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ESCOBAR - URIBE ASOCIADOS

A B O G A D O S

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SUPERINDUSTRIA Y COMERCIO
Radicacion : 00072898 00000002 Folios: 2
Fecha (AMD): 2002-09-17 16:38:09
Tramite : 002 PATENTES B 1 REGISTRO/ 538 PETICION
Dependencia: 2020 DIVISION DE NUEVAS CREACIONES

As. 2363/P.

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO
DIVISIÓN DE NUEVAS CREACIONES
E. S. D.

Ref.: Expediente No. 00-072.898
Solicitud de Patente a nombre de
Johnson & Johnson Indústria e Comércio Ltda.

Yo, JIMENA ESCOBAR URIBE, identificada como aparece al pie de mi firma, domiciliada en Bogotá, en la Carrera 11 A No. 94-76 Of. 305, obrando como apoderada de la sociedad Johnson & Johnson Indústria e Comércio Ltda., domiciliada en São Paulo, Brasil, solicitante de la patente de la referencia, pido a usted que se proceda a examinar si la invención, cuya patente se tramita en el expediente de la referencia, es patentable.

Adjunto al presente memorial el recibo No. 02 - 61,715 de septiembre 16, 2002, por la suma de $318.000.oo, con lo cual queda cubierta la tasa oficial correspondiente a dicho estudio.

Señor Superintendente,

JIMENA ESCOBAR URIBE
C.C. 39.779.452 de usaquén
T.P. 68.228
Cod. 5376

JEU/ra.

2363 49 ~~58~~

Industria y Comercio
SUPERINTENDENCIA

SUPERINDUSTRIA Y COMERCIO
Radicacion : 00072898 00000002
Fecha (AMD): 2002-09-17 16:33:09 Folios: 2
Tramite : 002 PATENTES D 1 REGISTRO/ 538 PETICION
Dependencia: 2020 DIVISION DE NUEVAS CREACIONES

NIT : 800176089-2

RECIBO OFICIAL DE CAJA : 02 - 61,715
FECHA : SEPTIEMBRE 16 DE 2002

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

DEPOSITANTE	TIPO PAGO	BANCO	CUENTA	No. PAGO	FECHA PGO	Vr. PAGO
ESCOBAR URIBE ASOCIADOS	CONSIGNACION	BANCO POPULAR	050-00110-6	4884778	13/09/2002	4,005,000.00

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

CANT.	RENTISTICO		CONCEPTO	TOTAL CONCEPTO
1	50005-01-01	SOLICITUDES	85 EXAMEN DE PATENTABILIDAD DE INVEN	318,000.00
			TOTAL : $	318,000.00

SON: ESCIENTOS DIEZ Y OCHO MIL PESOS

RESPONSABLE : ______________________________

RECIBO DE CAJA APLICADO AL EXPEDIENTE No.______________________

Carrera 13 No. 27-00 Pisos 5, 7 y 10
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SUPERINTENDENCIA DE INDUSTRIA Y COMERCI
DIVISIÓN DE NUEVAS CREACIONES

2020
Bogotá, D. C., 8 de Julio de 2005

Doctora
JIMENA ESCOBAR URIBE
Representante **JOHNSON & JOHNSON INDUSTRIA E COMERCIO LTDA.**

ASUNTO	Radicación No.	**00-72898**
	Trámite	002
	Evento	001
	Actuación	430
	Oficio	05825
	Folios	078

Como resultado del examen de fondo, realizado con fundamento en el artículo 45 de la Decisión 486 de la Comisión de la Comunidad Andina, se le comunica

1) **Documentos estudiados:**

a) Para el presente estudio se tendrán en cuenta el capítulo descriptivo, comprendido en los folios 3 a 11 de la solicitud en estudio.

b) Para el presente estudio se tendrán en cuenta los dibujos comprendidos en los folios 15 a 16 de la solicitud en estudio.

c) Para el presente estudio se tendrá en cuenta el capítulo reivindicatorio que comprende 8 reivindicaciones en los folios 28 a 29 de la solicitud en estudio.

d) Conforme lo establece los artículos 9, 10 y 11 de la decisión 486 de la Comisión de la Comunidad Andina, la presente solicitud en estudio fue presentada el 26 de septiembre de 2000, y en el momento de la radicación **SI** se reclamo prioridad de la primera solicitud presentada en Brasil PI9904370-0.

2) **Objeto de la invención**

a) Las reivindicaciones 1 a 8 de la solicitud en estudio se refieren a una toalla sanitaria desechable para uso externo, que está constituida por pliegues longitudinales en toda su estructura, los cuales permiten que la toalla sanitaria se extienda y/o se encoja al adaptarse a la pantaleta de la usuaria.

b) El anterior producto busca mejorar las propiedades de artículos absorbentes desechables.

c) Según la Clasificación Internacional de Patentes, la codificación para esta solicitud corresponde a: A 61 F 13/15

3) **Determinación del Estado de la Técnica**

El artículo 16 de la Decisión 486 de la Comisión establece:

> *"El estado de la técnica comprenderá todo lo que haya sido accesible al público por una descripción escrita u oral, utilización, comercialización o cualquier otro medio antes de la fecha de presentación de la solicitud de patente o, en su caso, de la prioridad reconocida."*
>
> *"Sólo para el efecto de la determinación de la novedad, también se considerará dentro del estado de la técnica, el contenido de una solicitud de patente en trámite ante la oficina nacional competente cuya fecha de presentación o de prioridad fuese anterior a la fecha de presentación o de prioridad de la solicitud de patente que se estuviese examinando, siempre que dicho contenido este incluido en la solicitud de fecha anterior cuando ella se publique o hubiese transcurrido el plazo previsto en el artículo 40."*

Consultadas las bases de datos y los archivos con que cuenta la entidad, especialmente bajo las clasificaciones **A 61 F 13/15** y las más cercanas a ellas, se encontró que antes del 28 de septiembre de 1999 (fecha para determinar el estado de la técnica) habían sido publicados los documentos que se enumeran en la siguiente tabla los cuales se relacionan con artículos absorbentes desechables con pliegues.

De acuerdo con o establecido en el artículo 16 se determinó el estado de la técnica y se encontró el siguiente antecedente:

Nº	*Documento*	*Título*	*Fecha de Publicación*
D1	AU659916362	Corrugated top layer for absorbent articles	1999.02.09
D2	WO 9720531	Web materials having elastic-like and expansive zones	1997.06.12
D3	US 5683374	Absorbent padding for undergarments	1997.11.04
D4	WO9534264	Elastic sheet-like composite	1995.12.21

4) **Evaluación de los requisitos de patentabilidad**

El artículo 14 de la Decisión 486 de la Comisión de la Comunidad Andina establece:

> *"Los Países Miembros otorgarán patentes para las invenciones, sean de producto o procedimiento, en todos los campos de la tecnología, siempre que sean nuevas tengan nivel inventivo y sean susceptibles de aplicación industrial".*

En cumplimiento con este artículo, se procedió a evaluar los requisitos de novedad, nivel inventivo y aplicación industrial con el fin de establecer la patentabilidad de la invención reivindicada en la solicitud en estudio.

a) Evaluación del Nivel Inventivo

El art. 18 de la Decisión 486 de la Comisión de la Comunidad Andina establece:

"Se considerará que una invención tiene nivel inventivo, si para una persona del oficio normalmente versada en el arte en la materia técnica correspondiente, esa invención no hubiese resultado obvia ni se hubiese derivado de manera evidente del estado de la técnica".

Para cualquier técnico es conocido que el uso de pliegues permite al medio que incorpora los pliegues adaptarse de forma más sencilla a otros medios. De ahí que se use mucho en textiles y aun más en artículos absorbentes. Los documentos citados incorporan referencias a artículos absorbentes, donde todos poseen pliegues que permiten que dicho artículo se incorpore de mejor forma al usuario o usuaria. La solución propuesta por el solicitante resultaría obvia para un técnico medio a la luz de las anterioridades citadas y de las referencias que estas incorporan.

b) Resumen

En conclusión los requisitos de patentabilidad de la presente solicitud se podrían ver afectados así:

N°	Documento	Reivindicaciones afectadas	Requisito que afecta
D1	AU659916362	1 - 8	Nivel inventivo
D2	WO 9720531	1 - 8	Nivel inventivo
D3	US 5683374	1 - 8	Nivel inventivo
D4	WO9534264	1 - 8	Nivel inventivo

5) **Notificación**

En cumplimiento del artículo 45 de la Decisión 486 de la Comisión de la Comunidad Andina, se le indica que dentro del término de sesenta días contados a partir de la fecha de la notificación de la presente comunicación debe responder a la notificación. En caso de no dar respuesta al presente requerimiento, o si a pesar de la respuesta subsistieran los impedimentos para la concesión, se denegará la patente.

Notifíquese el presente oficio conforme a lo dispuesto por el numeral 5.2, literal e) del capítulo quinto del título primero de la Circular Única Nº 10 de 2001

ALIX CARMENZA CÉSPEDES DE VERGEL
Jefe División de Nuevas Creaciones

El anterior requerimiento fue notificado por fijación en la lista, de fecha

14 JUL 2005

Concepto Técnico Nº	EXAMINADOR TÉCNICO Código No.	EXAMINADOR JURÍDICO Código No.
1006	**202003**	

ABSTRACT

An absorbent sanitary product for the absorption of body liquids consisting of a liquid-proof covering layer (underwear protecting foil 1) on the back, a liquid-permeable covering layer (9) on top and an absorbent body (2) inserted between back and top covering layer (9, 1). The top covering layer (9) is equipped with two or more folds (10) on the area within the absorbent body, which folds (10) follow the longitudinal direction of the product.

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Regulation 3.2(2)

AUSTRALIA

Patents Act 1990

ORIGINAL
COMPLETE SPECIFICATION
STANDARD PATENT

Application Number: 16362/99
Lodged: 9 FEBRUARY 1999

Invention Title: CORRUGATED TOP LAYER FOR ABSORBENT ARTICLES

The following statement is a full description of this invention, including the best method of performing it known to us :-

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CORRUGATED TOP LAYER FOR ABSORBENT ARTICLES

The invention relates to an absorbent sanitary product for the absorption of body fluid, such as for example sanitary napkins, diapers, incontinence articles or the like, having a liquid proof back covering layer, a top liquid-permeable covering layer and an absorbent body inserted therebetween.

Sanitary products of this type are known. An example of such a product is disclosed in GB -A- 2023067. They are all provided with a liquid-proof covering layer on the back and a liquid-permeable covering layer on the top with an absorbent body inserted between these two layers.

The covering layer on the back usually consists of a thin polyethylene foil. The liquid-permeable covering layer is mostly of nonwoven material, but perforated foils can also be used.

Normally the absorbent body is produced of cellulosic flocs or so-called air-laid-material.

In addition of the basic absorptive capacity of the absorbent body the product's technical features of the body-facing covering layer such as the tactile softness, absorbing time in relation to the body liquids, the distribution over the sanitary product and the rewet properties are of vital importance. The nonwoven covers normally used for the body-facing cover layer are comparable in most of the above-mentioned features.

The previously mentioned perforated foils have been improved in their absorptive capacity and in the visual impression after admission of menstruation liquid for instance, whereas impairments might occur by the plastic-like character of the perforated foils which causes perspiration.

Above-mentioned properties of the body-facing covering layer regarding the absorbing time and distribution of incurring body liquids and rewetting have a major impact on the leaking safety of the respective sanitary product. Due to the technical standard a variety of measures are known which influence these factors positively. For instance a transport layer has been inserted under the body-facing covering layer to improve the absorbing time and the rewet properties. Improvements on the liquid distribution in the longitudinal direction of mentioned

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sanitary products - which lead to an increased safety against lateral leakage of the body liquid - have been substantially obtained by impressed, longitudinal lines on the surface of a sanitary napkin.

A substantial contribution regarding the sanitary product's leaking safety are so-called cuffs, which, arranged on both of the lateral longitudinal margins of the absorbent body, form a liquid barrier that stays upright by means of elasified material and hinders lateral leakage of the body liquid. While there cuffs greatly increase the leaking safety, they considerable complicated the production of sanitary napkins, diapers, incontinence articles and the like.

From the reference GB-A-20 23 067 it is also known to provide the liquid-permeable top sheet with a plurality of folds following the longitudinal direction of the product. These folds are evenly distributed over the width of the sanitary product. The foot areas of the folds are attached to the absorbent body of the sanitary product.

It is an object of the invention to modify sanitary products of the known type in a manner that the arrangement of folds is optimized concerning the distribution and absorption of body liquids on the one hand and low manufacturing efforts concerning the pleating of a top sheet on the other hand.

According to the present invention, there is provided a sanitary product for the absorption of body liquids including a top liquid-permeable covering layer, a liquid-proof back covering layer, and an absorbent body inserted between the back and top covering layers, the sanitary product having a longitudinal direction and a center plane which bisects the sanitary product through the top layer, absorbent body and back layer in the longitudinal direction, wherein the top covering layer in the area of the absorbent body is arranged in two or more folds following the longitudinal direction of the sanitary product, wherein foot areas of the folds, directing towards the absorbent body, are attached to the absorbent body or to a support layer inserted between the absorbent body and the top covering layer, wherein the foot areas of the folds are glued or welded on the absorbent body or the support layer and wherein several folds are provided on two lateral strips and whereas there is at least a strip without folds in the top layer

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between the center plane and the folds provided on at least one of the two lateral strips.

Preferably, center folds are provided symmetrically to the center plane whereas a strip without folds remains between the center folds and the folds provided on the two lateral strips.

Preferably, center folds are provided symmetrically to said center plane.

Preferably, said top liquid-permeable covering layer is of a non-woven material.

Preferably, the foot areas of the folds are glued or welded on the absorbent body or the support layer over a width of 0.2-10 mm.

Preferably, 2-10 folds are provided on said two lateral strips.

Preferably, the foot area of two adjacent folds are fixed with a mutual spacing of from 1 to 20 mm.

Preferably, the height of the folds is from 1 to 20 mm in no-load condition.

The following statements relate to exemplary embodiments of the invention.

Furthermore it is noted that the folds in most areas of the covering layer built a spacing between themselves and the absorbent body underneath, which improves both the absorptive or penetrating action of the body liquid into the absorbent body and the rewet properties. The visual impression after admission of for instance menstruation liquid will also be improved because raised folded areas are not in contact with the liquid-soaked absorbent body. The flexibility of the folds will also have an effect on the softness of the body-facing surface of the sanitary product thus providing a higher wearing comfort and the natural comfort and the natural touch.

Due to the fixing of folds these are stabilised in such a manner, that the created positive effects will remain, even after storage in pressed condition and over an extended wearing period.

As noted above the foot area of the folds can be directly fastened by gluing or welding on the absorbent body or on a support layer which is inserted between the covering layer and the absorbent body. This support layer helps to improve

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the functional features of the folds regarding the further transmission of liquid and the rewet properties.

In order that the invention might be more fully understood, embodiments of the invention will be described, by way of example only, with reference to the accompanying drawings, in which:

Fig. 1 is a perspective partial view of a sanitary napkin known from prior art,

Fig. 2 is a cross-section of a prior art sanitary napkin according to Fig. 1 with a partial enlargement,

Fig. 3 is a cross-section of a further known sanitary napkin known from the prior art,

Fig. 4 is a cross-section of a sanitary napkin according to an embodiment of the invention; and

Fig. 5 is a schematic perspective view of a sanitary napkin's surface in a further embodiment of the invention.

As can be seen in the attached drawings, the different types of the respective sanitary napkin all have a base structure which is identical in vital parts. The back is provided with a liquid-proof covering layer, the underwear protecting foil 1, which is underneath the absorbent body 2 consisting of a pad of cellulosic flocs in the area of its back 3 - i.e. on the body-averting side of the sanitary napkin when worn. Furthermore the longitudinal edges 4 of the underwear protecting foil 1 reach over the later margin 5 of the absorbent body.

A support layer 7 for instance made of nonwoven material is arranged on the front surface area 6. The longitudinal edges 8 of this support layer 7 also reach over the lateral margin 5 of the absorbent body 2 and overlap the longitudinal edges 4 of the underwear protecting foil 1. Both of these parts are glued together in the usual manner in the overlapping area.

On top of support layer 7 a liquid-permeable covering layer 9 is arranged which is provided with folds 10 as later described in detail. The prior art sanitary napkin shown in Fig. 1, 2 and the embodiments of the invention shown in Figure 4 are a so-called "fully wrapped sanitary napkin", which consists of a covering layer 9

- for instance of polypropylene card web - and encloses the absorbent body 2 and the support layer 7. Covering layer 9 is folded on the back 3 and attached to the center by means of a glued connection 11.

The prior art in Fig. 3 and the embodiment of the invention in Figure 5 are provided with lateral wings 12, which are formed by overlapping flaps 13, 14 being connected to the lateral margins of covering layer 9 on the front and covering layer 15 on the back. The covering layer 15 might be of nonwoven material such as the case in the prior art shown in Fig. 3. which shall be provided with a separate underwear protecting foil 1. The covering layer can also consist of liquid-proof material, for instance of polyethylene foil, thus taking over the underwear protecting foil's function and omitting it.

Now the different configurations of folds used in illustrated sanitary napkins shall be explained in more detail.

The folds 10 are formed by a suitable folding device in the sanitary napkin's production machine so that the foot areas 16 are located on support layer 7 with a spacing of 1 to 20 mm in the transversal direction of the sanitary napkin. A spacing of 3 to 5 mm has proven to be most practicable. The foot areas 16 are attached to the support layer 7 by means of longitudinal glue strips 17, for instance of spray adhesive. Between each adjacent foot area 16 the fold 10 stands upright with a height H ranging from 1 to 20 mm. The most practicable values for the height were also in the area of 3 to 5 mm. The foot width F defined by the glue strips 17 can vary from 0.2 to 10 mm depending on the spacing A and the height H, whereas it must be considered that the maximum foot width F is half the spacing A. With spacing A and height H in the range of 3 to 5 mm, foot widths of 0.5 to 1 mm proved to be successful.

In the prior art shown in Fig. 1 through 3, eight folds are provided evenly spread over the entire width of the absorbent body's surface, working with a spacing A of approx. 6 mm between the folds.

In the embodiment of the invention shown in Fig 4, within two lateral strips 18 are provided two folds 10, respectively, which run in the longitudinal direction of the sanitary napkin and which have a spacing A and height H of approx. 6 mm.

The remaining center strip 19 between both lateral strips 18 consists of a liquid-permeable covering 9 which lays evenly on top of the support layer 7 to which it is additionally fastened by a center glue strip 17'. A liquid-permeable glueing over the entire area can also be obtained with a small quantity of adhesive.

The further embodiment of a sanitary napkin shown in Fig. 5, has in addition to folds 10 on both lateral strips 18, further folding configurations, symmetrical to center plane L consisting of three folds 10. A strip without folds 20 remains between the center folds 10 and the lateral folds 10.

Like noticeable form the cross-sections according to Fig 2. through 4, the top of the folds 10, the chamfers 21 in between and the tubes 22 which are underneath the folds 10 between the glued foot areas 16 built channel for the longitudinal distribution of body liquids admitted on the sanitary napkin.

In closing, it has to be pointed out that the individual components of the sanitary napkin of the embodiments of the invention shall be of suitable known material according to known criteria for the production of these sanitary products. Suitable constructional measures shall be utilized. For instance it is advisable to glue the strips 17 on the support layer (7) surface in such manner, that they hinder the penetration of liquids only to a very small extent that the absorbent surface of the sanitary napkin still remains relatively high. Spray adhesive or small threads of melt-blown adhesive can be used, another possibility is welding or sealing by laser, ultrasound or heat.

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THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A sanitary product for the absorption of body liquids including a top liquid-permeable covering layer, a liquid-proof back covering layer, and an absorbent body inserted between the back and top covering layers, the sanitary product having a longitudinal direction and a center plane which bisects the sanitary product through the top layer, absorbent body and back layer in the longitudinal direction, wherein the top covering layer in the area of the absorbent body is arranged in two or more folds following the longitudinal direction of the sanitary product, wherein foot areas of the folds, directing towards the absorbent body, are attached to the absorbent body or to a support layer inserted between the absorbent body and the top covering layer, wherein the foot areas of the folds are glued or welded on the absorbent body or the support layer and wherein several folds are provided on two lateral strips and whereas there is at least a strip without folds in the top layer between the center plane and the folds provided on at least one of the two lateral strips.

2. The sanitary product according to claim 1, wherein center folds are provided symmetrically to the center plane whereas a strip without folds remains between the center folds and the folds provided on the two lateral strips.

3. The sanitary product according to claim 2, wherein 2-10 center folds are provided symmetrically to said center plane.

4. The sanitary product according to any one of claims 1 to 3, wherein said top liquid-permeable covering layer is of a non-woven material.

5. The absorbent article according to any one of claims 1 to 4, wherein the foot areas of the folds are glued or welded on the absorbent body or the support layer over a width of 0.2-10 mm.

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6. The sanitary product according to any one of claims 1 to 5, wherein 2-10 folds are provided on said two lateral strips.

7. The absorbent article according to any one of claims 1 to 6, wherein the foot area of two adjacent folds are fixed with a mutual spacing of from 1 to 20 mm.

8. The absorbent article according to any one of claims 1 to 7, wherein the height of the folds is from 1 to 20 mm in no-load condition.

9. An absorbent article substantially as hereinbefore described and illustrated with reference to either Figures 4 or 5 of the accompanying drawings.

DATED this 10th day of September 2001

THE PROCTER AND GAMBLE COMPANY

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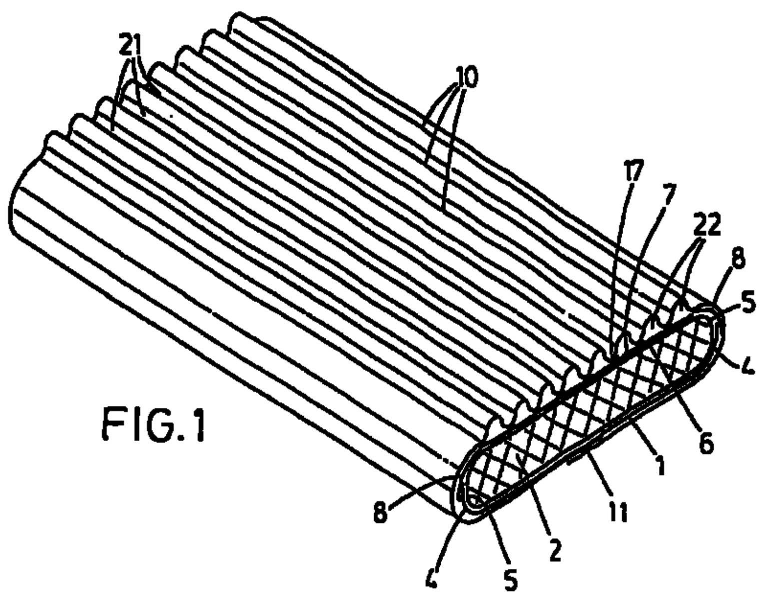

FIG.1

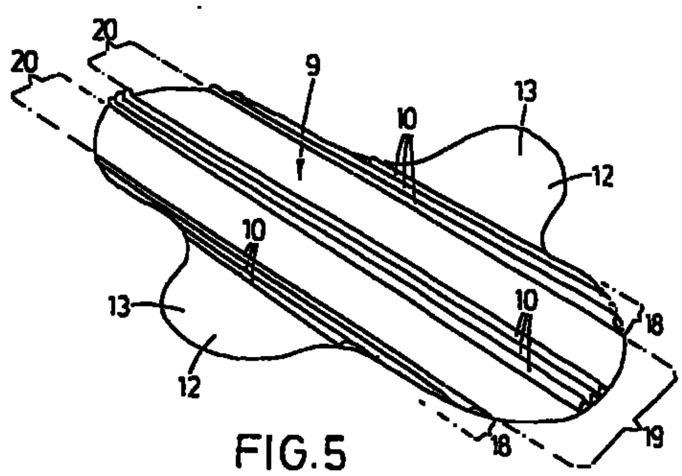

FIG.5

65. 7T

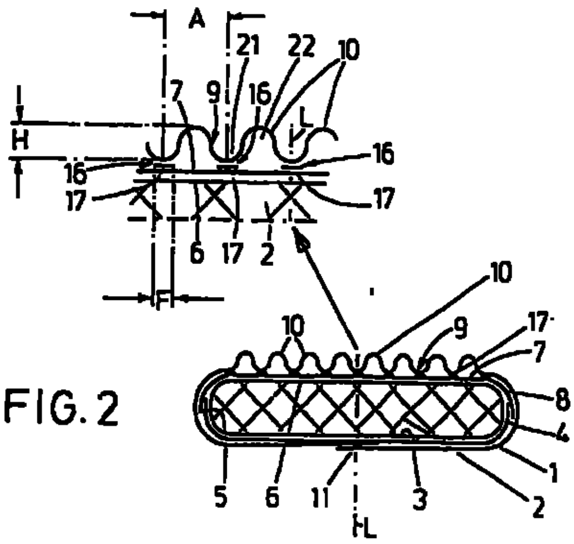

FIG. 2

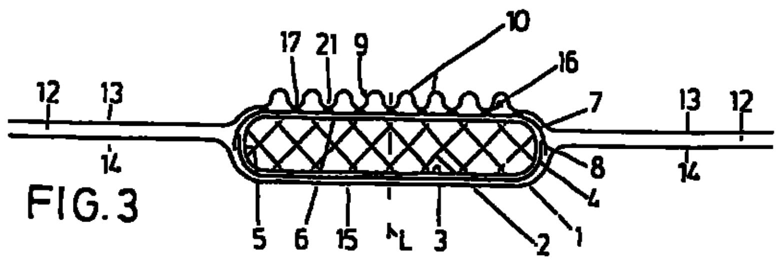

FIG. 3

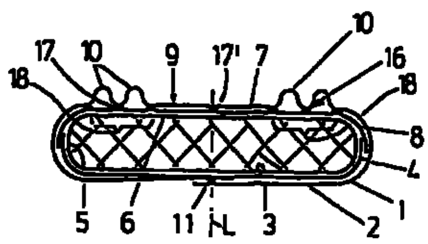

FIG. 4

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PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification [6] : A61F 13/15, D04H 1/54 — A1

(11) International Publication Number: WO 97/20531

(43) International Publication Date: 12 June 1997 (12.06.97)

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

(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

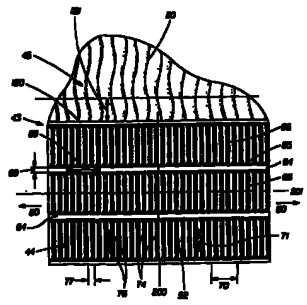
Published

With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: WEB MATERIALS HAVING ELASTIC-LIKE AND EXPANSIVE ZONES

(57) Abstract

A web material exhibiting both an elastic-like and an expansive behavior in response to an applied elongation. The web material includes an elastic-like zone and an expansive zone disposed adjacent to the elastic-like zone. The expansive zone allows the elastic-like zone to extend without generating excessive tensional forces. The elastic-like zone includes a strainable network having a first region and a second region. The second region has a surface-pathlength greater than the surface-pathlength of the first region. The expansive zone has a surface-pathlength greater than the first region and different than that of the second region.



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WEB MATERIALS HAVING ELASTIC-LIKE AND EXPANSIVE ZONES

FIELD OF THE INVENTION

The present invention relates to web materials, and more particularly, to such web materials having elastic-like and expansive zones. Web materials of the present invention having elastic-like and expansive zones exhibit an elastic-like behavior in response to an applied and subsequently released (i.e., cycled) elongation along at least one axis.

Web materials of the present invention have a wide range of potential uses in both durable and disposable articles, but are particularly well suited for use in disposable absorbent articles such as disposable diapers, incontinent briefs, incontinent undergarments, training pants, feminine hygiene garments, and the like.

BACKGROUND OF THE INVENTION

Infants and other incontinent individuals wear absorbent articles such as diapers to receive and contain urine and other body exudates. Absorbent articles function both to contain the discharged materials and to isolate these materials from the body of the wearer and from the wearer's garments and bed clothing. Disposable absorbent articles having many different basic designs are known to the art. For example, U.S. Patent Re. 26,152, entitled "Disposable Diaper", issued to Duncan and Baker on January 31, 1967, describes a disposable diaper which has achieved wide acceptance and commercial success. U.S. Patent 3,860,003, entitled "Contractible Side Portions For Disposable Diaper", issued to Buell on January 14, 1975, describes an elasticized leg cuff disposable diaper which has achieved wide acceptance and commercial success.

Problem

However, absorbent articles have a tendency to sag or gap away from and to slide/slip down on the body of the wearer during wear. This sagging/gapping and sliding/slipping is caused by the relative motions of the wearer as the wearer breathes, moves and changes positions, by the downward forces generated when the absorbent is loaded with body exudates, and by the materials of the absorbent article itself when subjected to such wearer's motions. This sagging/gapping and sliding/slipping of the absorbent article can lead to premature leakage and poor fit of the absorbent article about the wearer in the waist regions and the leg regions of the absorbent article.

In order to more snugly fit absorbent articles about the wearer, certain

commercially available absorbent articles have been provided with elastic features. An example of a disposable diaper with elastic side panels is disclosed in U.S. Patent 5,151,092, entitled "Absorbent Article With Dynamic Elastic Waist Feature Having Predisposed Flexural Hinge", issued to Buell, Clear, and Falcone on September 22, 1992. However, elastics are costly and require a certain degree of manipulation and handling during assembly. Further, while elastics do provide a degree of stretch for the absorbent article, the components of the absorbent article to which the elastics are attached are typically not elastic such that the elastics must be prestretched prior to being secured to the absorbent article or the inelastic components must be subjected to mechanical stretching (e.g., ring rolling) to enable the added elastic to be effective. Otherwise, the added elastic is restrained by the inelastic components.

Therefore, it is an object of the present invention to provide relatively low cost, easy to manufacture, web materials which exhibit an "elastic-like" behavior in response to an applied and subsequently released elongation. As used herein, the term "elastic-like" describes the behavior of web materials which when subjected to an applied elongation, the web materials extend in the direction of applied elongation and when the applied elongation is released the web materials return, to a substantial degree, to their untensioned condition.

It is a further object of the present invention to provide a relatively low cost, easy to manufacture, absorbent article having sustained dynamic fit about the wearer during use.

It is a further object of the present invention to provide an absorbent article having a unique extensible waist feature, preferably without the use of elastic, that provides sustained dynamic fit and improved resistance to leakage during use due to the conformability of the materials forming the waist feature by virtue of their readily extensible nature.

These and other objects of the present invention will be more readily apparent when considered in reference to the following description and when taken in conjunction with the accompanying drawings.

SUMMARY OF THE INVENTION

The present invention provides a web material which exhibits an elastic-like behavior in response to an applied and subsequently released elongation without the use of elastic materials such as natural or synthetic rubber. Web materials of the present invention have an elastic-like zone and an adjacent expansive zone.

The elastic-like zone is intended to elastically expand and contract. The elastic-like zone preferably comprises a structural elastic-like film (SELF) web, since a SELF web allows the force/extension characteristics to be specifically designed with a minimum amount of materials (no elastic materials need to be used.)

A SELF web exhibits an elastic-like behavior in the direction of elongation without the use of added elastic materials. SELF webs exhibit at least two significantly different stages of controlled resistive force to elongation along at least one predetermined axis when subjected to an applied elongation in a direction parallel to the predetermined axis. SELF webs include a strainable network having at least two contiguous, distinct, and dissimilar regions. One of the regions is configured so that it will exhibit resistive forces in response to the applied elongation in a direction parallel to the predetermined axis before a substantial portion of the other region develops significant resistive forces to the applied elongation. At least one of the regions has a surface-pathlength which is greater than that of the other region as measured substantially parallel to the predetermined axis when the material is in an untensioned condition. The region exhibiting the longer surface-pathlength includes one or more rib-like elements which extend beyond the plane of the other region. SELF webs exhibit first resistive forces to the applied elongation until the elongation of the web is sufficient to cause a substantial portion of the region having the longer surface-pathlength to enter the plane of applied elongation, whereupon the SELF web exhibits second resistive forces to further elongation. The total resistive forces to elongation are higher than the first resistive forces to elongation provided by the first region.

SELF webs may also exhibit an elongation and recovery with a definite and sudden increase in the force resisting elongation where this definite and sudden increase in resistive force restricts further elongation against relatively small elongation forces. The definite and sudden increase in the force resisting elongation is referred to as a "force wall". As used herein, the term "force wall" refers to the behavior of the resistive force of a web material during elongation wherein at some point in the elongation, distinct from the untensioned or starting point, the force resisting the applied elongation suddenly increases. After reaching the force wall, additional elongation of the web material is only accomplished via an increase in the elongation force to overcome the higher resistive force of the web material.

The rib-like elements allow the second region to undergo a substantially "geometric deformation" which results in significantly less resistive forces to an

applied elongation than that exhibited by the "molecular-level deformation" of the first region. As used herein, the term "molecular-level deformation" refers to deformation which occurs on a molecular level and is not discernible to the normal naked eye. That is, even though one may be able to discern the effect of molecular-level deformation, e.g., elongation of the web material, one is not able to discern the deformation which allows or causes it to happen. This is in contrast to "geometric deformation". As used herein the term "geometric deformation" refers to deformations which are discernible to the normal naked eye when the web material or articles embodying the web material are subjected to an applied elongation. Types of geometric deformation include, but are not limited to bending, unfolding, and rotating.

The expansive zone, disposed adjacent to the elastic-like zone, allows the elastic-like zone to extend without generating any excessive tensional forces. The expansive zone is preferably subjected to mechanical stretching at least to a degree to be extensible (i.e., the material making up the expansive zone has been pre-strained or permanently elongated). Without the expansive zone disposed adjacent the elastic-like zone, the tensional forces would be concentrated along a line extending adjacent the elastic-like zone which would substantially inhibit the expansion of the elastic-like zone.

BRIEF DESCRIPTION OF THE DRAWINGS

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

Fig. 1 is a plan view of a disposable diaper embodiment of the present invention having portions cut-away to reveal underlying structure, the outer surface of the diaper facing the viewer;

Fig. 2 is an enlarged, fragmentary plan view of the extensible back waist feature of the present invention showing the elastic-like zone and the expansive zone;

Fig. 3 is a graph of the resistive force versus percent elongation comparing the behavior of a SELF web of the present invention, as shown in Fig. 5, formed from Clopay 1401, with a base web of similar material composition;

Fig. 4A is a segmented, perspective illustration of a SELF web in an unrensioned condition:

Fig. 4B is a segmented, perspective illustration of a SELF web in a tensioned condition corresponding to stage I on the force-elongation curve depicted in Fig. 3;

Fig. 4C is a segmented perspective illustration of a SELF web in a tensioned condition corresponding to stage II on the force-elongation curve depicted in Fig. 3;

Fig. 5 is a graph of the elastic hysteresis behavior of the SELF web which is graphically represented by curve 720 in Fig. 3 when the SELF web is subjected to a hysteresis test at 60% elongation;

Fig. 6 is a simplified illustration of a preferred apparatus used to form the extensible waist belt of Fig 2;

Fig. 7 is a plan view of another embodiment of a diaper of the present invention;

Fig. 8 is a plan view of the diaper of Fig. 7 in a tensioned or stretched condition; and

Fig. 9 is a plan view of another embodiment of a diaper of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

As used herein, the term "absorbent article" refers to devices which absorb and contain body exudates, and, more specifically, refers to devices which are placed against or in proximity to the body of the wearer to absorb and contain the various exudates discharged from the body. The term "disposable" is used herein to describe absorbent articles which are not intended to be laundered or otherwise restored or reused as an absorbent article (i.e., they are intended to be discarded after a single use, and, preferably, to be recycled, composted or otherwise disposed of in an environmentally compatible manner). Because of their single use nature, low cost materials and methods of construction are highly desirable in disposable absorbent articles. A "unitary" absorbent article refers to absorbent articles which are formed of separate parts united together to form a coordinated entity so that they do not require separate manipulative parts like a separate holder and liner.

A preferred embodiment of an absorbent article of the present invention is the unitary disposable absorbent article, diaper 30, shown in Figure 1. As used herein, the term "diaper", refers to an absorbent article generally worn by infants and incontinent persons that is worn about the lower torso of the wearer. It should be understood, however, that the present invention is also applicable to other absorbent

articles such as incontinent briefs, incontinent undergarments, diaper holders and liners, feminine hygiene garments, training pants, and the like.

Fig. 1 is a plan view of a disposable diaper 30 of the present invention in its flat-out, uncontracted state (i.e., with elastic induced contraction pulled out) with portions of the structure being cut-away to more clearly show the construction of the diaper 30 and with the portion of the diaper 30 which faces away from the wearer, i.e., the outer surface, facing the viewer. As shown in Fig. 1, the diaper 30 comprises a liquid pervious topsheet 32, a liquid impervious backsheet 33 joined with the topsheet 32, an absorbent core 34 positioned between the topsheet 32 and the backsheet 33, elasticized leg cuffs 35, an extensible back waist feature 43 comprising an elastic-like zone 44 and an expansive zone 45, a front waist feature 90, ear flaps 92, and a fastening system 80 comprising a pair of first fastening members 81 and a second fastening member 82.

While the diaper 30 may be assembled in a variety of well known configurations, preferred diaper configurations are described generally in U.S. Pat. No. 3,860,003, issued to Kenneth B. Buell on Jan. 14, 1975; and U.S. Pat. No. 5,151,092 issued to Kenneth B. Buell et al. on Sept. 29, 1992. Each of these patents are hereby incorporated herein by reference.

The diaper 30 is shown in Figure 1 to have an inner surface 50, an outer surface 51 (facing the viewer in Figure 1) opposed to the inner surface, a first waist region 40, a second waist region 41 opposed to the first waist region 40, a crotch region 42 positioned between the first waist region 40 and the second waist region 41, and a periphery which is defined by the outer perimeter or edges of the diaper 30 in which the longitudinal edges are designated 38 and the end edges are designated 39. The inner surface 50 of the diaper comprises that portion of the diaper 30 which is positioned adjacent to the wearer's body during use (i.e., the inner surface 50 is generally formed by at least a portion of the topsheet 32 and other components joined to the topsheet 32). The outer surface 51 comprises that portion of the diaper 30 which is positioned away from the wearer's body (i.e., the outer surface 51 is generally formed by at least a portion of the backsheet 33 and other components joined to the backsheet 33). As used herein, the term "joined" encompasses configurations whereby an element is directly secured to the other element by affixing the element directly to the other element, and configurations whereby the element is indirectly secured to the other element by affixing the element to intermediate members(s) which in turn are affixed to the other element. The first

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waist region 40 and the second waist region 41 extend, respectively, from the end edges 39 of the periphery to the crotch region 42. The lateral direction (x direction or width) is defined as the direction parallel to the lateral centerline 101 of the diaper 30; the longitudinal direction (y direction or length) is defined as the direction parallel to the longitudinal centerline 100; and the axial direction (z direction or thickness) is defined as the direction extending through the thickness of the diaper 30.

The absorbent core 34 may be any absorbent member which is generally compressible, conformable, non-irritating to the wearer's skin, and capable of absorbing and retaining liquids such as urine and other certain body exudates. The absorbent core 34 has an outer surface 95, an inner surface 96, side edges 97, and waist edges 98. The absorbent core 34 may be manufactured in a wide variety of sizes and shapes (e.g., rectangular, hourglass, "T"-shaped, asymmetric, etc.) and from a wide variety of liquid-absorbent materials commonly used in disposable diapers and other absorbent articles such as comminuted wood pulp which is generally referred to as airfelt. Examples of other suitable absorbent materials include creped cellulose wadding; meltblown polymers including coform; chemically stiffened, modified or cross-linked cellulosic fibers; tissue including tissue wraps and tissue laminates; absorbent foams; absorbent sponges; superabsorbent polymers; absorbent gelling materials; or any equivalent material or combinations of materials.

The configuration and construction of the absorbent core 34 may vary (e.g., the absorbent core may have varying caliper zones, a hydrophilic gradient, a superabsorbent gradient, or lower average density and lower average basis weight acquisition zones; or may comprise one or more layers or structures). However, the total absorbent capacity of the absorbent core 34 should be compatible with the design loading and the intended use of the diaper 30. The size and absorbent capacity of the absorbent core 34 may also be varied to accommodate wearers ranging from infants through adults.

One embodiment of the diaper 30 has asymmetric, modified T-shaped, absorbent core 34 having ears in the first waist region 40 but a generally rectangular shape in the second waist region 41. Exemplary absorbent structures for use as the absorbent core 34 of the present invention that have achieved wide acceptance and commercial success are described in U.S. Patent 4,610,678 entitled "High-Density Absorbent Structures" issued to Weisman et al. on September 9,

1986; U.S. Patent 4,673,402 entitled "Absorbent Articles With Dual-Layered Cores" issued to Weisman et al. on June 16, 1987; U.S. Patent 4,888,231 entitled "Absorbent Core Having A Dusting Layer" issued to Angstadt on December 19, 1989; and U.S. Patent 4,834,735, entitled "High Density Absorbent Members Having Lower Density and Lower Basis Weight Acquisition Zones", issued to Alemany et al. on May 30, 1989. The absorbent core may further comprise the dual core system containing acquisition/distribution core of chemically stiffened fibers positioned over the absorbent storage cores as detailed in U.S. Patent 5,234,423, entitled "Absorbent Article With Elastic Waist Feature and Enhanced Absorbency" issued to Alemany et al., on August 10, 1993; and in U.S. Patent 5,147,345, entitled "High Efficiency Absorbent Articles For Incontinence Management" issued to Young, LaVon and Taylor on September 15, 1992. All of these patents are incorporated herein by reference.

The backsheet 33 is positioned adjacent the outer surface of the absorbent core 34 and is preferably joined thereto by attachment means (not shown) such as those well known in the art. For example, the backsheet 33 may be secured to the absorbent core 34 by a uniform continuous layer of adhesive, a patterned layer of adhesive, or an array of separate lines, spirals, or spots of adhesive. Adhesives which have been found to be satisfactory are manufactured by H. B. Fuller Company of St. Paul, Minnesota and marketed as HL-1258. An example of a suitable attachment means comprising an open pattern network of filaments of adhesive is disclosed in U.S. Patent 4,573,986 entitled "Disposable Waste-Containment Garment", which issued to Minetola et al. on March 4, 1986. Another suitable attachment means comprising several lines of adhesive filaments swirled into a spiral pattern is illustrated by the apparatus and methods shown in U.S. Patent 3,911,173 issued to Sprague, Jr. on October 7, 1975; U.S. Patent 4,785,996 issued to Ziecker, et al. on November 22, 1978; and U.S. Patent 4,842,666 issued to Werenicz on June 27, 1989. Each of these patents are incorporated herein by reference. Alternatively, the attachment means may comprise heat bonds, pressure bonds, ultrasonic bonds, dynamic mechanical bonds, or any other suitable attachment means or combinations of these attachment means as are known in the art.

The backsheet 33 is impervious to liquids (e.g., urine) and is preferably manufactured from a thin plastic film, although other flexible liquid impervious materials may also be used. As used herein, the term "flexible" refers to materials which are compliant and will readily conform to the general shape and contours of the human body. The backsheet 33 prevents the exudates absorbed and contained in the absorbent core 34 from wetting articles which contact the diaper 30 such as bedsheets and undergarments. Further, the backsheet 33 may permit vapors to escape from the absorbent core 34 (i.e., breathable) while still preventing exudates from passing through the backsheet 33. Thus, the backsheet 33 may comprise a woven or nonwoven material, polymeric films such as thermoplastic films of polyethylene or polypropylene, or composite materials such as a film-coated nonwoven material. An example of a suitable backsheet is a thermoplastic film having a thickness of from about 0.012 mm (0.5 mil) to about 0.051 mm (2.0 mils). Other suitable materials for the backsheet 33 include RR8220 blown films and RR5475 cast films as manufactured by Tredegar Industries, Inc. of Terre Haute, IN. The backsheet 33 is preferably embossed and/or matte finished to provide a more clothlike appearance.

The topsheet 32 is positioned adjacent the inner surface of the absorbent core 34 and is preferably joined thereto and to the backsheet 33 by attachment means (not shown) such as those well known in the art. Suitable attachment means are described with respect to joining the backsheet 33 to the absorbent core 34. In a preferred embodiment of the present invention, the topsheet 32 and the backsheet 33 are joined directly to each other in the diaper periphery and are indirectly joined together by directly joining them to the absorbent core 34 by the attachment means (not shown).

The topsheet 32 is compliant, soft feeling, and non-irritating to the wearer's skin. Further, the topsheet 32 is preferably liquid pervious permitting liquids (e.g., urine) to readily penetrate through its thickness. A suitable topsheet 32 may be manufactured from a wide range of materials, such as porous foams; reticulated foams; apertured plastic films; or woven or nonwoven webs of natural fibers (e.g., wood or cotton fibers), synthetic fibers (e.g., polyester or polypropylene fibers), or a combination of natural and synthetic fibers. The topsheet 32 is preferably made of a hydrophobic material to isolate the wearer's skin from liquids which have passed through the topsheet 32 and are contained in the absorbent core 34 (i.e. to prevent rewet). If the topsheet 32 is made of a hydrophobic material, at least the upper surface of the topsheet 32 is treated to be hydrophilic so that liquids will transfer through the topsheet more rapidly. This diminishes the likelihood that body exudates will flow off the topsheet 32 rather than being drawn through the

topsheet 32 and being absorbed by the absorbent core 34. The topsheet 32 can be rendered hydrophilic by treating it with a surfactant. Suitable methods for treating the topsheet 32 with a surfactant include spraying the topsheet 32 material with the surfactant and immersing the material into the surfactant. A more detailed discussion of such a treatment and hydrophilicity is contained in U.S. Patents 4,988,344 entitled "Absorbent Articles with Multiple Layer Absorbent Layers" issued to Reising, et al on January 29, 1991 and U.S. Patent 4,988,345 entitled "Absorbent Articles with Rapid Acquiring Absorbent Cores" issued to Reising on January 29, 1991, each of which is incorporated by reference herein.

There are a number of manufacturing techniques which may be used to manufacture the topsheet 32. For example, the topsheet 32 may be a nonwoven web of fibers. When the topsheet 32 comprises a nonwoven web, the web may be spunbonded, carded, wet-laid, melt-blown, hydroentangled, combinations of the above, or the like. A suitable topsheet 32 is carded and thermally bonded by means well known to those skilled in the fabrics art. A satisfactory topsheet 32 comprises staple length polypropylene fibers having a denier of about 2.2 As used herein, the term "staple length fibers" refers to those fibers having a length of at least about 15.9 mm (0.625 inches). Preferably, the topsheet 32 has a basis weight from about 18 to about 25 grams per square meter. A suitable topsheet is manufactured by Veratec, Inc., a Division of International Paper Company, of Walpole, Mass. under the designation P-8.

The diaper 30 preferably further comprises elasticized leg cuffs 35 for providing improved containment of liquids and other body exudates. Each elasticized leg cuff 35 may comprise several different embodiments for reducing the leakage of body exudates in the leg regions. (The leg cuff can be and is sometimes also referred to as leg bands, side flaps, barrier cuffs, or elastic cuffs.) U.S. Patent 3,860,003 describes a disposable diaper which provides a contractible leg opening having a side flap and one or more elastic members to provide an elasticized leg cuff (gasketing cuff). U.S. Patent 4,909,803 entitled "Disposable Absorbent Article Having Elasticized Flaps" issued to Aziz et al. on March 20, 1990, describes a disposable diaper having "stand-up" elasticized flaps (barrier cuffs) to improve the containment of the leg regions. U.S. Patent 4,695,278 entitled "Absorbent Article Having Dual Cuffs" issued to Lawson on September 22, 1987, describes a disposable diaper having dual cuffs including a gasketing cuff and a barrier cuff. While each elasticized leg cuff 35 may be configured so as

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to be similar to any of the leg bands, side flaps, barrier cuffs, or elastic cuffs described above, each elasticized leg cuff 35 comprises a gasketing cuff as described in the above-referenced U.S. Patent 3,860,003.

The diaper 30 further comprises an extensible back waist feature 43 that provides a more comfortable and contouring fit by initially conformably fitting the diaper to the wearer and sustaining this fit throughout the time of wear well past when the diaper has been loaded with exudates since the extensible back waist feature 43 allows the diaper to expand and contract. Further, the extensible back waist feature 43 develops and maintains wearing forces (tensions) that enhance the tensions developed and maintained by the closure system to maintain the diaper on the wearer and that enhance the fit of the diaper about the waist of the wearer. The extensible back waist feature 43 further provides more effective application of the diaper since even if the diaperer pulls one side of the extensible back waist feature farther than the other during application (asymmetrically), the diaper will "self-adjust" during wear.

As shown in Figure 1, the extensible back waist feature 43 comprises an elastic-like zone 44 and an expansive zone 45. In the embodiment shown in Figure 1, the elastic-like zone 44 extends longitudinally inwardly from the end edge 39 of the diaper 30 in the first waist region 40. The expansive zone 45 is joined to and extends longitudinally inwardly from the elastic-like zone 44. In the embodiment shown in Figure 1, the expansive zone 45 extends both longitudinally inwardly from the waist edge 98 of the absorbent core 34 toward the centerline 101 and outwardly from the waist edge 98 of the absorbent core 34 toward the elastic-like zone 44. The term "zone" is used herein to denote an area or element of the waist feature or of the diaper. (While a zone is typically a distinct area or element, a zone may overlap somewhat with an adjacent zone.)

In the embodiment shown in Figure 1, the elastic-like zone 44 comprises a structural elastic-like film (SELF) web comprising a portion of the backsheet 33. The elastically contractive and extensible behavior of the elastic-like zone 44 is derived from the backsheet without the need for added elastic material. The expansive zone 45 is unitary with the elastic-like zone 44 and also comprises a portion of the backsheet 33. Preferably, the expansive zone 45 is subjected to mechanical stretching at least to a degree to be extensible. The extension forces of the elastic-like zone 44 are higher than the extension forces of the adjacent expansive zone 45.

The elastic-like zone 44 is the primary component of the extensible back waist feature 43 that provides waist fit and appearance. (The elastic-like zone 44 may also be referred to as the waistband or waist panel of the back waist feature.) The elastic-like zone 44 is contiguous with the expansive zone 45 and is disposed longitudinally outwardly from the expansive zone 45 so as to fit in the lower back of the wearer. The elastic-like zone 44 is positioned toward the end edge 39 of the diaper 30 and preferably, forms at least a portion of the end edge 39 of the diaper 30. The elastic-like zone 44 maintains an area coverage, contacts the wearer in the lower back to snugly fit the wearer, and elastically expands and contracts, preferably in a direction having a vector component in the lateral direction, more preferably in the lateral direction, so as to dynamically move, fit, and conform to the wearer. It should be noted that the elastic-like zone 44 may elastically expand and contract in any other direction or in more than one direction.

The elastic-like zone 44 may take on a number of different sizes and shapes. Examples of suitable shapes for the elastic-like zone include arcuate, trapezoidal, triangular, etc. In a preferred embodiment such as shown in Fig. 1, the elastic-like zone has a rectangular shape.

The elastic-like zone 44 can be constructed of elements of the diaper such as the topsheet and/or the backsheet. For performance and cost reasons the elastic-like zone 44 preferably comprises a portion of the backsheet formed into a structural elastic-like film (SELF) web as described hereinafter. The term "web" herein refers to a sheet-like material comprising a single layer of material or a composite or a laminate of two or more layers.

In the embodiment of the present invention shown in Fig. 1, the extensible back waist feature 43 includes one elastic-like zone 44 and one expansive zone 45. However, diapers can be constructed to have multiple elastic-like zones and multiple expansive zones. For example, the diaper 30 can be constructed to also have an extensible front waist feature in the second waist region 41.

The expansive zone 45 is extensible in a direction having a vector component in substantially the same direction as the elastic-like zone. In the embodiment shown in Fig. 1, the expansive zone 45 is extensible in the lateral direction. It should be noted, however, that the expansive zone may be extensible in any other direction or in more than one direction. The expansive zone 45 is preferably positioned immediately adjacent to the elastic-like zone 44. The expansive zone 45 is designed to have lower extension forces than the elastic-like

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zone 44 up to a predetermined point. The expansive zone 45 is preferably subjected to mechanical stretching at least to a degree to be extensible (i.e., the material making up the expansive zone 45 is pre-strained or permanently elongated). The pre-straining of the expansive zone 45 allows the expansive zone to effectively elongate (yield) when the adjacent elastic-like zone 44 is extended, without generating any excessive tensional forces in the elastic-like zone 44. Without the expansive zone 45 disposed adjacent to the elastic-like zone 44, the tensional forces would be concentrated along a line extending adjacent to the elastic-like zone 44 which would inhibit the expansion of the elastic-like zone 44. Therefore, the diaper must be constructed so that the expansive zone does not restrict the designed expansion and contraction of the elastic-like zone.

The expansive zone 45 may take on a number of different sizes and shapes. For example, the expansive zone may have a trapezoidal, arcuate, or complex shape. As shown in Fig. 1, the expansive zone 45 preferably has a rectangular shape. The size of the expansive zone may also widely vary, depending upon the desired properties of the extensible back waist feature. The expansive zone 45 may extend longitudinally inwardly from the elastic-like zone 44 to the crotch region 42 to the lateral centerline 101, to the front waist feature 90, or the entire length of the diaper.

The expansive zone 45 can be constructed of elements of the diaper such as the backsheet and/or the topsheet. In the embodiment of the present invention shown in Fig. 1, the expansive zone 45 comprises a portion of the backsheet which has been prestrained or permanently elongated as described hereinafter.

Fig. 2 is an enlarged, fragmentary plan view of the extensible back waist feature 43 showing the elastic-like zone 44 and the expansive zone 45. In the embodiment of the present invention shown in Figures 1 and 2, the extensible back waist feature comprises a portion of the backsheet. The backsheet 33 is preferably a web material constructed of a single layer of polymeric material. The web material is preferably comprised substantially of linear low density polyethylene (LLDPE), although it may also be comprised of other polyolefins such as polyethylenes including low density polyethylene (LDPE), ultra low density polyethylene (ULDPE), high density polyethylene (HDPE), or polypropylene and/or blends thereof and other materials. Examples of other suitable polymeric materials include, but are not limited to polyester, polyurethanes, compostable or biodegradable polymers, and breathable polymers.

The extensible back waist feature is shown in Figure 2 in its substantially untensioned condition. The SELF web 52 forming the elastic-like zone 44 has two centerlines, a first centerline 201, (which is also referred to as an axis, line, or direction), and a second centerline 200, (which is also referred to as an axis, line, or direction), which is generally perpendicular to the first centerline 201.

The SELF web 52 includes a "strainable network" of distinct regions. As used herein, the term "strainable network" refers to an interconnected and interrelated group of regions which are able to be extended to some useful degree in a predetermined direction providing the SELF web with an elastic-like behavior in response to an applied and subsequently released elongation. The strainable network includes at least a first region 64 (also generally referred to herein as bands or channels) and a second region 66 (also generally referred to herein as ribs). The SELF web also includes a transitional region 65 which is at the interface between the first region 64 and the second region 66. The transitional region 65 will exhibit complex combinations of the behavior of both the first region and the second region. It is recognized that every embodiment of the present invention will have a transitional region, however, preferred embodiments of the present invention will exhibit elastic-like behavior substantially as a result of the first region 64 and the second regions 66. Therefore, the ensuing description of the present invention will be concerned with the behavior of the SELF web in the first regions and the second regions only and not the complex behavior of the SELF web in the transitional regions 65.

SELF web 52 has a first surface and a second surface. In the preferred embodiment shown in Fig. 2, the strainable network includes a plurality of first regions 64 and a plurality of second regions 66. The first regions 64 have a first axis 68 and a second axis 69, wherein the first axis 68 is preferably longer than the second axis 69. The first axis 68 of the first region 64 is substantially parallel to the first axis 201 of the SELF web 52, while the second axis 69 is substantially parallel to the second axis 200 of the SELF web 52. The second regions 66 have a first axis 70 and a second axis 71. The first axis 70 is substantially parallel to the first axis 201 of the SELF web 52, while the second axis 71 is substantially parallel to the second axis 200 of the SELF web 52. In the preferred embodiment of Fig. 2, the first regions 64 and the second regions 66 are substantially linear, extending continuously in a direction substantially parallel to the first axis of the SELF web 52.

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

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The second region 66 has a modulus E2 and a cross-sectional area A2.

In the illustrated embodiment, the SELF web 52 has been "formed" such that the SELF web 52 exhibits a resistive force along an axis, which in the case of the illustrated embodiment is substantially parallel to the first axis 201 of the SELF web, when subjected to an applied elongation or axial elongation in a direction substantially parallel to the first axis 201. As used herein, the term "formed" refers to the creation of a desired structure or geometry upon a web material that will substantially retain the desired structure or geometry when it is not subjected to any externally applied elongations or forces. A SELF web of the present invention is comprised of at least a first region and a second region, wherein the first region is visually distinct from the second region. As used herein, the term "visually distinct" refers to features of the SELF web which are readily discernible to the normal naked eye when the SELF web or objects embodying the SELF web are subjected to normal use. A SELF web of the present invention is comprised of a strainable network of contiguous, "distinct", and "dissimilar" regions, wherein the strainable network includes at least a first region and a second region, where the first region has a "surface-pathlength" less than that of the second region, as measured parallel to a predetermined axis when the material is in an untensioned state. As used herein, the term "formed portion" refers to the portion of the material which is comprised of the desired structure or geometry of the strainable network. As used herein the term "surface-pathlength" refers to a measurement along the topographic surface of the region in question in a direction parallel to a predetermined axis. As used herein, the term "distinct" or "dissimilar" when referring to regions, refers to regions within the strainable network having measurably different surface-pathlengths as measured parallel to a predetermined axis while the SELF web is in an untensioned condition. The method for determining the surface-pathlength of the respective regions can be found in the Test Methods section set forth in subsequent portions of the present specification.

In the preferred embodiment shown in Figure 2, the first regions 64 are substantially planar. That is, the material within the first region 64 is in substantially the same condition before and after the formation step undergone by the SELF web 52. The second regions 66 include a plurality of ribs or rib-like elements 74. The rib-like elements 74 may be embossed, debossed or a combination thereof.

The rib-like elements 74 have a first or major axis 76 which is substantially parallel to the second axis 200 of the SELF web 52, and a second or minor axis 77

which is substantially parallel to the first axis 201 of the SELF web 52. The first axis 76 of the rib-like elements 74 is at least equal to, and preferably longer than the second axis 77. Preferably, the ratio of the first axis 76 to the second axis 77 is at least about 1:1 or greater, and more preferably at least about 2:1 or greater.

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

The first region 64 and the second region 66 each have a "projected pathlength". As used herein the term "projected pathlength" refers to the length of a shadow of a region that would be thrown by parallel light. The projected pathlength of the first region 64 and the projected pathlength of the second region 66 are equal to one another. Accordingly, the overall dimension of the SELF web as measured parallel to the first axis 201 will be substantially the same before and after formation.

The second region 66 has a surface-pathlength, L2, greater than the surface-pathlength, L1, of the first region 64 as measured topographically in a direction parallel to the first axis of the SELF web while the SELF web is in an untensioned condition. Preferably, the surface-pathlength of the second region 66 is at least about 15% greater than that of the first region 64, more preferably at least about 30% greater than that of the first region, and most preferably at least about 70% greater than that of the first region. In general, the greater the surface-pathlength of the second region, the greater will be the elongation of the SELF web before encountering the force wall.

What makes the SELF web particularly well suited for use as the elastic zone 44 of the extensible back waist feature 43 is that it exhibits a modified "Poisson lateral contraction effect" substantially less than that of an otherwise identical base web of similar material composition. As used herein, the term "Poisson lateral contraction effect" describes the lateral contraction behavior of a material which is being subjected to an applied elongation. The method for determining the Poisson lateral contraction effect of a material can be found in the Test Methods section set forth in subsequent portions of the present specification. Preferably, the Poisson lateral contraction effect of the SELF web of the present invention is less than about 0.4 when the web is subjected to about 20% elongation. Preferably, the SELF web exhibits a Poisson lateral contraction effect less than about 0.4 when the web is

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subjected to about 40, 50 or even 60% elongation. More preferably, the Poisson lateral contraction effect is less than about 0.3 when the SELF web is subjected to 20, 40, 50 or 60% elongation. The Poisson lateral contraction effect of SELF webs of the present invention is determined by the amount of the web material which is occupied by the first and second regions, respectively. As the area of the SELF web material occupied by the first region increases, the Poisson lateral contraction effect also increases. Conversely, as the area of the SELF web material occupied by the second region increases the Poisson lateral contraction effect decreases. Preferably, the percent area of the SELF web material occupied by the first area is from about 2% to about 90%, and more preferably from about 5% to about 50%.

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

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

In Figure 3 there is shown a graph of the resistive force-elongation curve 720 of a formed polymeric SELF web material along with a curve 710 for a base film of similar composition. Specifically the samples are polymeric web materials, comprised substantially of linear low density polyethylene, approximately 0.001" thick, designated sample 1401 available from Clopay, Cincinnati Ohio. The method for generating the resistive force-elongation curves can be found in the Test Methods section set forth in subsequent portions of the present specification. Referring now to the force-elongation curve 720, there is an initial substantially linear, lower force versus elongation stage I designated 720a, a transition zone designated 720b which indicates the encounter of the force wall, and a substantially linear stage II designated 720c which displays substantially higher force versus elongation behavior.

As seen in Figure 3 the SELF web exhibits different elongation behavior in the two stages when subjected to an applied elongation in a direction parallel to the

first axis of the SELF web. The resistive force to the applied elongation is significantly different between stage I (720a) and stage II (720c) of curc 720 as compared to curve 710 which does not exhibit this behavior. As seen in Figure 3, the SELF web exhibits different elongation behavior in the two stages when subjected to an applied elongation in a direction parallel to the first axis of the SELF web. The resistive force exerted by the SELF web to the applied elongation is significantly less in the stage I region (720a) versus the stage II region (720c) of curve 720. Furthermore, the resistive force exerted by the SELF web to the applied elongation as depicted in stage I (720a) of curve 720 is significantly less than the resistive force exerted by the base web as depicted in curve 710 within the limits of elongation of stage I. As the SELF web is subjected to further applied elongation and enters stage II (720c) the resistive force exerted by the SELF web increases and approaches the resistive force exerted by the base web. The resistive force to the applied elongation for the stage I region (720a) of the SELF web is provided by the molecular-level deformation of the first region of the SELF web and the geometric deformation of the second region of the SELF web. This is in contrast to the resistive force to an applied elongation that is provided by the base web, depicted in curve 710, which results from molecular-level deformation of the entire web. SELF web materials can be designed to yield virtually any resistive force in stage I which is less than that of the base web material by adjusting the percentage of the web surface which is comprised of the first and second regions, respectively. The force-elongation behavior of stage I can be controlled by adjusting the width, cross-sectional area, and spacing of the first region and the composition of the base web.

Referring now to Figures 4A-4C, as SELF web 52 is subjected to an applied axial elongation, D, indicated by arrows 80, the first region 64 having the shorter surface-pathlength, L1, provides most of the initial resistive force, P1, as a result of molecular-level deformation, to the applied elongation which corresponds to stage I. While in stage I, the rib-like elements 74 in the second region 66 are experiencing geometric deformation, or unbending and offer minimal resistance to the applied elongation. In the transition zone (720b) between stages I and II, the rib-like elements 74 are becoming aligned with the applied elongation. That is, the second region is exhibiting a change from geometric deformation to molecular-level deformation. This is the onset of the force wall. In stage II, as seen in Figure 4C, the rib-like elements 74 in the second region 66 have become substantially aligned with the plane of applied elongation (i.e. the second region has reached its limit of geometric deformation) and begin to resist further elongation via molecular-level deformation. The second region 66 now contributes, as a result of molecular-level deformation, a second resistive force, P2, to further applied elongation. The resistive forces to elongation depicted in stage II by both the molecular-level deformation of the first region 64 and the molecular-level deformation of the second region 66 provide a total resistive force, PT, which is greater than the resistive force depicted in stage I which is provided by the molecular-level deformation of the first region 64 and the geometric deformation of the second region 66. Accordingly, the slope of the force-elongation curve in stage II is significantly greater than the slope of the force-elongation curve in stage I.

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

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

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

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

The maximum elongation occurring while in stage I is the "available stretch" of the SELF web. The available stretch corresponds to the distance over which the second region experiences geometric deformation. The available stretch can be effectively determined by inspection of the force-elongation curve 720 as shown in Fig. 3. The approximate point at which there is an inflection in the transition zone between stage I and stage II is the percent elongation point of "available stretch". The range of available stretch can be varied from about 10% to 100% or more; this range of elongation is often found to be of interest in disposable absorbent articles, and can be largely controlled by the extent to which the surface-pathlength L2 in the second region exceeds the surface-pathlength L1 in the first region and the properties (composition) of the base film. The term available stretch is not intended to imply a

limit to the elongation which the SELF web may be subjected to as there are applications where elongation beyond the available stretch is desirable. Significantly higher forces are required to achieve percent elongations in the base film equivalent to those percent elongations in the SELF web. The approximate extent of stage I can be controlled as desired by adjusting the pathlengths, L1 and L2, in an untensioned condition. The force-elongation behavior of stage I can be controlled by adjusting the width, thickness, and spacing of first region 64 and the properties of the base film.

The curves 730 and 735 in Figure 5 depict the elastic hysteresis behavior exhibited by the SELF web. The sample is the same as used to produce the graph in Figure 3 (Clopay 1401). The sample was examined for elastic hysteresis behavior at an elongation of 60%. Curve 730 represents the response to an applied and released elongation during the first cycle and curve 735 represent the response to an applied and released elongation during the second cycle. The force relaxation during the first cycle 731 and the percent set 732 are depicted in Figure 5. Note that significant recoverable elongation, or useful elasticity, is exhibited at relatively low forces over multiple cycles, i.e., this means the SELF web can easily expand and contract to a considerable degree. The method for generating the elastic hysteresis behavior can be found in the Test Method section set forth in subsequent portion of the present specification.

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

While the SELF web may be easily and reversibly extended in the direction of applied axial elongation, in a direction substant perpendicular to the first axis 76 of the rib-like elements, the SELF web is not easily extended in a direction substantially parallel to the first axis of the rib-like elements. The formation of the rib-like elements allows the rib-like elements to geometrically deform in a direction substantially perpendicular to the first or major axis of the rib-like elements, while requiring substantially molecular-level deformation to extend in a direction substantially parallel to the first axis of the rib-like elements.

The amount of applied force required to extend the SELF web is dependent upon the composition and thickness of the base material forming the SELF web and the width and spacing of the first regions, with narrower and more widely spaced first regions requiring lower applied extensional forces to achieve the desired elongation for a given composition and thickness. The first axis 68, (i.e., the length) of the undeformed first regions is preferably greater than the second axis 69, (i.e., the width) with a preferred length to width ratio of about 5:1 or greater.

The depth and number of rib-like elements 74 can also be varied to control the extension force and available stretch of the SELF web. The available stretch or elongation is increased if for a given number of rib-like elements, the height or degree of formation imparted on the rib-like elements is increased. Similarly, the available stretch is increased if for a given height or degree of formation, the number or frequency of the rib-like elements is increased.

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

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

While an entire SELF web may include a strainable network of first and second regions, the present invention may also be practiced by providing only specific portions of the SELF web with a strainable network comprised of first and second regions.

The configuration and spacing of the first and second regions may also be varied to vary the characteristics of the SELF web. For example, the second regions may comprise curvilinear rib-like elements, or the first regions and the second regions may be curvilinear. The SELF web may also exhibit an elastic-like behavior along a plurality of axes by extending the axes in a radial, fan-like array to allow the SELF web to exhibit an elastic-like behavior along a plurality of axes. For example, the multiple axes may be positioned at various angles to one another such as 45°, 90°, 135°, etc. In addition to the various angles of orientation, the regions themselves may be straight, curvilinear, or combinations thereof. The surface-pathlengths in the second region may also provide a difference in amplitude of the rib-like elements such that the SELF web will have different zones of available stretch. It is also possible that the rib-like elements can be varied between adjacent regions to provide different available stretches in the adjacent second regions. The widths of the first region may also vary across the web with the narrower regions offering a lower resistive force to an applied elongation as compared to the higher resistive force offered by the wider first region.

The SELF web also need not be extensible only in the direction parallel to the lateral centerline 101 of the diaper 30 as shown in Figure 1. For example, the first axis and the second axis of the SELF web may be disposed at an angle to the longitudinal centerline and lateral centerline of the diaper 30, respectively. Thus, the SELF web would axially elongate along a line at an angle to the lateral centerline of the diaper. This angle is preferably between about 0° and about 30° for the diapers of the present invention. Further, portions of the SELF web may have different angles of extensibility.

Referring to Figure 2, the expansive zone 45, and the elastic-like zone 44 meet at a common border 120. In the embodiment shown in Fig. 2, the border 120 is substantially parallel to the axis of expansion and contraction, axis 201. The expansive zone 45 includes a plurality of incrementally stretched regions 110. The incrementally stretched regions 110 are formed by subjecting the expansive zone 45 to mechanical stretching such as an incremental stretching system as will be described in greater detail hereinafter.

The incrementally stretched regions 110 have been stretched, strained, or elongated in a direction parallel to the first axis 201 of the SELF web 52. The incremental stretching of regions 110 of expansive zone 45 allow the expansive zone to effectively elongate (yield) when the elastic-like zone 44 is extended, without generating any excessive tensional forces. The expansive zone 45 has a surface-pathlength greater than the surface-pathlength of the first region 64 of the SELF web 52 of the elastic-like zone 44 as measured in a direction parallel to the first axis 201 of the SELF web 52 while both zones are in an untensioned condition. In addition, the expansive zone 45 has a surface-pathlength different than the surface-pathlength of the second region 66 of the SELF web 52 of the elastic-like zone 44 as measured in a direction parallel to the first axis 201 of the SELF web 52 while both zones are in an untensioned condition.

As the extensible waist feature 43 is subjected to an applied axial elongation indicated by arrows 80, the expansive zone 45 provides a relatively low resistive force to the applied elongation as the expansive zone 45 undergoes substantially geometric deformation. The incrementally stretched regions 110 initially experience geometric deformation or unbending and offer minimal resistance to the applied elongation. As elongation continues the incrementally stretched regions 110 become substantially aligned with the plane of elongation (the incrementally stretched regions 110 have reached their limit of geometric deformation) and they begin to resist further elongation via molecular-level deformation. The expansive zone 45 now contributes a higher resistive force as a result of this molecular-level deformation. The amount or extent of geometric deformation that the expansive zone will undergo before experiencing molecular-level deformation is dependent at least to some degree upon the amount of pre-straining or stretching that is imparted upon the expansive zone.

If the expansive zone 45 has a surface-pathlength greater than the surface-pathlength of the second region 66, the second region 66 will first begin to contribute a significant resistive force before the expansive zone 45 contributes a significant resistive force. Alternatively, if the expansive zone 45 has a surface-pathlength less than the surface-pathlength of the second region 66, the expansive zone 45 will be the first to contribute a significant resistive force.

Preferably, the expansive zone 45 must be free of restrictions to expansion for a certain distance from the elastic-like zone 44 which distance is indicated as 121 in Fig. 2, to permit the elastic-like zone 44 to elastically expand and contract within its designed limits. Examples of restrictions to expansion are bonding the expansive zone 45 to a non-expansive member such as an absorbent core, a tape fastening member, or a topsheet. It should be recognized by those skilled in the art that distance 121 will depend on the desired amount of elastic expansion and contraction

in elastic-like zone 44, the surface-pathlength of expansive zone 45 and the nature of the potential restriction of movement.

Referring now to Figure 6, there is shown an apparatus generally indicated as 500 for forming the extensible back waist feature 43 comprising both the elastic-like zone 44 and the expansive zone 45, where the elastic-like zone 44 comprises a SELF web and the expansive zone comprises a prestrained web comprising incrementally stretched regions. Apparatus 500 employs opposed pressure applicators having three-dimensional surfaces which at least to a degree are complimentary to one another. Apparatus 500 comprises a pair of intermeshing rolls 502 and 520. Roll 502 includes a plurality of first corrugated or toothed regions 506, a plurality of second corrugated or toothed regions 509, and a plurality of grooved regions 512. Grooved regions 512 extend in a direction substantially parallel to a longitudinal axis running through the center of cylindrical roll 502. In the embodiment shown in Figure 6, roll 502 includes three grooved regions 512. However, roll 502 may include any number of grooved regions 512. Toothed region 506 which are located between grooved regions 512, include a plurality of teeth 507. Toothed regions 509 include a plurality of teeth 510. Roll 520 includes a plurality of teeth 522 which mesh with teeth 507 and 510 of roll 502.

As a web, such as a backsheet 33 of disposable diaper 30, is directed through apparatus 500 between intermeshing rolls 502 and 520, the portion of the web passing between toothed regions 509 containing teeth 510, and teeth 522 on roll 520 will be incrementally stretched forming incrementally stretched regions which correspond to incrementally stretched regions 110 in the expansive zone 45, shown in Figure 2. The portion of the web passing between grooved regions 512 and teeth 522 on roll 520 will remain unformed, thus providing unformed regions in the web which correspond to the first regions 64 of the SELF web 52 shown in Figure 2. The portions of the web passing between toothed regions 506 containing teeth 507 and teeth 522 on roll 520 will be incrementally stretched forming rib-like elements in the web which correspond to rib-like elements 74 in the second regions 66 of the SELF web 52 shown in Figure 2.

The exact configuration, spacing and depth of the teeth on the rolls 502 and 520 may be varied depending on the amount of incremental stretching desired. The degree of overlap of the teeth on rolls 502 and 520 may also be adjusted, as desired, to produce more or less incremental stretching.

While the extensible waist feature comprising the elastic-like zone and the

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expansive zone has been described as a single layer of polymeric material, the present invention may be practiced equally well with other materials or with laminates of two or more materials. Examples of suitable materials include two-dimensional apertured films, macroscopically expanded, three-dimensional, apertured formed films. Examples of other suitable materials include composite structures or laminates of polymer films, and nonwovens. Laminates of polymer films and nonwovens may also comprise absorbent or fibrous absorbent materials, foams, or other compositions. Examples of such laminates include a nonwoven topsheet and a polymeric film backsheet found on commercially available disposable diapers. Additional reinforcing elements can also be added for strength and recovery benefits.

The expansive zone and the elastic-like zone may also be used on other portions of the diaper. For example, the expansive zone and the elastic-like zone may be used to form the elasticized leg cuffs 35, the front waist feature 90, or the ear flaps 92. In addition, the expansive zone and the elastic-like zone may be used to form other extensible portions on the diaper.

The present invention is intended to produce a functional equivalent to a conventional diaper having an elastic member secured to diapers to provide contractive and expansive properties. Conventional diapers are made by bonding an elastic member in a tensioned state to the topsheet and backsheet in the waist area. After bonding, the tension is released causing gathers to form in the waist. By use of the elastic-like and expansive zones of the present invention, the same result is accomplished without the addition of an elastic member.

Referring now to Fig. 7 there is shown a plan view of another embodiment of a diaper 130 of the present invention. Diaper 130 comprises a backsheet 133 comprising an extensible back waist feature 143 and an extensible front waist feature 147, a topsheet and a backsheet, (for simplification the topsheet and backsheet are not shown in Fig. 7). Back waist feature 143 comprises an elastic-like zone 144 and an expansive zone 145. Front waist feature 147 comprises an elastic-like zone 146 and an expansive zone 145. In this embodiment the axis of elastic contraction and expansion in the elastic-like zones and the direction of expansion in the expansive zone are parallel to each other and also to the transverse axis 101.

The expansive zone 145 will cover part, or preferably, all of the width and length of the underlying absorbent core of the diaper which is added in a later step in the assembly. The width, length and amount of expansion of the expansive zone 145

can be adjusted to provide the desired properties. The unexpanded width of the expansion zone 145, (as measured in a direction parallel to the transverse axis 101), can be larger, smaller, or the same as the unexpanded width of the elastic-like zones 144 and 146. However, only the portion of elastic-like zone which has a common boundary with the expansive zone will behave contractively in the finished product to produce a gathered waist feature. The unexpanded width of the expansive zone 145 is shown in Figure 7 as being equal to the unexpanded width of the elastic-like zones 144 and 146 which maximizes the amount the elastic-like zones contract relative to the expansive zone 145.

The surface-pathlength of the expansive zone 145 determines the amount of relative "contraction" of the elastic-like zones. For example, if the surface-pathlength of the expansive zone is 40% longer than the elastic-like zone, the elastic-like zone has the potential to exhibit 40% contracted stretch in the finished product.

In Figure 8 the diaper 130 is stretched in the direction indicated by arrows 150 to fully extend the expansive zone 145 and to put the elastic-like zones 144 and 146 under tension. Similar to distance 121 in Fig. 2., distance 151 between lines 152 and 153 of Fig. 8, represents the minimal distances the expansive zone must extend uninhibited, e.g., unbonded to another layer such as an absorbent core, from the elastic-like zone to produce the elastically expansive and contractive behavior. Line 152 represents the common border between the two zones. Line 153 can represent the waist edge of the absorbent core or it can represent the topmost extent of the bond between the core and the backsheet. The distance 151 must be determined so that the elastic-like zone can contract without hindrance to its unstrained length when the tension is removed.

Although Figure 8 indicates a single uniform expansive zone having the same width as the elastic-like zones, it should be understood that as long as the requirement for unhindered motion is met between lines 152 and 153, the remainder of the expansive zone could have multiple regions with different widths and surface-pathlengths.

Referring now to Fig. 9, there is shown a plan view of another embodiment of a diaper 160 of the present invention. Diaper 160 comprises a backsheet 161 comprising an extensible back waist feature 162 comprising an elastic-like zone 164 and an expansive zone 166. The width of the expansive zone 164, (as measured in a direction parallel to the transverse centerline 101), is greater than the width of the adjacent expansive zone 166. The expansive zone 166 may extend to the

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longitudinal edge of the diaper.

To make a diaper of the present invention, the backsheet is first provided with the desired arrangement of elastic-like and expansive zones. The backsheet is then tentered or extended to expand the expansive zone. An absorbent core is then bonded to the expansive zone while the expansive zone is in its expanded condition by any suitable means, for example, thin spirals of glue. A suitable topsheet is then bonded to the absorbent core and backsheet. The topsheet is sized substantially the same as the backsheet. Once the tension is removed, the elastic-like zones will contract causing the elastic-like zones to neck down and gather.

Alternatively, the diaper may be made by first providing the backsheet with one or more expansive zones. The expansive zones are then expanded and secured to another substrate such as an absorbent core. A topsheet is then secured to the backsheet and absorbent core. The elastic-like zones are then formed in both the topsheet and the backsheet.

Other suitable methods may also be used to manufacture the diaper of the present invention. In addition, the order of steps may be also be changed. Furthermore, some steps may also be combined with other steps.

Referring again to Fig. 8, the bonding of the backsheet to the absorbent core becomes very important. The absorbent core may have any length, for example, the absorbent core may extend substantially along the entire length of the diaper. However, line 153 in Fig. 8, represents the uppermost limit of bonding between the core and the backsheet. As seen in Fig. 8, line 153 is completely within expansive zone 145. If line 153 is located within the elastic-like zone, it will significantly inhibit the contractive and expansive properties of the elastic-like zone, thus significantly eliminating the benefits of the expansive zone, i.e., the removal of the line of tension. It should be noted that a portion of the elastic-like zone may be bonded to the absorbent core to keep the absorbent core from floating. Preferably, such bonding will be at or near centerline 100 where the amount of expansion and contraction of the elastic-like zone is at a minimum.

Test Methods

Surface-Pathlength

Pathlength measurements of formed material regions are to be determined by selecting and preparing representative samples of each distinct region and analyzing

these samples by means of microscopic image analysis methods.

Samples are to be selected so as to be representative of each region's surface geometry. Generally, the transition regions should be avoided since they would normally contain features of both the first and second regions. The sample to be measured is cut and separated from the region of interest. The "measured edge" is to be cut parallel to a specified axis of elongation. Usually this axis is parallel to the formed primary-axis of either the first region or the second region. An unstrained sample length of one-half inch is to be "gauge marked" perpendicular to the "measured edge": while attached to the web material, and then accurately cut and removed from the web material.

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 highly formed sample regions it has been found desirable to gently extend the sample in its axial direction (without imposing significant force) simultaneous 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. Fig. 38 shows a typical view of a portion of the second region of a sample 900 having a first side edge 901 and a second side edge 902 used to determine the surface-pathlength. Data herein presented was obtained using the following equipment; Keyence VH-6100 (20x Lens) video unit, with video-image prints made with a Sony Video printer Mavigraph unit. Video prints were image-scanned with a Hewlett Packard ScanJet IIP scanner. Image analysis was 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 .500" with .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

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program. All samples are measured with freehand line-measurement tool selected. Samples are measured on both side-edges and the lengths are recorded. Simple film-like (thin & constant thickness) samples require only one side-edge to be measured. Laminate and thick foam samples are measured on both side-edges. Length measurement tracings are to be made along the full gauge length of a cut sample. In cases of highly deformed samples, 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 for each region is obtained by averaging the lengths of five (5) separate 1/2" 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 web materials of the present invention it is recognized that the test method may have to be modified to accommodate some of the more complex web materials within the scope of the present invention.

Poisson's Lateral Contraction Effect

The Poisson's lateral contraction effect is measured on an Instron Model 1122, as available from Instron Corporation of Canton, Massachusetts, which is interfaced to a Gateway 2000 486/33Hz computer available from Gateway 2000 of N. Sioux City, South Dakota, using Test Works™ software which is available from Sintech, Inc. of Research Triangle Park, North Carolina. All essential parameters needed for testing are input in the TestWorks™ software for each test. Data collection is accomplished through a combination of manual sample width measurements, and elongation measurements made within TestWorks™.

The samples used for this test are 1" wide x 4" long with the long axis of the sample cut parallel to the direction of the first region of the sample. The sample should be cut with a sharp knife or suitably sharp cutting device designed to cut a precise 1" wide sample. It is important that a "representative sample" should be cut so that an area representative of the symmetry of the overall pattern of the deformed region is represented. There will be cases (due to variations in either the size of the deformed portion or the relative geometries of regions 1 and 2) in which it will be necessary to cut either larger or smaller samples than is suggested herein. In this

case, it is very important to note (along with any data reported) the size of the sample, which area of the deformed region it was taken from and preferably include a schematic of the representative area used for the sample. In general, an "aspect ratio" of (2:1) for the actual extended tensile portion (l1:w1) is to be maintained if possible. Five samples are tested.

The grips of the Instron consist of air actuated grips designed to concentrate the entire gripping force along a single line perpendicular to the direction of testing elongation having one flat surface and an opposing face from which protrudes a half round. No slippage should be permitted between the sample and the grips. The distance between the lines of gripping force should be 2" as measured by a steel rule held beside the grips. This distance will be referred to from here on as the "gauge length".

The sample is mounted in the grips with its long axis perpendicular to the direction of applied elongation. An area representative of the overall pattern geometry should be symmetrically centered between the grips. The crosshead speed is set to 10 *in/min*. The crosshead moves to the specified strain (measurements are made at both 20 and 60% elongation). The width of the sample at its narrowest point (w2) is measured to the nearest 0.02" using a steel rule. The elongation in the direction of applied extension is recorded to the nearest 0.02" on the TestWorks software. The Poisson's Lateral Contraction Effect (PLCE) is calculated using the following formula:

$$PLCE = \frac{\frac{|w2 - w1|}{w1}}{\frac{|l2 - l1|}{l1}}$$

where
- w2 = The width of the sample under an applied longitudinal elongation;
- w1 = The original width of the sample;
- l2 = The length of the sample under an applied longitudinal elongation; and
- l1 = The original length of the sample (gauge length);

Measurements are made at both 20 and 60% elongation using five different samples for each given elongation. The PLCE at a given percent elongation is the

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average of five measurements.

While the test method described above is useful for many of the web materials of the present invention it is recognized that the test method may have to be modified to accommodate some of the more complex web materials within the scope of the present invention.

Hysteresis Test

The hysteresis test is used for measuring the percent set and percent force relaxation of a material. The tests are performed on an Instron Model 1122, available from Instron Corporation of Canton, Mass. which is interfaced to a Gateway 2000 486/33Hz computer available from Gateway 2000 of N. Sioux City, South Dakota 57049, using TestWorks™ software which is available from Sintech, Inc. of Research Triangle Park, North Carolina 27709. All essential parameters needed for testing are input in the TestWorks™ software for each test (i.e. Crosshead Speed, Maximum percent elongation Point and Hold Times). Also, all data collection, data analysis and graphing are done using the TestWorks™ software.

The samples used for this test are 1" wide x 4" long with the long axis of the sample cut parallel to the direction of maximum extensibility of the sample. The sample should be cut with a sharp exacto knife or some suitably sharp cutting device design to cut a precise 1" wide sample. (If there is more than one direction of elongation of the material, samples should be taken parallel to representative directions of elongation). The sample should be cut so that an area representative of the symmetry of the overall pattern of the deformed region is represented. There will be cases (due to variations in either the size of the deformed portion or the relative geometries of the first and second regions) in which it will be necessary to cut either larger or smaller samples than is suggested herein. In this case, it is very important to note (along with any data reported) the size of the sample, which area of the deformed region it was taken from and preferably include a schematic of the representative area used for the sample. Three separate tests at 20, 60 and 100% strain are typically measured for each material. Three samples of a given material are tested at each percent elongation.

The grips of the Instron consist of air actuated grips designed to concentrate the entire gripping force along a single line perpendicular to the direction of testing stress having one flat surface and an opposing face from which protrudes a half round to minimize slippage of the sample. The distance between the lines of

gripping force should be 2" as measured by a steel rule held beside the grips. This distance will be referred to from hereon as the "gauge length". The sample is mounted in the grips with its long axis perpendicular to the direction of applied percent elongation. The crosshead speed is set to 10 in/min. The crosshead moves to the specified maximum percent elongation and holds the sample at this percent elongation for 30 seconds. After the thirty seconds the crosshead returns to its original position (0% elongation) and remains in this position for 60 seconds. The crosshead then returns to the same maximum percent elongation as was used in the first cycle, holds for thirty seconds and then again returns to zero.

A graph of two cycles is generated. A representative graph is shown in Fig. 7. The percent force relaxation is determined by the following calculation of the force data from the first cycle:

$$\frac{\text{Force at Max. \% elongation} - \text{Force after 30 sec. hold}}{\text{Force at Maximum \% elongation (cycle 1)}} \times 100 = \text{\% Force Relaxation}$$

The percent set is the percent elongation of the sample of the second cycle where the sample starts to resist the elongation. The percent set and the percent force relaxation are shown graphically also in Figs. 7, 9, 11, 13 and 15. The average percent force relaxation and percent set for three samples is reported for each maximum percent elongation value tested.

While the test method described above is useful for many of the web materials of the present invention it is recognized that the test method may have to be modified to accommodate some of the more complex web materials within the scope of the present invention.

Tensile Test

The tensile test is used for measuring force versus percent elongation properties and percent available stretch of a material. The tests are performed on an Instron Model 1122, available from Instron Corporation of Canton, Mass. which is interfaced to a Gateway 2000 486/33Hz computer available from Gateway 2000 of N. Sioux City, South Dakota , using TestWorks™ software which is available from Sintech, Inc. of Research Triangle Park, North Carolina. All essential parameters needed for testing are input in the TestWorks™ software for each test. Also, all data collection, data analysis and graphing are done using the TestWorks™ software.

The samples used for this test are 1" wide x 4" long with the long axis of the sample cut parallel to the direction of maximum extensibility of the sample. The sample should be cut with a sharp exacto knife or some suitably sharp cutting device design to cut a precise 1" wide sample. (If there is more than one direction of extensibility of the material, samples should be taken parallel to representative direction of elongation). The sample should be cut so that an area representative of the symmetry of the overall pattern of the deformed region is represented. There will be cases (due to variations in either the size of the deformed portion or the relative geometries of regions 1 and 2) in which it will be necessary to cut either larger or smaller samples than is suggested herein. In this case, it is very important to note (along with any data reported) the size of the sample, which area of the deformed region it was taken from and preferably include a schematic of the representative area used for the sample. Three samples of a given material are tested.

The grips of the Instron consist of air actuated grips designed to concentrate the entire gripping force along a single line perpendicular to the direction of testing stress having one flat surface and an opposing face from which protrudes a half round to minimize slippage of the sample. The distance between the lines of gripping force should be 2" as measured by a steel rule held beside the grips. This distance will be referred to from hereon as the "gauge length". The sample is mounted in the grips with its long axis perpendicular to the direction of applied percent elongation. The crosshead speed is set to 10 in/min. The crosshead elongates the sample until the sample breaks at which point the crosshead stops and returns to its original position (0 % elongation).

Graphs of the tensile data are shown in Figs. 6, 8, 10, 12 and 14. The percent available stretch is the point at which there is an inflection in the force - elongation curve, beyond which point there is a rapid increase in the amount of force required to elongate the sample further. This point is shown graphically in Figs. 6, 8, 10, 12 and 14. The average of the percent available stretch for three samples is recorded.

While the test method described above is useful for many of the web materials of the present invention it is recognized that the test method may have to be modified to accommodate some of the more complex web materials within the scope of the present invention.

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:

1. A web material exhibiting both an elastic-like and an expansive behavior in response to an applied elongation along at least one axis thereof, said web material characterized by:

   an elastic-like zone and an expansive zone disposed adjacent to said elastic-like zone, said elastic-like zone and said expansive zone being formed of substantially the same material composition, said elastic-like zone comprising a strainable network comprising a first region having a surface-pathlength and a second region having a surface-pathlength, the surface-pathlength of said second region being greater than the surface pathlength of said first region as measured parallel to said axis while said web is in an untensioned condition, said expansive zone having a surface-pathlength greater than the surface-pathlength of said first region and a surface-pathlength different than the surface-pathlength of said second region as measured parallel to said axis while said web is in an untensioned condition.

2. The web material of Claim 1, wherein said first region undergoes a substantially molecular-level deformation and said second region initially undergoes a substantially geometric deformation in response to the applied elongation.

3. The web material of Claim 2, wherein said expansive zone initially undergoes a substantially geometric deformation in response to the applied elongation.

4. The web material of any one of the preceding claims, wherein said first region and said second region are visually distinct from one another.

5. The web material of any one of the preceding claims, wherein said second region comprises a plurality of rib-like elements.

6. The web material of any one of the preceding claims, wherein said expansive

zone comprises a plurality of incrementally stretched regions.

7. The web material of any one of the preceding claims, wherein said expansive zone is contiguous with said elastic-like zone.

8. The web material of any one of the preceding claims, wherein said web material comprises a portion of a disposable absorbent article.

9. The web material of any one of the preceding claims, wherein said web material comprises a portion of a backsheet on a disposable absorbent article.

10. The web material of any one of the preceding claims, wherein said web material comprises a portion of a topsheet on a disposable absorbent article.

11. The web material of any one of the preceding claims, wherein said web material forms a waist feature, an elasticized leg cuff, or an ear flap on a disposable diaper.

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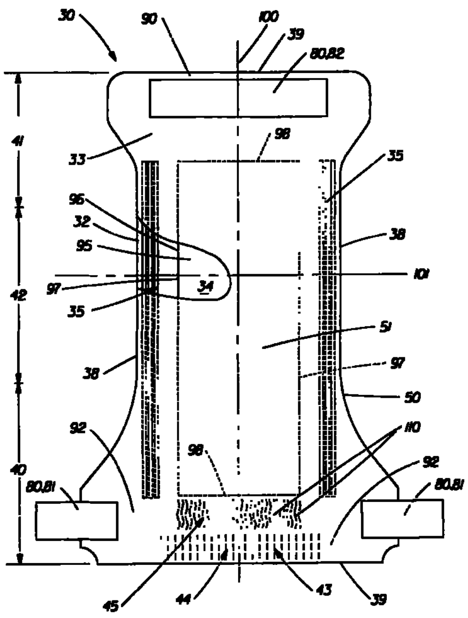

Fig. 1

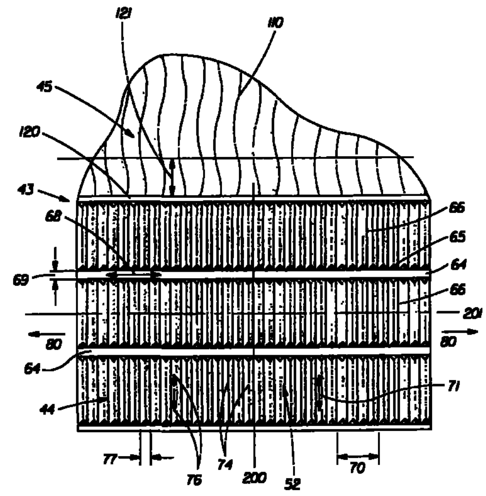

Fig. 2

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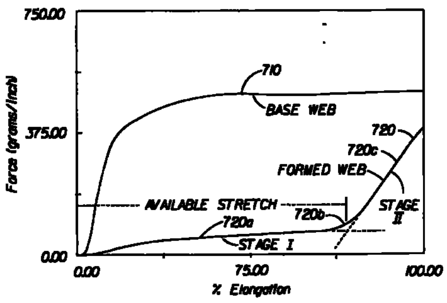

Fig. 3

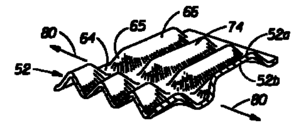

Fig. 4A

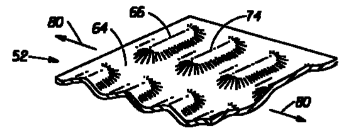

Fig. 4B

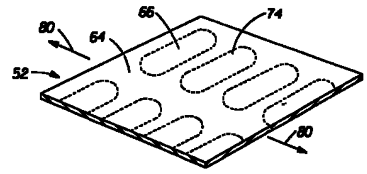

Fig. 4C

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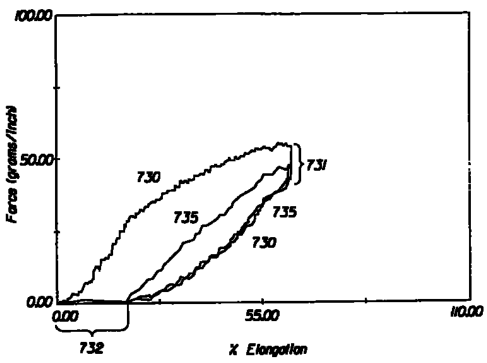

Fig. 5

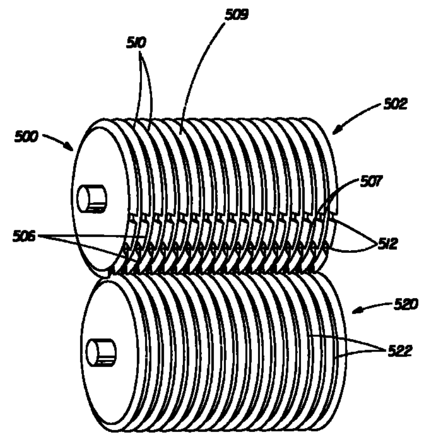

Fig. 6

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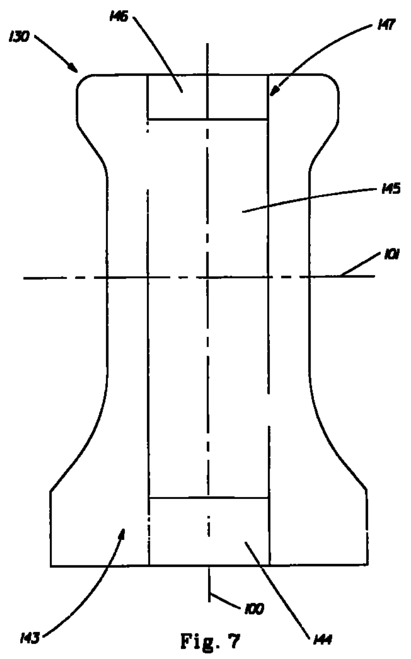

Fig. 7

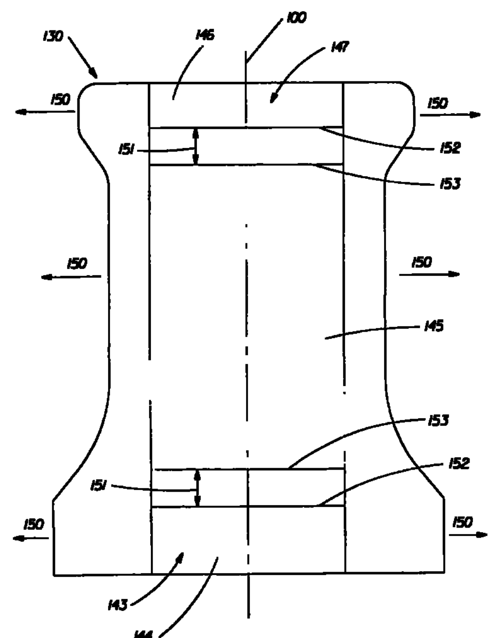

Fig. 8

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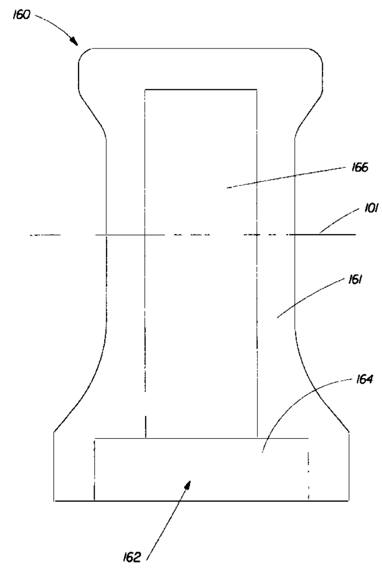

Fig. 9

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US005683374A

United States Patent [19]

Yamamoto et al.

[11] **Patent Number:** 5,683,374

[45] **Date of Patent:** Nov. 4, 1997

[54] **ABSORBENT PADDING FOR UNDERGARMENTS**

[75] Inventors: Masamitsu Yamamoto, Ehime-ken; Yoshihisa Fujioka, Kagawa-ken; Yoshio Ono, Ehime-ken, all of Japan

[73] Assignee: Uni-Charm Corporation, Kawanoe, Japan

[21] Appl. No.: 636,346

[22] Filed: Apr. 23, 1996

Related U.S. Application Data

[62] Division of Ser. No. 488,803, Jun. 8, 1995.

[51] Int. Cl.^{6} A61F 13/15; A61F 13/20

[52] U.S. Cl. 604/385.2; 604/378

[58] Field of Search 604/378, 385.1, 604/379, 380, 382, 383, 385.2, 358

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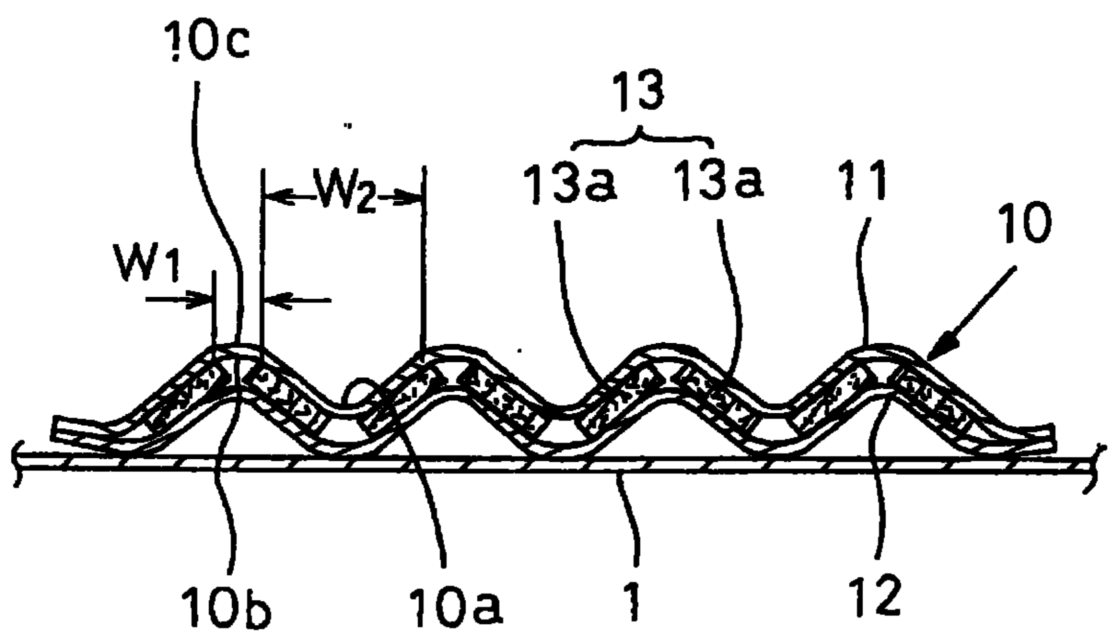
Primary Examiner—John G. Weiss
Assistant Examiner—Ki Yong O
Attorney, Agent, or Firm—Morrison Law Firm

[57] **ABSTRACT**

A liquid absorbent pad includes an elastically stretchable basic sheet upon which an absorbent core is periodically bonded. The absorbent core is bonded while the basic sheet is stretched. The absorbent core includes a structure which encourages the formation of corrugations therein when the basic sheet is released. The corrugations enable the flow of material in the troughs of the corrugations, and thereby reduce soilage of the upper surface of the absorbent core by fetal matter. The liquid absorbent pad is suitable for undergarment use in which the basic sheet includes a waist opening and a pair of leg openings. In one embodiment, the structure which encourages the formation of corrugations includes gaps between adjacent strips of absorbent material. In another embodiment, the structure is periodic regions of reduced density or rigidity. In a further embodiment, the structure includes periodic longitudinal indentations alternating on opposite sides of the absorbent pad.

8 Claims, 4 Drawing Sheets



Lb

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FIG.1

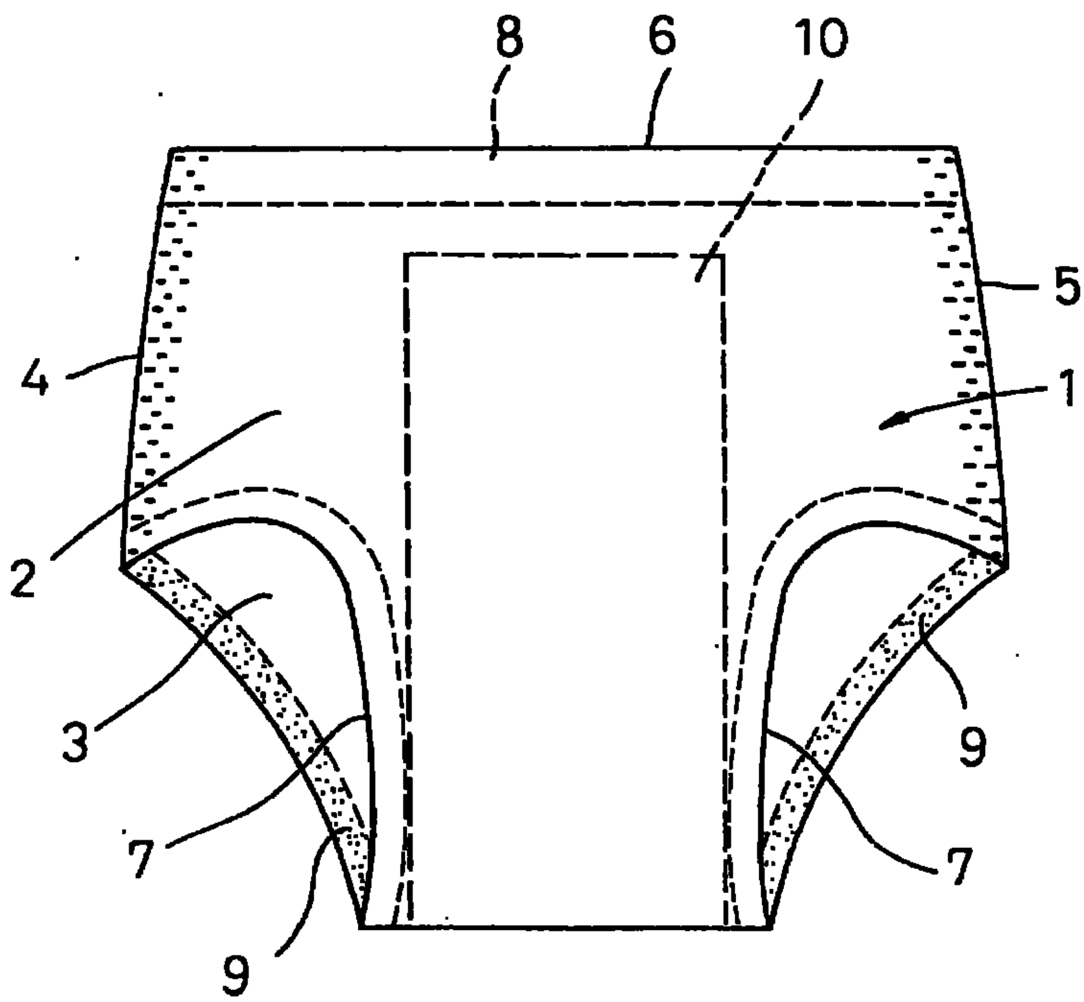
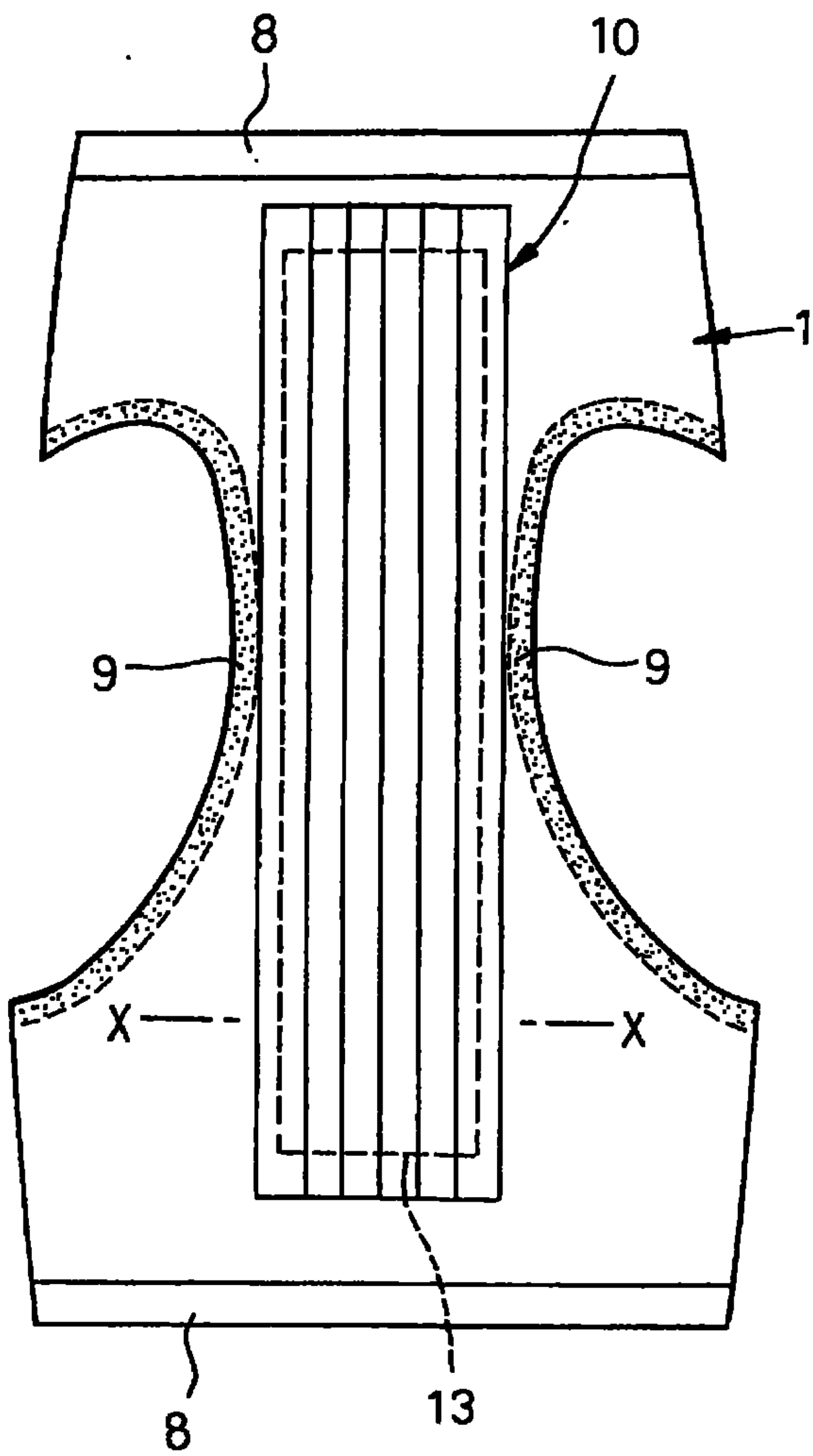


FIG.2



93 100

FIG.3

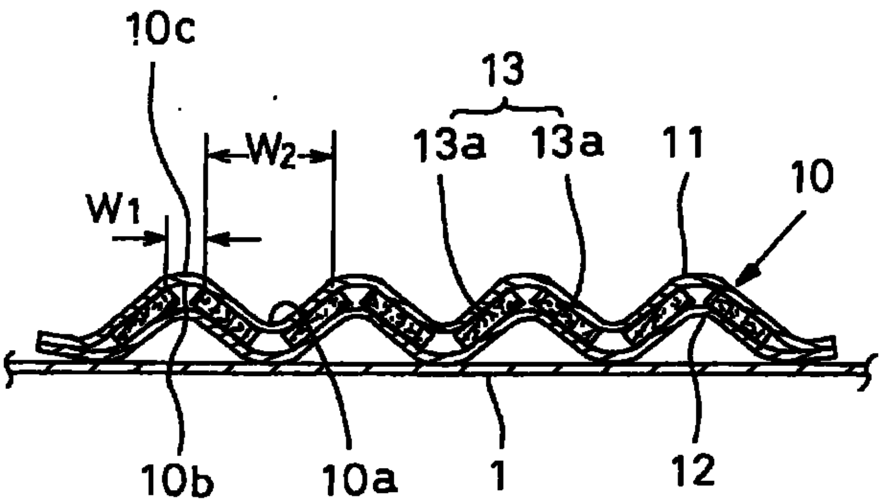


FIG.4

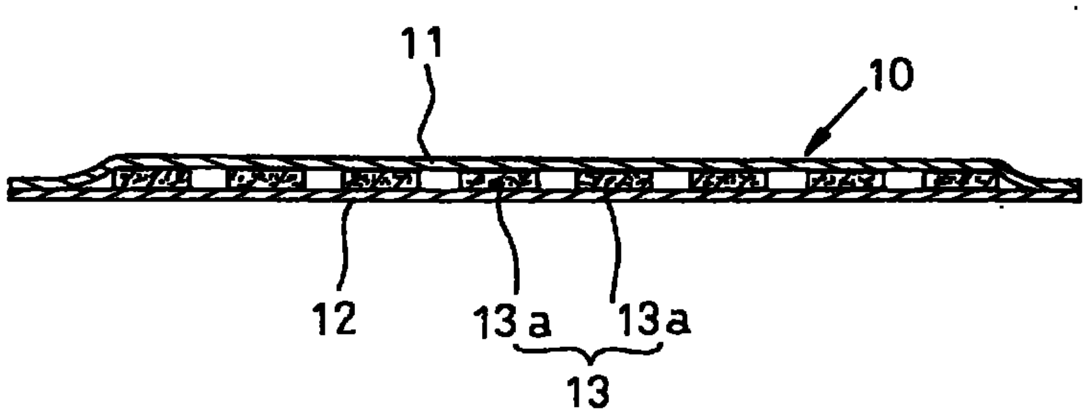


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FIG.5

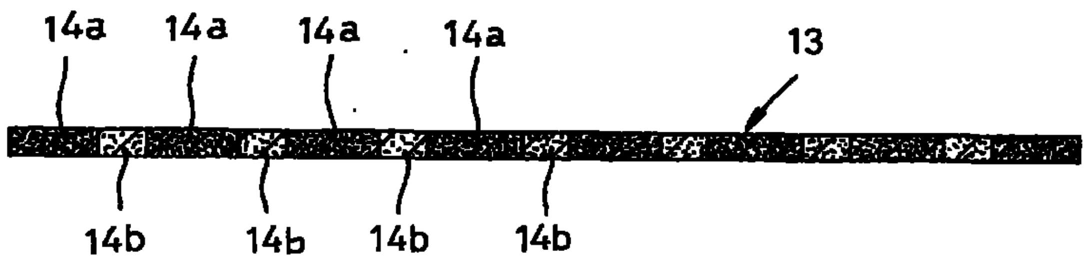
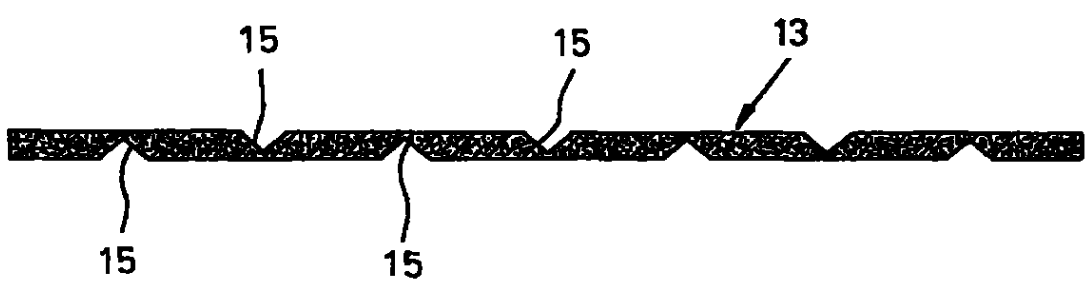


FIG.6



ABSORBENT PADDING FOR UNDERGARMENTS

This is a divisional of co-pending application Ser. No. 08/488,803 filed on Jun. 8, 1995, pending.

BACKGROUND OF THE INVENTION

The present invention relates to an absorbent padding and, more particularly, to an absorbent padding suitable for use as an absorbent undergarment in diapers for incontinence, diapers for infants, training pants for infants or menstruation pads having front and rear bodies connected to each other along their transversely opposite side edges.

Conventional pants type absorbent undergarments generally have a liquid-absorbent core primarily made of fluffy pulp disposed between a top sheet and a back sheet. One version of conventional absorbent undergarments includes a liquid-absorbent core having transversely alternating troughs and crests, each extending longitudinally along the liquid-absorbent core. Such troughs and crests assure that liquid excretions flow diffusibly longitudinally along the core and thereby avoid sideways leakage of liquid excretion that might occur if liquid excretion diffusibly flows transversely along the core.

Prior art troughs and crests are formed by embossing the liquid-absorbent core, which, in turn, causes the garment to become more rigid and lose desirable pliability. The rigidity caused by the embossing treatment leads to discomfort of the wearer.

In addition, the top sheet (the inner sheet closest to the wearer's body) covering a top surface of the liquid absorbent core remains substantially flat despite the corrugation of the liquid-absorbent core. As a result of the top sheet of the core assembly lacking the desirable corrugated configuration, liquid fecal material not passing through the top sheet can diffusibly flow sideways and cause undesirable leakage.

It is also well known to wrinkle or crease the top sheet of conventional absorbent undergarments so that the top sheet itself may be corrugated and to cover the liquid-absorbent core with this corrugated top sheet. While this known technique has been found to be effective to some degree in preventing liquid fecal material from diffusibly flowing sideways, the configuration formed by this technique has other disadvantages.

Chief among them is that the wrinkled or creased top sheet floats at its respective crests away from the top surface of the liquid-absorbent core. Consequently, the absorptive power for liquid excretion is significantly deteriorated because the top sheet is out of contact with the liquid-absorbent core.

OBJECTS AND SUMMARY OF THE INVENTION

It is an object of the present invention to provide a disposable absorbent padding material which overcomes the drawbacks of the prior art.

It is a principal object of the invention to solve the problems, as mentioned above, by configuring an absorbent pad separately of a basic sheet and bonding this absorbent pad to the inner surface of the basic sheet to obtain the desired corrugated configuration.

It is an object of this invention to provide a disposable absorbent pad formed with a plurality of transversely alternate troughs and crests extending longitudinally.

Briefly stated, the present invention provides a liquid absorbent pad which includes an elastically stretchable basic sheet upon which an absorbent core is periodically bonded. The absorbent core is bonded while the basic sheet is stretched. The absorbent core includes a structure which encourages the formation of corrugations therein when the basic sheet is released. The corrugations enable the flow of material in the troughs of the corrugations, and thereby reduce soilage of the upper surface of the absorbent core by fecal matter. The liquid absorbent pad is suitable for undergarment use in which the basic sheet includes a waist opening and a pair of leg openings. In one embodiment, the structure which encourages the formation of corrugations includes gaps between adjacent strips of absorbent material. In another embodiment, the structure is periodic regions of reduced density or rigidity. In a further embodiment, the structure includes periodic longitudinal indentations alternating on opposite sides of the absorbent pad.

According to an embodiment of the invention, there is provided a liquid absorbent pad comprising: a first substantially planar element, at least part of the first substantially planar element being an absorbent material, a second substantially planar element, the second substantially planar element being stretchable, the first substantially planar element including parallel portions having one of a greater flexibility and a lower rigidity than a remainder thereof, the first planar element being fastened to the second planar element at a plurality of places while the second substantially planar element is stretched, whereby, when the second substantially planar element is released, the first substantially planar element is deformed into corrugations along the parallel portions having a greater flexibility.

According to a feature of the invention, there is provided a method for making a liquid absorbent pad comprising: applying a tension for stretching a first substantially planar element along an axis, forming parallel portions in a second substantially planar element, having one of reduced rigidity and increased flexibility compared to a remainder thereof, periodically affixing the second substantially planar element to the first substantially planar element, and releasing the tension, whereby the second substantially planar element is corrugated along the parallel portions.

According to a further feature of the invention, there is provided a liquid absorbent undergarment comprising: an elastically stretchable material basic sheet having an inner surface, a front body and a rear body, the sheet including a waist opening and a pair of leg openings, an absorbent pad intermittently bonded to the inner surface across the front and the rear bodies, and the absorbent pad including a plurality of transversely alternate troughs and crests each extending longitudinally of the pad.

The above, and other objects, features and advantages of the present invention will become apparent from the following description read in conjunction with the accompanying drawings, in which like reference numerals designate the same elements.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front view of an undergarment according to an embodiment of the invention.

FIG. 2 is a plan view showing an inside of the undergarment of FIG. 1 as developed.

FIG. 3 is a sectional view showing an absorbent pad as taken along a line X—X in FIG. 2.

FIG. 4 is a sectional view showing the absorbent pad of FIG. 2 that includes a corrugated configuration.

FIG. 5 is a sectional view showing another embodiment of an absorbent pad as taken along a line X—X in FIG. 2.

96 103

FIG. 6 is a sectional view showing further another embodiment of an absorbent pad as taken along a line X—X in FIG. 2.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The object of the present invention is achieved, by an absorbent pad which is bonded intermittently to an inner surface of an exterior basic sheet. The basic sheet, in turn, is made of a fibrous nonwoven fabric which is elastically stretchable at least in length and width.

When configured as an undergarment such as an underpants, the basic sheet is formed with a waist opening and a pair of leg openings. The absorbent pad is intermittently bonded to the inner surface of the basic sheet, across the front and rear with the absorbent pad having a plurality of transversely alternate troughs and crests each extending longitudinally along the absorbent pad.

Liquid excretion diffusibly flows longitudinally along the troughs of the absorbent pad and is absorbed. Liquid fetal material also flows along the troughs but the invention keeps most of the fecal material away from the tops of the respective crests. Hence, the present invention substantially avoids the smearing of liquid fetal matter on top surface of the absorbent 'pad.

Referring to FIGS. 1 through 3, an undergarment according to an embodiment of the invention, shown generally at 20, includes a basic sheet 1. Basic sheet 1 is made up of a front 2 bonded to a rear body 3 along their transversely opposite side edges 4 and 5 to form a waist opening 6 and a pair of leg openings 7. Basic sheet 1 is cut from a fibrous nonwoven fabric which is elastically stretchable in length and width. It is preferable that the fabric be more elastically stretchable in width than in length.

Basic sheet 1 defining the front and rear bodies 2 and 3 may be cut from a web including thermo-crimpable synthetic fibers subjected to a known intertwining treatment under water jets. Alternatively, the web may have fibers dot-bonded together by heating under high pressure.

A circumferentially stretchable tape-like elastic member 8 is attached to an inner peripheral surface of waist opening 6. For an aesthetic effect, the elastic member 8 may have a color that is different from that of the basic sheet 1 defining the front and rear bodies 2 and 3, since the color of the elastic member 8 is visible through basic sheet 1.

Commonly known synthetic hot melt resins having rubber-like elasticity in their cured state can be continuously applied to the inner peripheral surface of each leg opening 7 without leaving a margin around the outer edge. This aids in the formation of a tape-like elastic zone 9 having a stretch stress of from about 50 to about 130 grams

In this manner, the tape-like elastic zone 9 around the leg openings 7 has a stretch stress higher than in the elastic-member-free portion of the basic sheet 1. Values of stretch stress are measured by cutting off a strip of the same size as tape-like elastic zone 9 from the portion of the basic sheet 1 having no hot melt type synthetic resin applied thereto and performing comparative measurements.

An alternative to using the above noted resins, a rubber or an elastomeric compound, preferably in a liquid- or gel-state can be used. A rubber or elastomeric compound that exhibits an elasticity in its cured state can also be used. If such rubber or elastomeric compound requires heat treatment for its generation or application, it must retain elasticity upon cooling.

To apply liquid-state elastic material to the inner peripheral surface of each leg opening 7 without leaving any margin around the outer edge thereof, the basic sheet 1 one of the above resins is applied to define a relatively large tape-like elastic zone 9 before basic sheet 1 is cut to form leg openings 7. The cut to form leg openings 7 is made along a cutting line lying within the applied zone. Thus, any excess resin is removed with the material of basic sheet 1 being removed to form leg openings 7.

Tape-like elastic zone 9 on the inner peripheral surface of leg openings 7 may be coated with a nonwoven fabric of stretchable fibers to add comfort to the wearer, particularly if the feel of elastic zone 9 against the wearer might be uncomfortable. Alternatively, elastic zone 9 can be formed on the outer peripheral surfaces of leg openings 7.

The elastic material composed of the above noted resins should preferably be of a color different from that of the basic sheet 1 which defines front and rear bodies 2 and 3. The elastic material may be used to form tape-like elastic zone 9 and thereby to rim leg openings 7 for an aesthetic effect as in the case of waist opening 6.

Referring to FIG. 3, a cross section, generally identified by 16, shows absorbent pad 10 disposed on an inner surface of basic sheet 1. Absorbent pad 10 is affixed by intermittent bonding (preferably dot-bonding) by adhesive or welding. Absorbent pad 10 includes a plurality of transversely alternate troughs 10*a* and crests 10*b*, each extending longitudinally along absorbent pad 10. To avoid smearing the wearers with liquid fecal material clinging to the surface of absorbent pad 10, top surface 10*c* of each crest 10*b* preferably has a width W1 narrower than a width W2 of trough 10*a* defined between each pair of adjacent top surfaces 10*c*. The total area of top surfaces 10*c* is preferably less than one-third of a total surface area of absorbent pad 10. Troughs 10*a* and crests 10*b* are formed by contraction of basic sheet 1 after absorbent pad 10 is bonded to basic sheet 1. In this process, basic sheet 1 is transversely tensioned.

Troughs 10*a* and crests 10*b* are formed over a liquid-absorbent core 13. Liquid-absorbent core 13 is made up of a plurality of narrow liquid-absorbent core strips 13*a* transversely spaced from one another. A liquid permeable top sheet 11 is disposed over core strips 13*a*. A liquid permeable back sheet 12 is disposed below core strips 13*a*. Top sheet 11 and back sheet 12 are made of a fibrous nonwoven fabric. In effect, the gaps between adjacent core strips 13*a* forms regions of low rigidity which encourages peaks and valleys of the corrugations of FIG. 3 to form in these locations when basic sheet 1 contracts during fabrication.

Referring now to FIG. 4, prior to being affixed to basic sheet, and shrunk into the corrugations shown in FIG. 3, absorbent pad 10, shown in cross section generally at 17, is a flat sheet. Core strips 13*a* are fixed in place between top sheet 11 and back sheet 12 using adhesive or welding. Top sheet 11 and back sheet 12 are bonded together about their outer perimeters to confine liquid-absorbent core 13 between them.

Referring now to FIG. 5, generally at 18, a further embodiment of the invention includes a one-piece liquid-absorbent core 13. One-piece core 13 is made up of a plurality of sections 14*a* having a high density or a high rigidity, alternating with a plurality of sections 14*b* having a low density or a low rigidity. Sections 14*a* and 14*b* extend longitudinally of the core 13.

In a manner similar to the prior embodiment, low density sections 14*b* provide preferred locations for the formation of troughs 10*a* and crests 10*b*, so that the final form of the embodiment of FIG. 5 is the same as the embodiment of FIGS. 3 and 4, with troughs and crests in low density or low rigidity sections 14b, alternating with high density or high rigidity, sections 14a therebetween.

Prior to affixing absorbent pad 10 to basic sheet 1, basic sheet 1 is held stretched. While basic sheet 1 is held stretched, absorbent core 13 is attached thereto at intermittent locations. Then, when basic sheet 1 is released, the contraction of basic sheet 1 deforms the intermittently attached absorbent pad 10 into the plurality of troughs 10a and crests 10b of FIG. 3.

Referring now to in FIG. 6, a further embodiment of a core 13, shown generally at 19, includes a plurality of compressed grooves 15 transversely spaced from one another on upper and lower surfaces, each extending longitudinally along core 13. Compressed grooves 15 provide regions of lower rigidity or increased flexibility for encouraging the formation of troughs 10a and crests 10b, upon the contraction of the basic sheet 1. Similar to the above described embodiment, basic sheet 1 is stretched while absorbent core 13 is intermittently attached thereto. Upon releasing basic sheet 1, the intermittently attached absorbent core 13 is deformed into a plurality of troughs and crests by contraction of basic sheet 1.

Cores 13 of FIGS. 5 and 6 are deformed into a corrugated configuration by being bent along the low density or low rigidity sections 14b, in the case of FIG. 5, or by being bent along grooves 15, in the case of FIG. 6. Though not shown, cores 13 shown in FIGS. 5 and 6 are also integrally disposed between top sheet 11 and back sheet 12, and grooves 15 are formed together with these sheets 11, 12.

Liquid-absorbent core 13 is made of one of, or a mixture of, thermo-crimpable synthetic fibers, fluffy pulp and high absorption polymer powders. It is preferable that the fibers of core 13 are partially fused together to provide a netlike structure. Although back sheet 12 is described as being liquid permeable, a liquid-impermeable sheet such as a water repellent fibrous nonwoven fabric or a plastic film may be also used.

With the undergarment of the invention constructed as described hereinabove, body exudates flow diffusibly longitudinally along the troughs of the absorbent pad to be absorbed thereby. Liquid fecal material also flows along the troughs below the top surface of the absorbent pad, i.e., away from the top surfaces of the crests 10b. Thus, smearing of the liquid fecal matter on the top surface of the absorbent pad is minimized. This invention not only avoids sideways leakage of material, but also allows clearance of troublesome accumulations by flow along troughs 10a. Further, possible outbreaks of skin diseases such as eruptions or sores due to liquid fecal material clinging to the wearer's skin are also minimized.

Having described preferred embodiments of the invention with reference to the accompanying drawings, it is to be understood that the invention is not limited to those precise embodiments, and that various changes and modifications may be effected therein by one skilled in the art without departing from the scope or spirit of the invention as defined in the appended claims.

What is claimed is:

1. A liquid absorbent undergarment comprising:

a basic sheet made from an elastically stretchable material, said basic sheet having an inner surface, a front body and a rear body;

said basic sheet including a waist opening and a pair of leg openings;

an absorbent pad intermittently bonded to said inner surface across said front and said rear bodies;

said absorbent pad including a liquid absorbent core between a top sheet and a back sheet;

said liquid absorbent core including a plurality of substantially parallel portions;

a first set of said plurality of substantially parallel portions transversely spaced from one another thereby forming gaps between each adjacent pair of said first set of said plurality of substantially parallel portions;

a second set of said plurality of substantially parallel portions forming regions between each adjacent pair of said first set of said plurality of said substantially parallel portions;

said second set of said plurality of substantially parallel portions being lower in rigidity than said first set of said plurality of substantially parallel portions; and

said absorbent pad including a plurality of transversely alternate troughs and crests each extending along said regions of low rigidity between each adjacent pairs of said first set of said plurality of substantially parallel portions.

2. The undergarment according to claim 1, wherein said troughs and crests are formed upon the contraction of said basic sheet after said absorbent pad has been bonded to said basic sheet while said basic sheet is tensioned transversely to said plurality of substantially parallel portions.

3. The undergarment according to claim 1, wherein:

said second set of said plurality of parallel portions includes a first plurality of substantially parallel grooves on a first surface of said liquid absorbent core;

said second set of said plurality of parallel portions further includes a second plurality of substantially parallel grooves disposed on an opposite second surface of said liquid absorbent core; and

said second plurality of grooves are disposed substantially parallel to and alternating with said first plurality of grooves.

4. The undergarment according to claim 3, wherein said substantially parallel grooves are compressed into said liquid absorbent core.

5. A liquid absorbent undergarment, comprising:

a first element;

said first element being an absorbent pad;

said absorbent pad including a liquid absorbent core between a top sheet and a back sheet;

said liquid absorbent-core including a plurality of substantially parallel portions;

a first set of said plurality of substantially parallel portions transversely spaced from one another thereby forming gaps between each adjacent pair of said first set of said plurality of substantially parallel portions;

a second set of said plurality of substantially parallel portions forming regions between each adjacent pair of said first set of said plurality of substantially parallel portions;

said second set of said plurality of substantially parallel portions being lower in rigidity than said first set of said plurality of said substantially parallel portions

a second element;

said second element being stretchable;

said second element being conformable to a shape wearable as an undergarment;

said first element being fastened to said second element at a plurality of places while said second element is

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stretched, wherein said first element is inclined to form peaks and troughs along said regions of low rigidity between each adjacent pair of said first set of said plurality of substantially parallel portions.

6. The undergarment according to claim 5, wherein said first set of said plurality of substantially parallel portions further include a plurality of liquid-absorbent core strips transversely spaced substantially parallel to each other.

7. The undergarment according to claim 5, wherein:

said second set of said plurality of substantially parallel portions includes a first plurality of substantially parallel grooves on a first surface of said liquid absorbent core;

said second set of said plurality of substantially parallel portions further includes a second plurality of substantially parallel grooves disposed on an opposite second surface of said liquid absorbent core; and

said second plurality of grooves are disposed substantially parallel to and alternating with said first plurality of grooves.

8. The undergarment according to claim 7, wherein said substantially parallel grooves are compressed into said liquid absorbent core.

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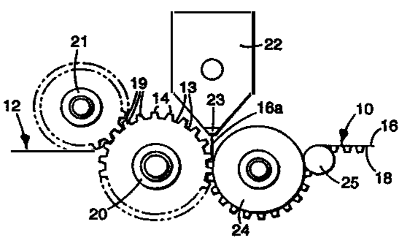
(54) Title: ELASTIC SHEET-LIKE COMPOSITE

(57) Abstract

An elastic sheet-like composite (10) comprising a multiplicity of elongate strands (16) of resiliently elastic material, and one or more sheets of material bonded along its length or at sheet bonding locations to the elastic strands (16) some of which sheets have arcuate portions (13) projecting from the elastic strands (16) between those sheet bonding locations. The elastic sheet-like composite (10) may be incorporated in disposable garments such as diapers or training pants. Also disclosed is a novel method and novel equipment for making the elastic sheet-like composite (10) including in different combinations, sheet corrugating members, equipment for compacting the sheet along its length and an extruder that extrudes the strands onto the sheets and affords versatility in selecting characteritics of the elastic sheet-like composite (10) to be produced without major modifications of the equipment.



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ELASTIC SHEET-LIKE COMPOSITE

Technical Field

The present invention relates to elastic sheet-like composites of the type comprising a multiplicity of elongate strands of resiliently elastic material, and one or more sheets of flexible material bonded to the elastic strands; and in certain important aspects, relates to methods and equipment for making such elastic sheet-like composites and products such as disposable garments (including diapers, training pants, and adult incompetence briefs) in which they are used.

Background Art

Known are elastic sheet-like composites of the type comprising a multiplicity of elongate strands of resiliently elastic material, and one or more sheets of flexible material anchored at spaced bonding locations to longitudinally spaced parts of the elastic strands so that arcuate portions of the sheets project from the elastic strands between those sheet bonding locations. U.S. Patents Nos. 4,552,795 and 4,640,859 provide illustrative examples. While the structures of the elastic sheet-like composites described in those patents and the methods and equipment by which they are made are suitable for many purposes, those structures and methods have features that present limitations for certain other purposes.

Disclosure of Invention

The present invention provides improved elastic sheet-like composites generally of the type comprising a multiplicity of elongate strands of resiliently elastic material and one or more sheets of flexible material bonded along sides of the elastic strands; which sheets are extendable with the elongate strands when the elongate strands are stretched either because (1) the sheets have arcuate portions projecting from the elastic strands between portions of the sheets that are bonded to the strands; or (2) the sheets are of stretchable material; or (3) the sheets are of a material that is compacted in the direction in which the strands extend so that the sheet can be extended in that direction; or (4) the sheets have a combination of such

structures. These elastic sheet-like composites provides advantages when used for many purposes particularly including being incorporated in disposable garments such as diapers, training pants, or adult incompetence briefs. The present invention also provides novel methods and novel equipment for making the elastic sheet-like composites that causes the elastic sheet-like composites to be well constructed and yet inexpensive to make, and affords versatility in selecting characteristics of the elastic sheet-like composites to be produced without major modifications of the equipment.

According to the present invention there is provided a method for forming an elastic sheet-like composite which comprises (1) providing a first sheet of flexible material (e.g., a polymeric film, or a sheet of woven natural or polymeric fibers, or nonwoven natural or polymeric fibers that are bonded internally of the sheet); (2) forming the first sheet of flexible material to have arcuate portions projecting in the same direction from spaced anchor portions of the first sheet of flexible material; (3) extruding spaced generally parallel elongate strands of molten thermoplastic material that is resiliently elastic when cooled (e.g., elastomeric polyester, polyurethane, polystyrene-polyisoprene-polystyrene, polystyrene-polybutadiene-polystyrene or polystyrene-poly(ethylene-butylene)-polystyrene) onto the anchor portions of the first sheet of flexible material to form, when cooled and solidified, resiliently elastic strands thermally bonded to and extending between the anchor portions of the first sheet of flexible material with the arcuate portions of the first sheet of flexible material projecting from corresponding elongate surface portions of the strands.

By this method there is provided a novel elastic sheet-like composite comprising the multiplicity of generally parallel extruded elongate strands of resiliently elastic thermoplastic material extending in generally parallel spaced relationship, and the first sheet of flexible material that has anchor portions thermally bonded at first sheet bonding locations to longitudinally spaced parts of the elastic strands along corresponding elongate surface portions, and has arcuate portions projecting from those elongate surface portions of the elastic strands between the sheet bonding locations.

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Extruding the elastic strands onto the anchor portions of the first sheet of flexible material causes the molten strands to form around and be indented by the arcuate convex surfaces of the anchor portions at the bonding locations with the bonds between the solidified strands and the anchor portions at the bonding locations extending along the entire parts of the strand's surfaces that are closely adjacent the anchor portions. The solidified strands have uniform morphology along their lengths including at those bonding locations and remain elastic at the bonding locations. The strands can be pressed against the convex surfaces of the anchor portions at the bonding locations so that the strands have a greater width between the opposite elongate side surface portions of the strands along the bonding locations than between the bonding locations to provide very firm attachment between the first sheet and the strands. The elastic sheet-like composite can be stretched longitudinally of the elastic strands without breaking that attachment so that the normally arcuate portions of the sheet material or sheet materials can lay along the side surface of the strands. During such stretching, the elastic sheet-like composite according to the present invention provides the advantage that it will retain its width in a direction transverse to the strands instead of necking down or become narrower at its midsection in a direction transverse of the strands (i.e., such narrowing will occur in elastic sheet-like composites which have a resiliently elastic sheet instead of the spaced elastic strands bonded to the anchor portions of the flexible sheet material). The resiliently elastic strands will retain a tension in the elastic sheet-like composite while they are stretched, and when the elastic sheet-like composite is released, will recover to their normal length to again cause those normally arcuate portions of the first sheet material to again be arcuate.

In the method described above for forming an elastic sheet-like composite the forming step can comprise the steps of (1) providing first and second generally cylindrical corrugating members each having an axis and including a multiplicity of spaced ridges defining the periphery of the corrugating member, the ridges having outer surfaces and defining spaces between the ridges adapted to receive portions of the ridges of the other corrugating member in meshing relationship with the sheet of

flexible material therebetween; (2) mounting the corrugating members in axially parallel relationship with portions of the ridges in meshing relationship; (3) rotating at least one of the corrugating members; (4) feeding the sheet of flexible material between the meshed portions of the ridges to generally conform the sheet of flexible material to the periphery of the first corrugating member and form the arcuate portions of the sheet of flexible material in the spaces between the ridges of the first corrugating member and the anchor portions of the sheet of flexible material along the outer surfaces of the ridges of the first corrugating member; and (5) retaining the formed sheet of flexible material along the periphery of the first corrugating member for a predetermined distance after movement past the meshing portions of the ridges; and the extruding step includes providing an extruder that, through a die with spaced openings, extrudes the spaced strands of molten thermoplastic material onto the anchor portions of the sheet of flexible material along the periphery of the first corrugating member within the predetermined distance. This method allows the diameter of the strands to be easily varied by either changing the pressure in the extruder by which the strands are extruded (e.g., by changing the extruder screw speed or type) and/or by changing the speed at which the first corrugating member, and thereby the first sheet material, is moved (i.e., for a given rate of output from the extruder, increasing the speed the first sheet material is moved will decrease the diameter of the strands, whereas decreasing the speed at which the first sheet material is moved will increase the diameter of the strands). Also, the die through which the extruder extrudes the elastic thermoplastic material can have an easily changeable die plate in which are formed a row of spaced openings through which the strands of molten thermoplastic material are extruded. Such die plates with openings of different diameters and different spacings can relatively easily be formed by electrical discharge machining to afford different spacings and diameters for the strands. Varied spacing and/or diameters for the openings along the length of the row of openings in one die plate can be used, for example, to produce an elastic sheet-like composite which, when stretched longitudinally of its strands, will be under greater tension adjacent its edges parallel to the strands than at its mid portion between those edges because of larger or more closely spaced strands

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adjacent its edges. Similar effects can be achieved by shaping and or modifying the die to form hollow strands, strands with shapes other than round (e.g., square or + shaped) or by-component strands.

As indicated above, the elastic sheet-like composite according to the present invention can further include a second sheet of flexible material having anchor portions thermally bonded at second sheet bonding locations to longitudinally spaced parts of the elastic strands along corresponding second elongate surface portions thereof, and having arcuate portions projecting from the second elongate surface portions of the elastic strands between the second sheet bonding locations.

Using the method described above, such a second sheet of flexible material can be provided in the elastic sheet-like composite in at least two different ways. One way is to form the second sheet of flexible material to have arcuate portions projecting in the same direction from spaced anchor portions of the second sheet of flexible material; and positioning the spaced anchor portions of the second sheet of flexible material in closely spaced opposition to the spaced anchor portions of the first sheet of flexible material with the arcuate portions of the first and second sheets of flexible material projecting in opposite directions so that the spaced generally parallel elongate strands of molten thermoplastic material are extruded between and onto the anchor portions of both the first and second sheets of flexible material to form resiliently elastic strands bonded to and extending between the anchor portions of both the first and second sheets of flexible material. Another way is to provide a second sheet of stretchable flexible material that, when stretched, will retain most of the shape to which it is stretched; and to position one surface of the second sheet of flexible material in closely spaced opposition to the spaced anchor portions of the first sheet of flexible material on the side of its spaced anchor portions opposite its arcuate portions so that the spaced generally parallel elongate strands of molten thermoplastic material are extruded between and onto both the anchor portions of the first sheet of flexible material and the adjacent surface of the second sheet of flexible material to form resiliently elastic strands bonded to and extending between the anchor portions of the first sheet of flexible material and extending along and bonded at spaced locations corresponding to

those anchor portions along the surface of the second sheet of flexible material; and then to stretch the elastic sheet-like composite longitudinally of the strands after they are cooled and solidified to permanently stretch the second sheet of flexible material so that upon elastic recovery of the elastic strands, the second sheet of flexible material will have arcuate portions projecting from corresponding side surface portions of the strands.

Either or both of the first and second sheets of flexible material in the elastic sheet-like composite can be (1) of polymeric film (e.g., polypropylene, polyethylene or polyester), (2) of conventionally woven flexible fibers or material, (3) of non-woven flexible fibers or material, (4) of multi layer non-woven materials, (5) of nonwoven fibers that are bonded internally of the sheet (e.g., including fibers that are needle punched, hydro entangled, spun bonded, thermally bonded, bonded by various types of chemical bonding such as laytex bonding, powder bonding, etc.) such as fibers of polypropylene, polyethylene, polyester, nylon, cellulose, super absorbent fibers, or polyamide, or combinations of such materials such as a core of polyester and a sheath of polypropylene which provides relatively high strength due to its core material and is easily bonded due to its sheath material, fibers of one material or fibers of different materials or material combinations may be used in the same sheet of material, or (6) fibers or materials of the types described above that have been prepared by the "Microcreping Process for Textiles" using the "Micrex/Microcreper" equipment available from Micrex Corporation, Walpole, MA, that bears the U.S. Patent Nos. 4,894,169; 5,060,349; and 4,090,385, which fibers or materials are crinkled and compressed within the sheet so that the sheet is compacted in a first direction along its surfaces and can be easily expanded in that first direction by partial straightening of the fibers in the sheet. Such sheets of crinkled and compressed fibers can both provide loops for hook and loop fasteners, and can allow the elastic sheet-like composite to be expanded past the condition where the major surfaces of the sheets of crinkled and compressed fibers are straightened, which can be an advantage for some uses of the elastic sheet-like composite. Such first and second sheets should be of polymeric materials that thermally bond with the resiliently elastic thermoplastic material from which the

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strands are extruded at the temperature of the extrudate, and if such first and second sheets and the resiliently elastic thermoplastic material from which the strands are extruded comprise generally the same thermoplastic material, the extrudate can become fused to the anchor portions of the sheets of polymeric material.

The elastic sheet-like composite can be conveniently included in a disposable garment (e.g., a disposable diaper or training pants or adult incontinence brief) of the type including an outer or covering polymeric layer by adhering the first sheet of flexible material (or the second sheet of flexible material, if present) surface to surface with the outer or covering polymeric layer (e.g., around the waist or leg opening of the garment) so that the strands cause the covering polymeric layer to have arcuate portions projecting away from the first elongate surface portions of the elastic strands between the sheet bonding locations corresponding to the arcuate portions of the first or second sheet of flexible material. Alternatively, when the disposable garment is a diaper or training pant or adult incontinence brief, the first sheet of flexible material can form the outer or covering layer of the garment with the elastic strands along its inner surface, and conventional absorbent lining or padding material can be positioned along the side of the strands opposite the covering layer. With this structure, the entire covering layer of the disposable garment can be stretched, and the elastic strands may be spaced apart, sized and oriented so that they provide a desired amount of resilient elasticity to keep the garment in place on a person wearing it without applying too much pressure to that person.

The elastic sheet-like composite can also be formed by a method comprising the steps of (1) providing a sheet of stretchable flexible material that when stretched in a first direction will retain most of the length to which it is stretched; (2) extruding spaced generally parallel elongate strands of molten thermoplastic material that is resiliently elastic when cooled; (3) thermally bonding together spaced anchor portions of the first sheet of flexible material and spaced portions of the resiliently elastic strands so that the strands extend in the first direction between the anchor portions of the first sheet of flexible material with a side surface of the

first sheet of flexible material laying along elongate side surface portions of the strands; and (4) cooling and solidifying the strands. Such elastic sheet-like composite can be stretched longitudinally of the strands so that upon elastic recovery of the strands, the sheet of flexible material will have arcuate portions projecting from corresponding side surface portions of the strands.

Additionally, the elastic sheet-like composite can also be formed by a method comprising the steps of (1) providing a sheet of flexible material having opposite major surfaces; (2) compacting the sheet in a first direction parallel to the surfaces so that the compacted sheet can be extended in the first direction in the range of 1.1 to over 4 times (and preferably over 1.3 times) its compacted length in the first direction; (3) extruding spaced generally parallel elongate strands of molten thermoplastic material that is resiliently elastic when cooled onto one of the surfaces of the compacted sheet to form resiliently elastic strands thermally bonded to and extending in the first direction along the first compacted sheet; and (4) cooling and solidifying the strands.

Brief Description of Drawing

The present invention will be further described with reference to the accompanying drawing wherein like reference numerals refer to like parts in the several views, and wherein:

Figure 1 is a schematic view illustrating a first embodiment of a method and equipment according to the present invention for making a first embodiment of an elastic sheet-like composite according to the present invention;

Figure 2 is a perspective view of the first embodiment of the elastic sheet-like composite according to the present invention made by the method and equipment illustrated in Figure 1;

Figure 3A is a fragmentary enlarged sectional view taken approximately along line 3A-3A of Figure 2;

Figure 3B is a fragmentary enlarged sectional view taken approximately along line 3B-3B of Figure 2;

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Figure 4 is a schematic view illustrating a second embodiment of a method and equipment according to the present invention for making a second embodiment of an elastic sheet-like composite according to the present invention;

Figure 5 is a perspective view of the second embodiment of the elastic sheet-like composite according to the present invention made by the method and equipment illustrated in Figure 4;

Figure 6 is a fragmentary enlarged sectional view taken approximately along line 6-6 of Figure 5;

Figure 7 is a fragmentary front view of a die plate included in the equipment illustrated in Figures 1 and 4;

Figure 8 is a fragmentary sectional view similar to that of Figure 6 which illustrates possible variations in the size and spacing of strands included in the elastic sheet-like composite;

Figure 9 is a schematic view illustrating a third embodiment of a method and equipment according to the present invention for making the second embodiment of the elastic sheet-like composite according to the present invention illustrated in Figure 5;

Figure 10 is a schematic view illustrating a fourth embodiment of a method and equipment according to the present invention for making a third embodiment of the elastic sheet-like composite according to the present invention;

Figure 11 is a fragmentary view taken approximately along line 11 of Figure 10;

Figure 12 is a schematic view illustrating a fifth embodiment of a method and equipment according to the present invention for making the first embodiment of the elastic sheet-like composite according to the present invention illustrated in Figures 2 and 3;

Figure 13 is a plan view of a first embodiment of a disposable garment or diaper incorporating elastic sheet-like composite according to the present invention;

Figure 14 is a perspective view of an assembly from which can be made a second embodiment of a disposable garment (i.e., a diaper or training pants) incorporating elastic sheet-like composite according to the present invention;

Figure 15 is a schematic view illustrating a sixth embodiment of a method and equipment according to the present invention for making a fourth embodiment of the elastic sheet-like composite according to the present invention;

Figure 16 is a perspective view of the fourth embodiment of the elastic sheet-like composite according to the present invention made by the method and equipment illustrated in Figure 15;

Figure 17 is a perspective view of a fifth embodiment of the elastic sheet-like composite according to the present invention that can be made by the method and equipment illustrated in Figure 15; and

Figure 18 is a schematic view illustrating a sixth embodiment of a method and equipment according to the present invention for making sixth and seventh embodiments of the elastic sheet-like composite according to the present invention.

Detailed Description

Referring now to Figure 1 of the drawing, there is schematically illustrated a first embodiment of a method and equipment according to the present invention for making a first embodiment of an elastic sheet-like composite 10 according to the present invention which is illustrated in Figures 2 and 3.

Generally the method illustrated in Figure 1 involves providing a first sheet 12 of flexible material; forming the first sheet 12 of flexible material to have arcuate portions 13 projecting in the same direction from spaced anchor portions 14 of the first sheet 12 of flexible material; extruding spaced generally parallel elongate strands 16a of molten thermoplastic material that is resiliently elastic when cooled onto the anchor portions 14 of the first sheet 12 of flexible material to form resiliently elastic strands 16 thermally bonded to and extending between the anchor portions 14 of the first sheet 12 of flexible material with the arcuate portions 13 of the first sheet 12 of flexible material projecting from corresponding elongate side surface portions 18 of the strands 16; and cooling and solidifying the strands 16.

As illustrated in Figure 1, the equipment for performing the method includes first and second generally cylindrical corrugating members 20 and 21 each having an axis and including a multiplicity of spaced ridges 19 defining the periphery of the

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corrugating member 20 or 21, the ridges 19 having outer surfaces and defining spaces between the ridges 19 adapted to receive portions of the ridges 19 of the other corrugating member in meshing relationship with the first sheet 12 of flexible material therebetween; means for mounting the corrugating members 20 and 21 in axially parallel relationship with portions of the ridges 19 in meshing relationship; means for rotating at least one of the corrugating members 20 or 21 so that when the first sheet 12 of flexible material is fed between the meshed portions of the ridges 19 the first sheet 12 of flexible material will be generally conformed to the periphery of the first corrugating member 20 to form arcuate portions 13 of the first sheet 12 of flexible material in the spaces between the ridges 19 of the first corrugating member 20 and to form anchor portions 14 of the first sheet 12 of flexible material along the outer surfaces of the ridges 19 of the first corrugating member 20; means (i.e., including the surface of the first corrugating member 20 being roughened by being sand blasted or chemically etched and being heated to a temperature generally in the range of 25 to 150 Fahrenheit degrees above the temperature of the first sheet 12 of flexible material) for retaining the formed first sheet 12 of flexible material along the periphery of the first corrugating member 20 for a predetermined distance after movement past the meshing portions of the ridges 19; means in the form of an extruder feeding a die 22 with a changeable die plate 23 (see Figure 7) with spaced through openings 40 for extruding resiliently elastic thermoplastic material (e.g., elastomeric polyester, polyurethane, polystyrene-polyisoprene-polystyrene, polystyrene-polybutadiene-polystyrene or polystyrene-poly(ethylene-butylene)-polystyrene, or the elastomeric polyolefin described in European Patent Application No. 0,416815, the content whereof is incorporated herein by reference, or the elastomeric low density polyethylene sold by Dow Chemical under the trade name "Engage" which is made using "Insite" technology) to form a multiplicity of generally parallel elongate molten strands 16a of the resiliently elastic thermoplastic material extending in generally parallel spaced relationship and for positioning the molten strands 16a on the anchor portions 14 of the first sheet 12 of flexible material along the periphery of the first corrugating member 20 within the predetermined distance. Also, that equipment further

includes a generally cylindrical cooling roll 24 having an axis; means for rotatably mounting the cooling roll 24 in axially parallel relationship with the corrugating members 20 and 21 with the periphery of the cooling roll 24 closely spaced from and defining a nip with the periphery of the first corrugating member 20 at the predetermined distance from the meshing portions of the ridges 19; and means including a nipping roller 25 for moving the elastic sheet-like composite 10 for a predetermined distance around the periphery of the cooling roll 24 past the nip with the strands 16 in contact with the cooling roll 24 to cool and solidify the strands 16.

The structure of the elastic sheet-like composite 10 made by the method and equipment illustrated in Figure 1 is best seen in Figures 2, 3A and 3B. The elastic sheet-like composite 10 comprises the multiplicity of generally parallel elongate strands 16 of resiliently elastic thermoplastic material extending in generally parallel spaced relationship. Each of the strands 16 is generally cylindrical and has opposite elongate side surface portions 26 (See Figure 3A) that are spaced from and are adjacent the elongate side surface portions 26 of adjacent strands; and each of the strands 16 also has corresponding opposite first and second elongate surface portions 18 and 28 extending between its opposite elongate side surface portions 26. The spaced anchor portions 14 of the first sheet 12 of flexible material are thermally bonded at first sheet bonding locations to longitudinally spaced parts of the strands 16 along their first elongate surface portions 18, and the arcuate portions 13 of the first sheet 12 of flexible material project from the first elongate surface portions 18 of the elastic strands 16 between the first sheet bonding locations. The first sheet bonding locations are spaced about the same distances from each other and aligned in generally parallel rows extending transverse of the strands 16 to form continuous rows of the arcuate portions 13 projecting about the same distance from the first surface portions 18 of the strands 16. Because the elastic strands 16 have been extruded in molten form onto the anchor portions 14 of the first sheet 12 of flexible material they can be pressed onto the anchor portions 14 of the first sheet 12 by the spacing between the ridges 19 on the first corrugating member 20 and the periphery of the cooling roll 24, in which case the molten strands 16 form around and are indented by the arcuate convex adjacent surfaces of

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the anchor portions 14. The bonds between the strands 16 and the anchor portions 14 at the first sheet bonding locations extend along the entire parts of the strand's surfaces that are closely adjacent the anchor portions 14. As is illustrated in Figure 3B, those parts of the strand's surfaces that are closely adjacent the anchor portions 14 can be widened along the surfaces of the anchor portions 14 by the indentations of the strands 16 by the anchor portions 14. Thus the areas of bonding between the strands 16 and the anchor portions 14 are at least as wide and can advantageously be made wider between their opposite elongate side surface portions along their sheet bonding locations than between their sheet bonding locations at the anchor portions 14.

Alternative structures that could be provided for the elastic sheet-like composite 10 include spacing the ridges 19 around the corrugating members 20 and 21 to produce repetitive patterns of different spacings between the anchor portions 14 of the first sheet 12, thereby causing the continuous rows of the arcuate portions 13 to project at different distances from the first surface portions 18 of the strands 16.

Figure 4 illustrates a second embodiment of a method and equipment according to the present invention for making a second embodiment of an elastic sheet-like composite 30 according to the present invention, which sheet 30 is illustrated in Figures 5 and 6. The method illustrated in Figure 4 is somewhat similar and uses much of the same equipment as is illustrated in Figure 1, and similar portions of that equipment have been given the same reference numerals and perform the same functions as they do in the equipment illustrated in Figure 1. In addition to the general method steps described above with reference to Figure 1, the method illustrated in Figure 4 further generally includes the steps of providing a second sheet 32 of material (e.g., polymeric or other material that could be a sheet or film or could be a nonwoven layer); forming the second sheet 32 of material to have arcuate portions 33 projecting in the same direction from spaced anchor portions 34 of the second sheet 32 of material; and positioning the spaced anchor portions 34 of the second sheet 32 of material in closely spaced opposition to the spaced anchor portions 14 of the first sheet 12 of flexible material with the arcuate

portions 13 and 33 of the first and second sheets 12 and 32 of material projecting in opposite directions; and the extruder die 23 extrudes the spaced generally parallel elongate strands 16a of molten thermoplastic material between and onto the anchor portions 14 and 34 of both the first and second sheets 12 and 32 of material to form resiliently elastic strands 16 bonded to and extending between the anchor portions 14 and 34 of both the first and second sheets 12 and 32 of material with the arcuate portions 13 and 33 of the first and second sheets 12 and 32 of material projecting in opposite directions from opposite corresponding first and second elongate side surface portions 18 and 28 of the strands 16.

The equipment illustrated in Figure 4, in addition to the first and second corrugating members 20 and 21, and the extruder 22 which are operated in the manner described above with reference to Figure 1, further includes third and fourth generally cylindrical corrugating members 36 and 37 each having an axis and including a multiplicity of spaced ridges 38 defining the periphery of the corrugating member 36 or 37, the ridges 38 having outer surfaces and defining spaces between the ridges 38 adapted to receive portions of the ridges 38 of the other corrugating member 36 or 37 in meshing relationship with the second sheet 32 of flexible material therebetween; means (which could be provided by a frame, not shown) for mounting the third and fourth corrugating members 36 and 37 in axially parallel relationship with portions of the ridges 38 in meshing relationship; means for rotating at least one of the third and fourth corrugating members 36 and 37 so that when the second sheet 32 of material is fed between the meshed portions of the ridges 38 the second sheet 32 of material will be generally conformed to the periphery of the third corrugating member to form arcuate portions 33 of the second sheet 32 of material in the spaces between the ridges 38 of the third corrugating member 36 and to form anchor portions 34 of the second sheet 32 of material along the outer surfaces of the ridges 38 of the third corrugating member 36; and means (i.e., including the surface of the third corrugating member 36 being texturized or roughened by being sand blasted or chemically etched and being heated to a temperature generally in the range of 25 to 150 Fahrenheit degrees above the temperature of the first sheet 32 of flexible material) for retaining the

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formed second sheet 32 of material along the periphery of the third corrugating member 36 for a predetermined distance after movement past the meshing portions of the ridges 38 of the third and fourth corrugating members 36 and 37. The third corrugating member 36 is positioned in spaced relationship from the first corrugating member 20 so that the extruder die 22 positions the molten strands 16a on the anchor portions 14 and 34 of both the first and second sheets 12 and 32 of material along the peripheries of the first and third corrugating members 20 and 36 within the predetermined distance. Air ducts 39 are provided to blow streams of cool air against opposite sides of the elastic sheet-like composite 30 to solidify the strands 16a and the bond between the strands 16a and the anchor portion 14 and 34 of the sheets 12 and 32.

The structure of the elastic sheet-like composite 30 made by the method and equipment illustrated in Figure 4 is best seen in Figures 5 and 6. The elastic sheet-like composite 30 comprises the multiplicity of generally parallel elongate strands 16 of resiliently elastic thermoplastic material extending in generally parallel spaced relationship. Each of the strands 16 has opposite elongate side surface portions 26 (See Figure 6) that are spaced from and are adjacent the elongate side surface portions 26 of adjacent strands; and each of the strands 16 also has corresponding opposite first and second elongate surface portions 18 and 28 extending between its opposite elongate side surface portions 26. The spaced anchor portions 14 of the first sheet 12 of flexible material are thermally bonded at first sheet bonding locations to longitudinally spaced parts of the strands 16 along their first elongate surface portions 18, and the arcuate portions 13 of the first sheet 12 of flexible material project from the first elongate surface portions 18 of the elastic strands 16 between the first sheet bonding locations. The second sheet 32 of material has its spaced anchor portions 34 thermally bonded at second spaced sheet bonding locations to longitudinally spaced parts of the strands 16 along their second elongate surface portions 28, and has its arcuate portions 33 projecting from the second elongate surface portions 28 of the elastic strands 16 between the second sheet bonding locations. The first and second sheet bonding locations are opposed to each other, are spaced about the same distances from each other, and are aligned

in generally parallel rows extending transverse of the strands 16 to form continuous rows of the arcuate portions 13 and 33 projecting about the same distances from the first and second surface portions 18 and 28 of the strands 16. Because the elastic strands 16 have been extruded in molten form onto the anchor portions 14 and 34 of both the first and second sheets 12 and 32, the molten strands 16 can form around and be indented on opposite sides by the arcuate convex adjacent surfaces of the anchor portions 14 and 34. The bonds between the strands 16 and the anchor portions 14 and 34 at the first and second sheet bonding locations extend along the entire parts of the strand's surfaces that are closely adjacent the anchor portions 14 and 34, which parts can be widened along the surfaces of the anchor portions 14 and 34 by the indentations of the strands 16 by the anchor portions 14 and 34. Thus, the areas of bonding between the strands 16 and the anchor portions 14 and 34 are at least as wide and can be wider between their opposite elongate side surface portions along their sheet bonding locations than between their sheet bonding locations at the anchor portions 14 and 34.

Alternative structures that could be provided for the elastic sheet-like composite 30 (in addition to the alternate structures noted above for the sheet like composite 10) include spacing the anchor portions 14 of the first sheet 12 and the anchor portions 34 of the second sheet 32 at different spacings along the strands 16 and/or causing the continuous rows of the arcuate portions 13 and 33 to project at different distances from the first and second surface portions 18 and 28 of the strands 16; or causing one of the sheets 12 or 32 to be discontinuous along its length, or across its width.

Figure 7 illustrates the face of the die 22 through which the molten strands 16a of molten thermoplastic material are extruded. The die 22 has spaced openings 40 (e.g., 0.762 millimeter or 0.03 inch diameter openings spaced 2.54 millimeter or 0.1 inch center to center) in its die plate 23 preferably formed by the known electrical discharge machining technique. The die plate 23 is retained in place by the bolts 41, and can be easily replaced with a die plate with openings of different or varied sizes, which openings are spaced on different or varied centers to produce a desired pattern of strands from the die 22.

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Figure 8 illustrates an elastic sheet-like composite 30b similar to that illustrated in Figures 5 and 6 and in which similar parts are identified with similar reference numerals except for the addition of the suffix "b". Figure 8 shows one of many possible variations in the spacing and diameters of the strands 16b that can cause the elastic sheet-like composite 30b when stretched longitudinally of its strands 16b to be under greater or lesser tensions across its width normal to the strands depending on the spacing and or diameters of the strands 16b.

Figure 9 illustrates a third embodiment of a method and equipment according to the present invention for making the elastic sheet-like composite 30 according to the present invention. The method illustrated in Figure 9 is quite similar to and uses most of the same equipment as is illustrated in Figure 1, and similar portions of that equipment have been given the same reference numerals and perform the same functions as they do in the equipment illustrated in Figure 1. In addition to the general method steps described above with reference to Figure 1, the method illustrated in Figure 9 further generally includes the steps of providing a second sheet 32a of stretchable flexible material that when stretched will retain most of the shape to which it is stretched; and

positioning one surface of the second sheet 32a of flexible material in closely spaced opposition to the spaced anchor portions 14 of the first sheet 12 of flexible material on the side of the spaced anchor portions 14 opposite the arcuate portions 13 of the first sheet 12 of flexible material so that the extruder die 22 extrudes the spaced generally parallel elongate strands of molten thermoplastic material between and onto both the anchor portions 14 of the first sheet 12 of flexible material and the adjacent surface of the second sheet 32a of flexible material to form resiliently elastic strands 16 bonded to and extending between the anchor portions 14 of the first sheet 12 of flexible material and extending along and bonded to spaced locations along the surface of the second sheet 32a of flexible material opposite the anchor portions 14 of the first sheet 12 of flexible material; and then stretching the elastic sheet-like composite 32a longitudinally of the strands 16 after they are cooled and solidified to permanently stretch the second sheet 32a of flexible material so that upon elastic recovery of the strands 16, the second sheet 32a of

flexible material will have arcuate portions 33 projecting from corresponding side surface portions 28 of the strands 16.

The equipment illustrated in Figure 9, in addition to the first and second corrugating members 20 and 21, the extruder and extruder die 22, the cooling and nipping rollers 24 and 25 which are operated in the manner described above with reference to Figure 1, further includes a nipping roller 42 that by rotation of the cooling roll 24 allows the second sheet 32a of flexible material to be fed into the nip between the cooling roll 24 and the first corrugating member 20, a pair of nipping rollers 44 and 45 (the roller 44 of which may be heated so that it heats the second sheet 32a after it is attached to the strands 16 in that nip if that is desired or needed to process the composite 30), and a pair of nipping rollers 46 that are rotated at a surface speed sufficiently faster than that of the nipping rollers 44 and 45 to stretch the second sheet 32a in the manner described above, so that after the elastic sheet-like composite 30 moves past the nipping rollers 46 the strands 16 will return to their normal or un-stretched length, and the second sheet 32a of flexible material will have arcuate portions 33 projecting from corresponding side surface portions 28 of the strands 16. The flat, non-corrugated second sheet 32a could, for example, be made of 3M brand porous film (XMD-8-044), which is a stretchable porous polymeric film material that when stretched will retain most of the shape to which it is stretched and for which the roller 44 should be heated to facilitate such stretching; or alternatively could be made of material that has been compacted (e.g., compacted or shortened along its length at up to a 4 to 1 ratio so that its compacted length can be only one quarter or less than the original length) using the Micrex process described above which allows for longitudinal stretching of the second sheet 32a after it is bonded to the strands 16, and normally does not benefit from the roller 44 being heated.

Figures 10 and 11 illustrate a fourth embodiment of a method and equipment according to the present invention for making an elastic sheet-like composite 50 according to the present invention. The elastic sheet-like composite 50 has portions that are similar to corresponding portions of the elastic sheet-like composite 10, and have been given the same reference numerals with the addition of

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the suffix "c". The method illustrated in Figures 10 and 11 uses some of the same equipment as is illustrated in Figure 1, and similar portions of that equipment have been given the same reference numerals and perform the same functions as they do in the equipment illustrated in Figure 1. The first and second corrugating members 20 and 21 of Figure 1, however, have been replaced by first and second cylindrical corrugating members or rollers 51 and 52 each having an axis and including a plurality of generally annular, circumferentially extending, axially spaced parallel elongate ridges 53 around and defining its periphery, with the ridges 53 having outer surfaces and defining spaces between the ridges 53 adapted to receive portions of the ridges 53 of the other corrugating member 51 or 52 in meshing relationship with the sheet of flexible material 12a between the meshed portions of the ridges 53. The corrugating members 51 and 52 are mounted in axially parallel relationship to mesh portions of the ridges 53 of the corrugating members 51 and 52. While neither corrugating member 51 or 52 need be rotated (i.e., the sheet of flexible material 12c could be pulled between fixed guides shaped like the adjacent and other portions of the corrugating members that are contacted by the sheet of flexible material 12c at any one time), preferably at least the corrugating member 51 is rotated; and the sheet of flexible material 12c is fed between the meshed portions of the ridges 53 of the corrugating members 51 and 52 to generally conform the sheet of flexible material 12c to the periphery of the first corrugating member 51 and form the arcuate portions 13c of the sheet of flexible material 12c in the spaces between the ridges 53 of the first corrugating member 51 and the generally parallel anchor portions 14c of the sheet of flexible material 12c along the outer surfaces of the ridges 53. The formed sheet of flexible material 12c is retained along the periphery of the first corrugating member 51 after separation of the ridges 53; the spaced strands 16c of extruded molten elastic thermoplastic material from the die 22 are deposited along the formed sheet of flexible material 12c along the periphery of the first corrugating member 51 while the die is reciprocated axially of the corrugating members 51 and 52 so that the strands 16c form an undulating or generally sinusoidal or similar pattern with the strands bridging or extending between a plurality of the anchor portions 14c (i.e., at least two and, as illustrated,

three anchor portions 14c), so that the molten strands partially envelope and adhere to the arcuate anchor portions 14c of the sheet of flexible material 12c at spaced anchor locations, after which the elastic sheet-like composite 50 is separated from the first corrugating member 51 and carried partially around the cooling roll 25 to complete cooling and solidification of its strands 16c.

The elastic sheet-like composite 50 made by the method illustrated in Figures 10 and 11 differs from the elastic sheet-like composite 10 made by the method illustrated in Figure 1 in that the rows of bonding locations 18c and the rows of arcuate portions 13c of the sheet of flexible material 12c projecting from the strands 16c extend longitudinally in what is called the machine direction along the elastic sheet-like composite 50 instead of in what is called the cross direction or transversely across the elastic sheet-like composite as do the arcuate portions 13 in the elastic sheet-like composite 10. Also, while the plurality of generally parallel elongate extruded strands 16c of resiliently elastic thermoplastic material extend in generally parallel spaced relationship with each of the strands 16c having opposite elongate side surface portions that are spaced from and are adjacent the elongate side surface portions of adjacent strands 16c, the strands 16c extend in a parallel undulating, generally sinusoidal pattern with the strands bridging or extending between a plurality of the anchor portions 14c, rather than in a generally straight lines as do the strands 16 in the elastic sheet-like composite 10.

Figure 12 illustrates a fifth embodiment of a method and equipment according to the present invention for making the elastic sheet-like composite 10 according to the present invention. The method illustrated in Figure 12 is quite similar to, and uses most of the same equipment as, the method illustrated in Figure 9; and similar portions of that equipment have been given the same reference numerals and perform the same functions as they do in the equipment illustrated in Figure 9. As a modification of the general method steps described above with reference to Figure 9, the method illustrated in Figure 12 does not use either the first sheet 12 of flexible material or the first corrugating member 21. The second sheet 32a of stretchable flexible material that when stretched will retain most of the shape to which it is stretched has one surface placed in closely spaced opposition to the ridges 19 on the ridged corrugating member 20 so that the extruder die 22 extrudes the spaced generally parallel elongate strands of molten thermoplastic material therebetween which are pressed by the ridges 19 onto the adjacent surface of the second sheet 32a of flexible material to form resiliently elastic strands 16 bonded to and extending between spaced locations along the surface of the second sheet 32a of flexible material; and then stretching the sheet-like composite 32a longitudinally of the strands 16 after they are cooled and solidified to permanently stretch the second sheet 32a of flexible material so that upon elastic recovery of the strands 16, the second sheet 32a of flexible material will have arcuate portions 33 projecting from corresponding side surface portions 28 of the strands 16. The equipment illustrated in Figure 12 includes the second corrugating member 20, the extruder 22 and extruder die 23, the cooling and nipping rollers 24 and 25 which are operated in the manner described above with reference to Figure 1; the nipping roller 42, the pair of nipping rollers 44 and 45 (the roller 44 may or may not be heated depending on the type of second sheet 32a being processed as noted above), and the pair of nipping rollers 46, all of which are operated in the manner described above with reference to Figure 9, so that after the elastic sheet-like composite 10 moves past the nipping rollers 46 the strands 16 will return to their normal or un-stretched length, and the second sheet 32a of flexible material will have arcuate portions 33 projecting from corresponding side surface portions 28 of the strands 16.

Figure 13 illustrates a disposable garment or diaper 60 including a conventional flexible covering layer 62, and a layer 64 of conventional moisture absorbent padding 64 adhered to an inner surface of the covering layer 62. Two elongate strips 61 of the elastic sheet-like composite 10 illustrated in Figures 1, 2, and 3 in which the strands 16 extend longitudinally of the strips 61 are adhered along the inner surface of the covering layer 62 along the edges that will form the leg openings of the diaper 60 when it is used. Also, two strips 63 of the elastic sheet-like composite 30 illustrated in Figures 5 and 6 in which the strands 16 extend longitudinally of the strips 63 are adhered along the outer surface of the covering layer 62 along the edges that will form the waist opening of the diaper 60 when it is

used. The outer surfaces of the first sheets 12 of flexible material on the two strips 61 of the elastic sheet-like composite 10 are adhered (while the strands 16 are under tension to flatten the two strips 61) surface to surface with the inner surface of the flexible covering layer 62 along the edges of the covering layer 62 that define the leg openings for the diaper 60 when the diaper 60 is in use so that the strands 16 cause the flexible covering layer 62 to have arcuate portions 65 projecting away from the elastic strands 16 corresponding to the arcuate portions 13 of the two strips 61 of the first sheet 12 of flexible material. Similarly, the outer surfaces of the first sheets 12 of flexible material of the two strips 63 of the elastic sheet-like composite 30 are adhered (while the strands 16 are under tension to flatten the strips 63) surface to surface with the outer surface of the flexible covering layer 62 along opposite edges thereof that define the waist opening of the diaper 60 when the diaper 60 is in use so that the strands 16 cause the flexible covering layer 62 to have arcuate portions 66 projecting away from the elastic strands 16 corresponding to the arcuate portions 13 of the first sheet 12 of flexible material. A sheet 67 of conventional loop material or nonwoven fibers or material that are bonded internally of the sheet either replaces the outer of the first or second sheets 12 or 32 of flexible material, or such a sheet 67 is adhered to the outer surface of the outer of the first or second sheet 12 or 32 of flexible material on the strip 63 of the elastic sheet-like composite 30 at one end of the diaper. That sheet 67 of loop or nonwoven material provides a loop fastener portion adapted to be engaged by hook fastener portions 68 of the type described in U.S. Patent No. 4,894,060 (the content whereof is incorporated herein by reference) positioned or carried on the ends of tabs 69 at the other end of the diaper 60 to afford closing and opening of the diaper 60.

Among many alternative structures that could be provided for the disposable garment or diaper 60, the two strips 61 could be of the elastic sheet-like composites 30 or 50 illustrated in Figures 4, 5, and 6 or 10 and 11 respectively and/or the two strips 63 could be of the elastic sheet-like composites 10 or 50 illustrated in Figures 1, 2, and 3 or 10 and 11 respectively. The two strips 63 could be adhered to the inner surface of the of the flexible covering layer 62, and the tabs 68 could be

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lengths of pressure sensitive adhesive coated tape adapted to adhere to the outer surface of the flexible covering layer 62.

Figure 14 illustrates an assembly 70 from which can be made disposable garments either in the form of diapers, training pants, or adult incontinence briefs. The assembly 70 was made using (1) a continuous length 72 of the elastic sheet-like composite 10 illustrated in Figures 2 and 3 modified (as was described with reference to Figure 8) so that the strands 16 are more closely spaced and/or are optionally larger in diameter adjacent opposite edges 74 of the length 72 (alternatively the length 72 could be of the elastic sheet-like composite 30), and (2) a plurality of elongate strips 75 extending transversely to the length 72, which strips 75 are of the elastic sheet-like composite 10 illustrated in Figures 2 and 3 in which the strands 16 extend longitudinally of the strips 75 (alternatively the strips 75 could be made of the elastic sheet-like composite 50 or of other conventional elastic material used in this type of product). The first sheet 12 of flexible material included in the continuous length 72 of the elastic sheet-like composite 10 could be of a non elastic or of an elastic polymeric sheet material. Pre-cut pieces of conventional moisture absorbent padding 76 extending transverse of the continuous length 72 between its edges 74 are adhered in spaced relationship to the continuous length 72 over its side on which its strands 16 extend. The outer surfaces of the first sheets 12 of flexible material on the strips 75 are adhered to the continuous length 72 over its side on which its strands 16 extend. That adhesion is done while the strands 16 of both the strips 75 and the length 72 are under tension to flatten the two strips 75 and the length 72. The strips 75 are thus adhered along the opposite sides of each of the spaced pieces of padding 76 that are extending transverse of the length 72 and along which will be formed the leg openings for the diapers or training pants to be made incorporating the pieces of padding 76. The strands 16 of the strips 75 cause the length 72 to have arcuate portions 78 along the strips 75 that project away from those elastic strands 16 and are oriented at right angles to the arcuate portions 13 in the length 72 that are caused by its strands 16. Individual diapers may then be cut from the assembly 70 by cutting the length 72 transversely between the adjacent pieces of padding 76 and between adjacent strips 75

therebetween and adding to the side of length 72 opposite the pieces of padding 76 two projecting tabs and a sheet of nonwoven fibers that are bonded internally of the sheet or other loop material similar to and located as the tabs 69 and the sheet of nonwoven fibers or loop material 67 illustrated in Figure 12. Alternatively if training pants are to be formed, the length 72 and pieces of padding 76 can be folded longitudinally of the length 72 to bring its edges 74 together with the folded padding 76 enclosed by the folded length 72, and portions 80 of the length 72 that will then be adjacent each other on opposite sides of the folded pieces of padding 76 can be attached together adjacent and for a short distance normal to the edges 74 by various means such as adhesives, chemical bonding, heat sealing, sonic welding, etc. The folded length 72 can be cut apart through the sealed portions 80 midway between the adjacent pieces of padding 76 and between the adjacent strips 75 therebetween to form individual training pants, each incorporating one of the pieces of padding 76 and two of the strips 75 around its leg openings.

Figure 15 illustrates a sixth embodiment of a method and equipment according to the present invention that can be used for making the fourth and fifth embodiments of elastic sheet-like composite 90 and 100 according to the present invention respectively illustrated in Figures 16 and 17.

The equipment illustrated in Figure 15 includes first and second generally cylindrical bonding rollers 82 and 83 each having an axis and a periphery around that axis defined by circumferentially spaced ridges 85 generally parallel to the axes of the bonding rollers 82 and 83; means such as a frame for the equipment (not shown) for mounting the bonding rollers 82 and 83 in axially parallel relationship with the peripheries of the bonding rollers 82 and 83 defining a nip therebetween; means provided by a pair of sheet compacting devices 86 and 87 (e.g., the devices commercially designated "Micrex/Microcreper" equipment available from the Micrex Corporation, Walpole, MA, which crinkles and compresses the fibers or materials of a sheet to form a sheet that is compacted in a first direction along its surfaces and can be easily expanded in that first direction by partial straightening of the fibers in the sheet) each adapted for receiving a sheet 88 or 89 of flexible material having opposite major surfaces; compacting that sheet 88 or 89 in a first

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direction parallel to its major surfaces (i.e., along its direction of travel through the device 86 or 87) so that the first and second compacted sheets 91 and 92 have opposite surfaces and can be extended in the first direction along those surfaces in the range of 1.1 to over 4 times its compacted length in the first direction; means for feeding the first and second compacted sheets 91 and 92 of flexible material into the nip in opposed relationship along the surfaces of the first and second bonding rollers 82 and 83; and means in the form of an extruder 83 that is essentially the same as the extruder 22 described above for extruding resiliently elastic thermoplastic material to form a multiplicity of generally parallel elongate molten strands 95 of the resiliently elastic thermoplastic material extending in generally parallel spaced relationship and for positioning the molten strands 95 between the opposed surfaces of the first and second compacted sheets 91 and 92 of flexible material in the nip between the first and second bonding rollers 82 and 83 with the strands 95 extending in the first direction along the first and second compacted sheets 91 and 92 where the strands 95 are thermally bonded to the first and second compacted sheets 91 and 92 at spaced bonding locations 96 along the strands 95 because of bonding pressure applied by the ridges 85. The elastic sheet-like composite 90 is retained along the periphery of the bonding roller 82 by a guide roller 97, and the bonding roller 82 is cooled (e.g., to 100 degrees Fahrenheit) to help solidify the strands 95.

As with the other sheets of flexible material described above, the compacted sheets 91 and 92 can be formed from many materials including non-woven fibers, or from polymeric film, and when the compacted sheets 91 and 92 and the strands 95 comprise generally the same thermoplastic material, the extruding strands 95 are fused to the compacted sheets 91 and 92 of flexible material.

The elastic sheet-like composite 90 made by the mechanism illustrated in Figure 15 is illustrated in Figure 16. That sheet-like composite 90 comprises in its un-stretched state (1) a multiplicity of the generally parallel elongate extruded strands 95 of resiliently elastic thermoplastic material extending in generally parallel spaced relationship, each of the strands 95 having opposite elongate side surface portions that are spaced from and are adjacent the elongate side surface portions of

adjacent strands 95, and each of the strands 95 also having corresponding opposite first and second elongate surface portions extending between the opposite elongate side surface portions; and (2) the first and second compacted sheets 91 and 92 of flexible material having opposite major surfaces, and being compacted in a first direction along those first surfaces so that the first and second compacted sheets 91 and 92 can be extended in the first direction in the range of 1.1 to over 4 times its compacted length (and preferably over 1.3 times its compacted length) in the first direction. Those first and second compacted 91 and 92 are respectively thermally bonded to the first and second elongate surface portions of the strands 95 at the spaced bonding locations 96 with the strands 95 extending in the first direction to afford elastic extension of the strands 95 and the compacted sheets 91 and 92 in the first direction.

The equipment illustrated in Figure 15 can be operated with only one of the sheets 88 or 89 of flexible material, in which case it will make an elastic sheet-like composite like the elastic sheet-like composite 100 illustrated in Figure 17. That elastic sheet-like composite 100 comprises in its un-stretched state (1) a multiplicity of the generally parallel elongate extruded strands 95 of resiliently elastic thermoplastic material extending in generally parallel spaced relationship, and only one compacted sheet 91 or 92 (identified as sheet 91 in the drawing) of flexible material that is compacted in a first direction along its surfaces so that the compacted sheet 91 or 92 can be extended in the first direction in the range of 1.1 to over 4 times its compacted length in the first direction. The compacted sheet 91 or 92 is thermally bonded to the first elongate surface portions of the strands at spaced bonding locations 96 with the strands extending in the first direction to afford elastic extension of the strands and the compacted sheet 91 in the first direction.

Figure 18 illustrates a sixth embodiment of a method and equipment according to the present invention that can be used for making embodiments of elastic sheet-like composite that are very similar to the embodiments of elastic sheet-like composites 90 and 100 respectively illustrated in Figures 16 and 17, except that the strands 95 are thermally bonded to the compacted sheets 91 and/or

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92 along essentially the entire lengths of the strands 95 rather than having longitudinally spaced parts of the strands thermally bonded to the first compacted sheets at spaced bonding locations 96 or 98 along the strands 95.

Parts of the equipment illustrated in Figure 18 that are the same as parts of the equipment illustrated in Figure 15 have been given the same reference numerals and provide the same function. The equipment illustrated in Figure 18 differs only from the equipment illustrated in Figure 15 in that first and second generally cylindrical bonding rollers 102 and 103 used in that equipment have peripheries 105 and 106 respectively around their axis that are cylindrical so that the strands 95 are thermally bonded to the first and second compacted sheets 91 and 92 along their entire lengths.

Examples

Example 1: Elastic sheet-like composite similar to the elastic sheet-like composite 10 illustrated in Figure 2 was made using equipment similar to that illustrated in Figure 1 using the following mixture in the extruder 22 to form the strands 16; ninety percent (90%) of a thermoplastic synthetic rubber commercially designated Kraton 1657 that is commercially available from Shell Chemical Co., Houston, Texas; two percent (2%) of a coloring agent commercially designated CBE 101P White commercially available from Spectrum Colors, Minneapolis, Minnesota; three percent (3%) of a slip agent commercially designated Ampacet 10110 and available from Ampacet Corp., Mount Vernon, N.Y.; and five percent (5%) of an anti blocking material commercially designated CBE 13782E that is available from Spectrum Colors. About ten strands 16 per inch of that material having diameters of about 0.05 centimeter or 0.020 inch were applied by equipment similar to that illustrated in Figure 1 to corrugated first sheets 12 of different materials including (1) 3M brand porous film (XMO-8-044), (2) 0.0036 centimeter or 0.0014 inch thick polyethylene of the type commonly used in diapers, and (3) nonwoven material comprising polypropylene staple fibers thermally point bonded together. All of the elastic sheet-like composites described above in this paragraph

had good elastic properties and did not neck down when extended within the limit of straightening the first sheets 12.

Example 2: Elastic sheet-like composite similar to the elastic sheet-like composite 30 illustrated in Figure 5 was made using the same mixture in the extruder 22 described in the preceding paragraph to form the strands 16a. About ten strands 16 per inch of that material having diameters of about 0.05 centimeter or 0.020 inch were applied by equipment similar to that illustrated in Figure 9 to a corrugated first sheet 12 of nonwoven flexible material comprising polypropylene staple fibers thermally point bonded together, and a non-corrugated second sheet 32a of 3M brand porous film (XMO-8-044), which is a stretchable porous polymeric film material that when stretched will retain most of the shape to which it is stretched, to form the structure extending from the periphery of the roll 24 to the rollers 44 and 45 in Figure 9. The two sets of rollers 44, 45 and 46 were not used; rather that structure was manually stretched to provide the function of the rollers 44, 45 and 46. The resulting elastic sheet-like composite 30 had arcuate portions 33 of the sheet 32a projecting from corresponding side surface portions 28 of the strands 16 on the side of the strands 16 opposite the sheet 12 of nonwoven flexible material, thus providing the elastic strands 16 between the corrugated nonwoven sheet 12 and the corrugated porous film sheet 32a. The resulting sheet material 30 had good elastic properties and did not neck down when extended within the limit of straightening the first and second sheets 12 and 32a.

Example 3: Elastic sheet-like composite similar to the elastic sheet-like composite 10 illustrated in Figure 2 was made using equipment similar to that illustrated in Figure 1. A thermo-plastic rubber commercially available under the trade name "Kraton G1657X" from Shell Chemical Company, A Division of Shell Oil Company, Atlanta, GA, was placed in the extruder 22 to form the strands 16. About ten strands 16 per inch of that material at a basis weight of 20 grams per square meter were applied by the equipment to a corrugated first sheet 12 of loop material formed of 0.8 ounces per square yard spunbond polypropylene commercially available under the trade name "Fiberweb Celestra" from FiberWeb North America, Inc., Simpsonville, South Carolina. That material was compacted

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approximately 30% using the Micrex process described above which softened the material and placed a micro structured loop pattern in the cross direction of the nonwoven material that allowed for longitudinal stretching of the material and engagement of hooks so that the material provided the loop portion of a hook and loop fastener. The first sheet 12 was corrugated in the cross direction between the corrugation rollers 20 and 21 to form 7 corrugations per inch, then bonded to the strands 16 by the ridges 19 in a nip between the corrugation roll 20 and the smooth chill roll 24. The corrugation roll 21 was at about 190 F; the corrugation roll 20 was at about 230 F, and the chill roll 24 was at about 85 F. The line speed was about 15 feet per minute, and the melt temperature in the extruder 22 was about 430 F. The sheet of loop material 10 produced was soft, breathable and inexpensive, had arcuate portions 33 projecting from the strands 16 that were 0.012 inch in height and width, was stretchable in the machine direction and had good elastic properties, and did not neck down when extended to straighten the first sheet 12 and to extend the length of the first sheet 12. The sheet of loop material 10 produced would have many uses, including as a side panel and/or as the loop portion of a hook and loop fastener.

Example 4: Elastic sheet-like composite similar to the elastic sheet-like composite 10 illustrated in Figure 2 was made with the equipment illustrated in Figure 12, except that the two pairs of nipping rollers 44, 45 and 46 were not used. A thermo-plastic rubber commercially available under the trade name "Kraton G1657X" from Shell Chemical Company, A Division of Shell Oil Company, Atlanta, GA, was used in the extruder 22 to form the strands 16. No first sheet 12 was used. About ten strands 16 per inch of that material that provided a basis weight of 20 grams per square meter of the strand material were applied by the equipment to a second sheet 32a of loop material formed of hydro-entangled Rayon/Polyester with a basis weight 56 grams per square meter commercially available under the trade name "Veratec Versalon" from Veratec, A Division of International Paper, Walpole, MA. That material was compacted approximately 40% (i.e., the compacted material could then be extended to 2.5 times its compacted length) using the Micrex process described above which softened the

material and placed a micro structured loop pattern in the cross direction of the nonwoven material that allowed for longitudinal stretching of the material and engagement of hooks so that the material provided the loop portion of a hook and loop fastener. The second sheet 32a was bonded at spaced locations to the strands 16 in the nip between the corrugation roll 20 and the smooth chill roll 24 by the ridges 19 of the corrugation member or roll 20. The corrugation roll 20 was at about 230 F, and the chill roll was at about 85 F. The line speed was about 15 feet per minute, and the melt temperature in the extruder 22 was about 425 F. The sheet of loop material produced was initially flat with the entire second sheet 32a lying against the strands 16, but was manually stretch in the machine direction and released so that the strands 16 returned to their original lengths and the portions of the second sheet 32a between the portions thereof attached to the strands 16 formed arcuate portions 13 about 0.012 inch wide at the strands 16 and approximately 0.06 inch in height from the strands 16. Before such stretching, the loop material produced could be wound flat on a roll which produced a roll that was more dense and thus more easily shipped and stored than a roll of the same material after it was stretched and released. The elastic sheet-like composite 10 thus produced was soft, breathable and inexpensive, had good elastic properties, did not neck down when extended to straighten the first sheet 12 and/or to extend the length of the first sheet 12, and was deemed useful as a side panel on a child or adult incontinent diaper or on a training pant, or as the loop portion of a hook and loop fastener, or as an elastic wrap.

Example 5: An elastic sheet-like composite similar to the elastic sheet-like composite 30 illustrated in Figure 5 was made using the equipment illustrated in Figure 4. A thermoplastic rubber commercially available under the trade name "Kraton G1657X" from Shell Chemical Company, A Division of Shell Oil Company, Atlanta, GA, was used in the extruder 22 to form the strands 16. About ten strands 16 per inch of that material that had a basis weight of about 40 grams per square meter were extruded at a temperature of 450 degree F between two sheets 12 and 32 of spunbonded non-woven point bonded material that had a basis weight of 0.5 ounce per square yard and were commercially available under the

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trade name "Amoco RFX", identification 9.585A, from Amoco Fabric and Fibers Company, Atlanta Ga. The sheets 12 and 32 of material were corrugated by the pairs of mating corrugating members or rollers 20, 21 and 36, 37 respectively, which pairs of corrugating members were identical and were synchronized to move the ridges 19 and 38 of the corrugating members 20 and 24 in opposed relationship through the nip between the rollers 20 and 36 as is illustrated in Figure 4, and to thereby place the anchor portions 14 and 34 of the sheets 12 and 32 of material opposite each other on the strands 16 as is illustrated in Figure 5. The surface speed of the corrugating members 20 and 36 was 20 feet per minute. The corrugating members 36 and 20 were heated to 230 degree F and had rough textured surface finishes to assist in holding the sheets 12 and 32 of material along their surfaces between the corrugating members 21 and 37 and the nip between the corrugating members 36 and 20 at which the strands were adhered between the anchor portions 14 and 34 of the sheets 12 and 32 of material. The corrugating members 21 and 37 were heated to 200 degree F and had a very smooth polished chrome surfaces to facilitate their release from the sheets 12 and 32 of material along the corrugating members 21 and 37. The resultant sheet of elastic material had arcuate portions 13 and 33 that projected from the strands 16 by about 2.5 millimeters, had an overall thickness un-stretched of about 5 millimeters, could be stretched longitudinally of the strands 16 to about 1.8 times its un-stretched length, and did not neck down sideways when it was thus stretched. The resultant sheet of elastic material was very soft and conformable, and was deemed suitable for many uses, including as a side panel on a diaper, as the loop portion of a hook and loop fastener or as a medical wrap.

Example 6: An elastic sheet-like composite similar to the elastic sheet-like composite 90 illustrated in Figure 16 was made with the equipment illustrated in Figure 15 except that the bonding roller 83 had a smooth cylindrical periphery. The two sheets 88 and 89 of material used were the spunbonded point bonded nonwoven material having a basis weight of 0.5 oz/square yard that is sold under the trade name "Amoco RFX", identification 9.585A by Amoco Fabric and Fibers Company, Atlanta Ga. The two sheets 88 and 89 were compacted to 30% of their

original length (3:1 compaction) by the Micrex process described above using the sheet compacting devices 86 and 87. The compacted sheets 91 and 92 were directed along the peripheries of the bonding rollers 82 and 83 on opposite sides of the curtain of molten strands 95 as is illustrated in Figure 15. A thermoplastic rubber commercially available under the trade name "Kraton G1657X" from Shell Chemical Company, A Division of Shell Oil Company, Atlanta GA, was used in the extruder 83 to form the strands 95. About ten strands 95 per inch of that material that had a basis weight of about 40 grams per square meter were extruded at a temperature of 450 degrees Fahrenheit between the two compacted sheets 91 and 92 along the peripheries of the bonding rollers 82 and 83. The bonding rollers 82 and 83 point bonded the strands 95 to the compacted sheets 91 and 92 at about 7 bonding location 96 per inch, although additional bonding between these bonding location 96 were noted. The resultant elastic sheet-like composite 90 was soft, exhibited good elastic properties and did not neck down when elongated to the maximum non compacted lengths of the first and second sheets 88 and 89. The elastic sheet-like composite 90 appeared to have many potential uses, such as a loop portion of a hook and loop fastener, a diaper side panel, a medical bandage or as a headband.

Example #7: An elastic sheet-like composite similar to the elastic sheet-like composite 100 illustrated in Figure 17 was made with the equipment illustrated in Figure 15 and described in example 6 except that only one sheet 88 of the sheet material described in Example 6 that was compacted about 3:1 to form the compacted sheet 91 was used to form the elastic sheet-like composite. The resulting elastic sheet-like composite was soft, conformable and did not neck down once stretched. The exposed side of the elastic strands 95 exhibited good cohesion to the elastic sheet-like composite when it was wrapped on itself. Apparent potential uses included a low cost medical wrap or as a side panel on a diaper.

Example 8: An elastic sheet-like composite similar to the elastic sheet-like composite 90 illustrated in Figure 16 (except that it did not have the specific bonding locations 96) was made with the equipment illustrated in Figure 18 in which the bonding rollers 102 and 103 both have smooth cylindrical peripheries 105 and 106. The two sheets 88 and 89 of material used were the spunbonded material sold under the trade designation "Celestra 0.5 oz PP spunbond" by FiberWeb North America, Inc., Simpsonville, SC. The two sheets 88 and 89 were compacted to 50% of their original length (2:1 compaction) by the Micrex process described above using the sheet compacting devices 86 and 87. The compacted sheets 91 and 92 were directed along the peripheries of the bonding rollers 102 and 103 on opposite sides of the curtain of molten strands 95 as is illustrated in Figure 18. A thermoplastic rubber commercially available under the trade name "Kraton G1657X" from Shell Chemical Company, A Division of Shell Oil Company, Atlanta GA, was used in the extruder 83 to form the strands 95. About ten strands 95 per inch of that material that had a basis weight of about 35 grams per square meter were extruded at a temperature of 450 degrees Fahrenheit between the two compacted sheets 91 and 92 along the peripheries of the bonding rollers 82 and 83. The bonding rollers 102 and 103 bonded the strands 95 to the compacted sheets along their entire lengths. The resultant elastic sheet-like composite was soft, exhibited good elastic properties and did not neck down when elongated to the maximum non compacted lengths of the first and second sheets 88 and 89.

The present invention has now been described with reference to several embodiments and modifications thereof. It will be apparent to those skilled in the art that many changes can be made in the embodiments described without departing from the scope of the present invention. Thus the scope of the present invention should not be limited to the structures and methods described in this application, but only by structures and methods described by the language of the claims and the equivalents of those structures and methods.

Claims:

1. An elastic sheet-like composite comprising:

a multiplicity of generally parallel elongate extruded strands of resiliently elastic thermoplastic material extending in generally parallel spaced relationship, each of said strands having opposite elongate side surface portions that are spaced from and are adjacent the elongate side surface portions of adjacent strands, and each of said strands also having corresponding opposite first and second elongate surface portions extending between said opposite elongate side surface portions; and

a first sheet of flexible material having spaced anchor portions thermally bonded at first sheet bonding locations to longitudinally spaced parts of the strands along said first elongate surface portions, and having arcuate portions projecting from said elastic strands between said first sheet bonding locations;

the bonds between said strands and said anchor portions at said first sheet bonding locations extending along the entire parts of the side surface portions of the strands that are closely adjacent the anchor portions, and the strands having uniform morphology along their lengths including at said bonding locations.

2. An elastic sheet-like composite according to claim 1 further including a second sheet of flexible material having anchor portions thermally bonded at second sheet bonding locations to longitudinally spaced parts of the strands along said second elongate surface portions, and having arcuate portions projecting from said second elongate surface portions of the elastic strands between said second sheet bonding locations.

3. An elastic sheet-like composite according to claim 1 wherein said first sheet is formed of nonwoven fibers that are bonded internally of the sheet, said fibers being crinkled and compressed within the first sheet so that the first sheet can be easily expanded by partial straightening of the fibers in the first sheet and can

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allow the elastic sheet-like composite to be expanded past the condition where the major surfaces of the first sheets are straightened.

4. An elastic sheet-like composite according to claim 1 wherein said strands have a greater width between said opposite elongate side surface portions along said first sheet bonding locations than between said first sheet bonding locations, and the strands are formed around and indented by the arcuate convex surfaces of the anchor portions at said first sheet bonding locations to provide firm attachment between said first sheet and said strands.

5. An elastic sheet-like composite comprising:

a multiplicity of generally parallel elongate extruded strands of resiliently elastic thermoplastic material extending in generally parallel spaced relationship, each of said strands having opposite elongate side surface portions that are spaced from and are adjacent the elongate side surface portions of adjacent strands, and each of said strands also having corresponding opposite first and second elongate surface portions extending between said opposite elongate side surface portions; and

a sheet of stretchable flexible material that when stretched in a first direction will retain most of the length to which it is stretched, said sheet having spaced anchor portions thermally bonded to longitudinally spaced parts of the strands along said first elongate surface portions at bonding locations;

the elastic sheet-like composite being stretchable past the condition where the major surfaces of the sheet are straightened, such stretching and release of the sheet-like composite causing arcuate portions of the sheet to project from said elastic strands between said first sheet bonding locations.

6. An elastic sheet-like composite according to claim 5 wherein said sheet is formed of nonwoven fibers that are bonded internally of the sheet, said fibers being crinkled and compressed within the sheet so that the sheet can be easily stretched by partial straightening of the fibers in the sheet.

7. A method for forming an elastic sheet-like composite, said method comprising:

providing a first sheet of flexible material;

forming the first sheet of flexible material to have arcuate portions projecting in the same direction from spaced anchor portions of the first sheet of flexible material;

extruding spaced generally parallel elongate strands of molten thermoplastic material that is resiliently elastic when cooled onto the anchor portions of the first sheet of flexible material to form resiliently elastic strands thermally bonded to and extending between the anchor portions of the first sheet of flexible material with the arcuate portions of the first sheet of flexible material projecting from corresponding elongate side surface portions of the strands; and

cooling and solidifying the strands.

8. A method for forming an elastic sheet-like composite according to claim 7 further including the step of pressing said strands onto the first sheet bonding locations so that said strands have a greater width along said first sheet bonding locations than between the first sheet bonding locations, the strands are formed around and indented by the arcuate convex surfaces of the anchor portions at the first sheet bonding locations to provide firm bonds between the first sheet and the strands along the entire side surface portions of the strands that are closely adjacent the anchor portions.

9. A method for forming an elastic sheet-like composite according to claim 7 further including the steps of:

providing a second sheet of flexible material;

forming the second sheet of flexible material to have arcuate portions projecting in the same direction from spaced anchor portions of the second sheet of flexible material; and

positioning the spaced anchor portions of the second sheet of flexible material in closely spaced opposition to the spaced anchor portions of the first sheet

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of flexible material with the arcuate portions of said first and second sheets of flexible material projecting in opposite directions;

and wherein said extruding step extrudes the spaced generally parallel elongate strands of molten thermoplastic material between and onto the anchor portions of both the first and second sheets of flexible material to form resiliently elastic strands bonded to and extending between the anchor portions of both the first and second sheets of flexible material with the arcuate portions of the first and second sheets of flexible material projecting in opposite directions from corresponding opposite first and second elongate side surface portions of the strands.

10. A method for forming an elastic sheet-like composite according to claim 7 further including the steps of

providing a second sheet of streachable flexible material that when stretched will retain most of the shape to which it is streached; and

positioning one surface of the second sheet of flexible material in closely spaced opposition to the spaced anchor portions of the first sheet of flexible material on the side of the spaced anchor portions opposite the arcuate portions of the first sheet of flexible material;

wherein said extruding step extrudes the spaced generally parallel elongate strands of molten thermoplastic material between and onto both the anchor portions of the first sheet of flexible material and the adjacent surface of the second sheet of flexible material to form resiliently elastic strands bonded to and extending between the anchor portions of the first sheet of flexible material and extending along and bonded to spaced locations along the surface of the second sheet of flexible material opposite the arcuate portions of the first sheet of flexible material; and

wherein said method further includes the step of

stretching said elastic sheet-like composite longitudinally of said strands after said cooling and solidifying step to permanently stretch said second sheet of flexible material so that upon elastic recovery of said strands, said second sheet of flexible

material will have arcuate portions projecting from corresponding side surface portions of the strands.

11. A method for forming an elastic sheet-like composite, said method comprising:

providing a sheet of stretchable flexible material that when stretched in a first direction will retain most of the length to which it is stretched;

extruding spaced generally parallel elongate strands of molten thermoplastic material that is resiliently elastic when cooled;

thermally bonding together spaced anchor portions of the first sheet of flexible material and spaced portions of the resiliently elastic strands so that the strands extend in the first direction between the anchor portions of the first sheet of flexible material with a side surface of the first sheet of flexible material laying along elongate side surface portions of the strands; and

cooling and solidifying the strands.

12. A method for forming an elastic sheet-like composite according to claim 11 wherein said method further includes the step of stretching the elastic sheet-like composite in the first direction longitudinally of said strands after said cooling and solidifying step so that upon elastic recovery of said strands, said sheet of flexible material will have arcuate portions projecting from corresponding side surface portions of the strands.

13. A method for forming an elastic sheet-like composite according to claim 11 wherein the sheet of flexible material provided in said providing step is a sheet of nonwoven fibers that are bonded internally of the sheet, said fibers being crinkled and compressed within the sheet so that the sheet can be easily stretched by partial straightening of the fibers in the sheet.

14. A disposable diaper or other garment including an elastic sheet-like composite comprising:

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a multiplicity of generally parallel elongate strands of resiliently elastic thermoplastic material extending in generally parallel spaced relationship, each of said strands having opposite elongate side surface portions that are spaced from and are adjacent the elongate side surface portions of adjacent strands, and each of said strands also having corresponding opposite first and second elongate surface portions extending between said opposite elongate side surface portions; and

a first sheet of flexible material having anchor portions thermally bonded at first sheet bonding locations to longitudinally spaced parts of the strands along the first elongate surface portions, and having arcuate portions projecting from said first elongate surface portions of the elastic strands between said first sheet bonding locations.

15. A disposable diaper or other garment according to claim 14 wherein said elastic sheet-like composite further includes a second sheet of nonwoven thermoplastic fibers that are bonded internally of the sheet having anchor portions thermally bonded at second sheet bonding locations to longitudinally spaced parts of the elastic strands along said second elongate surface portions, and having arcuate portions projecting from said second elongate surface portions of the elastic strands between said second sheet bonding locations, and wherein said garment further includes a covering flexible layer having opposite major surfaces and wherein the surface of said first sheet of flexible material opposite said strands is adhered surface to surface with said covering flexible layer so that said strands cause said covering flexible layer to have arcuate portions projecting from said first elongate surface portions of the elastic strands between said first sheet bonding locations corresponding to said arcuate portions of said first sheet of flexible material.

16. A disposable diaper or other garment according to claim 15 wherein in said second sheet of nonwoven thermoplastic fibers that are bonded internally of the sheet, said fibers are crinkled and compressed within the sheet so that sheet can be expanded by partial straightening of the fibers in the sheet.

17. A disposable diaper or other garment according to claim 14 wherein the bonds between said strands and said anchor portions at said first sheet bonding locations extend along the entire parts of the side surface portions of the strands that are closely adjacent the anchor portions, said strands have a greater width between said opposite elongate side surface portions along said first sheet bonding locations than between said first sheet bonding locations, and the strands are formed around and indented by the arcuate convex surfaces of the anchor portions at said first sheet bonding locations to provide firm attachment between said first sheet and said strands.

18. A disposable diaper or other garment according to claim 15 wherein said disposable garment incudes hook means adapted for engagement with said layer of non-woven fibers so that said hook means and said second layer of non-woven fibers provide a releasably engageable fastener for fastening together portions of said disposable garment.

19. Equipment adapted for forming elastic sheet-like composite from resiliently elastic thermoplastic material and a sheet of flexible material, said equipment comprising:

first and second generally cylindrical corrugating members each having an axis and including a multiplicity of spaced ridges defining the periphery of the corrugating member, the ridges having outer surfaces and defining spaces between said ridges adapted to receive portions of the ridges of the other corrugating member in meshing relationship with the sheet of flexible material therebetween;

means for mounting the corrugating members in axially parallel relationship with portions of the ridges in meshing relationship;

means for rotating at least one of the corrugating members so that when the sheet of flexible material is fed between the meshed portions of the ridges the sheet of flexible material will be generally conformed to the periphery of the first corrugating member to form arcuate portions of the sheet of flexible material in the

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spaces between the ridges of the first corrugating member and to form anchor portions of the sheet of flexible material along the outer surfaces of the ridges of the first corrugating member;

means for retaining the formed sheet of flexible material along the periphery of the first corrugating member for a predetermined distance after movement past the meshing portions of the ridges;

means for extruding resiliently elastic thermoplastic material to form a multiplicity of generally parallel elongate molten strands of the resiliently elastic thermoplastic material extending in generally parallel spaced relationship and for positioning the molten strands on the anchor portions of the sheet of flexible material along the periphery of the first corrugating member within the predetermined distance.

20. Equipment for forming elastic sheet-like composite according to claim 19 further including a generally cylindrical cooling roll having an axis;

means for rotatably mounting the cooling roll in axially parallel relationship with the corrugating members with the periphery of the cooling roll closely spaced from and defining a nip with the periphery of the first corrugating member at the predetermined distance from the meshing portions of the ridges;

means for guiding a second sheet of stretchable flexible material that when stretched will retain most of the shape to which it is stretched along the surface of the cooling roll into the nip with the periphery of the first corrugating member so that the molten strands of resiliently elastic material adhere the anchor portions of the first sheet of flexible material to the adjacent surface of the second sheet of flexible material to form resiliently elastic strands bonded to and extending between the anchor portions of the first sheet of flexible material and extending along and bonded to spaced locations along the surface of the second sheet of flexible material opposite the anchor portions of the first sheet of flexible material; and

means for stretching said elastic sheet-like composite longitudinally of said strands to permanently stretch said second sheet of flexible material so that upon

elastic recovery of said strands, said second sheet of flexible material will have arcuate portions projecting from corresponding side surface portions of the strands.

21. Equipment adapted for forming elastic sheet-like composite according to claim 19 further comprising:

third and fourth generally cylindrical corrugating members each having an axis and including a multiplicity of spaced ridges defining the periphery of the corrugating member, the ridges having outer surfaces and defining spaces between said ridges adapted to receive portions of the ridges of the other corrugating member in meshing relationship with a second sheet of flexible material therebetween;

means for mounting the third and fourth corrugating members in axially parallel relationship with portions of the ridges in meshing relationship;

means for rotating at least one of the third and fourth corrugating members so that when the second sheet of flexible material is fed between the meshed portions of the ridges the second sheet of flexible material will be generally conformed to the periphery of the third corrugating member to form arcuate portions of the second sheet of flexible material in the spaces between the ridges of the third corrugating member and to form anchor portions of the sheet of flexible material along the outer surfaces of the ridges of the third corrugating member;

means for retaining the formed second sheet of flexible material along the periphery of the third corrugating member for a predetermined distance after movement past the meshing portions of the ridges of the third and fourth corrugating members;

said third corrugating member being positioned in spaced relationship from said first corrugating member so that said means for extruding resiliently elastic thermoplastic material to form a multiplicity of generally parallel elongate molten strands of the resiliently elastic thermoplastic material extending in generally parallel spaced relationship positions the molten strands on the anchor portions of both the first and second sheets of flexible material along the peripheries of the first and third corrugating members within the predetermined distance.

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22. Equipment adapted for forming elastic sheet-like composite according to claim 19 wherein the ridges extend around and are spaced along the axis of the corrugating members and said equipment includes means for reciprocating the means for extruding to reciprocate the spaced strands of molten thermoplastic material axially of the corrugating members as they are extruded onto the anchor portions of the sheet of flexible material along the periphery of the first corrugating member.

23. Equipment adapted for forming elastic sheet-like composite from resiliently elastic thermoplastic material and a sheet of flexible material, said equipment comprising:

a generally cylindrical corrugating member having an axis and including a multiplicity of spaced ridges defining the periphery of the corrugating member;

means for extruding resiliently elastic thermoplastic material to form a multiplicity of generally parallel elongate molten strands of the resiliently elastic thermoplastic material extending in generally parallel spaced relationship;

a generally cylindrical cooling roll having an axis;

means for rotatably mounting the cooling roll in axially parallel relationship with the corrugating member with the periphery of the cooling roll closely-spaced from and defining a nip with the periphery of the corrugating member;

means for guiding a sheet of stretchable flexible material that when stretched will retain most of the shape to which it is stretched along the surface of the cooling roll into the nip with the periphery of the corrugating member so that the molten strands of resiliently elastic material adhere to the surface of the sheet of flexible material opposite the cooling toll to form resiliently elastic strands bonded to spaced locations along the surface of the sheet of flexible material by the ridges of the corrugating member; and

means for stretching said elastic sheet-like composite longitudinally of said strands to permanently stretch said second sheet of flexible material so that upon

elastic recovery of said strands, said sheet of flexible material will have arcuate portions projecting from corresponding side surface portions of the strands.

24. An elastic sheet-like composite comprising in its un-stretched state:

a multiplicity of generally parallel elongate extruded strands of resiliently elastic thermoplastic material extending in generally parallel spaced relationship, each of said strands having opposite elongate side surface portions that are spaced from and are adjacent the elongate side surface portions of adjacent strands, and each of said strands also having corresponding opposite first and second elongate surface portions extending between said opposite elongate side surface portions; and

a first compacted sheet of flexible material having opposite major surfaces, and being compacted between said surfaces in a first direction along said surfaces so that said first sheet can be extended in said first direction in the range of 1.1 to over 4 times its compacted length in said first direction, said first compacted sheet being thermally bonded to said first elongate surface portions of said strands with said strands extending in said first direction to afford elastic extension of said strands and said sheet in said first direction.

25. An elastic sheet-like composite according to claim 24 further including a second compacted sheet of flexible material having opposite major surfaces, and being compacted between said surfaces in a first direction along said surfaces so that said second compacted sheet can be extended in said first direction in the range of 1.1 to over 4 times its compacted length in said first direction, said second sheet being thermally bonded to said second elongate surface portions of said strands with said strands extending in said first direction to afford elastic extension of said strands and both of said compacted sheets in said first direction.

26. A method for forming an elastic sheet-like composite, said method comprising:

providing a first sheet of flexible material having opposite major surfaces;

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compacting the first sheet in a first direction parallel to the surfaces so that the first compacted sheet has opposite surfaces and can be extended in the first direction in the range of 1.1 to over 4 times its compacted length in the first direction;

extruding spaced generally parallel elongate strands of molten thermoplastic material that is resiliently elastic when cooled onto one of the surfaces of the first compacted sheet to form resiliently elastic strands thermally bonded to and extending in the first direction along the first compacted sheet; and

cooling and solidifying the strands.

27. A disposable diaper or other disposable garment including an elastic sheet-like composite comprising in its un-stretched state:

a multiplicity of generally parallel elongate extruded strands of resiliently elastic thermoplastic material extending in generally parallel spaced relationship, each of the strands having opposite elongate side surface portions that are spaced from and are adjacent the elongate side surface portions of adjacent strands, and each of the strands also having corresponding opposite first and second elongate surface portions extending between the opposite elongate side surface portions; and

a first compacted sheet of flexible material having opposite major surfaces and being compacted between said surfaces in a first direction along said surfaces so that said first compacted sheet can be extended in said first direction in the range of 1.1 to over 4 times its compacted length in said first direction, said first compacted sheet being thermally bonded to said first elongate surface portions of said strands with said strands extending in said first direction to afford elastic extension of said strands and said first compacted sheet in said first direction.

28. A disposable diaper or other disposable garment according to claim 27 wherein longitudinally spaced parts of the strands are thermally bonded to said first compacted sheet at spaced bonding locations along said strands.

29. A disposable diaper or other disposable garment according to claim 27 wherein the strands are thermally bonded to said first compacted sheet along essentially the entire lengths of said strands.

30. A disposable diaper or other disposable garment according to claim 27 further including a second compacted sheet of flexible material having opposite major surfaces, and being compacted between said surfaces in a first direction along said surfaces so that said second compacted sheet can be extended in said first direction in the range of 1.1 to over 4 times its compacted length in said first direction, said second compacted sheet being thermally bonded to said second elongate surface portions of said strands with said strands extending in said first direction to afford elastic extension of said strands and both of said first and second compacted sheets in said first direction.

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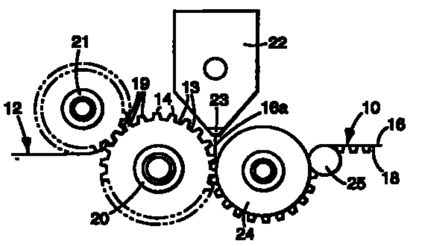


Fig. 1

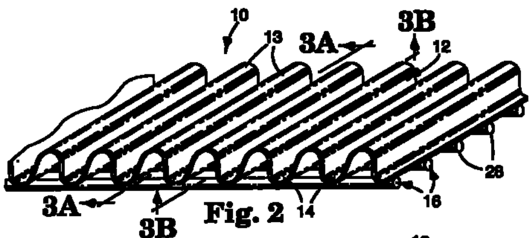


Fig. 2

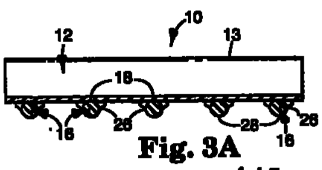


Fig. 3A

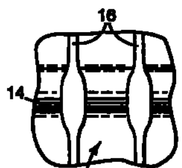


Fig. 3B

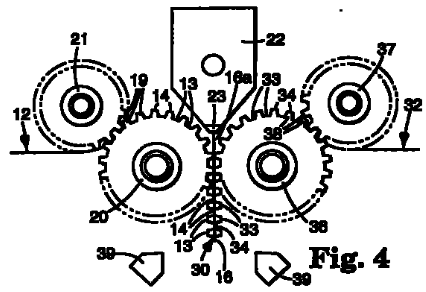


Fig. 4

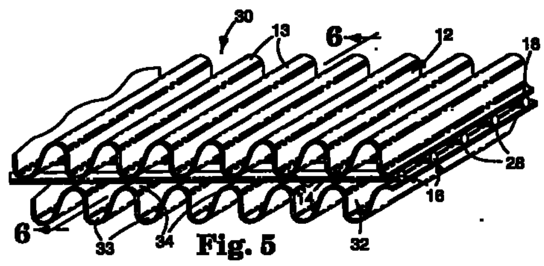
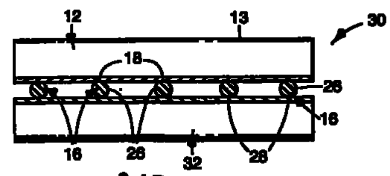


Fig. 5

Fig. 6



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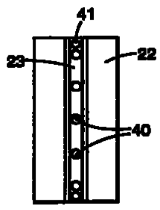
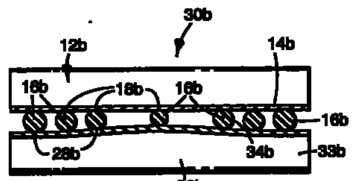


Fig. 7



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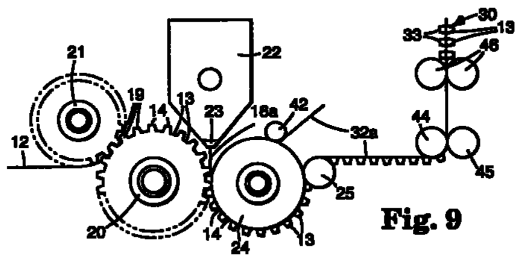

Fig. 9

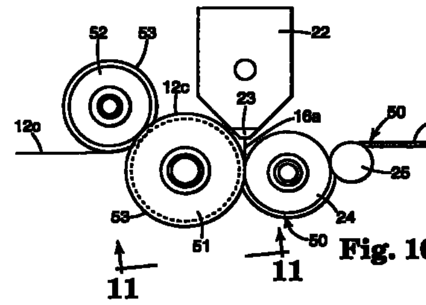

Fig. 10

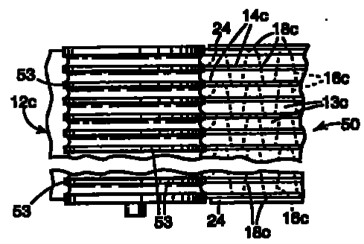

Fig. 11

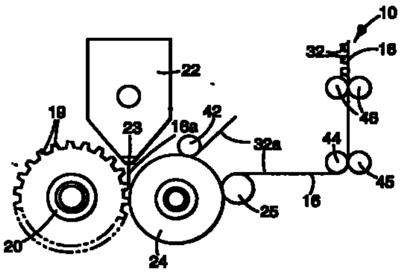

Fig. 12

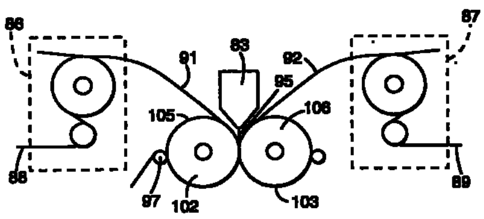

Fig. 18

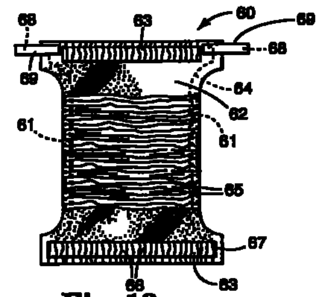

Fig. 13

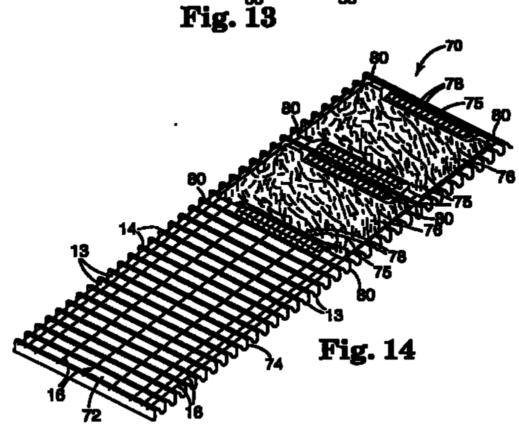

Fig. 14

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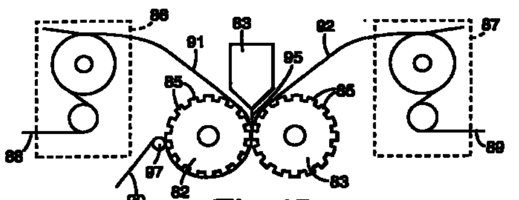

Fig. 15

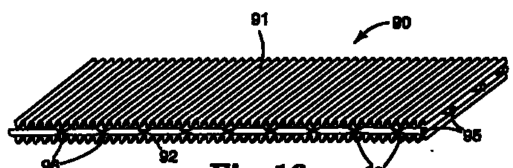

Fig. 16

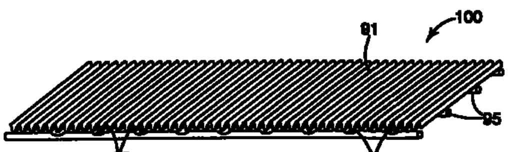

Fig. 17

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INTERNATIONAL SEARCH REPORT

PCT/US 95/05817

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 - A61F13/15

B. FIELDS SEARCHED
IPC 6 A61F

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP-A-0 182 942 (REINHARDT NILS SABEE) 4 June 1986 see page 2, line 29 - line 34 see page 3, line 11 - line 35 see page 6, line 22 - line 12; claims; figure 1	1-9, 14-17, 19-22
Y		10-13, 16,23-30
X	DE-A-34 23 644 (PAUL HARTMANN) 2 January 1986 see page 6, line 14 - page 8, line 4 see page 8, line 23 - page 9, line 11; claims; figures 3,10	1,5,7,8, 19,24,28

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[X] [illegible]

[X] [illegible]

Date of the actual completion of the international search	Date of mailing of the international search report
4 September 1995	12. 09. 95

Name and mailing address of the ISA	Authorized officer
[illegible]	Soederberg, J

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