® 2500 film is a microporous polypropylene film. The test dish was a 68-1 Vapometer cup distributed by Thwing-Albert Instrument Company of Philadelphia, Pennsylvania. One hundred milliliters of water were poured into each Vapometer cup and individual samples of the test materials and control material were placed across the open tops of the individual cups. A rubber gasket and metal ring (fitted to the cup) were placed over the sample and clamped using metal clamps. The sample test material and control material were exposed to room temperature over a 6.5 centimeter diameter circle, having an exposed area of approximately 33.17 square centimeters. The cups were placed in an oven at a temperature of about 38°C (100°F), long enough for the cups to reach thermal equilibrium. The cups were removed from the oven, weighed and replaced in the oven. The oven was a constant temperature oven with external air circulating through it to prevent water vapor accumulation inside. A suitable forced air oven is, for example, a Blue M Power-O-Matic 60 oven distributed by Blue M. Electric Company of Blue speak, Illinois. After 24 hours, the cups were removed from the oven and weighed again. The preliminary test water vapor transmission rate values were calculated with Equation (I) below:

APP MVT = (grams weight loss over 24 hours) x 7571/24

expressed in $g/m^2/24$ hours

Approximate moisture vapor transfer is designated by "APP MVT". Under the predetermined set conditions of about 38 °C (100 °F) and ambient relative humidity, the WVTR for the CELGARD® 2500 control has been defined to be 5000 grams per square meter for 24 hours. Accordingly, the control sample was run with each test and the preliminary test values were corrected to set conditions using Equation (II) below:

(II) WVTR = (Test WVTR/control WVTR) x (5000 $g/m^2/24$ hours)

Hydrohead: A measure of the liquid barrier properties of a fabric is the hydrohead test. The hydrohead test determines the height of water (in centimeters) which the fabric will support before a predetermined amount of liquid passes through, usually 3 drops. A fabric

with a higher hydrohead reading has a greater barrier to liquid penetration than a fabric with a lower hydrohead. The hydrohead test is performed according to Federal Test Standard 191A, Method 5514 using a Textest FX-3000 Hydrostatic Head Tester available from Marlo Industries, Inc., P.O. Box 1071, Concord, North Carolina. A circular head having an inner circumference of 28 cm was used to clamp down the sample.

% Theoretical Extensibility: The % Theoretical Extensibility is the amount of extensibility and retractability that can be expected for necked laminates of the present invention, based upon how much the original width is reduced and assuming the original laminate has no inherent extensibility. In the following equations, original width is the un-necked width (transverse dimension) of the laminate, while necked width is the width of the laminate after necking. % Theoretical Extensibility can be determined as follows:

% Theoretical Extensibility = 100 X [(original width - necked width) ÷ necked width]

which can be rewritten as:

% Theoretical Extensibility = 100 X [(original width ÷ necked width) - 1]

The % of the original width that the laminate is necked can be represented by the following equation:

% original width = 100 X (necked width ÷ original width)

which can be rewritten as:

(original width ÷ necked width) = 100 ÷ % original width

Substituting this equation into % Theoretical Extensibility above:

% Theoretical Extensibility = 100 X [(100 ÷ % original width) - 1]

So, for each sample below, the original width was measured, as was the necked width, and % Theoretical Extensibility was calculated as shown below in Table 3.

Example 1

This Example explains the process used to prepare the necked laminate which was then used as part of the composite materials below. The necked laminate was prepared from a non-elastic film layer and a non-elastic nonwoven web layer. A 1.5 mil layer of blown film made of 48% by weight (25 volume percent) SUPERCOAT calcium carbonate as manufactured by English China Clay America, Inc. of Sylacauga, Alabama, 47% by weight (68 volume percent) linear low density polyethylene (LLDPE) available under the trade designation DOWLEX NG3347A as manufactured by the Dow Chemical Company ("Dow"), 5% by weight (7 volume percent) low density polyethylene (LDPE) available under the trade designation 640I as manufactured by Dow, and 2000 ppm antioxidant stabilizer available under the trade designation B900 as manufactured by Ciba Specialties Company of

Tarrytown, New York. The film layer, made of the composition as described above, was pre-made and wound onto a roll. To make this film layer highly breathable, it should be stretched over about 4X (4 times its original length), e.g. up to 5X and more. The film layer was then unwound from a film unwind unit into a conventional machine direction orienter manufactured by the Marshall and Williams Company where it was partially stretched as shown in Table 1 below (stretching draw) in the machine direction to form a partially stretched, breathable film layer. Likewise, a 0.4 OSY basis weight standard polypropylene spunbond having a wireweave bond pattern, such as that made by the Kimberly-Clark Corporation of Dallas, Texas, was unwound and an adhesive of 3 gsm weight (at the application point) available as H2525A from Ato-Findley of Wauwatosa, WI was applied to one surface of the nonwoven web layer using an air assisted spraying device such as a meltblown device as described in Butin, et al., supra. Such devices are generally described in, for example, commonly assigned U.S. Patent No. 4,949,668 to Heindel et al.; U.S. Patent No. 4,983,109 to Miller et al., assigned to Nordson Corporation; and U.S. Patent No. 5,728,219 to Allen et al., assigned to J&M Laboratories, Inc.

The adhesive side of the nonwoven web layer was then laminated to the partially stretched film layer using laminating rollers at a pressure of 30 pli (5.4 kg/linear cm) of a smooth resilient (rubber coated) anvil roll on one side and a smooth, unheated, steel roll to form a laminate.

The laminate was then stretched in the longitudinal dimension and necked in the transverse direction by passing it through a stretch nip at a greater speed than the speed of the laminating rollers (see Table 1 below, Laminate Necking Draw). The necking draw caused contraction (necking) of the laminate in the transverse direction. The laminating rollers were spaced about 8 feet (2.4 m) from the stretch nip. "Total draw" in Table 1 is the necking draw multiplied by the stretching draw and was sufficient to insure enough orientation or stretching of the film layer to make it highly breathable. The thus formed transversely extensible and retractable necked laminate was then wound onto a roll. Samples were cut from the necked laminate and subjected to tests, the results of which are reported below in Table 1. Samples C1 and C2 are comparative (baseline) examples wherein the film layer was stretched as indicated, but the laminate was not necked. Figure 10 shows an oblique image of a prior art laminate of Sample C1, wherein the film layer 12 was fully stretched prior to lamination to the neckable material 14 to form the laminate which was not subsequently necked. Sample 8 was a repeat of Sample 7. "Peak strain" is the strain at "peak load".

158

Table 1

Sample	Total Draw	Film Stretching Draw	Laminate Necking Draw	WVTR g/m²/ 24 hr	Hydrohead mbar	LD Peak Strain %	LD Peak Load lb. (kg)	TD Peak Strain %	TD Peak Load lb. (kg)
C1	5.0X	5.0X	1.0X	2799	353	35.7	25.82 (11.82)	92.15	5.11 (2.32)
C2	3.6X	3.6X	1.0X	1759	285	66.4	23.36 (10.59)	100.82	6.16 (2.79)
3	3.9X	3.6X	1.1X	1004	316	65.6	26.33 (11.94)	99.98	6.15 (2.79)
4	4.3X	3.6X	1.2X	886	437	69.1	30.75 (13.95)	94.99	6.01 (2.73)
5	4.6X	3.6X	1.3X	1474	383	65.2	33.32 (15.11)	128.92	5.43 (2.46)
6	5.0X	3.6X	1.4X	1213	454	55.6	44.07 (19.99)	197.79	4.99 (2.26)
7	5.2X	3.6X	1.45X	-	383	48.8	35.01 (15.88)	144.25	5.48 (2.48)
8	5.2X	3.6X	1.45X	1140	367	56.0	40.20 (18.23)	141.24	4.70 (2.13)

Sample 6 has the highest TD peak strain. In this laminate, the film layer has been drawn a total of 5.0X, which is typical drawing for such articles. The laminate has additionally been necked by a 1.4X draw. The film layer of Sample C1 has also been drawn a total of 5.0X, but the laminate has not been necked at all. Even though the film layers have been drawn by the same amount, the example of the present invention, Sample 6, has a much greater TD peak strain than the comparative example, which is an indication of the improvement of the transverse extensibility and retractability of the present invention. Figures 11a, b, and c, and 12a, b, and c, graphically illustrate load versus extension curves for samples C1 and 6, while Figures 14 and 15 graphically illustrate enlarged curves of load versus extension for these samples. Figures 11a, b, and c relate to three replicates of the delaminated film layer of Sample C1, whereas Figures 12a, b, and c relate to three replicates of the delaminated film layer of Sample 6, having the striated rugosities.

Table 3 below represents necked width in inches (cm) as a function of percent stretch and shows how readily the necked laminates elongated in the transverse direction for each of the samples of Table 1. From the tensile strength test above, the force in pounds (kilograms) was recorded below in Table 2 for each sample at 30%, 60%, 90%,

120%, 150%, and 180%. The laminates which had been necked to a narrower width (Samples 5,6,8; Table 3 "Laminated Necked Width" column) elongated at a much less force at the same % elongation than the control and to a much greater extent before breaking. If the sample broke either on or before the percent step change, it has been designated as "- -".

Table 2

Sample	30%	60%	90%	120%	150%	180%
C1	2.51 (1.14)	4.21 (1.91)	5.05 (2.29)	--		
C2	3.16 (1.43)	5.05 (2.29)	6.02 (2.73)	--		
3	2.74 (1.24)	4.88 (2.21)	5.88 (2.67)	--		
4	2.78 (1.26)	4.89 (2.22)	5.92 (2.69)	--		
5	1.30 (0.59)	2.84 (1.29)	4.41 (2.00)	5.27 (2.39)	--	
6	0.60 (0.27)	1.28 (0.58)	2.13 (0.97)	3.22 (1.46)	4.09 (1.86)	4.73 (2.15)
7	1.51 (0.68)	2.78 (1.26)	4.18 (1.90)	5.06 (2.30)	5.38 (2.44)	--
8	1.21 (0.55)	2.33 (1.06)	3.42 (1.55)	3.89 (1.76)	4.47 (2.03)	--

Table 3 additionally shows the calculated % Theoretical Extensibility as described above for each of the samples of Table 1.

Table 3

Sample	Laminate Necked Width in. (cm)	% Original Width	% Theoretical Extensibility
C1	12 3/8 (31.43)	100	0
C2	12 ¼ (31.12)	99	1
3	11 ½ (29.21)	93	7.5
4	10 ¾ (27.31)	87	15
5	8 ¾ (22.23)	71	41
6	7 ½ (19.05)	61	65
8	6 3/8 (16.19)	51	94

The breathability was measured by WVTR for the necked laminate when it was in the TD extended configuration, since this is the configuration it would have when in use as for instance in a diaper. Three repetitions of Sample 6 were extended 100% and 166% and tested for WVTR. The results were as follows in Table 4. Note that the TD extended laminate has a WVTR much higher than either of the comparative examples.

159

Table 4

Sample 6	WVTR g/m²/24 hr
Unstretched (from Table 1 above)	1213
100% extended	3960
166% extended	4250

To better describe the TD extensibility of the film layer, for Samples C1 and 6 above, the film layer was delaminated from the spunbond layer for a further test. Prior to delamination, a length of 3 inches (7.62 cm) was marked on the film side of the laminate across the TD. The delamination was conducted by completely immersing and soaking the laminate in denatured ethyl alcohol (ethanol) which softened and partially dissolved the adhesive bonding between the film layer and spunbond layer, such that the striated rugosities of the film layer were not removed, damaged, or otherwise distorted. Once delaminated, the film layer was tested in a tensile tester as described above and the force was measured when the film layer had been extended by 0.3 inches (0.762 cm) (10% strain). The force required to extend Sample C1 (the average of three repetitions) was approximately 1000 grams per mil of the film layer thickness. The force required to extend Sample 6 (the average of three repetitions), on the other hand, was approximately 60 grams per mil of the film layer thickness, which was the thickness determined with the striated rugosities flattened out.

Example 2

Additional laminates were prepared as described above, except that a non-elastic adhesive was used in some samples and that some samples were heated after being necked. The modifications were made to evaluate the impact of: 1) using a non-elastic adhesive as compared with the semi-elastic adhesive used above, and 2) heating the laminate after the necking process. For each sample, the non-elastic film layer was stretched to 4X its length prior to lamination to the spunbond layer. The laminates were necked as indicated in Table 5 and tested for permanent set as described above. The non-elastic adhesive used was Rextac® 2730, available from Huntsman Polymers in Odessa, TX. Further, the samples that were heated after necking were contacted with heated rolls maintained at a temperature of about 170°F (76°C).

A 10 cm x 10 cm (3.94 in. x 3.94 in.) sample was measured while the laminate was still wound on a roll. Since the materials were wound under tension and some degree of

relaxation tends to occur over time, the samples were re-measured after being cut from the roll. Samples C9 and C10 are comparative (baseline) materials wherein the film was stretched but the laminate was not necked.

Table 5

Sample	Laminate Necking Draw	Actual Draw	Adhesive Type	Heat Applied	Sample Size Measured cm (in.)	Sample Size After Relaxation cm (in.)	% Permanent Set cm (in.)
C9	1.1X	1.03X	Non-elastic	No	10 x 10 (3.94 x 3.94)	10 x 10 (3.94 x 3.94)	-
C10	1.1X	1.03X	Semi-elastic	No	10 x 10 (3.94 x 3.94)	10 x 10 (3.94 x 3.94)	-
11	1.43X	1.32X	Non-elastic	No	10 x 10 (3.94 x 3.94)	10 x 12.2 (3.94 x 4.80)	78
12	1.4X	1.28X	Semi-elastic	No	10 x 10 (3.94 x 3.94)	9.8 x 11.6 (3.78 x 4.57)	79
13	1.45X	1.3X	Semi-elastic	No	10 x 10 (3.94 x 3.94)	9.5 x 11.8 (3.74 x 4.65)	79
14	1.5X	1.36X	Semi-elastic	Yes	10 x 10 (3.94 x 3.94)	10 x 10.5 (3.94 x 4.13)	78
15	1.45X	1.3X	Non-elastic	Yes	10 x 10 (3.94 x 3.94)	10 x 10.3 (3.94 x 4.06)	80
16	1.45X	1.3X	Non-elastic	No	10 x 10 (3.94 x 3.94)	10 x 11.25 (3.94 x 4.43)	80

The heat set materials, Samples 14 and 15, maintained their original dimensions better than the materials that were necked and not heat set, based on a comparison between the sample size before and after cutting from the roll. Further, all of the materials, regardless of use of elastic or inelastic adhesive, exhibited the same degree of permanent set. There was little difference between the permanent set of the laminates made with the semi-elastic adhesive and those made with the inelastic adhesive, indicating that the small amount of elastic adhesive used does not bear on the overall extensibility and retractability of the nonwoven web laminate.

The samples were additionally tested for tensile properties in the transverse dimension (TD) and WVTR according to the test methods described above. The results are summarized in Table 6.

160

Table 6

Sample	Actual Draw	Adhesive Type	Heat Applied	TD Load at 50% Elongation lb. (kg)	TD Peak Strain %	TD Peak Load lb. (kg)	Unstretched WVTR $g/m^2/24$ hr
C9	1.03X	Non-elastic	No	5.73 (2.60)	82.5	6.24 (2.83)	1687
C10	1.03X	Elastic	No	4.85 (2.20)	89.7	6.15 (2.79)	2121
11	1.32X	Non-elastic	No	0.0904 (0.041)	175	4.56 (2.07)	1272
12	1.28X	Elastic	No	0.375 (0.170)	201	4.72 (2.14)	1222
13	1.3X	Elastic	No	0.617 (0.280)	212	4.78 (2.17)	903
14	1.36X	Elastic	Yes	0.419 (0.190)	192	3.57 (1.62)	1482
15	1.3X	Non-elastic	Yes	0.375 (0.170)	174	3.37 (1.53)	1400
16	1.3X	Non-elastic	No	0.190 (0.086)	174	4.52 (2.05)	N/A

When the samples were elongated 50%, the control (un-necked) materials, Samples C9 and C10, exhibited a significantly higher load than the necked materials, Samples 11-16, indicating that a much greater force was needed to extend the control samples in the transverse dimension.

Example 3

Strands of elastomeric filaments in the form of rubber bands were attached lengthwise to the longitudinal dimension of the film side of the necked laminate of Sample 6 from Example 1 above, using 3M "Super 77" spray adhesive. The entire film surface was sprayed with the adhesive. The stretched rubber bands were pressed against the adhesive and held there for about 15 seconds. While the rubber bands were still under tension, baby powder (as available from Johnson & Johnson), was sprinkled on the adhesive coated sample to eliminate the adhesive effect in locations other than at the rubber band attachment locations. Upon release of the biasing force, the elastomeric filaments recovered, drawing the necked laminate along with it. The thus formed composite material exhibited LD stretch and recovery and TD extensibility and retractability. Figures 20 and 21 show images of the thus formed composite material.

Example 4

A composite material was made as essentially described above for Example 3, except that the elastomeric filaments were not stretched and were attached perpendicular to the longitudinal dimension and the striated rugosities. In other words, the elastomeric filaments were attached in the transverse dimension of the necked laminate as can be seen in Figure 22. The thus formed composite material exhibited TD stretch and recovery.

Example 5

A Stretch Bonded Laminate (SBL) of a 73 gsm elastic material as an inner elastic material, which had a standard polypropylene spunbond facings such as that made by the Kimberly-Clark Corporation of Dallas, Texas, attached to both sides of the inner elastic material, was carefully delaminated from one of the spunbond layers. "Stretch bonded" conventionally refers to an elastic member being bonded to another member while the elastic member is extended at least about 25 percent of its relaxed length. "Stretch bonded laminate" refers to a material having at least two layers in which one layer is a gatherable layer and the other layer is an elastic layer. The layers are joined together when the elastic layer is in an extended condition so that upon relaxing the layers, the gatherable layer is gathered. Such a material may be stretched to the extent that the non-elastic material gathered between the bond locations allows the elastic material to elongate. One type of stretch bonded laminate is disclosed, for example, by commonly assigned U.S. Patent 4,720,415 to Vander Wielen et al., in which multiple layers of the same polymer produced from multiple banks of extruders are used.

The elastic material with one spunbond facing was attached to the laminates from Example 1 above. For the elastic material of the delaminated SBL used herein, the elastic material was formed by meltblowing a blend of 70 percent, by weight, of an A-B-A' block copolymer having polystyrene "A" and "A'" endblocks and a poly(ethylene-butylene) "B" midblock (obtained from the Shell Chemical Company under the trade designation KRATON® GX 1657) and 30 percent, by weight, of a polyethylene (obtained from U.S.I. Chemical Company under the trade designation PE Na601).

Meltblowing of the elastic material was accomplished by extruding the blend of materials through an extruder and through a meltblowing die as described in commonly assigned U.S. Patent No. 4,663,220 to Wisneski et al.

The elastic material and spunbond layer were then laminated to the necked laminates of Example 1 above to form composite materials as follows in Table 7. The

161

elastic material side was bonded directly to the film side of the necked laminate through the use of sine wave pattern bond plate and Carver Press (Model #1528, Serial #2518-66). The bond pattern used is shown in Figure 19a. A press temperature of 150 °F (65.56 °C) was used, and the bonding period was 15 seconds. The force used was 20,000 pounds (88,960 Newtons) as indicated by the gauge on the Carver Press. The sample size was about 9 X 10 inches (22.86 X 25.4 cm).

Samples 1-8 of Example 1 above were used to form the necked laminate for the composite materials of Samples 9-16, respectively. The Samples were elongated to break and the peak load and elongation at that peak load were recorded as follows in Table 7 below. By having the additional spunbond layer (from the SBL), "TD Peak Strain" increases for all of the Samples 9-16 to about 150 to 160%. This was because the peak load is now augmented by the SBL spunbond layer as is shown by the high TD peak loads. The one exception is that Sample 14 (which was Sample 6 with the attached elastic layer and the additional spunbond layer) had a strain of 169.657% as compared to Sample 6's strain of 197.79% because Sample 6 had such a high elongation itself. Figure 25 is a cross-sectional optical photomicrograph of a composite material wherein the elastic material was not stretched showing the multiple layers of Sample 14.

Table 7

Sample	Description	TD Peak Strain	TD Peak Load
C1	Laminate Control (Total Draw 5.0x, Necking Draw 1.0x)	92.16	2319.03
C2	Laminate (Total Draw 3.6x, Necking Draw 1.0x)	100.823	2795.73
C3	Laminate (Total Draw 3.9x, Necking Draw 1.1x)	99.98	2792.10
C4	Laminate (Total Draw 4.3x, Necking Draw 1.2x)	94.993	2758.96
C5	Laminate (Total Draw 4.6x, Necking Draw 1.3x)	126.92	2465.87
C6	Laminate (Total Draw 5.0x, Necking Draw 1.4x)	197.79	2263.64
C7	Laminate (Total Draw 5.2x, Necking Draw 1.45x)	144.25	2478.84
C8	Laminate (Total Draw 5.2x, Necking Draw 1.45x)	141.24	2131.53
9	Laminate 1 with SBL attached	165.055	8691.14
10	Laminate 2 with SBL attached	157.06	8863.44
11	Laminate 3 with SBL attached	160.283	10312.16
12	Laminate 4 with SBL attached	153.473	9129.49
13	Laminate 5 with SBL attached	166.35	8913.38
14	Laminate 6 with SBL attached	169.657	8996.92
15	Laminate 7 with SBL attached (same as laminate 8)	153.665	8564.71
16	Laminate 8 with SBL attached	138.765	7894.15

In Table 8, Samples 1-8 of Example 1 above are compared with Samples 9-16, respectively for the cycling test performed as described above. Each of the Samples was cycled to different lengths depending on "Elongation at Peak Load" from the tensile tests

above. As can be deduced from this data, elastic materials helped to maintain the extension force and retractive force after the initial stretch, e.g. Samples 1-8 extended without tearing but did not retract very much, or at least very quickly. Samples 9-16, on the other hand, stretched and recovered in the TD direction as can be seen by the lower permanent set and the maintenance of the extension force and retractive force at 50% of the elongation distance. Figure 16 shows cycling for Sample 6, while Figure 17 shows cycling for Sample 1. Sample 6 has a high permanent set as compared to Sample 14.

Table 8

Sample	% elongation cycled to	at 50% of elongation cycled to, in grams				Permanent Set (%)	TD Peak Load (g)	Elong @ Peak Load (%)
		First up	Third up	First Down	Second Down			
C1	50	1027	98	5	6	62	2400	92
9	85	2757	458	242	231	20	8900	178
C2	55	1513	97	1.4	13	61	2900	90
10	81	2815	448	237	217	21	10700	175
C3	55	1114	57	8	11	64	3100	104
11	78	1913	374	225	206	20	9700	168
C4	52	1014	33	3	7	64	2900	118
12	78	1915	396	234	217	20	9800	185
C5	66	448	5	0	5	72	2700	157
13	87	1530	340	225	206	19	10400	216
C6	101	420	12	9	6.6	76	2300	194
14	98	1064	380	248	230	19	8100	174
C7	75	650	3.5	10	6	72	2600	151
15	80	1354	344	181	192	21	9800	188
C8	73	193	24	2	4	79	2000	215
16	72	837	306	200	200	25	8100	182

Example 6

A Stretch Bonded Laminate (SBL) having a 73 gsm elastic material was formed as described above for Example 5 except that both spunbond facings were removed from Samples 18-22. The inner elastic material, the KRATON® elastic meltblown, was then combined without stretching to the necked laminates of Example 1 above as follows:

Sample 18 was made from Sample C1; Sample 19 was made from Sample C2; and Samples 20 and 21 were made from Sample 6. Also, this time, a press temperature of 120 °F (48.89 °C) and bonding period of 30 seconds was used. Sample sizes were 8 X 10 inches (20.32 X 25.4 cm). The sine wave bond pattern from Figure 19a was used for Samples 18-20, while the dot bond pattern from Figure 19b was used for Sample 21. These samples were cycle tested as described above for Example 2 and the results are reported below in Table 9. Again, the permanent set was greatly reduced when the elastic material was used to make the composite material. The extensive and retractive forces were significantly increased. Figure 16 shows cycling for Sample 6, while Figure 18 shows cycling for Sample 20.

Table 9

Sample	% elongation cycled to	at 50% of % elongation cycled to, in grams				Permanent Set (%)	TD Peak Load (g)	Elong @ Peak Load (%)
		First up	Third up	First Down	Second Down			
C1	50	1027	98	5	6	62	2400	92
18	51	1328	172	58	51	40	3400	100
C2	55	1513	97	1.4	13	61	2900	90
19	56	1694	178	56	47	41	3500	94
C6	101	420	12	9	6.6	76	2300	194
20	102	683	112	70	65	32	3000	242
21	102	747	125	80	74	27	2900	221

Table 10 provides results from WVTR and hydrohead testing for all of the above described Samples, including Sample 22 which was made by stretching Sample 20 100% in the transverse direction.

Table10

Sample	Description	WVTR g/m²/24 h	Hydrohead mbar
C1	Laminate Control (Total Draw 5.0x, Necking Draw 1.0x)	2799	353
C2	Laminate (Total Draw 3.6x, Necking Draw 1.0x)	1759	265
C3	Laminate (Total Draw 3.9x, Necking Draw 1.1x)	1004	316
C4	Laminate (Total Draw 4.3x, Necking Draw 1.2x)	888	437
C5	Laminate (Total Draw 4.8x, Necking Draw 1.3x)	1474	383
C6	Laminate (Total Draw 5.0x, Necking Draw 1.4x)	1213	454
C7	Laminate (Total Draw 5.2x, Necking Draw 1.45x)	1793	383
C8	Laminate (Total Draw 5.2x, Necking Draw 1.45x)	1140	387
9	Laminate 1 with SBL attached	2362	253
10	Laminate 2 with SBL attached	1404	331
11	Laminate 3 with SBL attached	1118	427
12	Laminate 4 with SBL attached	970	457
13	Laminate 5 with SBL attached	1126	358
14	Laminate 6 with SBL attached	188	239
15	Laminate 7 with SBL attached (same as laminate 8)	1293	100
16	Laminate 8 with SBL attached	791	104
18	Laminate 1 with unstretched Kraton attached	2819	242
19	Laminate 2 with unstretched Kraton attached	1560	289
20	Laminate 6 with unstretched Kraton attached	1476	310
21	Laminate 20 w/dot pattern instead of sine	1471	350
22	Laminate 20 stretched 2x	2407	207

Table 11 below summarizes the WVTR data for Samples C1, C2, and 6, corresponding to their counterparts from above in Example 5 (Samples 9, 10, and 14) and Example 6 (18, 19, and 20), respectively. Composite materials which have the elastic material which is not stretched, therefore, have not been adversely affected with respect to breathability by addition of the elastic material.

Table 11

Sample	Necked Laminate	Example 2	Example 3
C1	2799	2362	2819
C2	1759	1404	1550
6	1213	1388	1476

Example 7

Sample 17 was made by adding the elastic material (KRATON® meltblown nonwoven web) from the inner elastic material described in Example 6 above to Sample 6 from Example 1 above. The elastic material was first stretched in the LD and bonded in the stretched state to the film side of Sample 6. Bonding was accomplished using the Carver Press as described above for Example 5. The bond pattern used was the sine wave pattern shown in Figure 19a. A press temperature of 110 °F (43.33 °C) was used,

and the bonding period was 15 seconds. The force used was 20,000 pounds (88,960 Newtons). The sample size was about 6 X 6 inches (15.24 X 15.24 cm). The samples were tested and the results reported in Table 12 below. Exemplary tensile testing curves are shown in Figures 28-31for both LD and TD testing. Figure 25 is a cross-sectional optical photomicrograph of the composite material of the present invention showing the multiple layers of Sample 17. Some of the samples were stretched as indicated and retested for WVTR to mimic breathability when the composite material was stretched as it would likely be in actual use. Sample 17 has both stretch and recovery in the LD and TD, as well as in all directions, which is not specifically indicated by this data. This Sample also has excellent liquid (water) barrier properties, breathability and has a very nice appearance and feel.

Table 12

Sample	Description	WVTR g/m²/ 24 hr	Hydro-head mbar	LD Peak Strain %	LD Peak Load g	TD Peak Strain %	TD Peak Load g
C1	Laminate Control (Total Draw 5.0X, Necking Draw 1.0X)	2799	353	35.7	11631	92.15	2319
6	Laminate (Total Draw 5.0X, Necking Draw 1.4X)	1213	454	56.62	20010	197.79	2264
	Laminate 6 stretched 2X	3980	207				
17	Laminate 6 with stretched KRATON® attached	1859	280*	126.64	15014	196.53	3979
	Laminate 17 stretched 2X in LD	1424					
	Laminate 17 stretched 2X in TD	3018					

*Supported by a lightweight (approximately 0.4 osy) layer of spunbond since it is elastic and would otherwise break under the weight of the water.

These samples were cycle tested as described above for Example 5 and the results are reported below in Tables 13 and 14. The Samples in Table 13 were cycle tested in the LD which is graphically illustrated in Figures 32-34. The Samples in Table 14 were cycle tested in the LD which is graphically illustrated in Figures 35-37.

Table 13

Sample	% elongation cycled to	at 50% of % elongation cycled to, in grams				Permanent Set (%)	LD Peak Load (g)	Elong @ Peak Load (%)
		First up	Third up	First Down	Second Down			
C1	21	4378	476	631	16	29	12533	43
6	31	7088	971	732	7	28	20536	64
17	66	339	252	199	18	18	15437	189

Table 14

Sample	% elongation cycled to	at 50% of % elongation cycled to, in grams				Permanent Set (%)	TD Peak Load (g)	Elong @ Peak Load (%)
		First up	Third up	First Down	Second Down			
C1	50	1027	98	5	6	62	2400	92
6	101	420	12	9	6.6	76	2300	194
17	72	905	107	12	14	58	4662	177

Having thus described the invention in detail, it should be apparent that various modifications can be made in the present invention without departing from the spirit and scope of the following claims.

164

We claim:

1. A composite material comprising:
   a) at least one first layer of a non-elastic neckable material;
   b) at least one second layer of a non-elastic film attached to said at least one first layer to form a laminate; wherein said laminate is necked in a first dimension to form a necked laminate and wherein said second film layer has striated rugosities in a dimension perpendicular to said first dimension; and
   c) at least one layer of an elastic material attached to said necked laminate.

2. The composite material of claim 1, wherein said material exhibits extension and retraction in at least one dimension and stretch and recovery in at least one dimension.

3. The composite material of claim 2, wherein said striated rugosities comprise trapezoidal, crenellated, or pleated striations.

4. The composite material of claim 2, wherein said means of attaching comprises point bonding, thermal point bonding, adhesive bonding, or sonic welding.

5. The composite material of claim 4, wherein adhesive bonding is used to attached the layers.

6. The composite material of claim 2, wherein said first dimension is defined by a transverse dimension and said perpendicular dimension is defined by a longitudinal dimension.

7. The composite material of claim 2, wherein said material is breathable.

8. The composite material of claim 2, wherein said non-elastic neckable material has a basis weight of from about 0.3 osy (10 gsm) to about 2.7 osy (90 gsm).

9. The composite material of claim 2, wherein said non-elastic neckable material or said non-elastic film comprises a polyolefin.

10. The composite material of claim 2 or 9, wherein said neckable material comprises a spunbond nonwoven material.

11. A conformable composite material for use in a garment comprising:
a) at least one first layer of a non-elastic neckable material;
b) at least one second layer of a non-elastic film attached to said at least one first layer to form a laminate; wherein said laminate is necked in a first dimension to form a necked laminate and wherein said second film layer has striated rugosities in a dimension perpendicular to said first dimension; and
c) at least one layer of an elastic material attached to said necked laminate; wherein a biasing force applied to said first dimension of said material will cause said material to extend, stretch and conform around the body of the user.

12. The conformable composite material of claim 11, wherein said striated rugosities comprise trapezoidal, crenellated, or pleated striations.

13. The conformable composite material of claim 11, wherein said means of attaching comprises thermal point bonding, point bonding, adhesive bonding, or sonic welding.

14. The conformable composite material of claim 13, wherein adhesive bonding is used to attach the layers.

15. The conformable composite material of claim 11, wherein said first dimension is defined by a transverse dimension and said perpendicular dimension is defined by a longitudinal dimension.

165

16. The conformable composite material of claim 11, wherein said non-elastic neckable material has a basis weight of from about 0.3 osy (10 gsm) to about 2.7 osy (90 gsm).

17. The conformable composite material of claim 11, wherein said composite material is breathable.

18. The conformable composite material of claim 11, wherein said laminate forms at least a portion of a personal care absorbent article.

19. The conformable composite material of claim 11, 17 or 18, wherein said laminate forms at least a portion of an outer cover for a personal care absorbent article.

20. The conformable composite material of claim 11 wherein said composite material contains apertures.

21. The conformable composite material of claim 20 wherein said composite material forms at least a portion of a liner for a personal care absorbent article.

22. The conformable composite material of claim 11, wherein said laminate forms at least a portion of a protective garment.

23. The conformable composite material of claim 11 or 20, wherein said laminate forms at least a portion of a facemask.

24. A method for making a composite material comprising:

a) providing at least one first layer of a non-elastic neckable material;

b) providing at least a second layer of a non-elastic film layer;

c) attaching said non-elastic neckable material to said non-elastic film to form a laminate;

d) stretching said laminate in a first dimension to neck said laminate in a dimension perpendicular to said first dimension to form a necked laminate such that striated rugosities are formed in said non-elastic film layer in said perpendicular dimension; and

e) further attaching at least a third layer of an elastic material to said necked laminate.

25. The method of claim 24, further comprising partially stretching said non-elastic film layer prior to formation of the laminate to render said film layer in the laminate breathable.

26. The method of claim 25, wherein said non-elastic film layer contains from about 20% to about 45% by volume of filler.

27. The method of claim 25, wherein said laminate has a WVTR of at least about 1000 g/m^2/24 hours.

28. The method of claim 24, further comprising heating said laminate.

29. The method of claim 24, wherein said step of attaching comprises adhesive bonding, thermal point bonding, point bonding, or sonic welding.

30. The method of claim 29, wherein adhesive bonding is used to attach the layers.

31. The composite material of claim 24, wherein said laminate is stretched to about 1.2 to about 1.6 times its original length.

32. A breathable, conformable composite material for use in a garment, comprising:

a) at least one first layer of a non-elastic neckable spunbond material having a basis weight of from about 0.3 osy (10 gsm) to about 0.7 osy (24 gsm);

b) at least one second layer of a non-elastic film containing from about 20% to about 45% by volume of filler, said second film layer attached to said non-elastic neckable spunbond material to form a laminate; wherein said laminate is necked in a first dimension to about 30% to about 80% of its original width to form a necked laminate, and wherein said film layer has striated rugosities in a dimension perpendicular to said first dimension, such that a biasing force applied to said first dimension of said laminate will cause said necked laminate to extend and conform around the body of the user; and

166

c) at least one layer of a stretched elastic material attached to said necked laminate such that the composite material exhibits stretch and recovery in at least one dimension.

33. The breathable, conformable composite material of claim 32 wherein said composite material exhibits stretch and recovery in multiple dimensions.

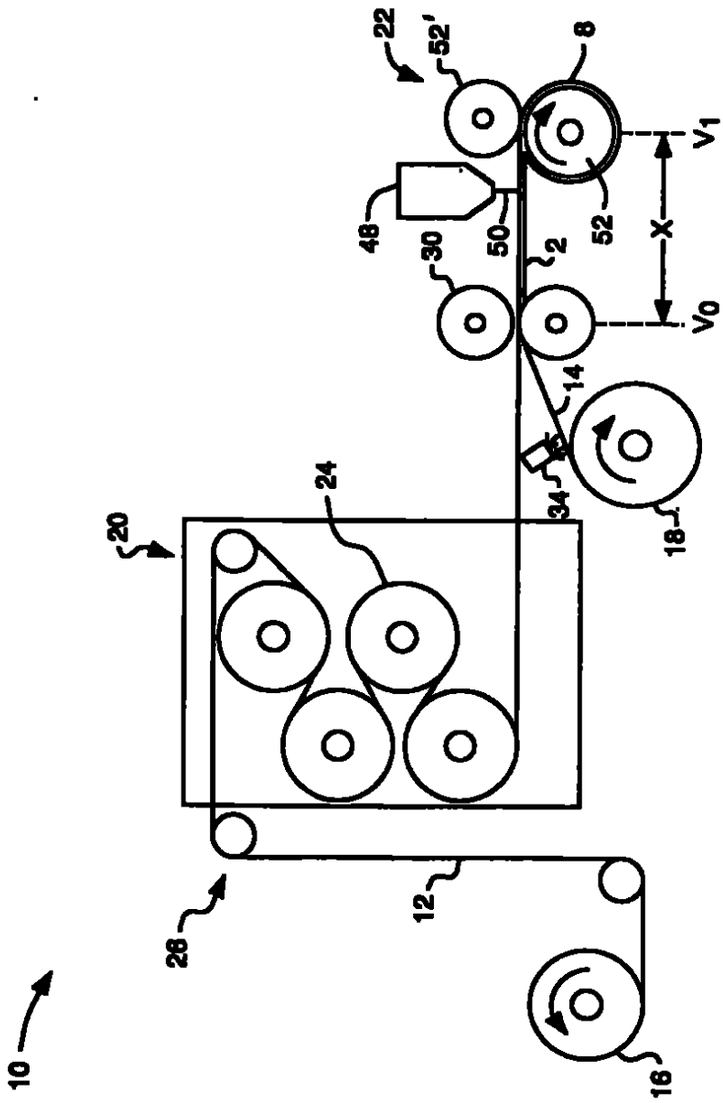


FIG. 1

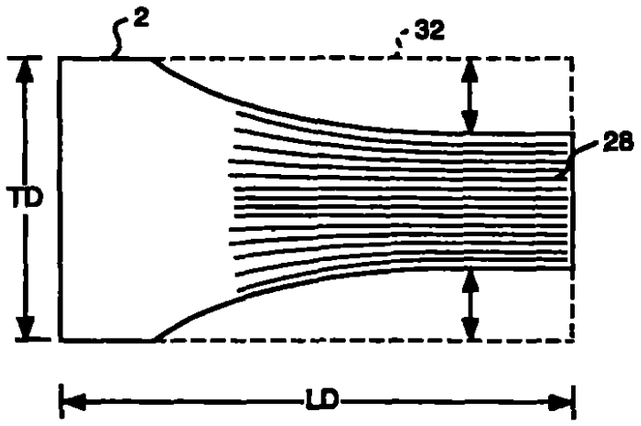


FIG. 2

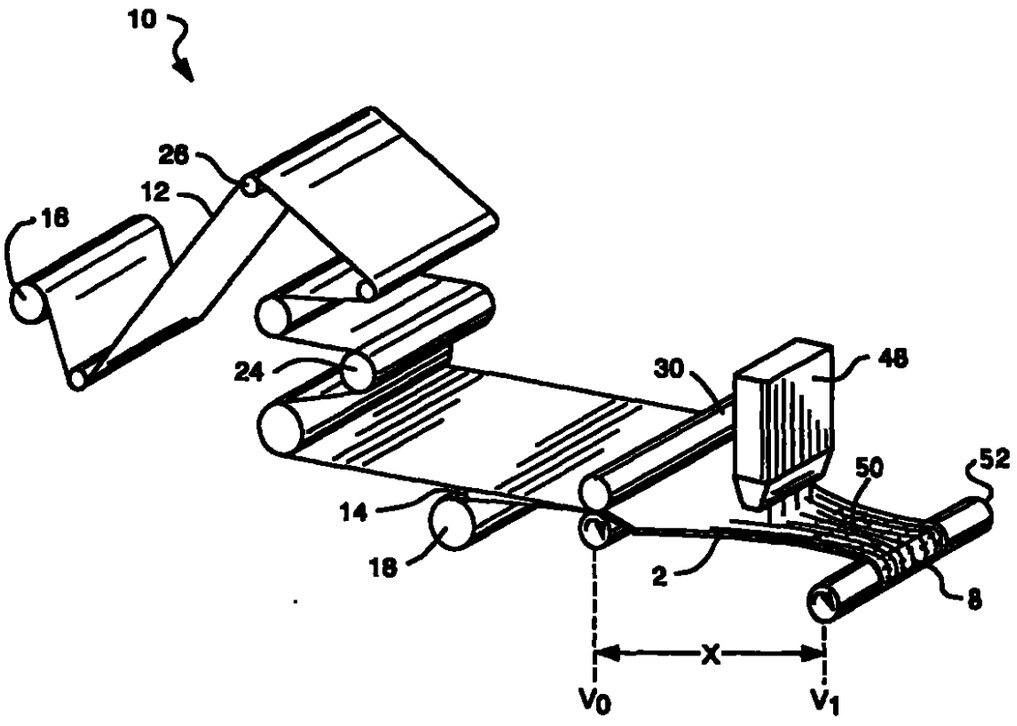


FIG. 3

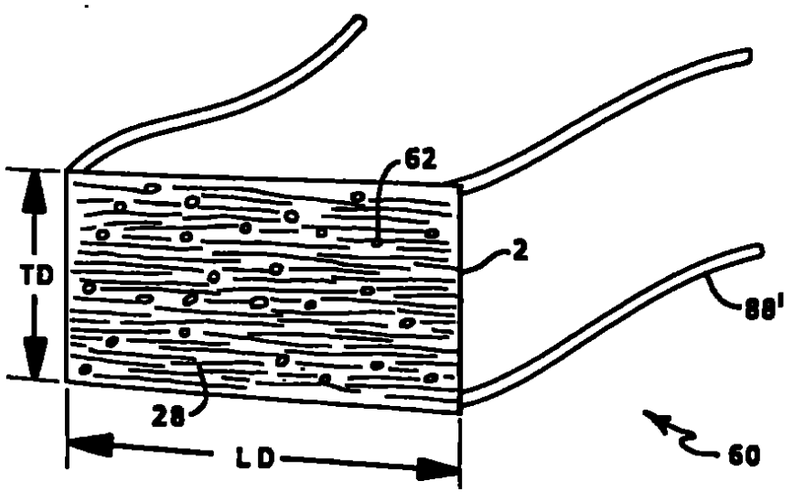


FIG. 5

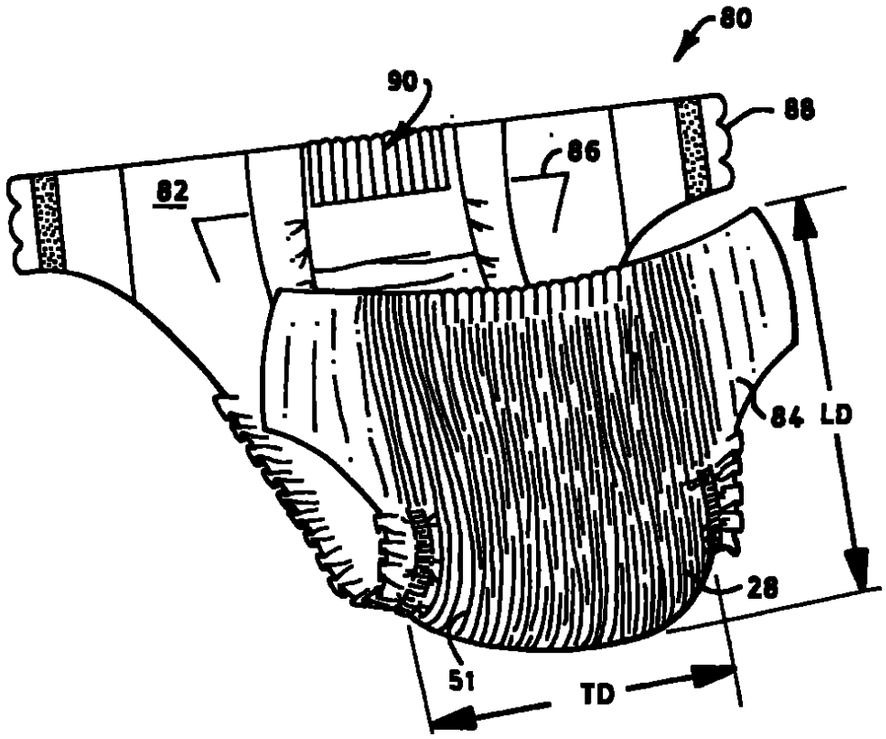


FIG. 4

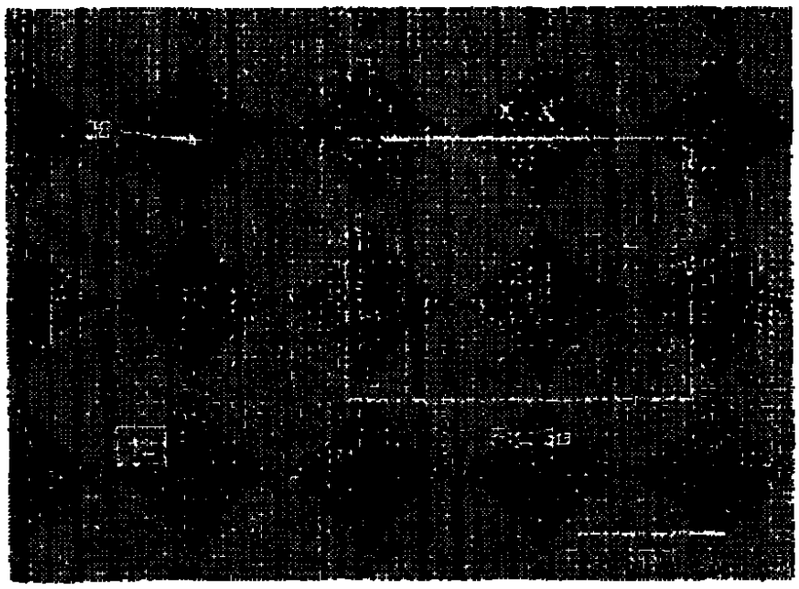


FIG. 6

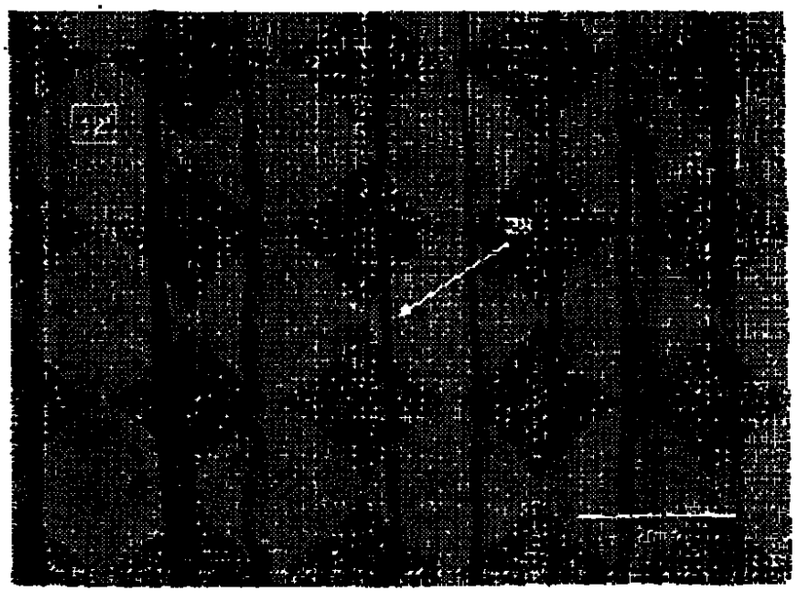


FIG. 6a

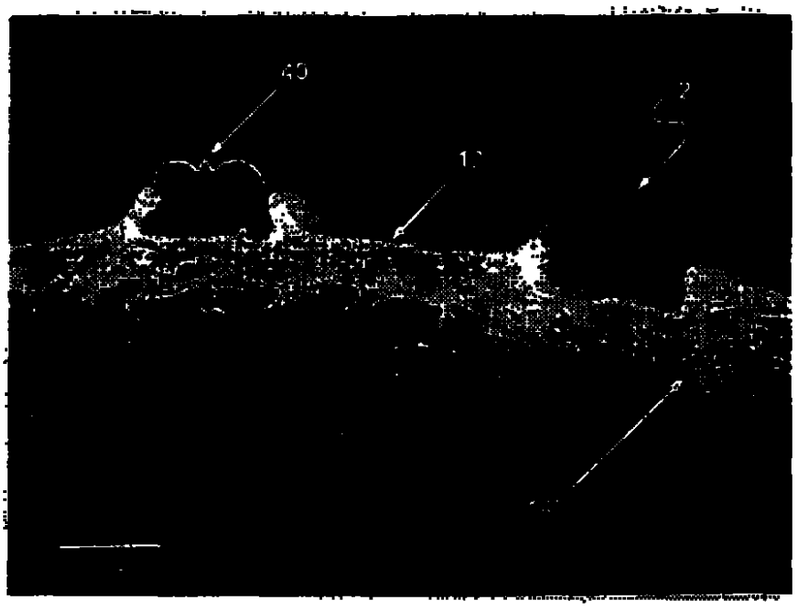


FIG. 7

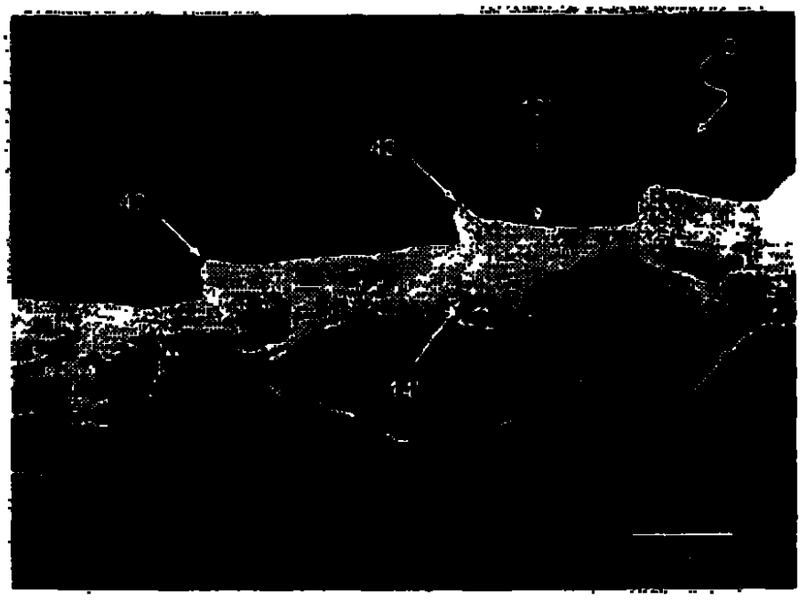


FIG. 8

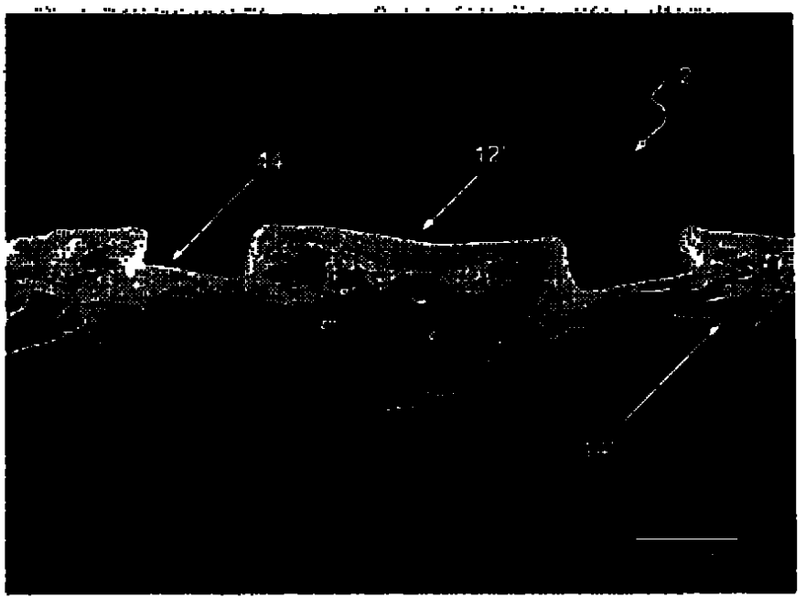


FIG. 9

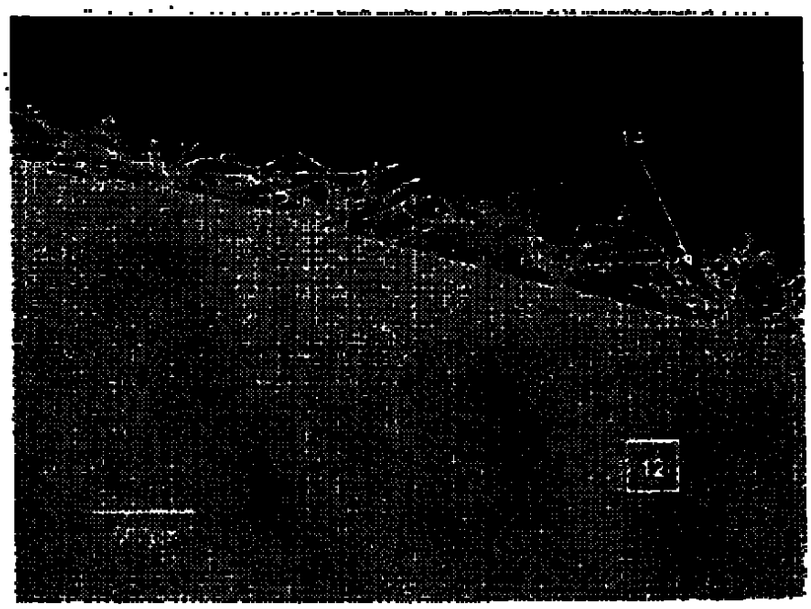
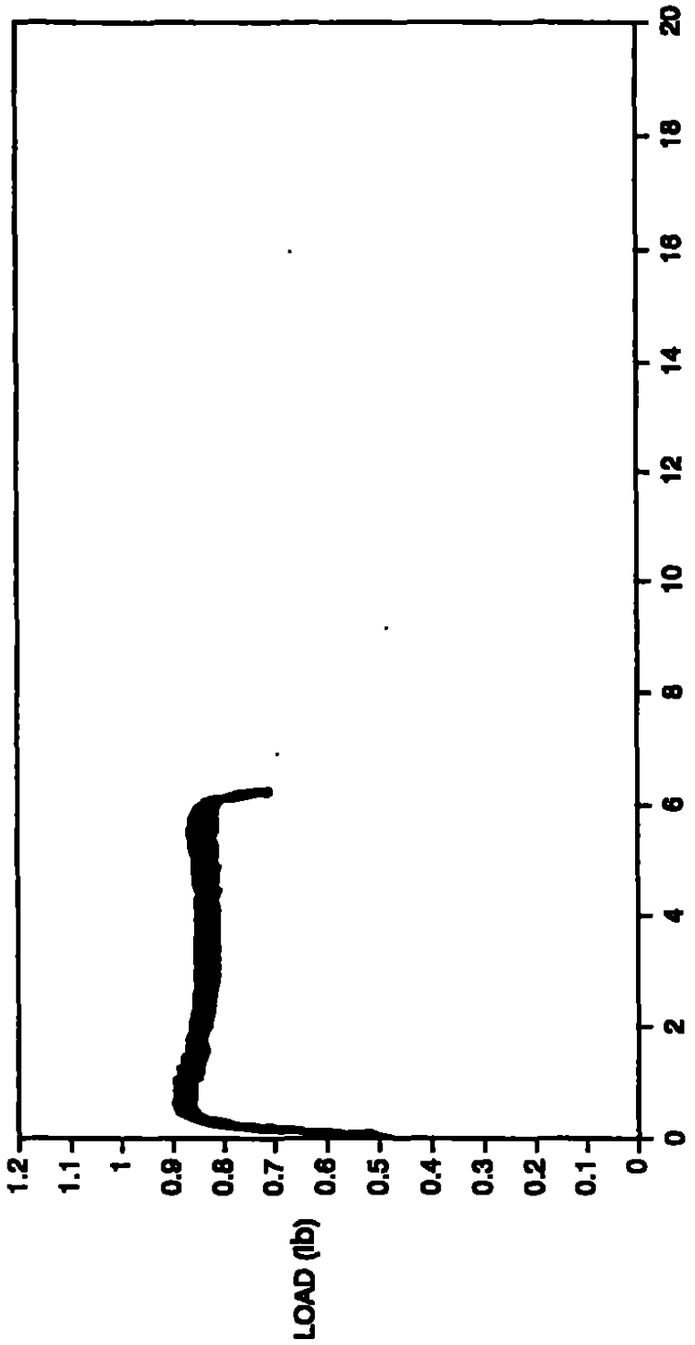


FIG. 10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6
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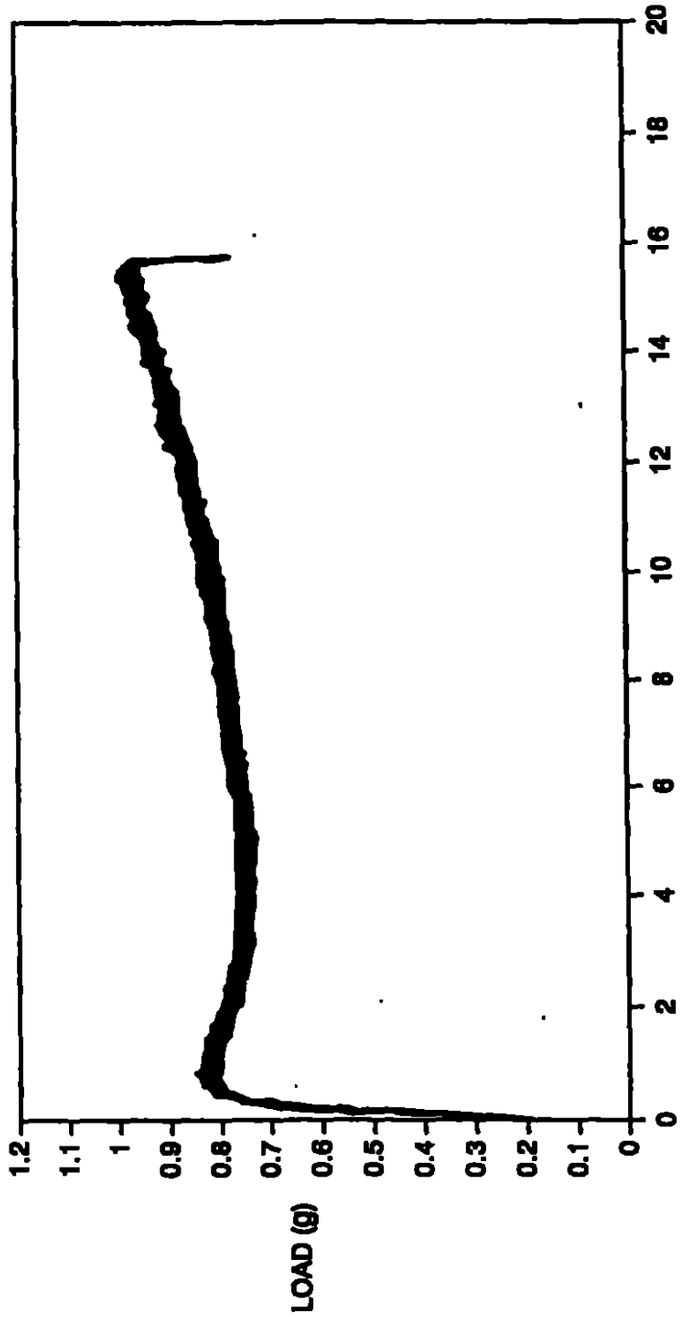
12
14
16
18
20

FIG. 11A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EXTENSION (in)
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2
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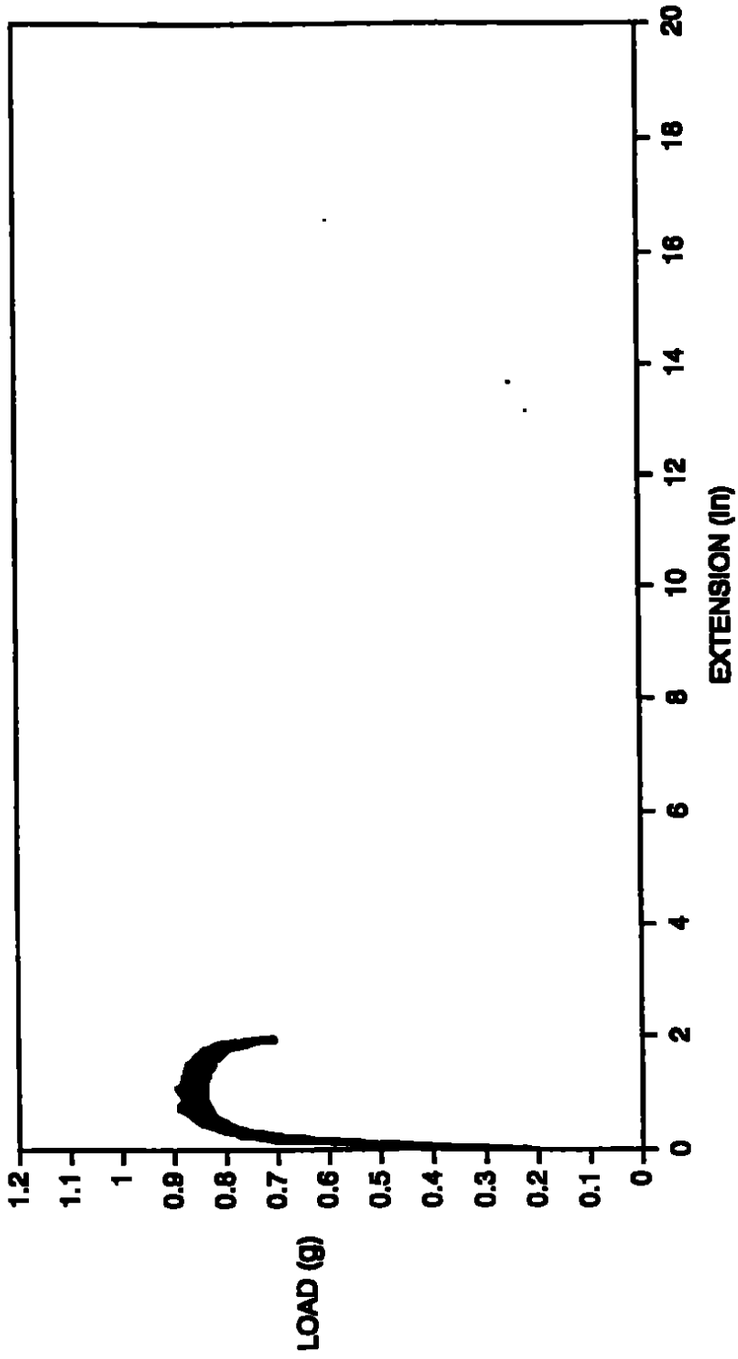
6
8
10
12
14
16
18
20

FIG. 11B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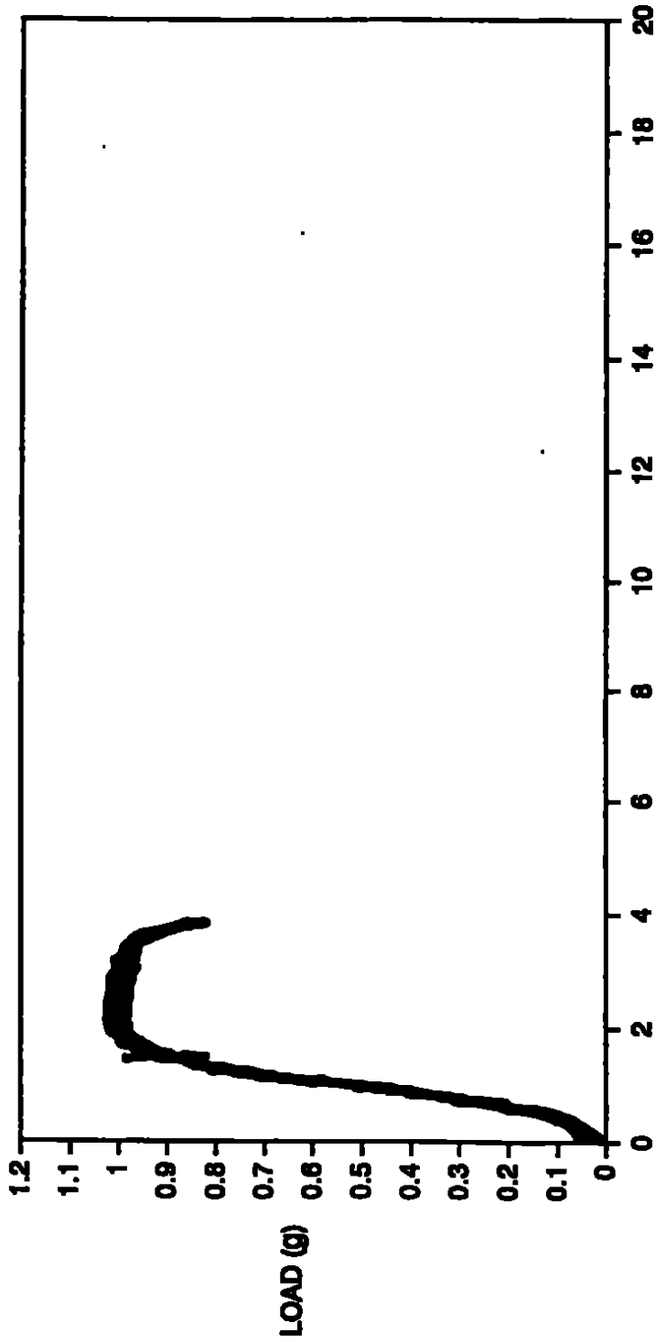
0
2
4
6
8
10
12
14
16
18
20
EXTENSION (in)

FIG. 11C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0.8
0.7
0.6
0.5
0.4
0.3
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EXTENSION (in)
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2
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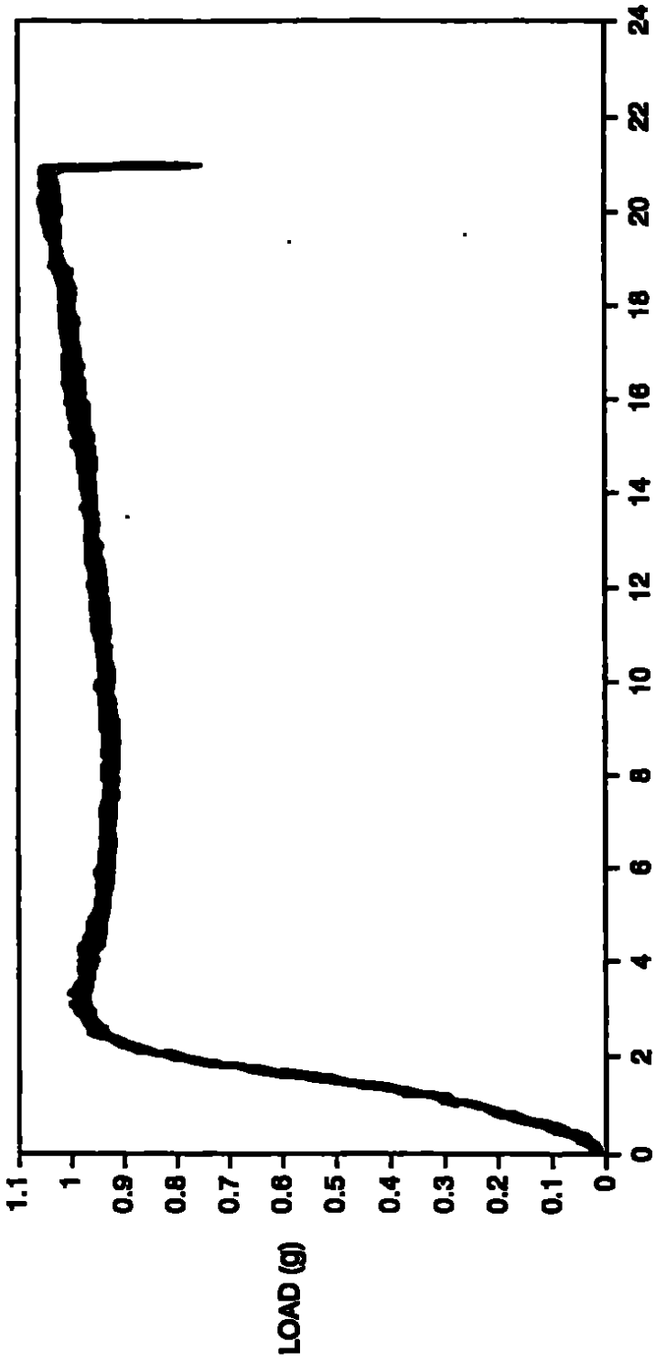
6
8
10
12
14
16
18
20

FIG. 12A


LOAD (g)
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0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
2
4
6
8
10
12
14
16
18
20
22
24
EXTENSION (in)

FIG. 12B

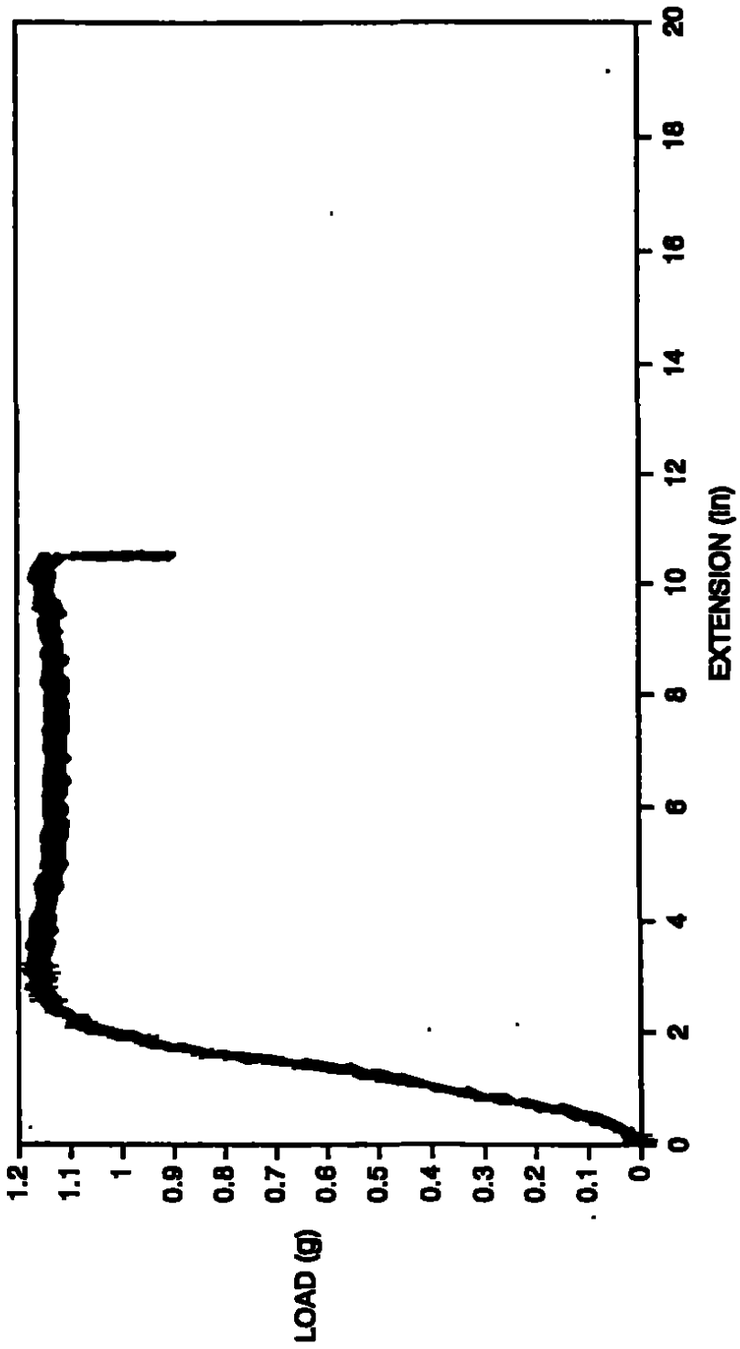
LOAD (g)
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
2
4
6
8
10
12
14
16
18
20
EXTENSION (in)

FIG. 12C

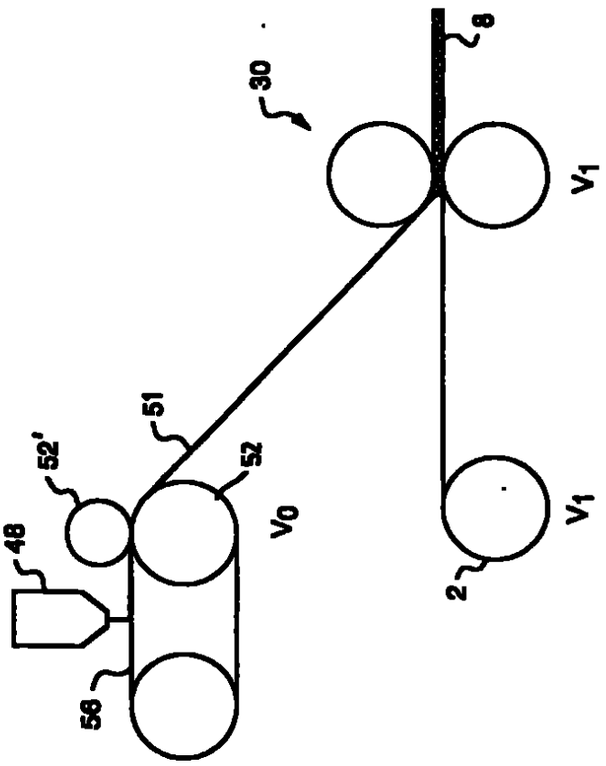

FIG. 13

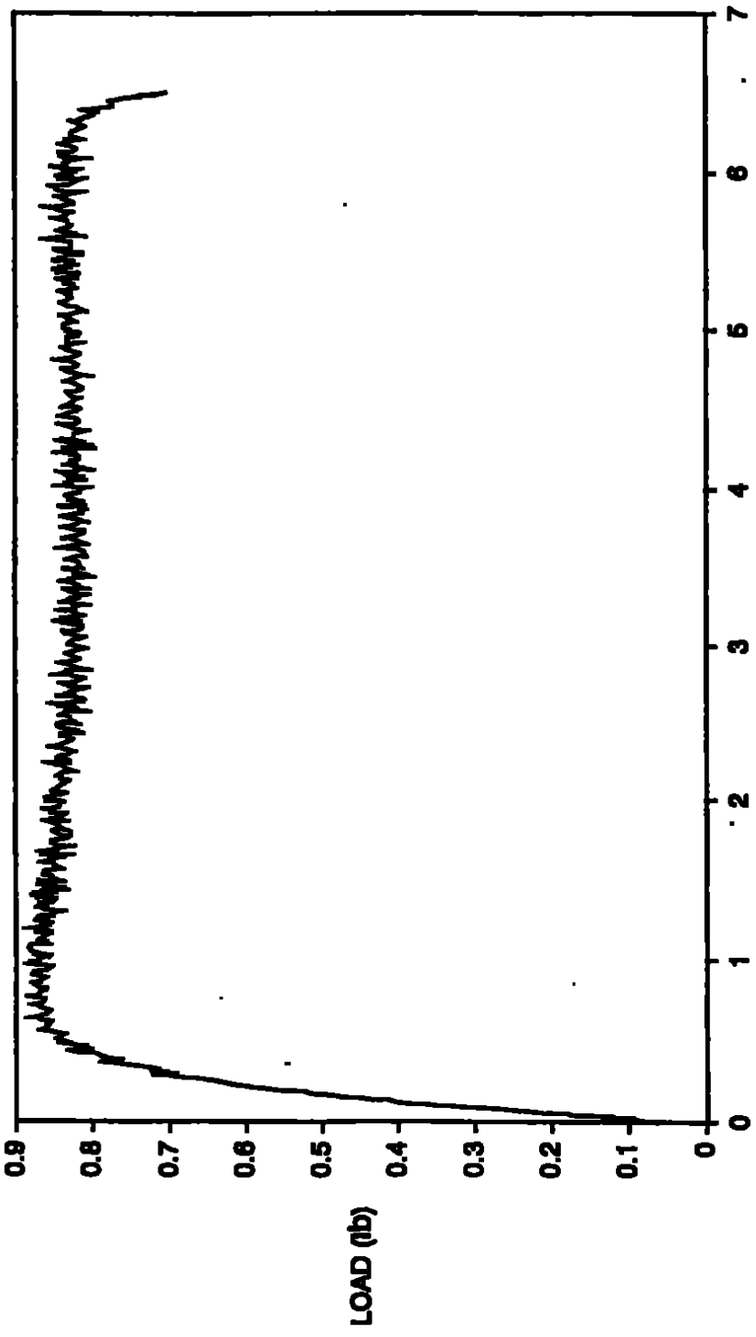

FIG. 14

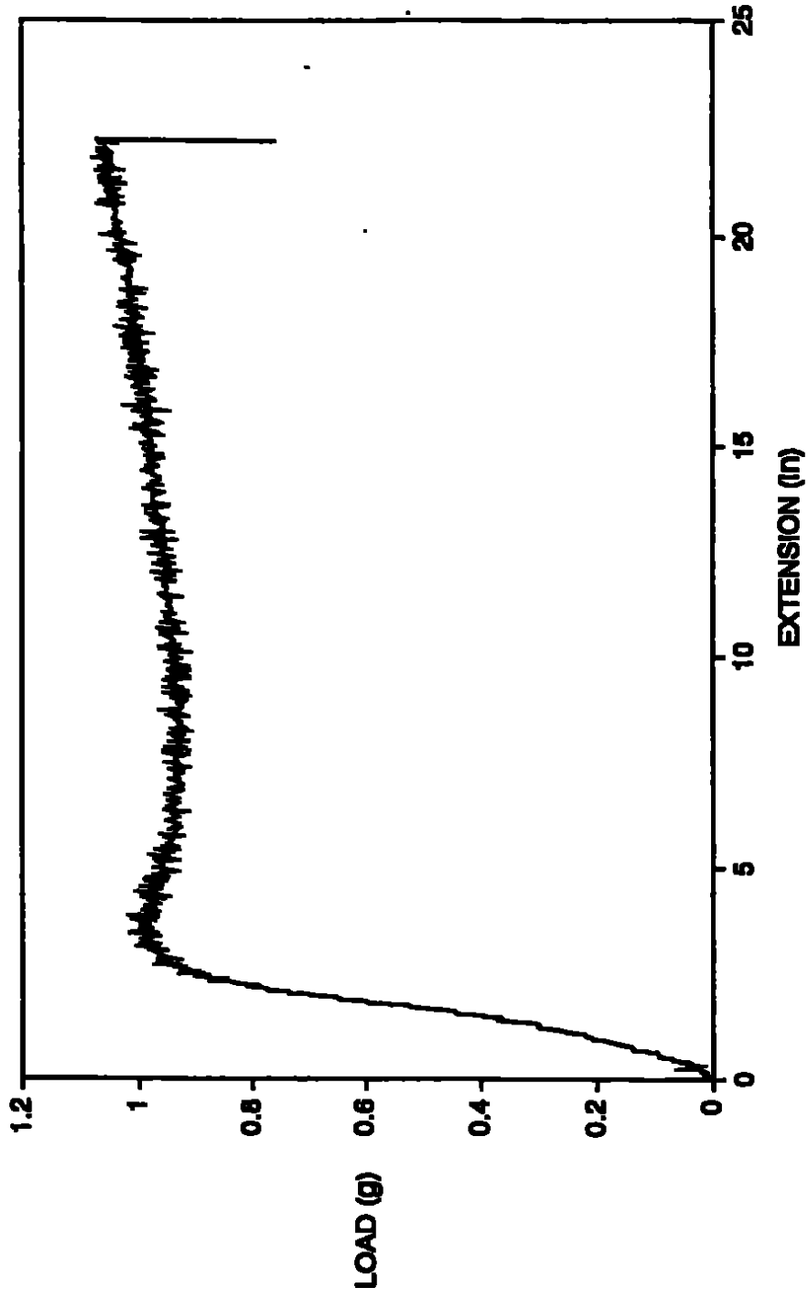

FIG. 15

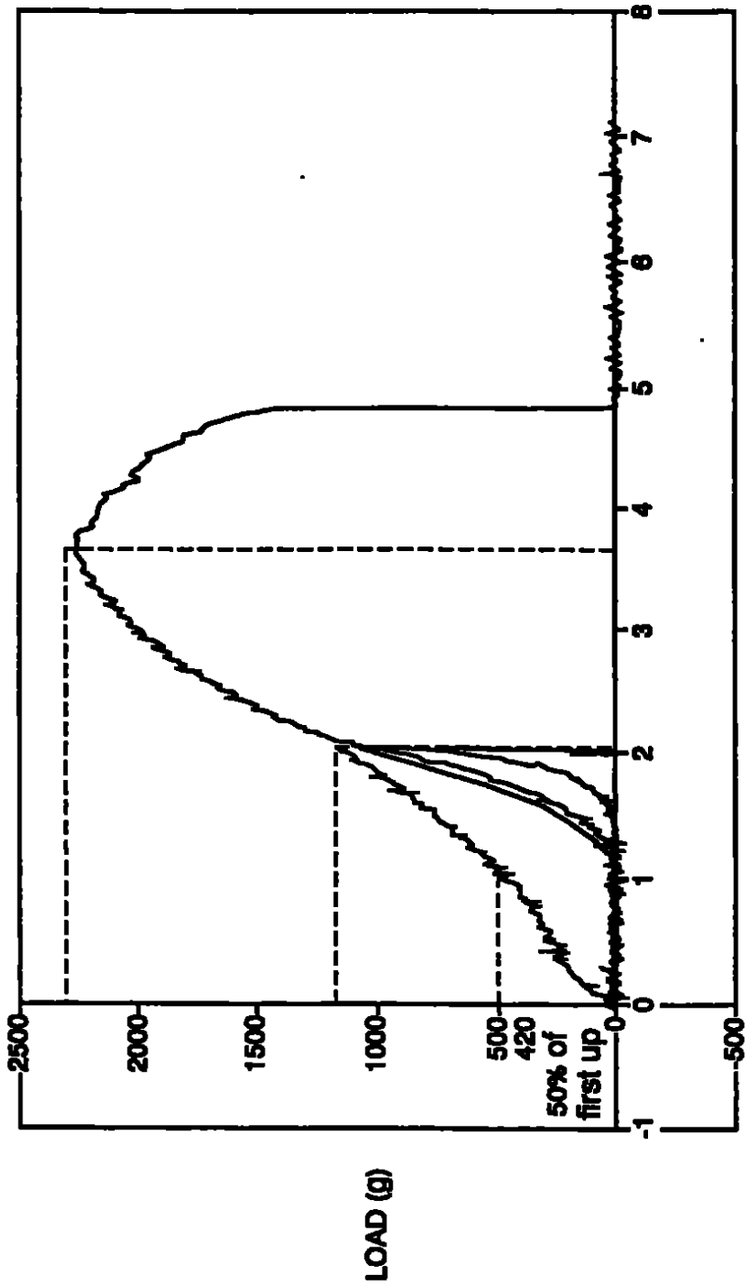
LOAD (g)
2500
2000
1500
1000
500
420
50% of first up
0
500
-1
0
1
2
3
4
5
6
7
8
EXTENSION (in)

FIG. 16

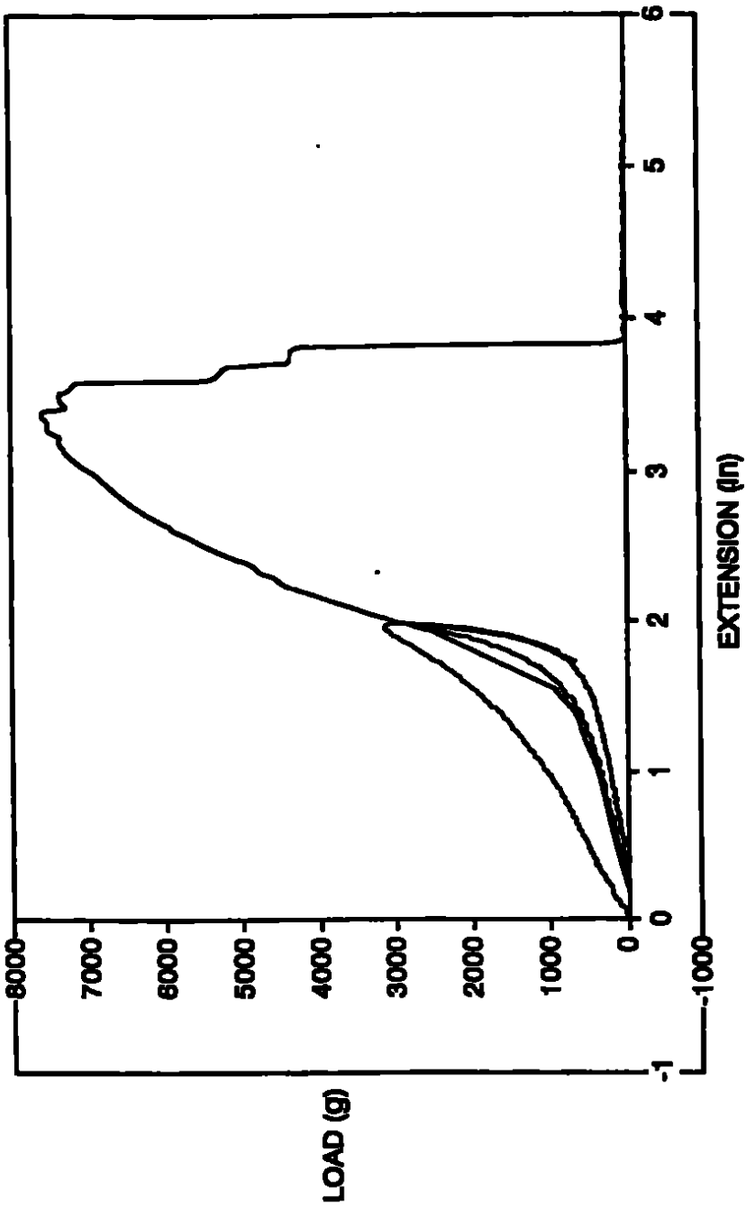
LOAD (g)
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
-1
0
1
2
3
4
5
6
EXTENSION (in)

FIG. 17

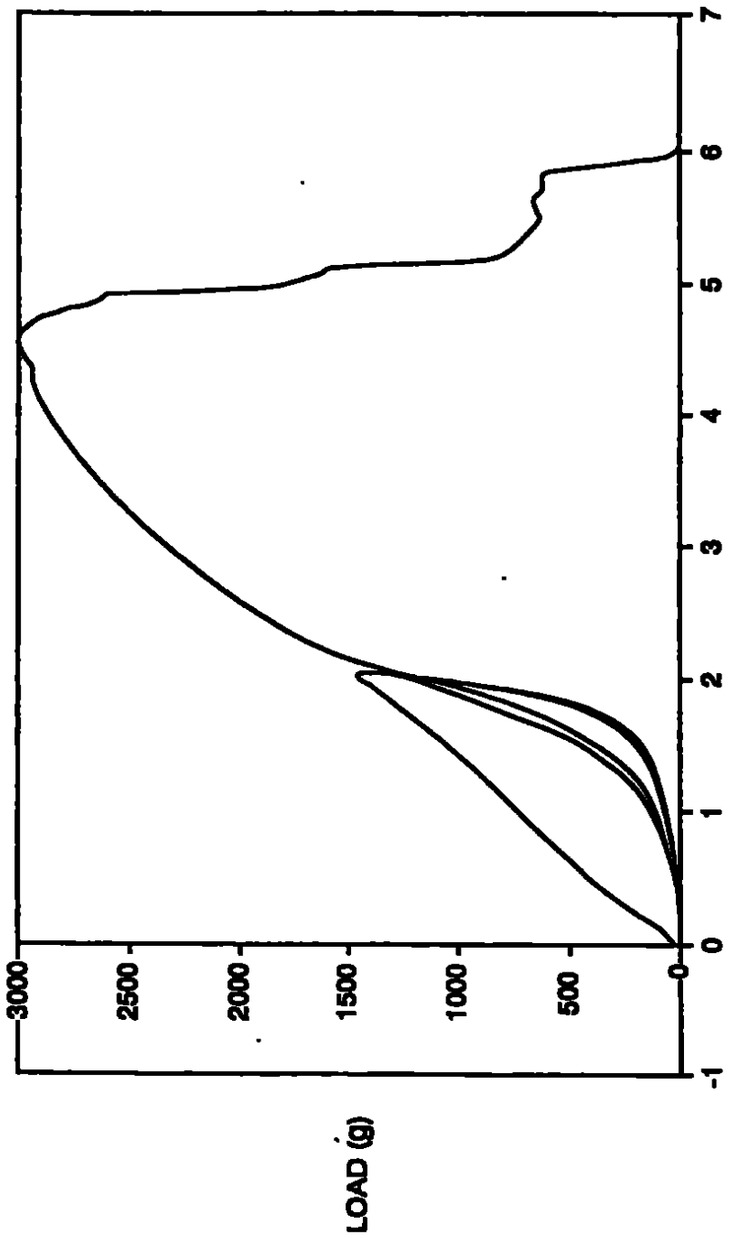

FIG. 18

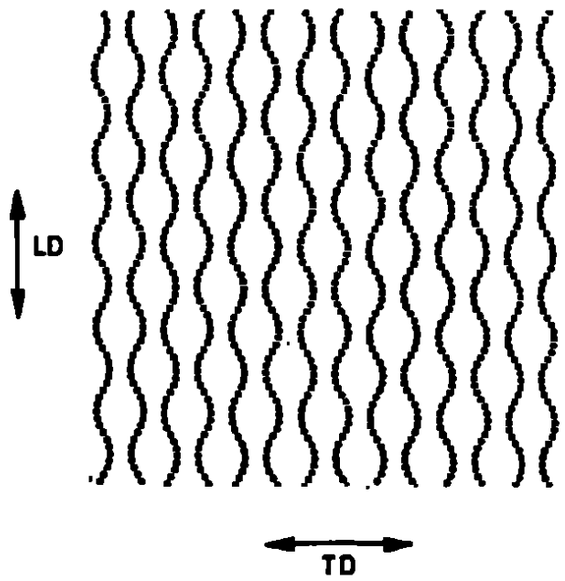

FIG. 19a

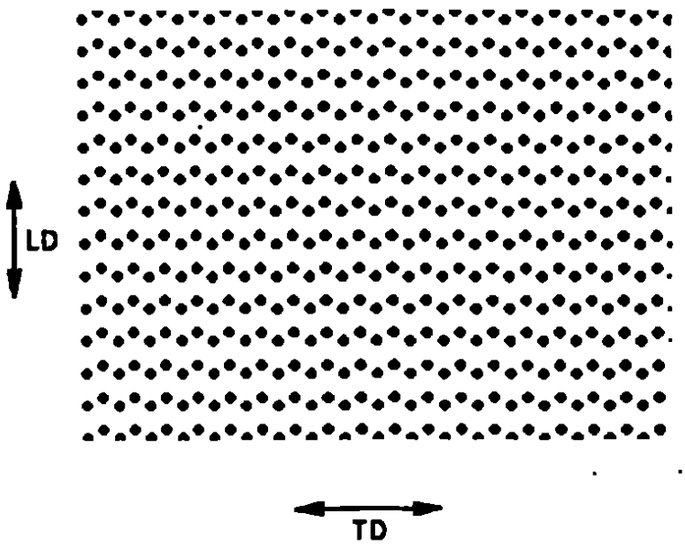

FIG. 19b

176

FIG. 20

FIG. 21

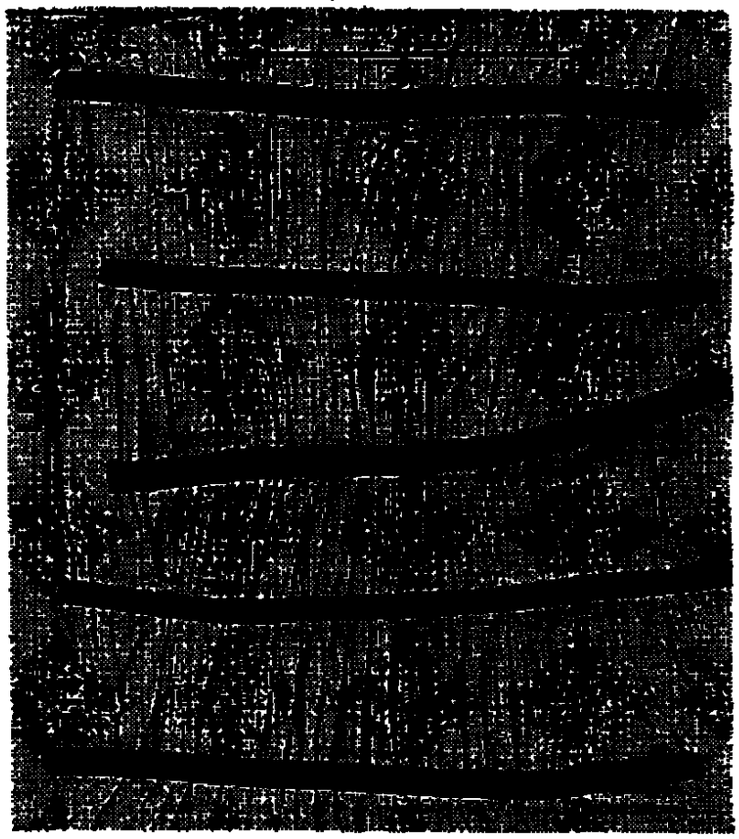

FIG. 22

178

Radicacion : [illegible] Folios: 1/8

Fecha (AAAA): [illegible]

Tramite : [illegible]

Dependencia: [illegible] DIVISION DE NUEVAS CREACIONES

[illegible] PARA [illegible] TRAMITE

	USUARIO	RADICADOR
[illegible] O DE UTILIDAD	( )	( )
[illegible] una patente.		( )
[illegible] que [illegible] solicitud.		( )
		( )
		( )
[illegible]	( )	( )
[illegible] registro de Diseño [illegible]	( )	( )
[illegible] o de la par[illegible]	( )	( )
[illegible] Diseño [illegible]		
[illegible]	( )	( )
[illegible] ablecidas	( )	( )
[illegible] INCOMPLET[illegible]	( )	

ESQUEMA DE TRAZADO ( )

	USUARIO	RADICADOR
- Indicación de que solicita el registro de un Esque[illegible] de trazado.	( )	( )
- Datos de identificación [illegible]	( )	( )

ANDREA POSE