94

ESCOBAR – URIBE ASOCIADOS

A B O G A D O S

Carrera 11A No. 94-76 - Of.305 - P.O. Box 94948, Bogotá, D.C. - Colombia
Tels: (571) 6162051 - Fax (571) 6161889
www.escobaruribe.com - info@escobaruribe.com

As. 2550/PCT.

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

SUPERINTENDENCIA Y COMERCIO
Radicación : 03036519 00000003 Folios: 3
Fecha (DMA): 2005-03-03 16:37:23
Trámite : 811 PCT-PATENT 378 FASE NACI 530 PETICION
Dependencia: 2020 DIVISION DE NUEVAS CREACIONES

Ref.: Expediente No. **03-036.519**
Solicitud de Patente a nombre de
McNeil-PPC, Inc.

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 **McNeil-PPC, Inc.**, domiciliada en Skillman, New Jersey, Estados Unidos de América, 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 los recibos No. 04 - 90,556 de 22 de noviembre de 2004 y No. 05 - 549 de 4 de enero de 2005, por la suma de $371.000.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.

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SUPERINTENDENCIA Y COMERCIO
Radicacion : 03966519 00000003 Folios: 3
Fecha (AMD): 2005-03-03 16:27:23
Tramite : 011 PCT-PATENT 370 FASE NACI 538 PETICION
Dependencia: 0020 DIVISION DE NUEVAS CREACIONES

NIT : 800176089-2

RECIBO OFICIAL DE CAJA : 04 - 90,536
FECHA : NOVIEMBRE 22 DE 2004

***** 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	29814620	19/11/2004	5,038,000.00

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

CANT.	RENTISTICO	CONCEPTO		TOTAL CONCEPTO
1	50005-01-01 SOLICITUDES	85	EXAMEN DE PATENTABILIDAD DE INVEN	353,000.00
			TOTAL : $	353,000.00

SON: TRESCIENTOS CINCUENTA Y TRES MIL PESOS

RESPONSABLE : _____

RECIBO DE CAJA APLICADO AL EXPEDIENTE No._____

SUSTITUIDA POR NINGUN RECIBO.

46

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SUPERINDUSTRIA Y COMERCIO
Radicacion : 03036519 00000003 Folios: 3
Fecha (AMD) : 2005-03-03 16:37:23
Tramite : 811 PCT-PATENT 378 FASE NACI 538 PETICION
Dependencia: 2020 DIVISION DE NUEVAS CREACIONES

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO

NIT : 800176089-2

CERTIFICACION DE EXCEDENTE : 05 - 549
FECHA : ENERO 4 DE 2005

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 .	35848353	03/01/2005	9,441,000.00

C O N C E P T O

CANT.	RENTISTICO	CONCEPTO	TOTAL CONCEPTO
1	50005-01-09 OTROS SERVICIOS DE PROPIEDAD I	99 OTROS SERVCIOS ADMINISTRATIVOS	18,000.00
		TOTAL : $	18,000.00

SON: DIEZ Y OCHO MIL PESOS .

RESPONSABLE : _____

RECIBO DE CAJA APLICADO AL EXPEDIENTE No._____

ESTA CERTIFICACION DE EXCEDENTE DE PAGO SOLO PODRA SER UTILIZADA

97

DIVISION DE NUEVAS CREACIONES

RADICACIÓN EXPEDIENTE No. **03-36519**

EL EXTRACTO DE LA PRESENTE SOLICITUD DE **PATENTE DE INVENCI N**

PCT FUE PUBLICADO EN LA GACETA DE PROPIEDAD INDUSTRIAL No **544,**

DE FECHA **30** DE **SEPTIEMBRE** DE **2004,** EL TERMINO HABIL SEÑALADO

POR LA LEY EXPIRA EL **29** DE **DICIEMBRE** DE **2004.**

NOTA: Dentro del plazo de los seis (6) meses siguientes a partir de la fecha de publicación en la gaceta de Propiedad Industrial, deberá solicitar y cancelar el examen de patentabilidad so pena de que la solicitud caiga en abandono, de acuerdo con lo establecido en el Artículo 44 de la Decisión 486/2000.

SE PRESENTARON OPOSICIONES POR PARTE DE TERCEROS.

SI _____ NO ___X____

Carrera 13 No. 27-00 Piso 5 y 10
Conmutador: 334 12 21-2-3-4
Fax: 281 31 25 e-mail: info@sic.gov.co
Santa Fe de Bogotá D.C. - Colombia

47 48

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO
DIVISIÓN DE NUEVAS CREACIONES

2020
Bogotá, D. C., 27 de Octubre de 2006

Doctora
JIMÉNA ESCOBAR URIBE
Representante McNEILL – PPC Inc.

ASUNTO		
	Radicación No.	**03-36519**
	Trámite	002
	Evento	001
	Actuación	430
	Oficio	12786
	Folios	073

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 11 a 25 de la solicitud en estudio.

b) Para el presente estudio se tendrán en cuenta los dibujos comprendidos en los folios 30 a 37 de la solicitud en estudio.

c) Para el presente estudio se tendrá en cuenta el capítulo reivindicatorio que comprende 19 reivindicaciones en los folios 26 a 28 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 2 de mayo de 2003 como solicitud PCT Fase nacional, la cual **SI** reclama prioridad de la primera solicitud presentada en Estados Unidos US 60/312330

2) **Objeto de la invención**

a) Las reivindicaciones 1 a 19 de la solicitud en estudio se refieren a una tela perforada que comprende una primera zona que incluye una primera disposición de zonas terminales y al menos dos aberturas, y una segunda zona que comprende una segunda disposición de zonas terminales y al menos dos aberturas, en donde la primera zona es separada de la segunda zona

b) El anterior producto busca mejorar los artículos absorbentes desechables.

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

3) **Claridad de la Solicitud**

a) El artículo 28 de la Decisión 486 de la Comisión de la Comunidad Andina de Naciones establece

> *"La descripción deberá divulgar la invención de manera suficientemente clara y completa para su comprensión y para que una persona capacitada en la materia técnica correspondiente pueda ejecutarla"*

La descripción no es clara toda vez que presenta elementos técnicos que son ambiguos, no comprensibles y que pueden deberse a fallas de traducción. Por ejemplo, la frase "zonas terminales" no tiene un sentido técnico claro en el tema que se trata. Lo mismo sucede con expresiones como "primera disposición es geométrica". Etc.

El título de la invención tampoco es claro y tampoco refleja lo que se quiere proteger por lo que se deberá modificar.

Por tanto, se recomienda que se revise el documento, y que un experto en la materia verifique la redacción de la misma.

b) El artículo 30 de la Decisión 486 de la Comisión de la Comunidad Andina establece que

> *"Las reivindicaciones definirán la materia que se desea proteger mediante la patente. Deben ser claras y concisas y estar enteramente sustentadas por la descripción. Las reivindicaciones podrán ser independientes o dependientes. Una reivindicación será independiente cuando defina la materia que se desea proteger sin referencia a otra reivindicación anterior. Una reivindicación será dependiente cuando defina la materia que se desea proteger refiriéndose a una reivindicación anterior. Una reivindicación será dependiente cuando defina la materia que se desea proteger refiriéndose a una reivindicación anterior.- Una reivindicación que se refiera a dos o más reivindicaciones anteriores se considerará reivindicación dependiente múltiple."*

El capítulo reivindicatorio no es claro toda vez que:

i) La misma objeción hecha en el punto 3) a) es aplicable acá. Por lo mismo, las reivindicaciones no son claras y no puede realizársele un estudio completo a la solicitud.

ii) La reivindicación 13, al parecer está ampliando la materia contenida inicialmente, por lo que no podría tomarse en cuenta al momento de hacer el examen de patentabilidad.

De acuerdo a lo anterior, el capítulo reivindicatorio no cumple con el requisito de claridad de acuerdo a lo establecido en el Art. 30 de la Decisión 486.

4) Determinación del Estad 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 14 de agosto de 2001 (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 telas empleadas en artículos absorbentes desechables.

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

N°	*Documento*	*Título*	*Fecha de Publicación*
D1	US 4 609 518	Multi-phase process for debossing and perforating a polymeric web to coincide with the image of one or more three dimensional forming structures	1986.09.02
D2	US 5647 862	Absorbent article with means for directional fluid distribution	1997.07.15
D3	GB 2 310 606	Surface material with slits	1997.09.03
D4	EP 761190	Sanitary articles with multi aperture size film top sheets having a selected distribution of the apertures	1997.03.12
D5	EP 165 807	Sanitary napkin with gross foramina overlying a low density, resilient structure	1985.12.27
D6	WO 9740793	An apertured covering sheet for an absorbent article and a method of producing the covering sheet	1997.11.06

5) 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 de la novedad y el del Nivel Inventivo

El art. 16 de la Decisión 486 de la Comisión de la Comunidad Andina establece:

> *"Una invención se considerará nueva cuando no está comprendida en el estado de la técnica." "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 prioridad de la solicitud de patente que se estuviese examinando, siempre que dicho contenido esté incluido en la solicitud de fechas de prioridad cuando ella se publique o hubiese transcurrido el plazo previsto en el artículo 40."*

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".*

Todas las anterioridades señaladas refieren telas perforadas con al menos dos zonas, donde cada zona tiene al menos dos aberturas y las zonas están separadas. Además, las telas referidas en las anterioridades muestran patrones regulares, irregulares, repetidos, no repetidos, con diversas configuraciones geométricas.

Las anterioridades también refieren su empleo en artículos absorbentes, y describen dichos artículos con la tela mencionada.

Es demasiado evidente que las anterioridades anticipan a la presente solicitud en todo.

De lo anterior se tiene que la presente solicitud carecería de los requisitos necesarios para que se le conceda el privilegio solicitado.

b) Resumen

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

Nº	Documento	Reivindicaci nes afectadas	Requisito que afecta
D1	US 4 609 518	1 - 19	Novedad
			Nivel inventivo
D2	US 5647 862	1 - 19	Novedad
			Nivel inventivo
D3	GB 2 310 606	1 - 19	Novedad
			Nivel inventivo
D4	EP 761190	1 - 19	Novedad
			Nivel inventivo
D5	EP 165 807	1 - 19	Novedad
			Nivel inventivo
D6	WO 9740793	1 - 19	Novedad
			Nivel inventivo

6) 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

03 NOV. 2006

Concepto Técnico Nº	EXAMINADOR TÉCNICO Código No.	EXAMINADOR JURÍDICO Código No.
1705	202003	

United States Patent [19]

Carro et al.

[11] Patent Number: 4,609,518

[45] Date of Patent: Sep. 2, 1986

[54] MULTI-PHASE PROCESS FOR DEBOSSING AND PERFORATING A POLYMERIC WEB TO COINCIDE WITH THE IMAGE OF ONE OR MORE THREE-DIMENSIONAL FORMING STRUCTURES

[75] Inventors: John J. Curro; James C. Baird; Donald L. Gerth, all of Cincinnati; George M. Vernon, West Chester; E. Kelly Linman, Cincinnati, all of Ohio

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

[21] Appl. No.: 738,145

[22] Filed: May 21, 1985

[51] Int. Cl.[4] B29C 59/04; B29C 49/42

[52] U.S. Cl. 264/504; 264/570; 425/71, 425/290, 425/326.1, 425/387.1, 425/388

[58] Field of Search 264/504, 154, 156, 555, 264/556, 570; 425/290, 326.1, 387.1, 388, 71

[56] References Cited

U.S. PATENT DOCUMENTS

Smith et al. [illegible]

[illegible]

FOREIGN PATENT DOCUMENTS

[illegible] United Kingdom

[illegible] United Kingdom

OTHER PUBLICATIONS

Commonly Assigned, Copending Patent Application Serial No. 623,274, filed on Jun. 21, 1984, in the name of Thomas Ward Osborne, III and entitled "Sanitary Napkin with Gross Formation Overlying a Low Density, Resilient Structure"

Primary Examiner—Jan Silbaugh

Attorney, Agent, or Firm—E. Kelly Linman; John V. Gorman; Richard C. Witte

[57] ABSTRACT

A continuous, multi-phase process for debossing and perforating a substantially continuous web of substantially planar polymeric film to coincide with the image of one or more forming structures, each having a patterned forming surface with a multiplicity of holes and an opposed surface. Each forming structure is open from the holes in the forming surface to its opposed surface. The web of film has an indefinite length, a first surface, a second surface and a thickness. The thickness comprises the distance between the first surface and the second surface. The process comprises at least two sequential forming phases, one of which involves three-dimensional conformance of the web to the macroscopic profile of the forming structure and another of which involves aperturing of the web to coincide with fine-scale apertures in either the same or a separate forming structure. The order in which the phases are carried out will depend upon the properties desired in the resultant macroscopically expanded, three-dimensional, apertured polymeric web. Because the process is carried out in sequential phases, previously incompatible characteristics which could not be provided by prior art single-phase forming processes can now be achieved.

47 Claims, 40 Drawing Figures

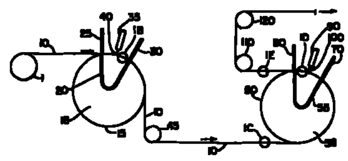


Fig. 1A

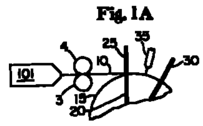


Fig. 1B

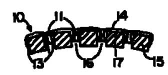


Fig. 1

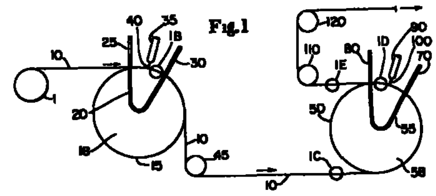
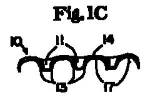


Fig. 1C



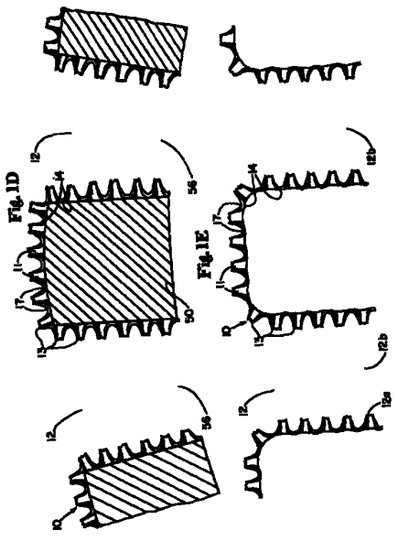


Fig. 1D

Fig. 1E

Fig. 2

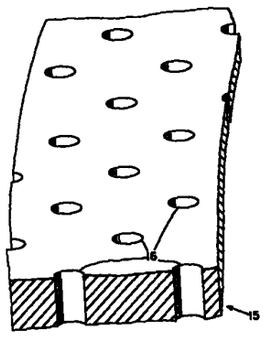


Fig. 3

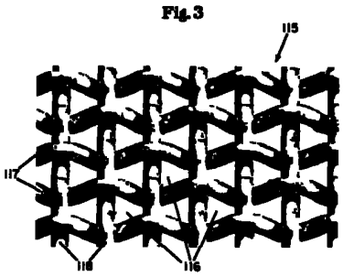


Fig. 4

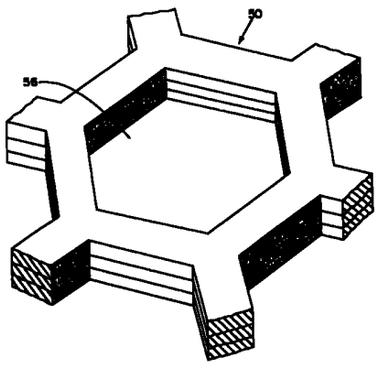


Fig. 5A

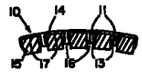


Fig. 5B

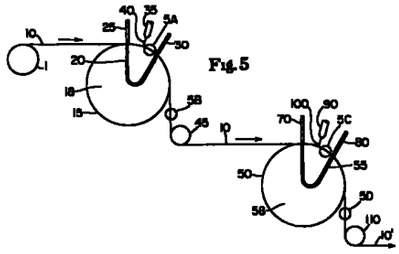


Fig. 5

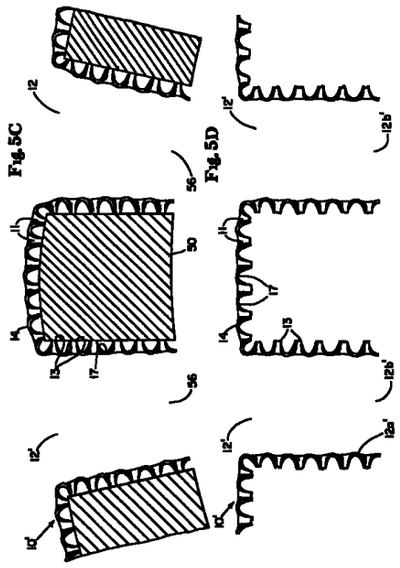
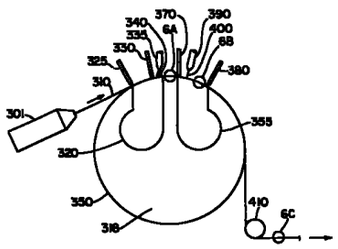


Fig. 5C

Fig. 5D

Fig. 6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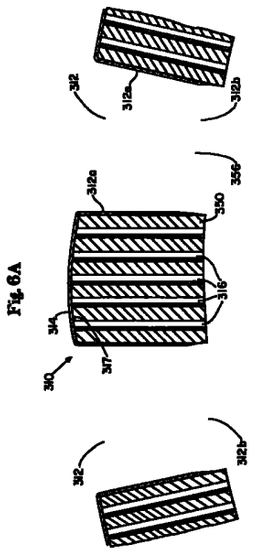
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Fig. 6A

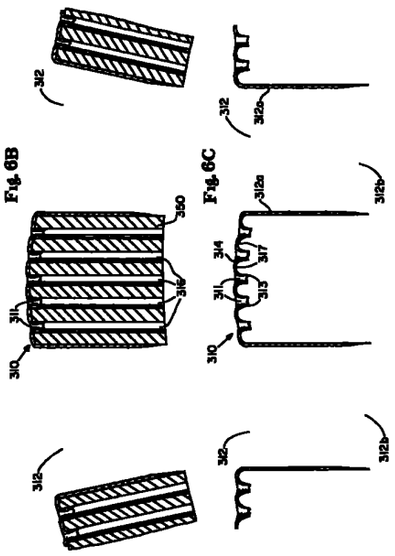


Fig. 6B

Fig. 6C

Fig.7

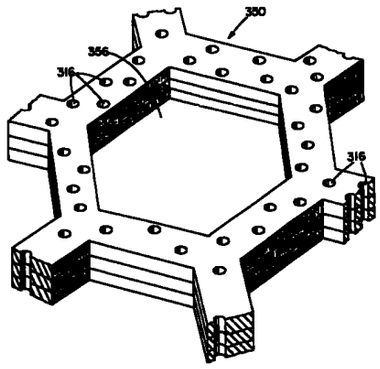
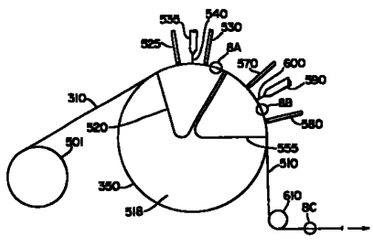


Fig. 8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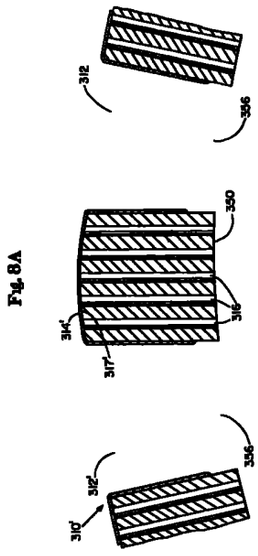
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310'

Fig. 8A

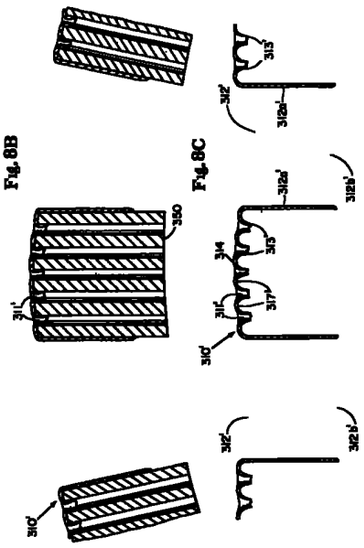
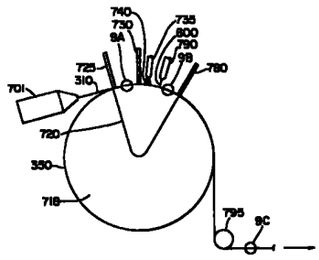


Fig. 8B
Fig. 8C
350
311'
310'
312'
312a'
312b'
313'
314
315
316
317

Fig. 9


740
730
9A
735
800
790
9B
780
725
310
701
720
350
718
795
9C

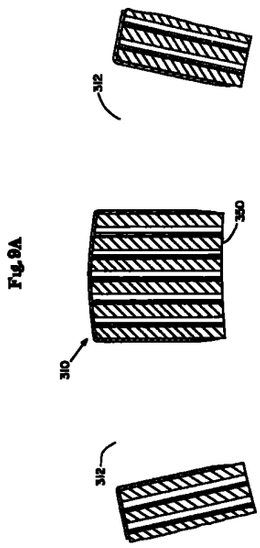


Fig. 9A

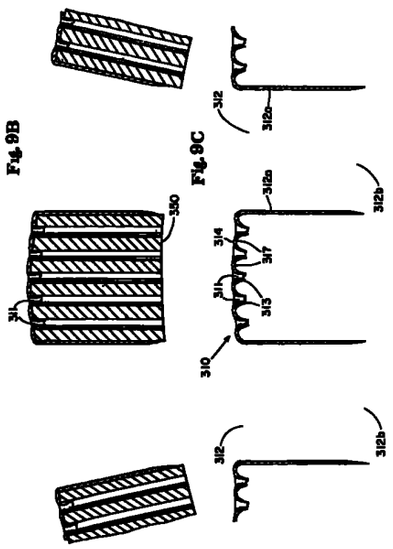


Fig. 9B

Fig. 9C

Fig. 10

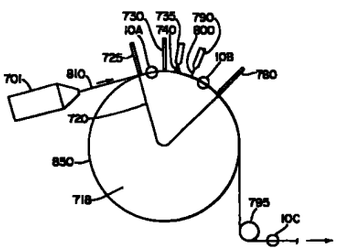


Fig. 10A

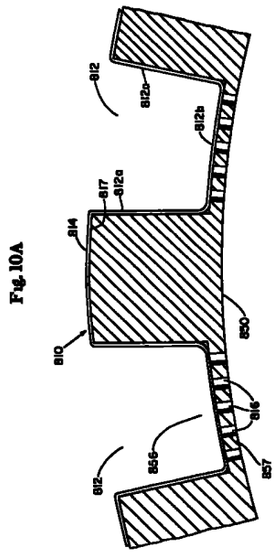


Fig.10B

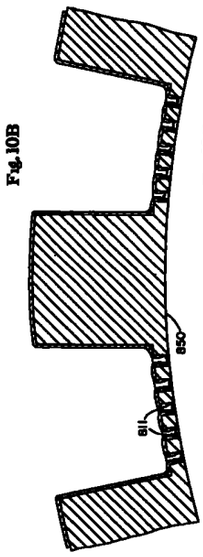


Fig.10C

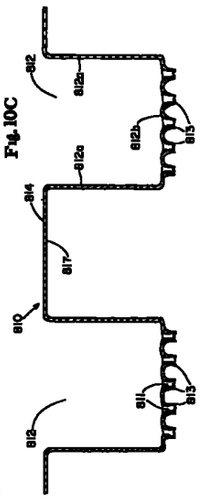


Fig.11

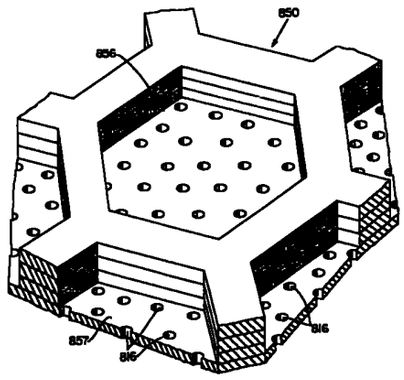


Fig. 12

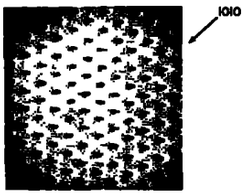


Fig. 13

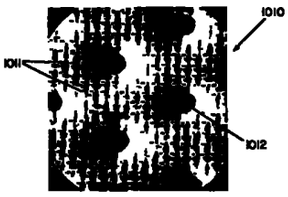


Fig. 14

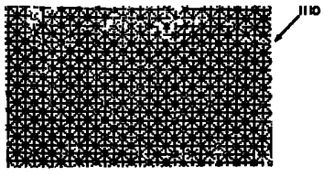


Fig. 15

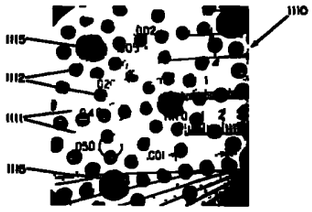


Fig. 16

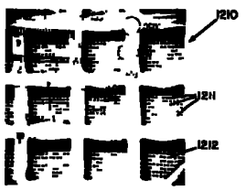

1210
1211
1212

Fig. 17

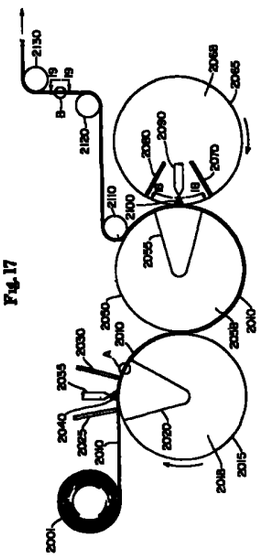

2130
15
19
18
2120
2110
2100
2060
2090
2070
2065
2055
2050
2010
2030
2035
2040
2025
2020
2015
2001

Fig. 18

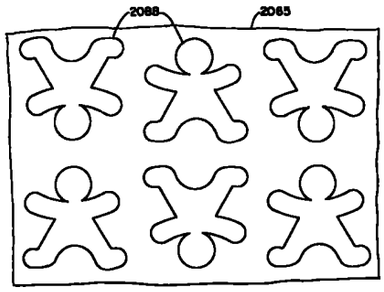
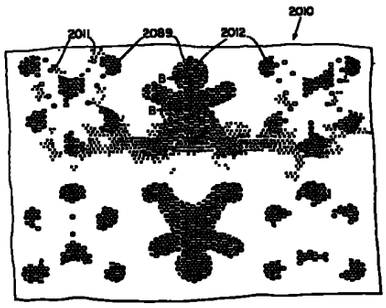


Fig. 19



MULTI-PHASE PROCESS FOR DEBOSSING AND PERFORATING A POLYMERIC WEB TO COINCIDE WITH THE IMAGE OF ONE OR MORE THREE-DIMENSIONAL FORMING STRUCTURES

TECHNICAL FIELD

The present invention has relation to a multi-phase process for debossing and perforating a substantially continuous web of substantially planar polymeric film so as to coincide with the image of one or more three-dimensional forming structures.

The present invention has further relation to a multi-phase process for producing plastic webs which exhibit a combination of desirable attributes which were incompatible with one another when produced using single-phase forming processes of the prior art.

The present invention has further relation to a multi-phase forming process capable of producing macroscopically expanded, three-dimensional, apertured polymeric webs comprised of materials which could not be effectively processed on single-phase forming processes of the prior art.

The present invention has further relation to a multi-phase forming process which is capable of reliable, high-speed, continuous operation, thereby greatly reducing the cost of the unique plastic webs produced by said process.

The present invention has still further relation to a multi-phase forming process for producing macroscopically expanded, three-dimensional, apertured plastic webs exhibiting highly desirable fluid and vapor transmission capabilities in addition to visual and tactile impressions which are actually preferred by consumers over woven and nonwoven fibrous webs when worn in contact with the skin.

BACKGROUND ART

Macroscopically expanded, three-dimensional, apertured polymeric webs are generally known in the art.

As utilized herein, the term "macroscopically expanded" when used to describe three-dimensional plastic webs, ribbons and films, refers to webs, ribbons and films which have been caused to conform to the surface of a three-dimensional forming structure so that both surfaces thereof exhibit the three-dimensional pattern of said forming structure, said pattern being readily visible to the naked eye when the perpendicular distance between the viewer's eye and the plane of the web is about 12 inches. By way of contrast, the term "planar" when utilized herein to describe plastic webs, ribbons and films, refers to the overall condition of the web, ribbon or film when viewed by the naked eye on a macroscopic scale. In this context "planar" webs, ribbons and films may include webs, ribbons and films having fine-scale surface aberrations on one or both sides, said surface aberrations not being readily visible to the naked eye when the perpendicular distance between the viewer's eye and the plane of the web is about 12 inches or greater.

One macroscopically expanded, three-dimensional, apertured plastic web which is particularly well suited to transferring fluid deposited on one surface thereof to its opposite surface and thereafter isolating the transferred fluid from the wearer's skin is disclosed in commonly assigned U.S. Pat. No. 3,929,135 issued to Thompson on Dec. 30, 1975, and hereby incorporated herein by reference. Thompson describes a macroscopically expanded, three dimensional topsheet comprised of liquid impermeable material, but provided with a pattern of tapered capillaries, said capillaries having a base opening in the plane of the topsheet and an apex opening remote from the plane of the topsheet, said apex opening being in intimate contact with the absorbent pad utilized in the disposable absorbent bandage. The Thompson topsheet allows the free transfer of fluids from the wearer's body into the absorbent element of the device while inhibiting the reverse flow of these fluids. This provides a relatively much drier surface in contact with the user than had previously been obtainable.

Another macroscopically expanded, three-dimensional, apertured plastic web well suited for use as a topsheet on absorbent bandages such as sanitary napkins is disclosed in commonly assigned U.S. Pat. No. 4,342,314 issued to Radel and Thompson on Aug. 3, 1982, said patent being hereby incorporated herein by reference. The macroscopically expanded, three-dimensional plastic web disclosed in the Radel and Thompson patent exhibits a fiber-like appearance and tactile impression which has been favorably received by consumers when used as a wearer contacting surface.

According to the teachings of the aforementioned commonly assigned patents to Thompson and to Radel et al., plastic webs of the aforementioned type can be made by applying a fluid pressure differential to the web while it is supported on a three-dimensional forming structure until the web is macroscopically expanded to comply with the three-dimensional cross-section of the forming structure on which it is supported. When aperturing of the macroscopically expanded, three-dimensional web is desired, said fluid pressure differential is applied continuously until such time as aperturing of the web in areas coinciding with the apertures in the forming structure has been completed.

While single-phase forming processes of this general type have been successfully utilized in producing macroscopically expanded, three-dimensional, apertured plastic webs exhibiting many characteristics generally viewed as favorable by consumers, the majority of such single-phase processing techniques have been unable to deliver all of the desired characteristics in a single finished web structure, particularly at high production speeds.

OBJECTS OF THE INVENTION

Accordingly, it is an object of the present invention to provide a process wherein various combinations of previously incompatible characteristics can be provided in a single macroscopically expanded, three-dimensional, apertured polymeric web.

It is another object of the present invention to provide macroscopically expanded, three-dimensional apertured plastic webs which offer improved fluid and vapor handling characteristics along with highly preferred appearance, softness and tactile impression when compared to woven and nonwoven fibrous structures.

It is still another object of the present invention to provide high-speed, reliable, multi-phase process and apparatus for debossing and perforating a substantially continuous web of substantially planar polymeric material to coincide with the image of one or more forming structures used in the process.

It is still another object of the present invention to provide multi-phase process and apparatus for producing macroscopically expanded, three-dimensional, apertured plastic webs wherein the different phases of the process may be separated from one another either temporally or spatially or both.

It is still another object of the present invention to provide such multi-phase process and apparatus, wherein the latter phases of the process may be so selected as not to alter either the solid state molecular structure of the web or any of the characteristics imparted to the web by earlier phases of the process.

DISCLOSURE OF THE INVENTION

The present invention pertains, in a particularly preferred embodiment, to a multi-phase method of making debossed and apertured polymeric webs which exhibit three-dimensional geometric forms, a number of which were at best difficult and at worst impossible to attain using single-phase forming processes of the prior art. Specifically, multi-phase processes of the present invention are capable of forming a film with very small and very large apertures or capillary networks immediately adjacent one another while accurately replicating the macroscopic, three-dimensional cross-section of the forming structure. In addition, it permits the formation of macroscopically expanded, three-dimensional, apertured plastic webs exhibiting a very large overall caliper in conjunction with very tiny apertures either in the land areas of the web or in the end walls of the capillary networks or both. Capillary networks having tiny apertures in their sidewalls may also be produced using embodiments of the present multi-phase process. In yet other preferred embodiments, webs exhibiting capillary networks having sidewalls extending in opposite directions from one another may also be produced.

In one preferred embodiment of the present process, a web of molten polymeric resin is extruded directly onto a perforate, three-dimensional forming structure and subjected to a fluid pressure differential, typically vacuum. This phase of the operation provides good conformation of the web to the forming structure and imparts significant overall caliper to the web. Those portions of the web coinciding with a multiplicity of macroscopic cross-section apertures in the forming structure will also be apertured during this phase of the forming process. The molten web is thereafter cooled while still subject to the forming vacuum to prevent spring-back and consequent loss of caliper. At lower production speeds, e.g., below about 50 feet per minute, web cooling is often carried out simply by the flow of air through or against the film, while at higher production speeds it is generally desirable to accelerate the cooling process by applying a low pressure water spray on the film. The film is then transported while on the same forming structure to a second forming phase, preferably comprising a high pressure liquid jetting operation, which provides aperturing of the web not only in those areas coinciding with the very small apertures present in the forming structure, but also in any as yet unapertured areas of the web coinciding with any of the macroscopic cross-section apertures in the forming structure. If desired, the macroscopically expanded web can be fed to the high pressure liquid jetting operation while it is still subject to the forming vacuum used in the initial phase of the process. In this situation, the high pressure liquid jet not only provides aperturing of the web in those areas coinciding with the very small apertures present in the forming structure, but may also afford some additional web cooling benefits.

While the present invention may take many different executional forms, multi-phase web forming processes of the present invention comprise at least two discrete forming phases, each of which utilizes a fluid pressure differential to achieve its objective. One of the phases involves macroscopically conforming the polymeric web to the macroscopic cross-sectional profile of the forming structure on which it is supported while subject to one of the fluid pressure differentials. Substantial aperturing of the web in those areas coinciding with the macroscopic cross-section apertures in the forming structure usually occurs during this phase of the process. The other phase of the forming process also involves applying a fluid pressure differential to the plastic web. However this phase is less concerned with macroscopically expanding the web to conform it to the three-dimensional cross-section of the forming structure. Rather, its primary objective is to fully aperture the web in all areas coinciding with apertures in the forming structure, including very fine apertures in the non-debossed land areas of the web and/or the end walls of the larger capillary networks formed therein.

The order in which these discrete forming phases are applied will depend upon the particular characteristics desired in the resultant macroscopically expanded, three-dimensional, apertured polymeric web.

The discrete forming phases may be utilized on a single forming structure including all of the features desired in the resultant web or on multiple forming structures, each of which imparts only a portion of the desired features to the web.

The fluid media applied during each of the forming phases of the present invention may be similar or dissimilar to one another again depending upon the particular characteristics desired in the resultant polymeric web.

Because the process variables for each discrete phase of the forming process can be optimized to achieve a precise result, macroscopically expanded, three-dimensional, apertured polymeric webs can be made to exhibit combinations of characteristics which were previously thought to be incompatible with one another due to limitations inherent in prior art single-phase forming processes.

BRIEF DESCRIPTION OF THE DRAWINGS

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

FIG. 1 is a simplified schematic illustration of a two-phase film forming process of the present invention;

FIG. 1A is a partial illustration of a variation of the process generally shown in FIG. 1, wherein the supply roll of substantially planar polymeric film is replaced by an extruder which extrudes a web of molten resin onto the first forming structure;

FIG. 1B is a greatly enlarged inset showing, in simplified terms, the condition of the polymeric web after it has been subjected to a first fluid pressure differential on the first forming structure;

FIG. 1C is a greatly enlarged inset of the polymeric web after it has been removed from the first forming structure;

FIG. 1D is a greatly enlarged inset of the polymeric web after it has been fed onto a second forming structure exhibiting a macroscopic, three-dimensional cross-sectional profile so that its opposite surface is in contact

68

with the second forming structure, said polymeric web having thereafter been subjected to a second fluid pressure differential;

FIG. 2E is a greatly enlarged inset of the polymeric web after completion of the two-phase forming process generally illustrated in FIG. 1;

FIG. 2 is a greatly enlarged fragmentary view of the first forming structure utilized to support the polymeric web when the web is subjected to a first fluid pressure differential generally in accordance with the process illustrated in FIG. 1;

FIG. 3 is a greatly enlarged photograph of a fragment of an alternative forming structure which could be utilized when the polymeric web is subjected to the first fluid pressure differential generally illustrated in FIG. 1;

FIG. 4 is a greatly enlarged fragmentary view of the forming structure on which the polymeric web is supported during application of the second fluid pressure differential generally illustrated in FIG. 1;

FIG. 5 is a simplified schematic illustration of an alternative two-phase forming process of the present invention;

FIG. 5A is a greatly enlarged inset showing the condition of the polymeric web after it has been subjected to a first fluid pressure differential identical to the one illustrated in FIG. 1;

FIG. 5B is a greatly enlarged inset showing the condition of the plastic web after its removal from the first forming structure illustrated in FIG. 1;

FIG. 5C is a greatly enlarged inset showing the condition of the web after it has been removed from the first forming structure and fed onto a second macroscopic cross-section forming structure without reversing its orientation, said web having thereafter been subjected to a second fluid pressure differential;

FIG. 5D is a greatly enlarged inset showing the resultant web after completion of the two-phase forming process generally disclosed in FIG. 5;

FIG. 6 is a simplified schematic illustration of an alternative two-phase forming process of the present invention;

FIG. 6A is a greatly enlarged inset showing the condition of the polymeric web after it has been subjected to vacuum forming and water assisted cooling;

FIG. 6B is a greatly enlarged inset showing the condition of the polymeric web after it has been subjected to a higher pressure liquid jetting process while supported on the same forming structure on which the vacuum forming process was carried out; and

FIG. 6C is a greatly enlarged inset showing the resultant web after the two-phase forming process generally illustrated in FIG. 6 has been completed;

FIG. 7 is a greatly enlarged fragmentary view of the forming structure utilized to carry out the two-phase process generally disclosed in FIG. 6;

FIG. 8 is a simplified schematic illustration of another two-phase forming process of the present invention;

FIG. 8A is a greatly enlarged inset showing the condition of the polymeric web after it has been subjected to a first high pressure liquid jetting operation on a forming structure of the type generally illustrated in FIG. 7;

FIG. 8B is a greatly enlarged inset showing the condition of the web after it has been subjected to a second, higher pressure jetting operation while supported on the same forming structure on which the first liquid jetting operation was carried out;

FIG. 8C is a greatly enlarged inset showing the resultant polymeric web after the two-phase forming process shown in FIG. 8 has been completed;

FIG. 9 is a simplified schematic illustration of still another embodiment of a two-phase forming process of the present invention;

FIG. 9A is a greatly enlarged inset showing the condition of the web after it has been subjected to a first fluid pressure differential comprising suction applied adjacent the innermost surface of the forming structure;

FIG. 9B is greatly enlarged inset showing the condition of the web after it has been subjected to a second fluid pressure differential comprising a high pressure liquid jet which serves to aperture the web in those areas corresponding to the small apertures in the land areas of the forming structure and to further cool the web before it leaves the influence of the forming vacuum;

FIG. 9C is a greatly enlarged inset showing the resultant web after the two-phase forming process generally illustrated in FIG. 9 has been completed;

FIG. 10 is a simplified schematic illustration of a process generally similar to that shown in FIG. 9 with the principal exception that a different forming structure is employed;

FIG. 10A is a greatly enlarged inset showing the condition of the web after it has been subjected to a first fluid pressure differential comprising suction applied adjacent the innermost surface of the forming structure;

FIG. 10B is greatly enlarged inset showing the condition of the web after it has been subjected to a second fluid pressure differential comprising a high pressure liquid jet while still subject to the influence of the forming vacuum;

FIG. 10C is a greatly enlarged inset showing the resultant web after completion of the two-phase forming process generally illustrated in FIG. 10;

FIG. 11 is a greatly enlarged fragmentary view of the forming structure employed in the process of FIG. 10;

FIG. 12 is a plan view photograph, enlarged many times actual size, of a macroscopically expanded, three-dimensional, apertured polymeric web made using a two-phase forming process generally similar to that disclosed in FIG. 1;

FIG. 13 is another plan view photograph of the web illustrated in FIG. 12, but at a much higher level of magnification;

FIG. 14 is a plan view photograph, enlarged many times actual size, of a macroscopically expanded, three-dimensional, apertured polymeric web made using a two-phase forming process generally similar to that disclosed in FIG. 6;

FIG. 15 is another view of the web shown in FIG. 14, but at a much higher level of magnification;

FIG. 16 is a plan view photograph, enlarged many times actual size, of a macroscopically expanded, three-dimensional, apertured polymeric web made utilizing a multi-phase forming process of the present invention and a forming structure generally similar to the one disclosed in FIG. 11;

FIG. 17 is a simplified schematic illustration of another two-phase, registered pattern forming process of the present invention wherein a masking element is also employed to produce a polymeric web exhibiting discrete predetermined areas of macroscopic, three-dimensional expansion;

FIG. 18 is a view of the inside of the masking element, taken along view line 18—18 of FIG. 17; and

FIG. 19 is a simplified schematic view of the finished web shown in FIG. 17 taken along view line 19—19 of FIG. 17

DETAILED DESCRIPTION OF THE PRESENT INVENTION

While the present invention will be described in the context of providing macroscopically expanded, three-dimensional, apertured plastic webs particularly suited for use as a wearer contacting surface on absorbent bandages such as disposable diapers, sanitary napkins, wound dressings and the like, the present invention is in no way limited to such applications. To the contrary, the present invention may be practiced to great advantage whenever it is desired to produce plastic films or webs exhibiting properties, characteristics, aesthetics, fineness of detail etc. not previously obtainable using prior art single-phase web forming processes. The patterns created may be of any desired shape, they may be regulated or random, reticulated or non-reticulated, continuous or interrupted, or any desired combination thereof. The detailed description of the structures disclosed herein and their suggested use as topsheets and/or backsheets in a disposable absorbent bandage context will allow one skilled in the art to readily adapt the invention to produce webs well suited to other applications.

A particularly preferred multi-phase, continuous forming process of the present invention is schematically illustrated in FIG 1. In the embodiment shown in FIG. 1, a web of substantially planar film 10 comprised of a polymeric material such as polyethylene is fed from a supply roll 1 onto the surface of a first forming drum 18 about which a forming structure 15 continuously rotates at substantially the same speed as the incoming web. The forming drum 18 preferably includes an internally located vacuum chamber 20 which is preferably stationary relative to the moving forming structure 15. A pair of stationary baffles 25, 30 approximately coinciding with the beginning and the end of the vacuum chamber 20 are located adjacent the exterior surface of the forming structure. Intermediate the stationary baffles 25, 30 there is preferably provided means for applying a fluid pressure differential to the substantially planar web of polymeric film 10 as it passes across the suction chamber. In the illustrated embodiment, the fluid pressure differential applicator means comprises a high pressure liquid nozzle 35 which discharges a jet of liquid 40, such as water, substantially uniformly across the entire width of the web 10. Details as to the construction, positioning and operating pressure of liquid nozzle 35 are fully set forth in the commonly assigned U.S. patent application of John J. Curro, Alan J. Trusty and George M. Vernon, Ser. No. 580,911 filed Feb. 16, 1984 and entitled FORMED MATERIAL PRODUCED BY SOLID-STATE FORMATION WITH A HIGH-PRESSURE LIQUID STREAM, said patent application being hereby incorporated herein by reference.

Forming structure 15, a greatly enlarged fragmentary segment of which is illustrated in FIG. 2, includes a multiplicity of relatively small apertures 16 across all or any desired portion of its surface. For disposable diaper topsheet applications these apertures typically range in size between about 1 mil and about 10 mils in diameter. Their spacing may be in a regular pattern or it may vary randomly, as desired, in the resultant web. Methods of constructing suitable three-dimensional tubular forming members of this general type are disclosed in commonly assigned U.S. Pat. No. 4,508,256 issued to Radel et al. on Apr. 2, 1985 and commonly assigned U.S. Pat. No. 4,509,908 issued to Mullane, Jr. on Apr. 9, 1985, said patents being hereby incorporated herein by reference.

The apertures 16 in the forming structure 15 may be of any desired shape or cross-section when the forming structure is fabricated utilizing the laminar construction techniques generally disclosed in the aforementioned commonly assigned patents.

Alternatively, the tubular shaped forming structure 15 may be comprised of non-laminar construction and the desired pattern of apertures 16 created by means of laser drilling or the like. It is also possible to use belts or the like comprised of pliable material and operating continuously about a pair of rolls. In the latter circumstance it is generally desirable to provide suitable support beneath the pliable belt when it is subjected to the fluid pressure differential to avoid distortion.

Still another suitable forming structure which can be used to provide fine-scale aperturing of the polymeric web 10 comprises a woven wire mesh 115, such as that shown in the highly enlarged fragmentary photograph of FIG. 3. In this situation a multiplicity of intersecting filaments 117 and 118 are interwoven with one another to provide a knuckle pattern, such as that generally shown in FIG. 3, about the surface of the forming structure 115. The woven wire mesh filaments may be comprised of metal or polymeric material. Woven wire mesh forming structures 115 having filaments 117, 118 ranging in diameter from about 3 mils to about 7 mils and mesh counts ranging from about 140 by 140 per square inch to about 80 by 80 per square inch, respectively, will typically produce very soft feeling apertured webs when subjected to the high pressure liquid jet 40 issuing from nozzle 35, as generally shown in FIG. 1. The relatively small apertures created in such webs substantially correspond to the void spaces created in the interstices 116 between the intersecting filaments.

As will be appreciated by those skilled in the art, the degree of conformance of the polymeric web 10 to the surface of the forming structure 15 and the size of the apertures created therein will be influenced by factors such as the temperature of the film 10 at the time it is subjected to the liquid jet 40, the pressure at which the jet 40 is applied to the surface of the film, the temperature of the liquid comprising the jet, the mass flux of the liquid jet, etc.

In general, when the fluid pressure differential applied to the web is in the form of vacuum, the higher the temperature of the incoming film 10, the greater will be the degree of conformance and aperturing. However, when the fluid pressure differential applied to the web is in the form of a high pressure liquid jet, as is the case in FIG. 1, it is generally preferred that the incoming web be in a solid rather than a molten state. In the case of the embodiment shown in FIG. 1A, a web of molten resin 10 extruded from a conventional extruder 101 could be fed between a pair of chill rolls 3,4 prior to being fed onto the forming structure 15 to substantially cool the resin before it passes beneath liquid jet 40.

Whatever the origin of the incoming web of polymeric material 10, after it passes beneath the liquid jet 40, its condition will be generally as shown in the greatly enlarged inset of FIG. 1B. At this point, fine-scale apertures 11 corresponding to the relatively small apertures 16 in forming structure 15 have been created

in the film 10. The small volcano-like cusps 13 formed about the edge of each aperture 11 reflect a degree of thinning of the film just prior to rupture.

Following application of the first fluid pressure differential to the film, the finely apertured polymeric web 10 is removed from the surface of the first fine-scale forming structure 15 about an idler roll 65 in the condition illustrated in greatly enlarged form in the inset of FIG. 1C. Because of the presence of the cusps 13 surrounding each of the tiny apertures 11, the surface 17 which contacted forming structure 15 exhibits a much softer tactile impression than the surface 14 which was contacted by the liquid jet 40. Accordingly, surface 17 of the web is generally preferred as a wearer contacting surface over surface 14.

After completion of the first phase of the web forming process disclosed in FIG. 1, the finely apertured web 10 may be fed to the second phase of the forming process for macroscopic expansion or to a rewind station for temporary storage. In the latter circumstance, application of the second phase of the process may be deferred until a later date, perhaps at a different location.

Alternatively, the finely apertured web 10 may be utilized without further processing in an end product wherein fluid permeability and a soft tactile impression are particularly desirable, but a macroscopically expanded, three-dimensional cross-section is not essential.

Because of the desirable tactile impression imparted to surface 17 of the web 10 in the embodiment illustrated in FIG. 1, a web which is to undergo macroscopic, three-dimensional expansion is preferably fed onto a second forming structure 50 which operates about forming drum 58 so that its opposite surface 14 is placed in contact with forming structure 50. Forming drum 58, which is generally similar to forming drum 18 also includes a stationary vacuum chamber 55 located adjacent the interior of forming structure 50. Stationary baffles 70 and 80 substantially coincide with the leading and trailing edges of the vacuum chamber 55, thereby defining a second fluid pressure differential zone wherein a second liquid nozzle 90, generally similar to liquid nozzle 35, is positioned. Liquid nozzle 90 also discharges a relatively high pressure liquid jet 100 against the surface 17 of web 10 as it passes thereunderneath.

Because the macroscopic cross-section of forming structure 50 is considerably different than that of forming structure 15, the pressure and mass flux rates of nozzle 90 are preferably adjusted independently of the pressure and mass flux rates used for nozzle 35. Additional details as to the construction, positioning and operating pressure of liquid nozzle 90 may be found in the commonly assigned, co-pending U.S. patent application of John J. Curro, Alan J. Trusty and George M. Vernon, Ser. No. 580,911, filed Feb. 16, 1984 and entitled FORMED MATERIAL PRODUCED BY SOLID-STATE FORMATION WITH A HIGH-PRESSURE LIQUID STREAM, said patent application being incorporated herein by reference.

The macroscopic cross-section of forming structure 50 is visible in the greatly enlarged fragmentary perspective of FIG. 4. As is more readily apparent from the inset of FIG. 1C, the web of film 10 containing fine-scale apertures 11 is fed onto the exterior surface of forming structure 50 such that its surface 14 contacts the forming structure, while its surface 17 is oriented toward fluid nozzle 90. Accordingly, the small cusps 13 of the apertures 11 are oriented toward nozzle 90.

The effect produced by fluid nozzle 90 on the web of plastic film 10 as it passes thereunderneath is generally illustrated in the greatly enlarged cross-section shown in FIG. 1D. In particular, the web 10 has been caused to assume the macroscopic cross-section exhibited by the forming structure 50 without destroying the fine-scale apertures 11. As will be appreciated by those skilled in the art, characteristics inherent in the incoming web or characteristics introduced in earlier phases of the present multi-phase forming process are generally preserved whenever the latter phases of the forming operation are carried out while the web is in a solid rather than a molten state. As a result, the web exhibits a multiplicity of capillary networks 12, each having interconnected sidewalls 12a corresponding to the edges of apertures 56 in forming structure 50. The capillary networks 12 are also ruptured to form apertures 120 in the shape of the apertures 56 in the forming structure. As can be seen from the greatly enlarged fragmentary perspective of FIG. 4, the forming structure 50 exhibits a fiber-like cross-section of the type generally disclosed in commonly assigned U.S. Pat. No. 4,342,314 issued to Radel et al. on Aug. 3, 1982 and incorporated herein by reference. Accordingly, the macroscopically expanded, three-dimensional, apertured web 10 exhibits a similar cross-section.

After completion of the second forming phase the macroscopically expanded, three-dimensional, apertured polymeric web 10 is removed from forming structure 50 and wrapped about idler rolls 110 and 120 from whence it may be fed either to a rewinding station for temporary storage or directly to converting lines where it may be applied to making finished product structures, such as disposable absorbent bandages. In most instances the latter approach is particularly desirable, since it minimizes the loss of caliper which sometimes results when macroscopically expanded, three-dimensional, polymeric webs are rewound under tension.

As will be apparent from the greatly enlarged web cross-section shown in FIG. 1E, the fully processed plastic web of film 10 exhibits a macroscopic cross-section generally similar to that shown in the aforementioned commonly assigned U.S. Pat. No. 4,342,314 to Radel et al. However, web 10 additionally exhibits a fine-scale pattern of apertures 11. As can be observed in FIG. 1E, each of the fine-scale apertures 11 actually forms a small capillary network resembling a tiny volcano, the outermost edges of which end in silky feeling cusps 13. Because the entire surface of the web is subjected to fine scale aperturing on first forming structure 15 prior to undergoing macroscopic expansion and large scale aperturing on forming structure 50, these tiny apertures 11 are present both in the non-debossed land areas of the film as well as in the capillary sidewalls 12a of the capillary networks 12. Due to the tactile impression imparted to the web by cusps 13, web 10 is normally perceived as well suited for sustained contact with the skin. Furthermore, because of the great disparity in cross-sectional size between the capillary networks 12 and the small apertures 11, films of the type generally illustrated in FIG. 1E are also capable of exhibiting excellent fluid handling and skin dryness benefits, i.e., large volumes of fluid deposited on surface 17 are rapidly transferred to surface 14 of the web by virtue of the relatively large cross-section of capillary networks 12, while capillary driven skin drying benefits are provided via the small scale apertures 11 present in the non-debossed land areas which normally contact the wearer's skin in use. In addition, it is believed that the upward projections associated with the tiny apertures 11 act as a network of baffles during gush flow situations, i.e., the large quantities of liquid deposited on surface 17 are caused to flow in many different directions before reaching an edge of the absorbent structure, thereby increasing the probability that the liquid will enter one or more capillary networks 12 before reaching an edge of the absorbent structure. This, in turn, reduces leakage from the edges of the absorbent bandage.

FIG. 5 is a simplified illustration of an alternative multi-phase polymeric web forming process of the present invention. Like the process generally illustrated in FIG. 1, the process shown in FIG. 5 is carried out in two discrete phases. As can be seen from a comparison of FIGS. 5A and 5B to FIGS. 1B and 1C, respectively, the first phase of the process which provides the fine-scale apertures 11 in the web of film 10 is essentially identical. However, in the embodiment shown in FIG. 5, the film is fed directly onto a second forming structure 50, identical to the one shown in FIG. 1, without reverse wrapping of the film. Accordingly, surface 17 is placed in contact with forming structure 50, while surface 14 is placed so that it will be contacted by the liquid jet 100 issuing from fluid nozzle 90.

With the exception of reversing the position of stationary baffles 70 and 80 and reversing the direction of rotation of forming structure 50 about forming drum 58, the second phase of the process shown in FIG. 5 is substantially identical with that shown in FIG. 1. The cross-section which results after passage of the web of film under fluid nozzle 90 is generally shown at 10' in FIG. 5C. As with the embodiment of FIG. 1, the web of film 10' has been caused to assume the macroscopic, three-dimensional cross-section of forming structure 50 and has been apertured in those areas coinciding with apertures 56 in the forming structure. The capillary networks 12' thus formed are generally similar to the capillary networks 12 shown in web 10 of FIG. 1 with the exception that the cusps 13 of the small apertures 11 are oriented toward rather than away from the forming structure 50.

After passing beyond stationary baffle 80, the macroscopically expanded, three-dimensional, apertured web of film 10' is passed about idler roll 110 and fed either to suitable rewind apparatus for temporary storage or directly to a converting operation for incorporation into the final product in which the web is to be employed.

The final cross-section of the resultant web 10' is shown after removal from forming structure 50 in the greatly enlarged inset of FIG. 5D. While the web of film 10' offers many of the same performance attributes relative to fluid handling as the web of film 10 shown in FIG. 1E, it exhibits a different tactile response, particularly when one touches the non-debossed land areas of the web. This is because of the difference in orientation of the cusps 13 of the fine scale apertures 11 located substantially throughout the macroscopic cross-section of the web.

As will be appreciated by those skilled in the art, process embodiments of the present invention which utilize multiple forming structures offer considerable flexibility with respect to the types of characteristics which may be provided in a single, macroscopically expanded, three-dimensional, apertured plastic web. In addition, they permit the production of macroscopically expanded webs exhibiting a substantially uniform macroscopic cross-section not only across the non-debossed land areas of the web's cross-sectional profile, but also along the sidewalls of the capillary networks formed in the web as it undergoes macroscopic expansion.

Notwithstanding the advantages afforded by the use of multiple forming structures in carrying out the present multi-phase web forming process, there may be circumstances when it is particularly desirable to practice the present invention using only a single three-dimensional forming structure. These situations may involve the production of polymeric webs wherein it is desired to provide macroscopic expansion to form relatively large capillary networks in combination with fine-scale aperturing of the web only in the non-debossed land areas of the web, i.e., the sidewalls of the capillary networks would remain substantially imperforate. It may also in certain instances be desirable to provide macroscopic conformance of a plastic web to the three-dimensional cross-section of the forming structure with only fine-scale aperturing rather than large scale aperturing in the end walls of the capillary networks formed in the web. In still other situations, it may be desirable to provide fine scale aperturing in the end walls of the capillary networks in conjunction with fine scale aperturing in the non-debossed land areas of the web without fine-scale aperturing in the sidewalls of the capillary networks. The multi-phase process embodiments illustrated in FIGS. 6, 8, 9 and 10 are illustrative of multi-phase forming processes of the present invention which are carried out utilizing only a single forming structure containing not only the desired macroscopic cross-sectional profile, but also the desired fine-scale aperturing pattern.

FIG. 6 is a simplified schematic illustration of one such process of the present invention. The single three-dimensional forming structure 300 utilized on forming drum 318, which is generally similar to forming drums 18 and 58 of FIG. 1, is shown in the greatly enlarged, fragmentary perspective view of FIG. 7. The macroscopic cross-sectional profile of forming structure 300 is generally similar to that of forming structure 50 shown in FIG. 4. Macroscopic cross-section apertures 356 correspond generally to macroscopic cross-section apertures 56 of the forming structure 50 shown in FIG. 4. However forming structure 300 also includes a multiplicity of much smaller apertures 316 extending from the film contacting to the non-film contacting surface of the forming structure. These apertures 316 are of the same general size range as the apertures 16 in forming structure 15 shown in FIG. 2. If the forming structure 300 is made utilizing the laminar construction techniques generally disclosed in commonly assigned U.S. Pat. No. 4,508,256 issued to Radel and Thompson on Apr. 2, 1985 and incorporated herein by reference, these relatively small apertures 316 may be provided by etching each of the lamina utilized to make the composite forming structure 300 prior to final assembly. Alternatively, if the apertures 316 are extremely small in size, it may be desirable to form a laminate forming structure 50 in the manner generally disclosed in the aforementioned commonly assigned U.S. Patent to Radel et al. and thereafter utilize laser drilling techniques to add the desired pattern of small apertures 316 to form the structure 300. This avoids filling of the small apertures 316

by the copper plating used to bond the various laminae to one another during the furnace brazing operation, as generally taught in the aforementioned patent to Radel et al.

The multi-phase polymeric web forming process generally illustrated in FIG. 6 is particularly desirable in those circumstances where it is desired to provide a relatively large overall caliper in the resultant plastic web, as well as good replication of the macroscopic, three-dimensional cross-section of the forming structure. Deep drawing of the film is generally best carried out while the film is at an elevated temperature and subject to a sustained fluid pressure differential such as vacuum. In the embodiment disclosed in FIG. 6, this is preferably accomplished by mounting a conventional extruder 301, similar to extruder 101 in FIG. 1, such that a continuous web of thermoplastic resin 310, similar to web of resin 10 in FIG. 1A, is extruded at a temperature above the melt temperature directly onto the surface of forming structure 300. Since it is preferable to maintain the temperature of the web in an elevated condition to maximize conformance when using vacuum as the fluid pressure differential, no chill rolls are used on the FIG. 6 embodiment. It is of course recognized that the incoming web may also be fed from a supply roll similar to that shown in FIG. 1. However in the latter case it is generally preferred that the temperature of the incoming film be elevated sufficiently to soften it and make it more conformable. When using roll stock this is typically accomplished by applying hot air or steam to the film prior to subjecting it to vacuum forming.

In the embodiment shown in FIG. 6 the web of relatively soft resin 310 passes beneath a first stationary baffle 325 and is immediately subjected to a fluid pressure differential via vacuum chamber 320 located in fixed position at the interior of forming drum 318. If desired, hot air jets (not shown) may be mounted opposite vacuum chamber 320 to assist in causing the molten resin 310 to macroscopically conform to the cross-section of forming structure 300 and to rupture to form apertures substantially coinciding with the macroscopic cross-section apertures 306 in the forming structure 300.

In order to assist in cooling the soft web of resin while it is at maximum caliper a second stationary baffle 330 and a cooling liquid nozzle 335 are preferably used to apply a low-pressure, e.g., typically below about 50 psig, spray of cooling liquid 340 to the deeply drawn web 310 prior to its leaving the influence of vacuum chamber 320. The baffle 330 helps to prevent the cooling liquid 340 from reaching the vacuum forming zone, as this could adversely impact upon the macroscopic web conforming and aperturing operation. While this liquid cooling step is not generally critical at relatively low production speeds, i.e., speeds less than about 20 feet per minute, it has been found that as the web production speed, and hence the speed of the forming structure 300, increases, adequate cooling of the film may not occur before the film leaves the influence of the forming vacuum. This can result in spring-back and loss of caliper in the web along with possible closing of some of the macroscopic cross-section apertures formed in the web. Applying cooling liquid 340 while the web is still subject to the influence of the forming vacuum helps to more completely cool the film while it is still subject to the forming vacuum, thereby avoiding the spring-back, loss of caliper and reclosing of holes which may otherwise occur

More specific details of the aforementioned liquid assisted cooling process are generally disclosed in the commonly assigned copending U.S. patent application of Thomas J. Koger II, Theodore E. Farrington, Jr and Eugene Weinshenker entitled PROCESS FOR HIGH-SPEED PRODUCTION OF WEBS OF DEBOSSED AND PERFORATED THERMOPLASTIC FILM, Ser. No. 549,525 filed Nov. 4, 1983, issued on Nov. 12, 1985 as U.S. Pat. No. 4,552,709 and hereby incorporated herein by reference.

Following the liquid assisted cooling operation, the macroscopic cross-section of the web 310 is generally as shown in the greatly enlarged inset of FIG. 6A. The web 310 has been macroscopically conformed to the three-dimensional cross-section of forming structure 300 and capillary networks 312 corresponding to macroscopic cross-section apertures 306 in the forming structure have been formed. The sidewalls of the capillary networks 312a correspond to the sidewalls of the macroscopic cross-section apertures 306 in the forming structure 300, and the apertures 312b in the end walls of the capillary networks 312 correspond substantially in cross-section to the cross-section of the apertures 306 in forming structure 300.

As can be observed from FIG. 6A, the relatively small apertures 316 in forming structure 300 do not significantly impact upon the web 310 when the web is subjected to suction via vacuum chamber 320. This is due to the fact that once the web 310 has been apertured in those areas coinciding with macroscopic cross-section apertures 306, there is normally insufficient fluid pressure differential remaining on opposite sides of the web to cause conformance and aperturing of the web in those areas corresponding to the relatively fine-scale apertures 316 in forming structure 300.

Accordingly, the fine scale apertures corresponding to apertures 316 in forming structure 300 are preferably produced intermediate a pair of stationary baffles 370, 380 by means of a high pressure liquid nozzle 390 which discharges a liquid jet 400 against the exposed surface 314 of the web, as generally shown in FIG. 6. The high pressure liquid jet 400, which is substantially the same as the high pressure liquid jet 40 employed in the process embodiment shown in FIG. 1, causes the macroscopically expanded web 310 to conform and rupture in those areas corresponding to apertures 316 in the forming structure 300. As with the earlier described embodiments employing liquid as either a forming or a cooling assist media, a secondary fixed position vacuum chamber 385 located generally opposite the liquid nozzle 390 captures the liquid 400 which passes through both capillary networks 312 and fine scale apertures 311 in the plastic web 310 and recycles it to one or more pumps (not shown) prior to its return to the nozzle from which it issued. This high pressure liquid jetting operation not only completes the processing operation by providing fine scale aperturing of the web in its non-debossed land areas, but reinforces conformance of the web to the macroscopic cross-section of the forming structure and completely apertures any of the unapertured portions of the web corresponding to apertures 306 in the forming structure.

The cross-section of the finished web is shown in the greatly enlarged inset of FIG. 6C. The web 310 is somewhat similar to the web 30' shown in FIG. 5D. However there is one principal difference, namely, the sidewalls 312a of capillary networks 312 are substantially unapertured.

Following the fine scale aperturing operation, the completed web passes about idler roll 410 from whence it may be forwarded either to suitable rewinding apparatus for temporary storage or directly to converting operations for incorporation into products employing the plastic web thus produced.

In FIG. 8 there is shown still another embodiment of the present multi-phase web processing invention wherein a single forming structure is utilized to provide macroscopic expansion/macroscopic aperturing of a plastic web as well as fine scale aperturing of the non-debossed land areas of the web. In the embodiment shown in FIG. 8, a forming structure 300 identical to that employed in the process of FIG. 6 operates about forming drum 518, which is generally similar to forming drum 318. A pair of stationary vacuum chambers 520 and 585 are located adjacent one another at the interior of the forming drum. In the embodiment shown in FIG. 8, a web of plastic 310 is fed in a substantially planar condition from a supply roll 501 onto the surface of forming structure 300. Located intermediate a pair of stationary baffles 525, 580 is a liquid jet nozzle 590 which discharges a high pressure liquid jet 540 against the exposed surface of the web 310. As can be seen from the cross-section of FIG. 8A, the high pressure liquid jet 540 causes macroscopic conformance of the web, thereafter designated as 310' to avoid confusion with the web processed in accordance with the process shown in FIG. 6, as well as aperturing of those portions of the web coinciding with the macroscopic cross-section apertures 306 in forming structure 300. After this phase, the web 310' exhibits a multiplicity of capillary networks 312' each having interconnected, non-apertured side walls 312a' tending to form apertures 312b' corresponding to macroscopic cross-section apertures 306 in forming structure 300. Thus the web cross-section 310' shown in FIG. 8A is generally similar in shape to the web cross-section 310 shown in FIG. 6A. However, the overall length of capillary networks 312' is generally not as great as when vacuum forming is utilized, nor is the image of the forming structure 300 quite as sharp as when the high temperature vacuum forming approach generally illustrated in FIG. 6 is employed.

For purposes of macroscopically conforming substantially planar webs of the type herein described to the macroscopic, three-dimensional cross-section of a forming structure, the high pressure liquid jet nozzle, such as nozzle 90 in FIG. 1, nozzle 540 in FIG. 8 and nozzle 2890 in FIG. 17 is typically operated at a pressure in the range of about 400 psig to about 800 psig and a water flow rate in the range of about 8 gallons per minute to about 14 gallons per minute per cross-machine direction inch of width of the plastic web. By way of contrast, when the principal object is to provide fine scale aperturing of the web rather than macroscopic conformation, the high pressure liquid jet nozzle, such as nozzle 35 in FIG. 1, nozzle 390 in FIG. 6, nozzle 590 in FIG. 8, nozzle 790 in FIGS. 9 and 10, and nozzle 2935 in FIG. 17, is typically operated at a pressure in the range of about 900 psig to about 1,200 psig and water flow rates on the order of about 8 gallons to about 14 gallons per minute per cross-machine direction inch of web width.

As can be seen in FIG. 8, high pressure liquid jet nozzle 590 positioned between stationary baffles 570 and 580 discharges liquid jet 600 against the exposed surface 314' of the macroscopically expanded web 310' as it passes therebeneath. The effect of the high pressure liquid jet 600 upon the macroscopically expanded web 310' is substantially identical to that of high pressure liquid jet 400 shown in FIG. 6, i.e., fine scale apertures 311 are created in those areas coinciding with fine scale apertures 316 in forming structure 300. Small cusps 317 are formed on surface 317' of the web about the periphery of each of the fine scale apertures 311. Thus, with the possible exceptions of slightly less overall caliper and somewhat less accurate replication of the forming structure 300, the resultant web 310' shown in FIG. 8B is identical to web 310 shown in FIG. 6B. As with the embodiment of FIG. 6, water passing through the web from the liquid nozzles is collected in vacuum chambers 520 and 585 and is preferably recycled to one or more pumps which return the liquid to the nozzles from which it issued.

After passing beyond the influence of high pressure liquid jet 600, the resultant web 310' is removed from forming structure 300 about idler roll 610 in the condition generally illustrated in FIG. 8C and is thereafter rewound or fed directly to subsequent converting operations.

It is of course recognized that drying macroscopically expanded, three-dimensional, apertured polymeric webs of the present invention to remove moisture left on its surface by the water assisted cooling and/or jetting operations described herein may be desirable, particularly in the event it is intended to rewind the web for temporary storage prior to undertaking converting operations. This may be accomplished by many and varied web drying techniques well known in the art, e.g., blow drying with hot air, wrapping the web about a multiplicity of rolls which apply centrifugal forces to sling the water from the web, etc. A particularly preferred drying approach which subjects the moving web to ultrasonic vibration is disclosed in the aforementioned commonly assigned, co-pending U.S. patent application of Curro et al., Ser. No. 520,911, which is incorporated herein by reference.

FIG. 9 discloses still another embodiment of the present invention which utilizes only a single three-dimensional forming structure. The process shown in FIG. 9 employs a forming structure 300 generally similar to that shown in FIGS. 6 and 8. The forming structure 300 rotates about forming drum 718, generally similar to forming drum 318. Forming drum 718 includes a single, internally located, stationary vacuum chamber 720.

The forming structure 300 is preferably fed by means of an extruder 701 which supplies a web of molten resin 310 directly onto its surface. A first stationary baffle 725 is aligned substantially even with the leading edge of vacuum chamber 720. The relatively high temperature of the web of soft resin 310 aids the web in conforming to the macroscopic cross-section of forming structure 300 under the influence of suction from vacuum chamber 720 in a manner substantially identical to that disclosed in connection with the first phase of the process disclosed in FIG. 6. Thus the cross-section of web 310 upon aperturing of those portions of the web coinciding with apertures 306 in the forming structure is generally as shown in FIG. 9A, which is substantially identical to that of the web 310 shown in FIG. 6B.

In order to avoid spring-back of the web along with possible loss of caliper and closing of some of the apertures corresponding to apertures 306 in the forming structure, the web embodiment 310 shown in FIG. 9 is preferably cooled while still subject to the forming vacuum provided in chamber 720. Since it is generally

without regard to the presence of the gross foramina, constitute from 15 to 60% open area (as measured by projection of the topsheet onto a plane), the gross foramina can comprise from 5 to 25% open area of the topsheet without regard to the fine foramina. Stated in an alternate fashion, if the topsheet is provided with fine foramina of Equivalent Hydraulic Diameter within the ranges mentioned above, and if the fine foramina, independently of the presence to the gross foramina, constitute from 15 to 60% open area of the topsheet then the number of gross foramina per unit area (the gross foramina having dimensions falling within the ranges mentioned above) can be selected so that the gross foramina provide from 5 to 25% open area independently of the open area provided by the fine foramina so long as the ratio of numbers of gross foramina to fine foramina is less than about 1 to 4 (0.25).

The exact shape of the gross and fine foramina is not critical; circular foramina are satisfactory.

The state of the art respecting wetting of materials allows for the definition of hydrophobicity and hydrophilicity in terms of contact angles and the surface tensions of the fluids and solids involved. This is discussed in detail in the American Chemical Society Publication *Contact Angle, Wettability, and Adhesion* edited by Robert F. Gould and copyrighted in 1964.

A surface is said to be wetted by fluid either when the contact angle between the fluid and the surface is less than 90° or when the fluid will tend to spread spontaneously across the surface; both conditions normally coexist. In a similar vein, a surface is said to be not wetted by a fluid when the contact angle between the fluid and the surface is greater than 90° and when the fluid does not tend to spread spontaneously across the surface.

Since menses and other bodily fluids are primarily aqueous solutions, materials which are wetted by these fluids can broadly be described as hydrophilic, and surfaces which are not wetted by these fluids can be broadly described as hydrophobic. Unless otherwise indicated, as used in this specification the term "hydrophobic" describes materials and surfaces which are not wetted by the fluid in question while the term "hydrophilic" describes materials and surfaces which are wetted by the fluid in question.

Vaginal discharges normally have a surface tension of from 35 to 60 dynes per centimeter. They will have contact angles of greater than 90° and will not tend to spread spontaneously across a solid surface which has a critical surface tension or energy value lower than the fluid surface tension. As a first approximation, any solid which is not wetted by water (i.e. which is literally hydrophobic in the precise, limited meaning of the word) is also usually not wetted by vaginal discharges.

In absorbent devices of the present invention, apertured topsheets 11 is hydrophobic. The absorbent device is therefore provided with a wicking layer 12 affixed to the inner surface of apertured topsheet 11. The "inner surface" of apertured topsheet 11 is that surface of apertured topsheet 11 which is opposite body-contacting surface 21. In the normal construction, wicking layer 12 is interposed between apertured topsheet 11 and resilient layer 13 described infra and, in general, the balance of the absorbent device.

The purpose of the wicking layer is to induce fluids to flow through apertured topsheet 11 and away from body-contacting surface 21. Wicking layer 12 should be more hydrophilic (or conversely, less hydrophobic) than apertured topsheet 11.

Wicking layer 12 can be provided by any convenient means. For example, it can comprise a tissue paper sheet made according to the teachings of Sanford and Sisson in U.S. Patent 3,301,746 issued January 31, 1967 or according the to teachings of Morgan and Rich in U.S. Patent 3,994,771 issued November 30, 1976.

An especially suitable tissue is sold under the registered trademark BOUNTY by Procter & Gamble of Cincinnati, Ohio.

Preferably, wicking layer 12 comprises a multiplicity of individual fibers which are evenly dispersed over and affixed to the inner surface of apertured topsheet 11. These fibers can be of any suitable material so long as they are more hydrophilic than apertured topsheet 11. For example, fibers of polyester, rayon, nylon, and cotton can be used with good results. Wood pulp fibers are, however, preferred. Typically, at least 1.6 grams and preferably at least 3.1 grams, of fibers are uniformly distributed and adhesively affixed to the inner surface of apertured topsheet 11. An acrylic adhesive, such as that marketed under the trademark Rhoplex HA-8 by Rohm & Haas Company of Philadelphia can be used.

Wicking layer 12 is continuous in those regions of the inner surface of apertured topsheet 11 in register with fine foramina 31. Preferably, wicking layer 12 does not exist in those regions in register with gross foramina 32; the degree of preference increases as the absolute size of gross foramina 32 increases.

Figure 3 is an enlarged fragmentary plan view of a portion of an absorbent device 30 embodying the teachings of the present invention. A small fraction of the fine foramina 31 with which apertured topsheet 11 is provided are illustrated as circular apertures. Gross foramina 32 are also illustrated as circular apertures.

Figure 4 is an enlarged fragmentary cross sectional view taken along line 4—4 of Figure 3. Figures 3 and 4 illustrate the preferred embodiment wherein wicking layer 12 exists in register with a significant number of fine foramina 31 but does not exist in register with gross foramina 32. Thus, bodily discharges have an essentially uninterrupted passage from body-contacting surface 21 of apertured topsheet 12 to resilient element 13.

In Figure 2, wicking layer 12 is shown to be coextensive with apertured topsheet 11 throughout the structure of sanitary napkin 10. This form

of construction results from the convenience of providing apertured topsheet 11 and wicking layer 12 affixed one to another as a unit during the construction of sanitary napkin 10. Wicking layer 12 need be coextensive with apertured topsheet 11 only in those regions of apertured topsheet 11 which contact the user's body and which receive bodily discharges.

Another necessary element of the absorbent device of this invention is a resilient layer as indicated by reference numeral 13 in Figure 2.

The resilient layer serves several functions in the absorbent device. For example, it tends to isolate the apertured topsheet from bodily discharges which have already passed through the apertured topsheet into the absorbent device. Because of its physical characteristics, as described infra, the resilient layer enhances the comfort perceived by the user of the absorbent device. It also serves as a reservoir for bodily discharges although this function is of lesser importance because of the presence of the absorbent core described infra.

Resilient layer 13 must possess certain physical characteristics. It must be resilient. That is to say, it must, without the application of external forces, return to essentially its original size and shape after deforming forces (such as those applied by the body of the user) are removed. For the purposes of the present invention, the resilient layer possesses such resilience that it will recover at least 60% of its original volume after it is compressed to 20% of its original volume and the compressing forces are removed. Its resilience must be essentially unaffected by the presence of moisture such as the moisture in bodily discharges; that is to say, the resilient layer must be essentially moisture insensitive.

The resilient layer must be compressible and conformable. In other terms, it must possess such physical properties of compressibility and conformability that, when it is in contact with the user's body and subjected to forces applied by the user's body and clothing, it will conform to the user's body without causing a feeling of discomfort to the user.

Finally, the resilient layer must be at least as hydrophilic as the apertured topsheet.

Preferably, resilient layer 13 comprises a mass or batt of fibers. Synthetic fibers useful in the present invention include those made of cellulose acetate, polyvinyl chloride, polyvinylidene chloride, acrylic resins, polyvinyl acetates, non-soluble polyvinyl alcohols, polyethylenes, polypropylenes, polyamide, and preferably, polyesters. Preferred polyester fibers have a density of from 0.44 to 6.6 Tex and a length of from 2 to 8 centimeters. The resilience of the resilient element can frequently be enhanced if the fibers are bonded one to another at a significant number of their points of contact by adhesive or thermal bonding as well known to those skilled in the art.

In those circumstances where the inherent hydrophobicity of the resilient layer must be alleviated (as when it is constructed from a hydrophobic material), a degree of hydrophilicity can be imparted to the resilient layer by treating it with surfactant, such as a nonionic or an anionic surfactant. It can be sprayed with a surfactant or dipped into a solution of a surfactant. Suitable surfactants include nonionic surfactants such as Brij 76 manufactured by ICI Americas Inc. of Wilmington, Delaware and the various materials sold under the Pegosperse trademark by Glyco Chemicals, Inc. of Greenwich, Connecticut. Anionic surfactants can be used, but are not preferred.

Since bodily discharges will, in general, pass through, or at least be contained by, the resilient element, it must be of relatively low density so that it will have sufficient void volume to accomplish its intended purpose. Low density also helps to ensure that the resilient element deforms under the influence of the user's body thereby exhibiting comfort attributes. Preferably, the resilient element has a density of from 0.01 to 0.5 gram per cubic centimeter.

The second element of the absorbent device of the present invention is absorbent core 14.

Absorbent core 14 is, as its name implies, intended to absorb the bulk of the bodily fluids discharged by the user. Thus, the absorbent core must be constructed so as to readily absorb such fluids.

In general, the absorbent core comprises a material which is hydrophilic. This material can achieve hydrophilicity by any convenient means. For example, the material itself can be inherently hydrophilic. Alternatively, the material can be provided with a finish which renders its surfaces hydrophilic. Another method of rendering the material hydrophilic is to treat it with a surfactant, such as one of the nonionic surfactants mentioned above or an anionic surfactant, as by spraying the material with a surfactant or dipping the material into the surfactant.

A preferred material of construction for the absorbent core comprises airlaid wood pulp fibers. These fibers, sometimes known as comminution grade wood pulp fibers are fibers which have been liberated from the wood by any convenient means and dried, likewise by any convenient means. The resulting sheets of fibers are then comminuted to produce essentially intact individual fibers in a gaseous stream from which the fibers are then formed into an absorbent batt. Such absorbent batts are well known to those skilled in the sanitary napkin, diaper and bandage art. Absorbent cores formed from such batts, as well as those described infra, can be of greater thicknesses in the central regions of the absorbent device than at the ends or edges or both the ends and the edges of the device.

Alternatively, but less preferably, the absorbent core can be made from an absorbent foam material such as cellulose foam or polyurethane foam. The latter, for example, can be made according to the teachings of U.S. Patent 4,067,832 which issued to Dabi et al on January 10, 1978. Another particularly useful foam material is the polyester foam made according to

the teachings of U.S. Patent 4,110,276 which issued to [illegible] on August 29, 1978.

Cellulose wadding as sometimes used in disposable diapers can also be used to construct the absorbent core. The absorbent core can be constructed from layers of tissue paper such as that mentioned supra.

Another material from which the absorbent core can be constructed comprises an unbonded array of nonabsorbent hydrophilic, resilient, moisture insensitive fibers as described in U.S. Patent 4,475,911 which issued to Gellert on October 9, 1984.

Preferably, the absorbent core is made from airlaid wood fibers and has a density of from 0.063 to 0.60 gram per cubic centimeter.

Optionally, the absorbent core can contain auxiliary absorbent material which tends to increase its absorbent capacity. Suitable auxiliary absorbent materials include those discussed supra. The auxiliary absorbent materials can be in fibrous or particulate form, and they can be either uniformly distributed throughout the bulk of the absorbent core or they can be concentrated in localized regions thereof.

Another element of the present invention is a moisture barrier as illustrated by reference numeral 15 in Figure 2. The moisture barrier which is sometimes called a backsheet, serves to prevent bodily discharges contained within the absorbent device from passing completely through the absorbent device and soiling the user's body and clothing. Any of the materials commonly used for moisture barriers in the sanitary napkin and disposable diaper art can be used in the practice of this invention. Suitable materials include the well known fluid impermeable polyethylene films. The moisture barrier can also comprise the liquid impermeable, but vapor permeable materials sometimes known as breathable backsheets. Examples of such breathable backsheets are shown in U.S. Patent 3,881,489 issued to Hartwell on May 6, 1975, and U.S. Patent 3,989,867 issued to Sisson on November 2, 1976. Obenour, in U.S. Patent 4,341,216 issued July 27 1982, describes a two element breathable backsheet useful in disposable diapers which can be used in the practice of the present invention.

Ferguson and Landrigan U.S. Patent 4341217 describes a barrierless disposable absorbent article encased in a homogeneous outerwrap. The techniques described in that patent can be used to provide an equivalent of the moisture barrier just discussed.

In addition to a moisture barrier comprising a separate element, an equivalent result can be obtained by treating the undersurface of the absorbent core with a material, such as silicone or a wax, which will render a portion of the absorbent core liquid impermeable.

In Figure 2, moisture barrier 15 is illustrated as being completely encased within apertured topsheet 11 which then functions as an overwrap for sanitary napkin 10 and is sealed along end seals 19 by any convenient means such as adhesive sealing. This form of construction is illustrative only; those skilled in the art can readily supply alternate design details.

The invention has been described in terms of a sanitary napkin. It has been noted several times previously that these basic teachings can be readily applied by skilled artisans to other absorbent devices such as disposable diapers. Diaper designs suitable for use with the present invention include those described in U.S. Patent Re. 26,151 which was issued to Duncan and Baker on January 31, 1967 and U.S. Patent 3,860,003 which was issued to Buell on January 14, 1975.

By way of illustration and not by way of limitation, the following example is presented.

Example 1

A sanitary napkin having the planform illustrated in Figure 1 and the cross-sectional configuration illustrated in Figure 2 is constructed. The apertured topsheet is formed thermoplastic film having round gross foramina 2.35 mm in diameter and fine foramina 0.76 mm in diameter. There are 69 fine foramina for every gross foramen. The wicking layer comprises a single ply of BOUNTY tissue and is attached to the apertured topsheet with [illegible] HA-8 adhesive. The wicking layer is coextent in register with the gross foramina. The resilient element is a latex-bonded polyester nonwoven manufactured by Stearns & Foster Company of Cincinnati, Ohio. The fiber type is 1.67 Tex Kodel Type 420 made by E. I. Dupont de Nemours & Company; the latex binder is UCAR 876 made by Union Carbide Co. and is applied at 15% by weight of the fiber. The resilient layer is 11.4 mm thick and has a density of 0.01 gram per cubic cm; it is treated with Pegosperse 200 ML. The absorbent core consists of 3 grams airlaid comminution pulp as made by The Buckeye Cellulose Corporation of Memphis, Tenn. The moisture barrier is polyethylene film. The panty fastening adhesive is Century A-3651 B adhesive and is covered by SL20MG-A Silox 91-0 release liner.

The sanitary napkin, which is 21.5 cm long by 6.4 cm wide, performs effectively and is comfortable to wear.

Claims

1. A device (10) for absorbing bodily fluids comprising a fluid pervious cover forming a topsheet (11) having an inner surface and an outer body-contacting surface (21) having an impact zone (18), said fluid porous topsheet being provided with a large number of small apertures (31) and on the part of said topsheet forming said body-contacting surface, a smaller number of larger apertures (32), an absorbent layer (14) underlying said cover a fluid impervious layer (15) underlying said absorbent layer such that said absorbent layer is disposed between said fluid impervious layer and said body-contacting surface of said cover adhesive garment attachment means (16, 17) secured to the outer surface of said device on the surface thereof opposed to said body-contacting surface and an intermediate layer (13) disposed between said cover and said absorbent layer, characterised in that:

said topsheet (11) is an apertured, formed, thermoplastic film;

the small apertures (31) comprise fine foramina distributed over a major proportion of said body contacting surface, each of said fine foramina having an equivalent hydraulic diameter defined as 4A/P where A is the area and P the perimetric dimension of the foramen, of from 0.12 to 1.25 mm;

the large apertures (32) comprise gross foramina disposed in at least said impact zone (18) and each having an equivalent hydraulic diameter of from 1.25 to 8.5 mm; wherein

the ratio of the number of said gross foramina to said fine foramina is less than 0.25 and the ratio of the equivalent hydraulic diameters of said gross foramina to said fine foramina is greater than 2;

the intermediate layer (13) comprises a resilient layer of uniformly low density that is capable of recovery to at least 60% of its original volume after it is compressed to 20% of its original volume and the compressing forces are removed, said resilient layer being absorbent, at least as hydrophilic as said apertured topsheet, and unattached thereto; and

a wicking layer (12) disposed between said intermediate layer (13) and said topsheet (11), adjacent the inner surface of said topsheet, and being coextent in register with the gross foramina (32) thereof, said wicking layer (12) being more hydrophilic than said apertured topsheet (11).

2. A device according to claim 1 wherein the ratio of the equivalent hydraulic diameters of the gross (32) and fine (31) foramina is greater than 2.

3. A device according to either one of claims 1 and 2 wherein the equivalent hydraulic diameters of said fine foramina (31) are in the range from 0.25 to 0.80 mm.

Patentansprüche

1. Einrichtung (10) zum Absorbieren von Körperflüssigkeiten, umfassend eine eine Abdecklage (11) bildende, flüssigkeitsdurchlässige Abdeckung, wobei die Abdecklage eine Innenseite und eine mit dem Körper in Berührung kommende Außenseite (21) mit einer Auftreffzone (18) aufweist, und wobei diese flüssigkeitsdurchlässige Abdecklage mit einer großen Anzahl von kleinen Öffnungen (31) ausgestattet ist, und auf demjenigen Teil der Abdecklage, der die mit dem Körper in Berührung kommende Oberfläche bildet, mit einer kleineren Anzahl von größeren Öffnungen (32) ausgestattet ist; eine absorbierende Schicht 14, welche unterhalb der Abdeckung angeordnet ist; eine flüssigkeitsundurchlässige Schicht (15), welche unterhalb dieser absorbierenden Schicht angeordnet ist, so daß diese absorbierende Schicht zwischen der flüssigkeitsundurchlässigen Schicht und der mit dem Körper in Berührung kommenden Oberfläche der Abdeckung angeordnet ist; Befestigungsmittel (16, 17) zum Anbringen der Einrichtung an einem Wäschestück, welche Befestigungsmittel an der Außenseite der Einrichtung, und zwar auf derjenigen Oberfläche derselben, welche zu der mit dem Körper in Berührung kommenden Oberfläche entgegengesetzt angeordnet ist, befestigt sind, und eine Zwischenschicht (13), welche zwischen der Abdeckung und der absorbierenden Schicht angeordnet ist; dadurch gekennzeichnet, daß:

die Abdecklage (11) ein gelochter, geformter thermoplastischer Film ist;

die kleinen Öffnungen (31) Feinöffnungen umfassen, welche über einen Hauptanteil der mit dem Körper in Berührung kommenden Oberfläche verteilt sind, wobei jede dieser Feinöffnungen einen äquivalenten hydraulischen Durchmesser von 0,12 bis 1,25 mm aufweist, und wobei der äquivalente hydraulische Durchmesser als 4A/P definiert ist, worin A die Fläche und P die Umfangserstreckung der Öffnung ist;

die großen Öffnungen (32) Groböffnungen umfassen, welche wenigstens in der Auftreffzone (18) angeordnet sind, wobei jede dieser Groböffnungen einen äquivalenten hydraulischen Durchmesser von 1,25 bis 8,5 mm aufweist; und wobei das Verhältnis von der Anzahl der Groböffnungen zu der Anzahl der Feinöffnungen weniger als 0,25 beträgt, und wobei das Verhältnis der äquivalenten hydraulischen Durchmesser der Groböffnungen zu demjenigen der Feinöffnungen größer als 2 ist;

die Zwischenschicht (13) eine elastische Schicht von gleichförmig niedriger Dichte umfaßt, welche elastische Schicht befähigt ist, auf wenigstens 60% ihres ursprünglichen Volumens zurückzufedern, nachdem sie auf 20% ihres ursprünglichen Volumens komprimiert worden ist und die komprimierenden Kräfte entfernt worden sind, wobei diese elastische Schicht absorbierend, wenigstens so hydrophil wie die gelochte Abdecklage, und an der letztgenannten nicht befestigt ist; und

eine dochtartig aufsaugende Schicht (12) zwischen der Zwischenschicht (13) und der Abdecklage (11), neben der Innenseite der Abdecklage, angeordnet, nicht vorstehend und deckungsgleich mit den Groböffnungen (32) der Abdecklage ist, wobei diese dochtartig aufsaugende Schicht (12) stärker hydrophil als die gelochte Abdecklage (11) ist.

2. Einrichtung nach Anspruch 1, worin das Verhältnis der äquivalenten hydraulischen Durchmesser der Groböffnungen (32) zu demjenigen der Feinöffnungen (31) größer als 3 ist.

3. Einrichtung nach Anspruch 1 oder 2, worin die äquivalenten hydraulischen Durchmesser der Feinöffnungen (31) in den Bereich von 0,25 bis 0,80 mm fallen.

Revendications

1. Dispositif (10) pour absorber les fluides corporels, comprenant une couverture perméable

aux fluides formant une feuille de dessus (11) ayant une surface interne et une surface externe (21) en contact avec le corps comportant une zone d'impact (18), ladite feuille de dessus poreuse aux fluides étant munie d'un grand nombre de petites ouvertures (31) et, sur la partie de ladite feuille de dessus formant la surface en contact avec le corps, d'un petit nombre d'ouvertures plus grosses (32), une couche absorbante (14) située au-dessous de la couverture, une couche (15) imperméable aux fluides située au-dessous de la couche absorbante de telle manière que la couche absorbante soit disposée entre la couche imperméable aux fluides et la surface en contact avec le corps de la couverture, des moyens adhésifs (16, 17) de fixation aux vêtements attachés à la surface externe du dispositif sur sa surface opposée à la surface en contact avec le corps et une couche intermédiaire (12) disposée entre la couverture et la couche absorbante, caractérisé en ce que:

la feuille de dessus (11) est un film thermoplastique formé ajouré;

les petites ouvertures (31) comprennent des trous fins répartis sur une majeure partie de la surface en contact avec le corps, chacun de ces trous fins ayant un diamètre hydraulique équivalent, défini comme étant 4A/P, où A est la surface et P le périmètre du trou, de 0,12 à 1,25 mm;

les grosses ouvertures (32) comprennent de gros trous disposés au moins dans la zone d'impact (18) et ayant chacun un diamètre hydraulique équivalent de 1,25 à 5,5 mm,

le rapport du nombre des gros trous au nombre des trous fins étant inférieur à 0,25 et le rapport des diamètres hydrauliques équivalents des gros trous à ceux des trous fins étant supérieur à 2;

la couche intermédiaire (12) comprend une couche élastique de densité uniformément faible qui est capable de recouvrer au moins 80% de son volume initial après avoir été comprimée à 30% de son volume initial et après la suppression des forces de compression, cette couche élastique étant absorbante, au moins aussi hydrophile que la feuille de dessus ajourée, et non attachée à celle-ci; et

une couche à effet de mèche (13) disposée entre la couche intermédiaire (12) et la feuille de dessus (11), adjacente à la surface interne de la feuille de dessus et n'étant pas en coïncidence avec les grosses ouvertures (32) de celle-ci, cette couche à effet de mèche (12) étant plus hydrophile que la feuille de dessus ajourée (11).

2. Dispositif selon la revendication 1 dans lequel le rapport des diamètres hydrauliques équivalents des gros trous (32) et des trous fins (31) est supérieur à 3.

3. Dispositif selon l'une quelconque des revendications 1 et 2, dans lequel les diamètres hydrauliques équivalents des trous fins (31) sont dans l'intervalle de 0,25 à 0,60 mm.

Fig.1

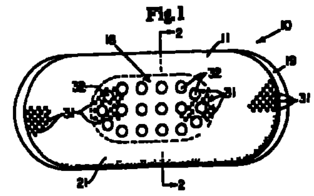


Fig.2

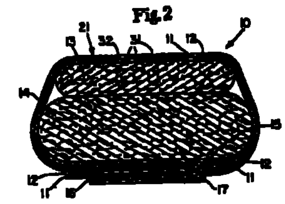


Fig.3

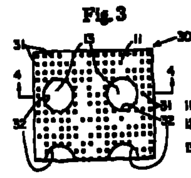
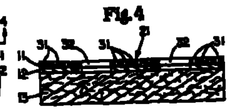


Fig.4



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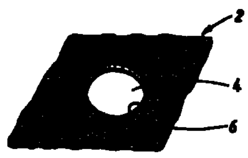
(54) Title: AN APERTURED COVERING SHEET FOR AN ABSORBENT ARTICLE AND A METHOD OF PRODUCING THE COVERING SHEET

(57) Abstract

The invention relates to a liquid permeable covering sheet (2) of an absorbent article such as a diaper (401), an incontinence protector (301), a sanitary napkin (201), etc., which comprises an apertured textile material. Characterizing for the invention is that the covering sheet (2) has a plurality of holes (4), each of which is surrounded by an essentially liquid-tight edge (6). The invention further comprises an absorbent article with a covering sheet (202, 402, 302) according to the invention. A method of making the covering sheet by [illegible] material comprising at least one thermoplastic component is also covered by the invention.



AN APERTURED COVERING SHEET FOR AN ABSORBENT ARTICLE AND A METHOD OF PRODUCING THE COVERING SHEET

Technical field

The present invention refers to a liquid permeable covering sheet for an absorbent article, such as a diaper, an incontinence protector, a sanitary napkin or the like, which comprises an apertured textile material. The invention also refers to an absorbent article provided with the covering sheet, and a method of producing the covering sheet.

Background of the invention

For liquid permeable covering layers for absorbent articles of this kind, which during use are intended to be in contact with the body of the user, there are high demands for softness as well as dryness.

It has, however, proven difficult to achieve a liquid permeable covering layer with a soft and textile-like surface which remains dry even after repeated wetting, when the covering layer is used on an absorbent article.

The use of non-woven fibrous fabrics, so-called non-woven materials, for creating a soft and smooth surface on an absorbent article has been known for a long time. Providing the non-woven material with apertures in order to more rapidly transfer liquid through the surface material down to an underlying absorbent material layer, is also known. When making the apertures, openings are created in the material, which are larger than the space between the fibres in the non-woven material.

One such apertured non-woven material is previously known from EP 235 309. The apertured non-woven material consists of a spunlace material with a high content of hydrophobic

fibres. In a spunlace process, holes are made in a fibrous material by treating the material with water jets which are sprayed against the material at very high pressure. The spunlace material constitutes one of two layers in a surface material laminate and is intended to be the layer which, during use, is closest to the user. The purpose is that the liquid will be guided through the holes in the spunlace material down to the underlying layer. The spunlace material has a higher content of hydrophobic fibres than the underlying material layer in the surface laminate. The fibres of the uppermost spunlace layer consist of 70% hydrophobic fibres and 30% hydrophilic fibres, while the underlying material layer consists of equal amounts of hydrophobic and hydrophilic fibres. Thus, the underlying layer thus has the ability to drain liquid from the upper layer.

However, a problem with the material described in EP 235,309 is that holes which are formed by water jets become irregular both in size and shape, and have fibres which protrude from the edges of the holes around and in the holes. These protruding fibres decrease the area of the holes, and also, due to capillary effects, wick liquid into the material between the holes. The protruding fibre ends and the irregular size and shape of the holes significantly increase the risk of liquid remaining in the layer after wetting. Since a very small amount of liquid is sufficient for the surface material to be perceived as wet, this is of course a significant disadvantage of the known surface material.

A similar surface material is described in EP 272,683. This publication also concerns an apertured covering layer of non-woven material. In the vicinity of the holes, which have been formed by perforating the non-woven material there are relatively loose fibres which are intended to

function as transport canals for the liquid down to an underlying non-woven layer of the so called meltblown type As long as the fibres of the perforated layer are arranged in such a way that they lead the liquid towards the underlying layer, the described surface material works It is, however, a well known fact that a non-woven material consists of irregularly formed fibres which are difficult to arrange in any particular direction This means that fibre capillaries which are intended to transport liquid to the underlying layer will also spread liquid in a horizontal direction across the surface of the non-woven material For this reason, some of the liquid will remain in the surface material after wetting, and the user of an article provided with the surface material will experience the surface of the article as being wet and unpleasant against the skin

A further problem with the above described non-woven materials is that it is difficult to achieve a particular, well defined, hole size It is, for instance from EP 409, 535 well known that the dimension of the holes in a perforated material is crucial in order to achieve optimal permeability for the liquid For non-woven materials having some areas with a dense fibre structure and other areas with a sparse fibre structure, this means that it is difficult to obtain a uniform hole size This is due to the fact that the holes in the dense fibre areas become smaller, since they are surrounded by more fibres

Further, the perforated non-woven materials in previously known surface materials further have a relatively low tensile strength, since the described hole-making process weakens the material Since it is important that the strength of the material is such that there is no risk that it will break, either during the hole-making process, during the manufacturing of the absorbent article, or

during use of the finished absorbent article, evidently the weakening of the known materials is a problem

In EP 214,608 holes are made in a non-woven material using warm needles which heat the non-woven material to a temperature which is slightly below the melting point of the material The holes which are thus made in the material are surrounded by an edge which has a densified fibre structure With a material with holes made in this way, the above mentioned problems with varying hole sizes and weakening of the material have been solved to a certain extent However, the problem of avoiding liquid being spread out in the non-woven material and remaining in its fibre structure still remains The denser fibre structure surrounding the holes is intended to absorb liquid thereby wicking the liquid further through the holes in to an underlying material layer There is, however, a risk that some liquid will remain in the denser hydrophilic fibre structure around the holes Liquid can also spread horisontally in the plane of the non-woven material via the fibre capillaries in the non-woven material Since the non-woven material during use is in direct contact with the skin of the user, this is of course extremely undesireable

Summary of the invention

The problem of achieving a liquid permeable surface layer for absorbent articles, which surface layer is soft and comfortable against the skin, but still has a high surface dryness, has essentially been solved with the present invention

By means of the invention an apertured covering layer of non-woven material has thus been achieved which significantly reduces the risk of wetting of the skin of the user during use

An apertured covering layer of non-woven material according to the invention is characterised primarily in that the textile material has a plurality of holes, each hole being surrounded by an essentially liquid-tight edge

In this context, the term textile material refers to a material in layer form, which has been manufactured from natural or synthetic textile fibres, such as for example cotton, rayon, polypropylene, polyester, polyethylene, bi-component fibres, etc

According to a preferred embodiment, the covering material surrounding the holes comprises a thermoplastic material which has been melted, and thus forms the liquid-tight edge

The holes can be made using warm needles, in which case the liquid-tight edges around the holes are made simultaneously with the holes

In an alternative embodiment, the holes in the covering layer have instead been made ultrasonically

Since the holes are surrounded by a melted edge which is liquid-tight and free from protruding fibres, a well defined hole size can be obtained The optimal hole size varies with the use of the surface layer For example menstrual fluid and urine have completely different surface energies and different rheological qualities, which means that the design of the surface layer must be adapted accordingly However, in a covering material according to the invention, the form and size of the holes deviate minimally from the intended optimal form and size which is determined with regard to the intended use of the covering material In accordance with the invention, it is therefore possible to create high performance covering materials with

a high degree of accuracy and repeatability for a number of different absorption applications

A non-woven material of the spunbond type has proven to perform especially well as surface material according to the invention The term spunbond refers to a thermobonded material of endless, randomised fibres It is, however, possible to use other types of non-woven materials Other types of non-woven materials which are not as strong, for example carded materials, which have a lesser strength in the transverse direction of the material than in its longitudinal direction may however also be used, since the continuous edge around the holes provides the material with increased tensile strength It is thus possible, according to the invention, to use carded non-woven materials, meltblown materials, etc A meltblown material is a non-woven material which has been formed by blowing an extruded melted plastic against a surface Furthermore, different woven, knitted, crocheted or plaited textile materials can be used in accordance with the invention

According to one embodiment of the invention the covering layer has holes of varying size The holes can be evenly distributed over the surface of the covering layer, or be more closely spaced in certain areas

According to another embodiment of the invention, the covering layer comprises at least two layers of material

In such an application a first layer of material is preferably more hydrophilic than a second layer of material in the covering layer It can furthermore be advantageous if the liquid-tight edge around the holes in the covering layer is provided only in the first layer of material

According to yet another embodiment, the covering layer can be laminated to an unperforated liquid transfer layer, which, when the covering layer is attached to an absorbent article, serves as liquid transferring means between the covering layer and the absorption body of the article

The invention also includes an absorbent article, such as for example a sanitary napkin, a diaper, an incontinence protector etc, which comprises an absorption body enclosed in a cover, where at least a section of the cover consists of a liquid permeable covering layer of a textile apertured material The article according to the invention is mainly characterised by having a plurality of apertures in the apertured covering layer, each aperture being surrounded by a liquid impermeable edge

In one embodiment the article has two end-portions and a crotch-portion positioned between the end-portions wherein the liquid permeable covering layer is provided with holes arranged in the crotch-portion which have a larger surface than holes made in the covering layer at either of the end-portions

In another embodiment, the article has two longitudinal side edges, where end side areas along each side edge is provided with holes which have a smaller dimension and/or are more sparsely arranged than holes arranged inside the edge areas in the crotch-portion of the article

Furthermore, the invention comprises a method of forming an apertured textile covering layer wherein heated needles are arranged to penetrate a textile material layer comprising at least one thermoplastic component, during which procedure the temperature of the needles exceeds the melting temperature of the thermoplastic component The main characteristic of this method is that the

thermoplastic component comprises at least 95 weight% of the material in the textile material layer, and in that the heated needles are arranged to melt the thermoplastic component in the immediate vicinity of the needles, after which the needles are removed and the melted material is solidified to form an essentially liquid impermeable edge around each of the holes made

A covering material according to the invention obtains an increased tensile strength in the apertured textile material Thus, the starting material for the production of the apertured covering material can be chosen more freely than has been possible with earlier known perforated non-woven materials

The liquid-proof edges around the holes also imply that liquid can not spread horizontally from the holes through fibre capillaries in the non-woven material When the covering material is attached to an absorbent body, the liquid will instead pass through the holes and can be absorbed by the absorption body of the article

Brief description of the drawings

The invention will be described in the following in further detail with reference to the embodiments shown in the attached drawings

Fig 1 shows an apertured non-woven material with melted edges around the holes

Fig 2 shows a sanitary napkin with a liquid permeable covering layer according to the invention, seen from that side which during use is intended to face the user

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thermoplastic component comprises at least 55 weight% of the material in the textile material layer, and in that the heated needles are arranged to melt the thermoplastic component in the immediate vicinity of the needles, after which the needles are removed and the melted material is solidified to form an essentially liquid impermeable edge around each of the holes made

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Fig 2 shows a sanitary napkin with a liquid permeable covering layer according to the invention, seen from that side which during use is intended to face the user

Fig 3 shows a cross-section through the sanitary napkin of Fig 2

Fig 4 shows a diaper with a liquid permeable covering layer according to the invention, seen from that side which during use is intended to face the user

Fig 5 shows an incontinence diaper with a liquid permeable covering layer according to the invention, seen from that side which during use is intended to face the user

The liquid permeable covering sheet 2, shown in Fig 1, consists of one or several layers, which together form the covering sheet 2 The different layers in the covering sheet 2 can be non-woven materials of different types or composition It is, however, also possible to use one or several layers of plastic film, net material, woven or knitted textile material etc If the covering sheet 2 consists of more than one layer, it is however essential to the invention that at least that layer which is intended to face the user during use of the covering sheet 2 as a liquid permeable surface sheet of an absorbent article, consists of a textile material

Examples of possible textile materials are woven or knitted fabrics, and so-called non-woven materials, i e non-woven fibrous fabrics In the following, the covering sheet 2 will for reasons of simplicity be described as though it consists of only one layer of textile nature It should however be understood in connection with all the described embodiments that the covering sheet 2 may consist of more than one layer of material

The textile material provides the covering sheet 2 with a soft and pleasant surface, which is not abrasive or otherwise irritating for the skin The textile material comprises at least one thermoplastic component, which can be in the form of whole fibres, or as one component in a so-called bi-component fibre Thermoplastic materials suitable for the purpose are polyethylene, polypropylene or polyester The thermoplastic component constitutes at least 55 weight% of the textile material, at least in the area which is perforated in accordance with the invention Preferably the thermoplastic component constitutes at least 70 weight% of the textile material It is, furthermore, possible to use textile materials which consist solely of a thermoplastic material

The covering sheet 2 further has a plurality of through-going holes 4, which have been made by penetrating the sheet 2 with heated needles During this procedure, the temperature of the needles has been such that it has exceeded the melting temperature of the thermoplastic component in the textile material The amount of material which melts during penetration of the covering layer is high enough to provide the finished material with an essentially liquid impermeable edge 6 around the hole The liquid-tight edge 6 increases the tensile strength of the covering layer and prevents liquid from spreading from the edge 6 of the hole, across the surface of the covering layer 2 This liquid barrier effect is due to the fact that there are no free fibre ends around the holes which might capture the liquid and, by capillary action, wick it in the wrong direction, away from the hole 4

Since the material around the holes 4 is melted in at least a first layer of the covering sheet 2, this implies that the edges 6 of the holes, inside the holes, are comparatively smooth, at least through a part of the

thickness of the material in the covering sheet 2 For this reason, the edges 6 of the holes have considerably less restricting influence on a flow of liquid through the covering sheet 2 than is the case with earlier known covering layers of perforated non-woven materials Passage of liquid through the covering sheet 2 according to the invention can thus take place rapidly and relatively unhindered

The sanitary napkin 201 of Figs 2 and 3 comprises a first liquid permeable covering sheet 202 according to the invention, a liquid impermeable covering sheet 203, and an absorption body 205 enclosed between the covering sheets 202,203 The liquid impermeable covering sheet 203 may consist of a liquid-tight plastic film, a non-woven layer which has been coated with a liquid impermeable material, or some other flexible material layer which is resistant to penetration of liquid It is generally an advantage if the liquid impermeable covering sheet 203 has a certain degree of breathability, i e it allows passage of water vapour The two covering sheets 202,203 have a somewhat larger extension in the plane than the absorption body 205, and extend somewhat outside the edges of the absorption body 205, around its entire circumference The surface sheets 202,203 are connected within the protruding parts 207, for example by glueing, or welding with heat or ultrasonically

The absorption body 205 usually consists of one or several layers of cellulose fibres, for example fluffed cellulose pulp An example of an absorbent structure suitable for this purpose is described in WO 94/10956, which publication describes an absorbent material, which is cut from a travelling material web, without previous defibering and mat forming The material increases the surface dryness of the finished absorbent article, which is an advantage

particularly when the liquid permeable covering layer 202 has a textile material layer closest to the user

The absorption body 205 may, in addition to cellulose fibres, also contain super absorbent materials, i e materials in the form of fibres, particles, granulates, film etc, which have the ability to absorb liquid corresponding to several times the weight of the super absorbent material The super absorbent material binds the absorbed fluid and in doing so, forms an aqueous gel Furthermore, the absorption body 205 may comprise binding agents, shape stabilizing components, etc Further absorbtion layers, which improve the absorption characteristics, may also be used, for example different kinds of liquid wicking inserts or layers of material The absorption body 205 may be chemically or mechanically treated in order to alter the absorption characteristics It is, for example, common to provide an absorption layer with compressed portions in order to direct the flow of liquid in the absorbtion body 205 Furthermore, other types of absorbing materials may be used, on their own, or in combination with cellulose fibres and super absorbent materials Examples of possible absorbing materials are absorbing non-woven material, foam, etc

On the outside of the liquid impermeable covering sheet 203, there is arranged an attachment element in the form of two areas 212 of self adhesive glue Before use, the glue areas 212 are suitably covered with releasable protective layers of paper which have been treated with a release agent, or plastic film The protective layers are not shown in the drawings A number of other glue patterns than those shown are of course conceivable as well as other kinds of attachment elements, such as for example Velcro fasteners, press buttons, girdles, special underwear, etc A sanitary napkin of the kind shown in Figs 2 and 3, will during use

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be attached to the inside of a pair of regular underwear In this application, the attachment element holds the sanitary napkin in place in the underwear during use The attachment element should of course be of a kind that will permit the sanitary napkin to be removed from the underwear without causing damage to the underwear

The sanitary napkin 201 is hour-glass shaped with wider end-portions 214,216 and a narrower crotch-portion 218 between the end-portions 214,216 The crotch-portion 218 is that part of the sanitary napkin which, during use, is intended to be positioned in the crotch of the user and serve as a receiving surface for body liquid which is secreted to the sanitary napkin Furthermore, the sanitary napkin has two transverse end edges 220,222 and two longitudinal side edges 224,226 which extend between the end edges 220,222

The sanitary napkin 201 is further provided with fastening flaps 228,230, which are formed by the two covering sheets 202,203, and which protrude from the side edges 224,226 of the sanitary napkin 201 at the crotch-section 218 During use of the sanitary napkin, the fastening flaps 228,230 are intended to be folded around the leg edges of the underwear of the user and to be attached to the outside of the underwear For this purpose, the fastening flaps 228,230 are provided with special attachment elements 232 which may be chosen in the same way as the attachment element 212 of the liquid impermeable covering sheet 203

The liquid permeable covering sheet 202 consists of a first layer of material 208 and a second layer 209 of material The first layer of material has a plurality of penetrating holes 204 The holes are arranged longitudinally on the sanitary napkin 201, in a band-shaped area which extends between the end edges 220,222, and has a width

corresponding to the width of the absorbtion body 205 in the crotch-portion 218 of the sanitary napkin

The first layer 208 of material is a textile material which, during use of the sanitary napkin, is intended to be in contact with the body of the user The textile material may consist of a woven or knitted fabric, but is preferably a non-woven material of the spunbond type The layer 208 of material consists at least in part of a material which is heat meltable During the making of the holes 204 in the layer 208 of material, the heat meltable material has been melted in the area immediately adjacent to each hole 204 When the melted material has solidified after the hole making process, it forms a continuous, essentially liquid-tight edge 206 around the entire circumference of the hole 204 As mentioned previously, the continuous edge 206 increases the tensile strength of the covering material 202 Furthermore, the edge 206 prevents liquid from spreading from the holes 204 into the covering sheet 202 Instead, body fluid which strikes the sanitary napkin 201 will pass down through the covering layer 202 to the absorption body 205, which is positioned inside of the covering sheet

The second layer 209 of material of the liquid permeable covering sheet 202 is arranged inside the first layer 208 of material The second layer 209 of material is thus positioned between the first layer 208 of material and the absorption body 205 of the sanitary napkin The second layer 209 of material consists of a material which is more hydrophilic than the first layer 208 of material, whereby transport of fluid between the two layers 208 209 of material takes place in the direction towards the absorption body 205 of the sanitary napkin Examples of suitable materials are different types of non-woven

materials, air laid or wet laid cellulose layers, different kinds of wadding, foam materials, etc

In order to facilitate transfer of fluid between the fluid permeable covering layer 202 and the absorption body 205, the second layer 209 of material is suitably in direct contact with the absorption body 205 Preferably the layer of material is connected to the absorption body by means of glueing, welding, needling, etc

Fig 3 shows the second layer 209 of material as a separate layer, with the same width as the absorbing body 205 The two layers of material 208,209 in the covering sheet 202 are preferably connected to each other, for example by glueing, ultrasonically, or by needling If the layers 208,209 of material are connected by means of needling, this is preferably done concurrently with the making of the holes 204 in the first layer 208 of material

Although the second layer 209 of material has been shown as a separate layer, with a smaller extension across the sanitary napkin than the first layer 208 of material, it is of course possible to instead make the liquid permeable covering sheet 202 out of two or more layers of material with equal extensions Such covering sheets may be formed by means of laminating the layers in question, or may consist of a single layer of material with an integrated layer structure

It may be advantageous to make the liquid permeable covering sheet 202 with holes 204 of different sizes in different areas of the sanitary napkin, or with a different number of holes in different areas For example, it is advantageous if the holes 204 in the area of the sanitary napkin 201, which will first be wet by excreted body fluid, are relatively large In this way, a large quantity of

fluid can be absorbed into the sanitary napkin in a short time The covering sheet 202 further has the ability to let in high-viscosity components and protein particles which appear in menstrual fluid For reasons of simplicity it is generally assumed that the part of the sanitary napkin which will initially be wetted is somewhere within the crotch-portion 218 of the sanitary napkin Since large holes have a reduced ability to mask, or at least decrease the visual impression of the menstrual fluid which has been absorbed by the sanitary napkin, it is, however, desirable to limit the area with large holes 204 as much as possible For this reason and since only a minor quantity of fluid is expected to pass into the sanitary napkin at the end-portions 214,216, the covering sheet 202 within these portions 214,216 suitably has holes 204 of a smaller dimension than at the crotch-portion 218 It is further more suitable if the holes 204 which are arranged along the side edges 224,226 of the sanitary napkins are fewer and/or have a smaller area than the centrally arranged holes 204 This reduces the risk that body fluid which has been absorbed by the sanitary napkin in the case of saturation of the absorption material will come out through the holes at the side edges 224,226

The diaper 401 of Fig 4 has essentially the same principal construction as the sanitary napkin of Figs 2 and 3 Thus, the diaper 401 has an absorption body 405 enclosed between two covering sheets 402,403

The absorption body 405 may be of any conventional kind Examples of frequently used absorption materials are fluffed cellulose pulp, tissue layers, high absorbing polymers, absorbing foam materials, absorbing non-woven materials etc Mixtures of materials, and absorption bodies constructed of layers of materials of different kinds and

with different properties and different shapes are also possible

The diaper 401 furthermore has two longitudinal side edges 424,426, a forward end edge 420 and a rear end edge 422 and has a front portion 414, a rear portion 416 and a thinner crotch-portion 418 between the front portion 414 and the rear portion 416

Furthermore, elastic elements 434,436 are arranged along the side edges 424,426 of the crotch-portion 418 of the diaper During use of the diaper, the elastic elements 434,436, serve to keep the diaper in sealing contact around the legs of the user A further elastic element 438 is arranged along the rear end edge 422 and is intended to give the diaper 401 a certain elasticity and to serve as a sealing means for the diaper around the waist of the user

A tape tab 440,442 is attached to each side edge 424,426, close to the rear end edge 422 The tape tabs 440,442 constitute closing means for the diaper 401, to allow the diaper to be closed so that it will enclose the lower portion of a users torso, in a manner similar to pants The tape tabs 440,442 co-operate with a receiving area 444 on the liquid impermeable covering sheet 403 of the diaper 401 at the forward section 414 The receiving area 444 can, for example, be in the form of a reinforcing material, which has been laminated to the liquid impermeable covering sheet 403 Thanks to the reinforcement, the diaper 401 may be closed and reopened without ruining the adhesion of the tape tabs 440,442 or ripping the liquid impermeable covering sheet 403

Of course, many other types of closure means may be used instead of the described tape tabs 440,442 Examples of

alternative closure means are Velcro fasteners press studs, ribbons for tying etc

As with the above described sanitary napkin, the liquid permeable covering sheet 402 comprises a perforated textile material according to the invention The covering sheet 402 is, however, only perforated within a rectangular area centrally arranged on the diaper

Fig 5 shows an incontinence protector 501 which has a liquid permeable covering sheet 502 and a liquid impermeable covering sheet 503, which together enclose an absorption body 505

Similar to the sanitary napkin 201 of Figs 2 and 3, the incontinence protector 501 is hourglass-shaped, with wider end-portions 514,516, and a thinner crotch-portion 518 The incontinence protector is limited in the plane by inwardly curved side edges 524,526, and outwardly curved end edges 520, 522

The incontinence protector 501 is intended, during use, to be worn inside a pair of regular underwear In order to fasten the incontinence protector inside the underwear, it is provided with a longitudinal rectangular area 512 of self-adhesive glue, arranged on the liquid impermeable covering sheet 503

The liquid permeable covering sheet 502 is a covering sheet according to the invention, and thus has a plurality of penetrating holes 504, each hole being surrounded by a continuous liquid-tight edge The holes 504 are distributed across the entire surface of the incontinence protector, but with a greater density within the crotch-section 518 of the incontinence protector than at the end-sections 514,516 In this manner, the incontinence

protector has a higher liquid permeability within that part which is intended to receive the majority of the body fluid which is secreted to the incontinence protector

The invention is not limited to the above described embodiments, a number of further variations and modifications are possible within the scope of the appended patent claims

The invention should also be regarded as comprising all possible combinations of the described embodiments

CLAIMS:

1 A liquid permeable covering sheet (2) for an absorbent article such as a diaper (401), an incontinence protector (501), a sanitary napkin (201) or similar articles, which comprises an apertured textile material characterized in that the covering sheet (2) has a plurality of holes (4) each hole surrounded by an essentially liquid-tight edge (6)

2 A liquid permeable covering sheet (2) according to claim 1, characterized in that the textile material comprises at least one heat meltable component, and in that the liquid-tight edge (6) is formed by at least partial melting of the heat meltable component around the holes (4)

3 A liquid permeable covering sheet (2) according to claim 2, characterized in that the holes (4) are formed by heated needles, and in that the liquid-tight edges (6) around the holes (4) are formed at the same time as the holes (4)

4 A liquid permeable covering sheet (2) according to claim 1 or 2, characterized in that the holes (4) in the covering sheet (2) are made ultrasonically

5 A liquid permeable covering sheet (2) according to any of the preceding claims characterized in that the textile material is a non-woven material

6 A liquid permeable covering sheet (502) according to any of the preceding claims, characterized in that the covering sheet (502) has holes (504) of different sizes

7 A liquid permeable covering sheet (2) according to any of the preceding claims, c h a r a c t e r i s e d i n that different areas of the covering sheet (2) have different densities of holes

8 A liquid permeable covering sheet (2) according to any of the preceding claims, c h a r a c t e r i s e d i n that it is laminated to a non-perforated liquid transfer layer

9 A liquid permeable covering sheet (202) according to any of the preceding claims, c h a r a c t e r i s e d i n that the covering sheet comprises at least two layers of material

10 A liquid permeable covering sheet (202) according to claim 7, c h a r a c t e r i s e d i n that it comprises a first layer (208) of material and a second layer (209) of material, wherein the second layer (209) of material is more hydrophilic than the first layer (208) of material

11 A liquid permeable covering sheet (202) according to claim 8, c h a r a c t e r i s e d i n that the holes (204) through the covering sheet (202) have a liquid-tight edge (206) only in the first layer (208) of material

12 An absorbent article such as a sanitary napkin (201), a diaper (401), an incontinence protector (501), etc, comprising an absorption body (205; 405; 505) enclosed in a covering sheet (202,203; 402,403; 502,503) where at least one portion of the covering sheet consists of a liquid permeable covering sheet (202; 402; 502) of a textile apertured material, c h a r a c t e r i s e d i n that the apertured covering sheet (202; 402; 502) has a

plurality of holes (204; 404; 504), all of which holes are surrounded by a liquid impermeable edge (206)

13 Absorbent article according to claim 12, c h a r a c t e r i s e d i n that it has two end-portions (214,216, 414,416; 514,516), and a crotch-portion (218; 418; 518) between the end portions (214,216; 414,416; 514,516), wherein the liquid permeable covering sheet (202; 402; 502) has holes (204; 404; 504) arranged at the crotch-portion (218; 418; 518) which have a larger surface than holes (204; 404; 504) made in the covering sheet (202; 402; 502) at either of the end-portions (214,216; 414,416; 514,516)

14 Absorbent article according to claims 12 or 13, c h a r a c t e r i s e d i n that it has two longitudinal side edges (224,225) whereby an edge area along each side edge (224,225) has holes (204) which are of a smaller dimension and/or are more sparsely arranged than holes (204) arranged at the crotch-portion (218) of the article within the edge areas

15 Method of making an apertured textile covering sheet (2) whereby heated needles are caused to penetrate a textile material layer comprising at least one thermoplastic component, and whereby the temperature of the needles exceeds the melting temperature of the thermoplastic component, c h a r a c t e r i s e d i n that the thermoplastic component constitutes at least 55% of the material in the textile material layer, and in that the heated needles are caused to melt the thermoplastic component closest to the needles, after which the needles are removed and the melted material is caused to solidify to an essentially liquid impermeable edge (6) around each of the holes (4) formed by the penetration

AMENDED CLAIMS
[received by the International Bureau on 25 September 1997 (25 09 97)
original claims 1-15 replaced by amended claims 1-14 (3 pages)]

1 A liquid permeable covering sheet (2) for an absorbent article such as a diaper (401), an incontinence protector (501), a sanitary napkin (201), or similar articles, which comprises an apertured textile material, c h a r a c t e r i z e d i n that the textile material comprises at least one thermoplastic component and that the covering sheet (2) has a plurality of holes (4), each hole being surrounded by an essentially liquid impermeable edge (6) which is formed by at least partial melting of the thermoplastic component

2 A liquid permeable covering sheet (2) according to claim 1, c h a r a c t e r i z e d i n that the holes (4) are formed by heated needles, and in that the liquid impermeable edges (6) around the holes (4) are formed at the same time as the holes (4)

3 A liquid permeable covering sheet (2) according to claim 1, c h a r a c t e r i z e d i n that the holes (4) in the covering sheet (2) are made ultrasonically

4 A liquid permeable covering sheet (2) according to any one of the preceding claims, c h a r a c t e r i z e d i n that the textile material is a non-woven material

5 A liquid permeable covering sheet (502) according to any one of the preceding claims, c h a r a c t e r i z e d i n that the covering sheet (502) has holes (504) of different sizes

6 A liquid permeable covering sheet (2) according to any one of the preceding claims, c h a r a c t e r i z e d i n that different areas of the covering sheet (2) have different densities of holes

7 A liquid permeable covering sheet (2) according to any one of the preceding claims, c h a r a c t e r i z e d i n that it is laminated to a non-perforated liquid transfer layer

8 A liquid permeable covering sheet (202) according to any of the preceding claims, c h a r a c t e r i z e d i n that the covering sheet comprises at least two layers of material

9 A liquid permeable covering sheet (202) according to claim 8, c h a r a c t e r i z e d i n that it comprises a first layer (208) of material and a second layer (209) of material, wherein the second layer (209) of material is more hydrophilic than the first layer (208) of material

10 A liquid permeable covering sheet (202) according to claim 9, c h a r a c t e r i z e d i n that the holes (204) through the covering sheet (202) have a liquid impermeable edge (206) only in the first layer (208) of material

11 An absorbent article such as a sanitary napkin (201) a diaper (401), an incontinence protector (501), etc, comprising an absorption body (205; 405, 505) enclosed in a covering sheet (202,203; 402,403; 502,503) wherein at least one portion of the covering sheet consists of a liquid permeable covering sheet (202 402; 502) of a textile apertured material, c h a r a c t e r i z e d i n that the textile material comprises at least one thermoplastic component and that the apertured covering sheet (202; 402; 502) has a plurality of holes (204; 404; 504), each hole being surrounded by a liquid impermeable edge (206), wherein the liquid impermeable edge (206) is

formed by at least partially melting the thermoplastic component surrounding the holes (204; 404; 504)

12 Absorbent article according to claim 11, c h a r a c t e r i s e d i n that it has two end-portions (214,216, 414,416; 514,516), and a crotch-portion (218; 418; 518) between the end portions (214,216; 414,416; 514,516) wherein the liquid permeable covering sheet (202; 402; 502) has holes (204; 404; 504) arranged at the crotch-portion (218; 418; 518) which have a larger surface than holes (204; 404; 504) made in the covering sheet (202; 402; 502) at either of the end-portions (214,216; 414,416; 514,516)

13 Absorbent article according to claims 11 or 12, c h a r a c t e r i s e d i n that it has two longitudinal side edges (224 225) wherein an edge area along each side edge (224,226) has holes (204) which are of a smaller dimension and/or are more sparsely arranged than holes (204) arranged at the crotch-portion (218) of the article inside the edge areas

14 Method of making an apertured textile covering sheet (2) wherein heated needles are caused to penetrate a textile material layer comprising at least one thermoplastic component, c h a r a c t e r i s e d i n that the temperature of the needles exceeds the melting temperature of the thermoplastic component and that the thermoplastic component constitutes at least 55% of the material in the textile material layer, wherein the heated needles are caused to melt the thermoplastic component closest to the needles, after which the needles are removed and the melted material is caused to solidify to an essentially liquid impermeable edge (6) around each of the holes (4) formed by the penetration

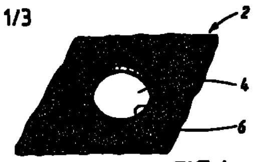

FIG 1

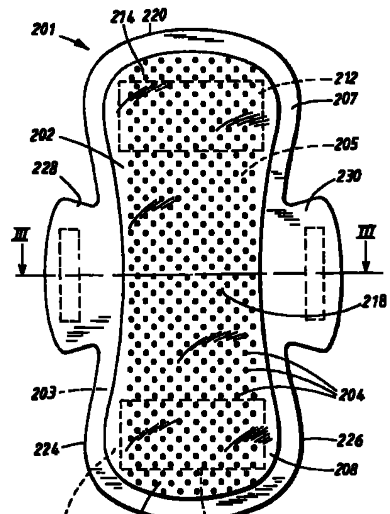

FIG 2

2/3

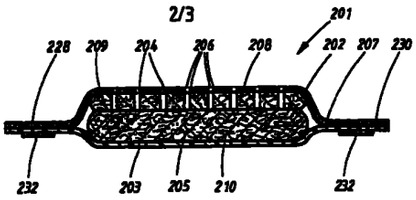

FIG 3

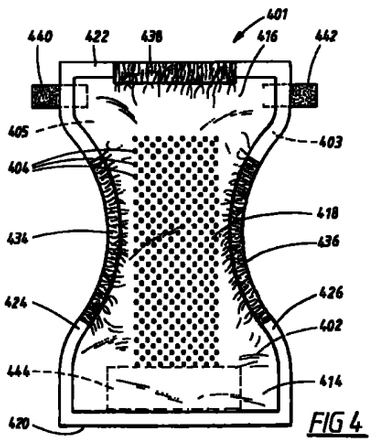

FIG 4

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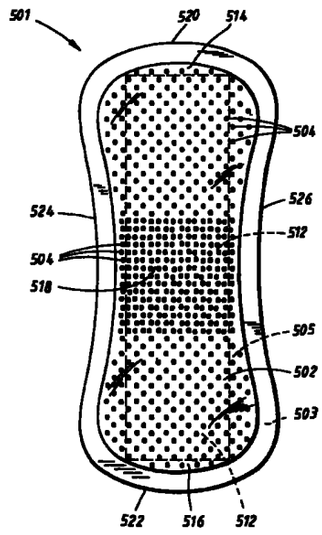

FIG. 5

means are simultaneously cut, so that they are divided into a number of short sections 5 between the slits 3

As can be seen from the drawing, the rows 4 of slits are displaced in relation to each other, so that the slits 3 of one row are positioned directly in front of the gaps of another row Such an arrangement is, of course, not necessary; the slits of the different rows can be arranged in any suitable manner in relation to each other in order to provide the material with a desired appearance and a desired function

In Fig 3 the stretching out of the web of material 1 has ceased, whereby the elastic means 2 have contracted In this way the portions of the material lying between the slits are wrinkled The contraction of the elastic means 2 also results in the edges of the slits 3 being pulled apart so that the slits 3 are widened in the transverse direction of the material layer 1, and assume the shape of oval or, more or less, rhombic openings 3'

The incontinence protector 10 shown in Fig 4 comprises a liquid-permeable surface layer 11 according to the invention, a liquid impermeable surface layer 12, and an absorption body 13 enclosed between the surface layers 11, 12 The liquid-impermeable surface layer 12 may consist of a liquid-impermeable plastic film, a non-woven layer which has been coated with a liquid barrier material, or some other flexible material layer which resists liquid penetration Generally, it is an advantage if the barrier layer 12 has a certain degree of breathability, i e it allows the passage of water vapour The two surface materials 11, 12 have a somewhat larger extension in the plane than the absorption body 13 and extend some distance beyond the edges of the absorption body 13 along all of its periphery The surface layers are mutually connected within

the protruding casing edge 14, for example by gluing or welding with heat or ultrasonic sound

The absorption body 13 can be of any conventional kind Examples of commonly used absorption materials are cellulose wadding, tissue layers, highly absorbing polymers, absorbing foam materials, absorbing non-woven materials and the like Mixtures of materials as well as absorption bodies constructed of layers of material of different kinds and with different properties are also known

A fastening means 15 in the form of two areas of self-adhesive glue is arranged on the outside of the liquid impermeable envelope layer 12 The glue areas 15 are preferably covered before use by (not shown) removable protection layers of release agent treated paper, or plastic film On the shown incontinence protector 10, the fastening means 15 consists of a transverse glue area at each end of the protector Numerous other glue patterns are, of course, conceivable, as well as other types of fastening means such as hook-and-loop surfaces, snap fasteners, girdles, special underpants or the like An incontinence protector of the kind shown in Fig 4 is primarily intended to be used by persons having comparatively minor incontinence problems and is easily contained within a pair of ordinary underpants The fastening means 15 then serves to keep the incontinence protector 10 in place in the underpants during use The fastening means 15 naturally has to be of such type that the incontinence protector can be removed from the underpants without damaging these

The incontinence protector 10 is hour glass shaped, with wider end portions 16, 17 and a narrower crotch portion 18 located between the end portions 16, 17 The crotch portion

18 is the portion of the incontinence protector 10 which is intended, during use, to be placed in the user s crotch and serves as a receiving surface for the body fluid which is secreted to the incontinence protector 10 The incontinence protector further exhibits two transverse end edges 19, 20, and two longitudinal side edges 21, 22 running between the end edges 19, 20

The liquid permeable surface layer 11 preferably consists of a liquid permeable material layer, such as a non-woven layer, or a perforated plastic film Elongate elastic means 2 are affixed to the surface layer and run transversely over it between the side edges 21, 22 of the incontinence protector 10 Suitable elongate elastic means 2 are, as earlier mentioned, elastic ribbons or threads The elastic means 2 are only arranged within the crotch portion 18 of the incontinence protector, while the end portions 16, 17 are without elastic means 2 In case a liquid impermeable layer has been used as surface layer, only the crotch portion 18 will be liquid permeable after slitting The end portions 16, 17 will then function as barriers to leakage out of the front- and rear portions 16, 17 of the incontinence protector

In the drawing, the elastic means 2 extend all the way out to the side edges 21, 22 of the incontinence protector It may then be advantageous to treat the elastic means 2 so that they lose their elasticity within the area of the protruding casing edge 14 Such a treatment may, for example, be performed chemically or by using heat It is, furthermore, possible to avoid an elastic contraction of the cover edge 14 by using a sealing glue along the edge 14 which allows the elastic means 2 to contract and creep inwards in the direction towards the absorption body 13, after being cut at the side edges 21,22

The surface layer 11 further exhibits a plurality of slits 3 arranged in transverse rows 4 which coincide with the extension of the elastic means 2 In this context, a slit 3 should be understood to mean a penetrating, longitudinal opening in the surface layer A slit is typically a cut in the material, i e an opening which has only a length dimension but no width dimension, but also slot-shaped openings, i e openings having a certain, but in comparison to the length of the opening small, width dimension, are intended to be covered by the concept of a slit

The slits 3 run perpendicularly across the elastic means 2 and divide them into several short pieces in the transverse direction of the incontinence protector At the central part of the crotch portion 18, i e at the area of the crotch portion which is situated closest to a transverse center line 23 through the incontinence protector, the slits 3 are somewhat longer, preferably between 5-10 mm in length, than at parts of the crotch portion 18 located closest to the end portions 16, 17 of the incontinence protector 10 where the slits are between 2-7 mm in length In addition, the centrally situated slits are arranged with a larger mutual spacing along the elastic means 2 than the slits closest to the end portions 16, 17 Furthermore, the elastic means 2 are affixed to the surface layer 11 with a larger degree of pre-tensioning within the area closest to the transverse center line 23 of the incontinence protector, whereby their contracting influence on the surface layer 11 is largest within this area

Through the combination of different sizes of the slits 3, different spacing between the slits and different pre-tension of the elastic means 2, the surface layer will attain the appearance shown in Fig 4. The openings 3' in the surface layer 11, which are formed when the elastic means 2 contract and the slits are widened, are larger at

the central part of the crotch portion 18 than at those parts of the crotch portion 18 which are located close to the end portions 16, 17 Furthermore, the wrinkling between the openings 3 in the surface layer 11 is larger within the central part of the crotch portion 18 This is partly due to the fact that the amount of material which can be wrinkled between the slits 3 is larger, partly because the contracting force is larger within this area

This arrangement is particularly advantageous since the central part of the crotch portion 18 will receive the major part of the secreted body fluid during use A large part of the body fluid can then quickly pass through the comparatively large openings 3' in the surface layer 11 Any part of the body fluid which does not have time to penetrate down through the surface layer 11 will instead be transported in the longitudinal channels 24 which are formed on the surface of the surface layer 11 through the wrinkling of the material between the openings 3 The wrinkles in the surface material 11 thus act as a space in which fluid can be caught temporarily and be distributed in a controlled manner in the longitudinal direction of the incontinence protector 10

Because the wrinkles, or channels, 24 run along the side edges 21, 22 of the incontinence protector, they furthermore act as barrier means which prevent the spreading of fluid in the transverse direction Further, this condition contributes greatly to minimising the risk of leakage of body fluid past the side edges 21, 22 of the incontinence protector

It is advisable to avoid the use of transverse elastic means 2 at the end portions 16, 17 of the incontinence protector One demand on incontinence protectors of this type is, namely, that they should be as discreet as

possible to wear and preferably be possible to conceal under ordinary clothes Because the end portions 16, 17 do not have elastic means, the surface material 11 is not wrinkled, leaving the end portions 16, 17 flat and thinner than the crotch portion 18 of the incontinence protector

As can be seen in Fig 4, the size of the openings 3' and the degree of wrinkling decreases gradually from the transverse centre line 23 of the incontinence protector in the direction towards the end portions 16, 17 This is accomplished by a gradually decreasing slit length and decreasing tension of the elastic means 2 In Fig 5 there is shown an incontinence protector 10 according to an alternative embodiment of the invention The protector 10 is of the same general construction as the incontinence protector 10 shown in Fig 4, wherefore the corresponding structural elements have been assigned the same numerals The incontinence protector in Fig 5 differs, however, from the incontinence protector of Fig 4 in that the surface material according to the invention is only present in the shape of a material strip 25 between the two transverse edges 19, 20 of the incontinence protector The material strip 25 extends along the full length of the incontinence protector 10 and has the same width as the width of the absorption body 13 at the transverse mid line 23 of the protector 10

Laterally outside the material strip, pieces 26, 27 of another sheet of material are arranged, and are firmly attached to the material strip using any known method Accordingly, these material pieces 26, 27, form together with the material strip 25 the liquid permeable surface layer 11 of the incontinence protector 10 The material pieces 26, 27, arranged on both sides of the material strip 25, extend past the edges of the absorption body 13 and are joined within the protruding parts 14 to corresponding

protruding parts 14 of the liquid-impermeable cover layer 12 of the incontinence protector 10

The material pieces 26, 27 arranged along the side edges 21, 22 can be made from any suitable cover material For example, different types of nonwoven material, as well as perforated or unperforated plastic films, nettings, laminates of plastic film and nonwoven, or similar can be used Preferably, a material is chosen which is soft and pleasant against the skin of the user and which allows ventilation between the skin and the material surface

The material pieces 26, 27 may, furthermore, have a lower liquid permeability than the centrally arranged material strip 25, whereby they act as liquid barrier means to prevent leakage of body fluid out of the absorption body 13 along the side edges 21, 22

By applying the surface material according to the invention as a material strip 25 only, the consumption of the comparatively expensive surface material can be minimized Furthermore, it is possible to choose a material for the parts of the incontinence protection located along the side edges 21, 22 which is especially designed to present a soft and pleasant border against the skin of the user Furthermore, it is avoided that the elastic means 2 stretch out into and wrinkle the cover parts 14 which are located outside the absorption body 13 of the incontinence protector 10 The embodiment shown in Fig 5 requires an additional manufacturing step, during which the separate material pieces 26, 27 along the side edges are affixed to the central material strip 25

According to an alternative embodiment, the central material strip 25 is arranged on an undivided, continuous material layer which forms the material pieces 26, 27 along

the side edges 21, 22 Such a material layer thus extends beneath the material strip 25, between this and the absorption body 13 and outwardly on each side of the material strip 25, and forms the edge parts 14 connected to the liquid-impermeable cover layer 12 It is preferred that the material strip 25 is affixed on the additional material layer with the elastic means 2 pre-stretched, and that the slits 3 which divide the elastic means 2 are formed through both the material strip 25 and the additional material layer after the lamination has been performed

A surface material according to the invention is particularly advantageous when it is used in connection with absorbent articles intended to be held by, and affixed inside, a pair of underpants Usually, such products lack special edge leakage barriers at the side edges The risk of edge leakage has therefore been rather high with earlier known such articles With the surface material according to the invention, however, a liquid barrier effect is achieved through the wrinkling, at the same time as the fluid is dispersed in the longitudinal direction of the article, so that the absorbing capacity of the article is better put to use The invention should, however, not be considered to be limited to such use, but the surface material is also suitable for use on childrens diapers, and different types of body-encompassing diapers for heavily incontinent grown-up persons

Although the described embodiments show elastic means arranged in straight lines, it is of course possible to arrange elastic means along curving lines instead The elastic means may be attached onto the surface of the surface material which is intended to be facing a user, but are preferably attached onto the surface which is facing away from the user The risk of chafing and irritation of the user s skin is thus minimized

CLAIMS

1 Liquid permeable surface material for an absorbent article such as a diaper, an incontinence protector, a sanitary napkin, or the like, comprising a flexible, skin friendly material layer (1), and having at least one penetrating opening (3), characterised in that the opening (3) is formed by a slit (3) in the material layer (1), whereby the slit (3) has two longitudinal edges, and that elongate elastic means (2) are pre-tensioned and arranged on both sides of the slit (3), substantially perpendicular to the edges of the slit (3), whereby the elastic means (2) act contractingly on the material on both sides of the slit (3) so that the edges of the slit (3) are pulled apart and the contracted material exhibits wrinkles (24) running substantially parallel to the slit (3)

2 Surface material according to claim 1, characterised in that it has a plurality of openings (3) formed by a row (4) of slits (3) arranged substantially parallel to each other, and that the elastic means (2) are arranged between the slits (3) and run along the row (4) of slits (3) substantially perpendicular to the edges of the slits (3), whereby the material between the slits (3) is wrinkled and the edges of the slits (3) are parted to form the openings (3)

3 Surface material according to claim 2, characterised in that it has two or more rows (4) of slits (3) with intermediate parts (5) of the elongate elastic means (2)

4 Surface material according to claim 2, characterised in that the slits (3) of two different rows (4) are of different lengths

5 Surface material according to claim 3 or 4, characterised in that the mutual distance between the slits (3) of two different rows (4) is different in length

6 Surface material according to any of the claims 2-5, characterised in that the distance between the slits (3) within the same row (4) varies

7 Surface material according to any of the preceding claims, characterised in that the pre-tension of the elastic means (2) varies

8 A method of manufacturing a surface material suitable for use in connection with an absorbent article, whereby a plurality of parallel elongate elastic means (2) are stretched out, applied and affixed to a flexible, skin friendly material layer (1) which is kept stretched to a planar condition during the application of the elastic means (2), characterised in that slits (3) are arranged through the material layer (1) whilst the material layer (1) is kept stretched out, which slits (3) are therewith arranged to substantially run perpendicularly across the elastic means (2), whereby the elastic means (2) are parted at the slits (3) whereafter the stretching of the material layer (1) is terminated and the parts (5) of the elastic means (2) between the slits (3) are allowed to contract whilst the material between the slits (3) is wrinkled and the slits (3) are widened through the pulling apart of the edges of the slits (3) by the contracting force of the elastic means (2)

9 Absorbent article (10) such as an incontinence protector, a diaper or a sanitary napkin comprising an absorption body (13) enclosed between a liquid-permeable envelope layer (11) and a liquid-impermeable envelope layer (12), characterised in that the liquid-permeable envelope

layer (11) has at least one penetrating opening (3') formed by a slit (3) in the envelope material whereby the slit (3) has two longitudinal edges, and that elongate elastic means (2) are pre-tensioned and affixed on both sides of the slit (3), substantially perpendicular to the edges of the slit, whereby the elastic means (2) act contractingly on the material on both sides of the slit (3) so that the edges of the slit are pulled apart and the contracted envelope material exhibits wrinkles (24) running substantially parallel to the slit (3)

10 Absorbent article according to claim 9, and further exhibiting two end portions (16, 17) and a intermediate crotch portion (18), characterised in that the liquid-permeable envelope layer (11) has openings (3) situated within the crotch portion (18) only

11 Surface material as claimed in claim 1 substantially as hereinbefore described with reference to and as illustrated in Figure 3 of the accompanying drawings

12 An absorbent article as claimed in claim 9 substantially as hereinbefore described with reference to and as illustrated in Figure 4 or 5 of the accompanying drawings

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The Patent Office

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Application No: GB 9703476.3 Examiner: Jon Broughton
Claims searched: 1 12 Date of search: 12 May 1997

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Databases searched:

UK Patent Office collections including GB EP WO & US patent specifications, in:

UK Cl (Ed O) A5R (RPM, RPC)

Int Cl (Ed.6) A61F 13/15

Other: Online: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2284786 A	(KIMBERLY-CLARK) see page 5 line 31 – page 6 line18, page 15 line 29-36 and figures.	1-3 and 9.
A	GB 2279878 A	(UNI-CHARM) see figures 9A and 9B and page 16 line 2-12.	
A	GB 821959	(PRITCHETT) see figures 1 and 2	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

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(54) Sanitary articles with multi aperture size film topsheets having a selected distribution of the apertures

Eine, mit in Grösse unterschiedlicher und definierter Verteilung der Perforationen, versehene Decklage für Hygieneartikel

Article d'hygiène avec une couche supérieure à perforations de dimensions multiples et une distribution sélectionnée de perforations

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Description

Field of the Invention

[0001] The present invention relates to absorbent articles particularly sanitary napkins preferably having film topsheets, see EP-A-0[illegible] 718. In particular a topsheet receiving the liquids to be absorbed comprises apertures of at least 4 different sizes which are distributed according to their respective size in longitudinal and transverse directions. This range of aperture sizes provides exceptionally good liquid intake performance for the range of liquid viscosities commonly found for liquids which are absorbed in sanitary napkins. The distribution of the apertures leaves a certain longitudinal side edge and preferably transverse end edge of the topsheet free of the larger apertures to improve comfort of the product during use.

Background of the Invention

[0002] Sanitary articles such as sanitary napkins, baby diapers, absorbent inserts, and absorbent adult incontinence articles are well-known in the art. Typically all these articles comprise a wearer facing surface and a garment facing surface. The wearer facing surface receives from the wearer of such articles liquids, bodily discharges such as urine, vaginal discharges or menses, to be absorbed. In order for the article to store the liquid the wearer facing surface has to be liquid permeable while maintaining integrity of the outer wearer facing surface of the absorbent article. This wearer facing surface is provided by a topsheet.

[0003] Well-known topsheets in the art of absorbent articles are non-woven fabrics, woven fabrics or films. Films have to be rendered permeable by aperturing. They are often made of polymeric material and typically comprise apertures which have been engineered to provide certain characteristics. These apertures can vary in shape and size but have commonly been provided in a single preferred size and shape. The walls of the apertures define the amount of extension if any- beyond the plane of the film thickness and the direction of such extensions. The film apertures also can be provided in the shape of a funnel. Films are generally preferred over fabrics since they can provide a cleaner surface even after liquid having passed through since they do not retain liquids. A typical topsheet made of polyethylene film has been successfully used in sanitary articles and adult incontinence products as well as inserts and baby diapers by Procter & Gamble under the tradenames Always and Attends.

[0004] Fabrics or non-woven fabrics are made of fibers which by their nature provide non-linear apertures in the liquid transport direction. Also the largest aperture size in fabric topsheets is limited by the requirement to maintain material strength. However, these materials can also be treated in a similar fashion as film materials in particular non-woven fabrics which are made of thermo-plastic fibers. Aperturing of fabrics or non-wovens is hence also considered by the present invention.

[0005] One problem remaining with all these topsheets is the rate of liquid capable of passing through such a topsheet under usual usage conditions due to the total amount of open area of all apertures and individual aperture size and shape in particular. Exceptionally large apertures increase the liquid passage rate but pose the potential problem of material stability for the topsheet at least during the manufacturing of absorbent articles, which is highly undesirable. Also large apertures possibly promote a backflow of absorbed liquid, so called rewet, which is undesirable. Small individual apertures on the other hand cannot provide the liquid passage characteristics required to let liquids of high surface tension, high viscosity or solid content such as coagulated blood clots pass through; this can be a problem in an absolute sense for very small apertures or cause too low a rate of liquid flow.

[0006] It also has been found that the total amount of open area for a given aperture size and shape is approximately linearly related to the rate of liquid passage. Again, masking of the liquid which has passed through but also material strength and other appearance considerations are limiting the extend as to which the total open area in a topsheet can be selected.

[0007] It is also known that the viscosity of liquids disposed on sanitary napkins can vary drastically from exceptionally low viscosities e.g. of urine from a person having a light incontinence or stress incontinence syndrome. Low viscosities also can be present for vaginal discharges or menses which comprise small amounts of surfactant. Some bodily discharges comprise natural surfactants already but also residue from washing soaps, which many wearers of such articles use regularly, can be found.

[0008] At the other end of the spectrum viscosities of menses changes drastically over the period of a woman and have been reported in EP-A-0 [illegible] to range from [illegible] to [illegible] mPas. The viscosities can change over time on the same person and can vary between persons compared at a similar stage of the monthly period.

[0009] Another problem which now has been recognized is that the presence of large hole apertures in the longitudinal side margins or the transverse end regions of the wearer facing surface of a topsheet can cause undesirable chafing or irritation. This is believed to be possibly due to the amount of material forming the rim of the aperture being more for larger apertures than for smaller apertures. It is well-known that even tiny points of irritation from such an article will

cause significant discomfort. In fact wearers claiming to experience discomfort typically still disregard any absorbency benefits obtained by the small aperture topsheet due to unacceptable comfort performance of such articles.

[0010] It is therefore an objective of the present invention to provide a topsheet for sanitary articles which provide the benefits previously recognized by inclusion of an aperture distribution in the topsheet while eliminating the problems associated with having large apertures in a region where relative movement between the topsheet and the skin of a wearer would potentially cause discomfort.

[0011] It is another an objective of the present invention to provide a topsheet for sanitary articles which can even better accommodate the viscosity changes of absorbent liquids without the need for different articles for different times. It has been found that this can be achieved by providing topsheets for absorbent disposable articles which have apertures of different open areas in an aperture distribution relating to the individual apertures open area.

[0012] It is hence an objective of the present invention to provide absorbent articles which have a topsheet with a distribution of aperture sizes and locations.

Description of the Invention

[0013] The present invention provides an absorbent article according to claim 1 having the benefit of an aperture topsheet for liquids of drastically different viscosities without discomfort to the wearer. In particular, the absorbent article comprises a topsheet having a wearer facing surface and a garment facing surface. The topsheet can comprise multiple layers which are preferably joined to each other. An absorbent article generally further comprises a backsheet and an absorbent structure, alternatively called absorbent core, placed between the topsheet and the backsheet.

Absorbent structure

[0014] The absorbent structure can include the following components: (a) optionally a primary fluid distribution layer preferably together with a secondary optional fluid distribution layer (b) a fluid storage layer (c) optionally a fibrous ("dusting") layer underlying the storage layer and (d) other optional components.

a Primary/Secondary Fluid Distribution Layer

[0015] One optional component of the absorbent structure according to the present invention is a primary fluid distribution layer and a secondary fluid distribution layer. The primary distribution layer typically underlies the topsheet and is in fluid communication therewith. The topsheet transfers the acquired fluid to this primary distribution layer for ultimate distribution to the storage layer. This transfer of fluid through the primary distribution layer occurs not only in the thickness, but also along the length and width directions of the absorbent product. The also optional but preferred secondary distribution layer typically underlies the primary distribution layer and is in fluid communication therewith. The purpose of this secondary distribution layer is to rapidly acquire fluid from the primary distribution layer and transfer it rapidly to the underlying storage layer. This helps the fluid capacity of the underlying storage layer to be fully utilized. The fluid distribution layers can be comprised of any material typical for such distribution layers. In particular fibrous layers materials like capillaries between fibers even when wet are useful as distribution layers.

b Fluid Storage Layer

[0016] Positioned in fluid communication with, and typically underlying the primary or secondary distribution layers, is a fluid storage layer. The fluid storage layer can comprise any usual absorbent material or combinations thereof. It preferably comprises absorbent gelling materials usually referred to as "hydrogel" "superabsorbent" hydrocolloid" materials in combination with suitable carriers.

[0017] The absorbent gelling materials are capable of absorbing large quantities of aqueous body fluids, and are further capable of retaining such absorbed fluids under moderate pressures. The absorbent gelling materials can be dispersed homogeneously or non-homogeneously in a suitable carrier. The suitable carriers, provided they are absorbent as such, can also be used alone.

[0018] Suitable absorbent gelling materials for use herein will most often comprise a substantially water-insoluble, slightly cross-linked, partially neutralized, polymeric gelling material. This material forms a hydrogel upon contact with water. Such polymer materials can be prepared from polymerizable, unsaturated, acid-containing monomers which are well known in the art.

[0019] Suitable carriers include materials which are conventionally utilized in absorbent structures such as natural cellulosic or synthetic fibers, particularly modified or non-modified cellulose fibers, in the form of fluff and/or tissues. Suitable carriers can be used together with the absorbent gelling material, however, they can also be used alone or in combinations. Most preferred are tissue or tissue laminates in the context of sanitary napkin/pantyliners.

[0020] An embodiment of the absorbent structure made according to the present invention comprises a double layer tissue laminate formed by folding the tissue over itself. These layers can be joined to each other for example by adhesive or by mechanical interlocking or by hydrogen bridge bonds. Absorbent gelling material or other optional material can be comprised between the layers.

[0021] Modified cellulose fibers such as the stiffened cellulose fibers can also be used. Synthetic fibers can also be used and include those made of cellulose acetate, polyvinyl fluoride, polyvinylidene chloride, acrylics (such as Orlon), polyvinyl acetate, non-soluble polyvinyl alcohol, polyolefins, polypropylene, polyamides (such as nylon), polyesters, bicomponent fibers, tricomponent fibers, mixtures thereof and the like. Preferably, the fiber surfaces are hydrophilic or are treated to be hydrophilic. The storage layer can also include filler materials, such as Perlite, diatomaceous earth, Vermiculite, etc., to improve liquid retention.

[0022] If the absorbent gelling material is dispersed non-homogeneously in a carrier, the storage layer can nevertheless be locally homogeneous, i.e. have a distribution gradient in one or several directions within the dimensions of the storage layer. Non-homogeneous distribution can also refer to laminates of carriers containing absorbent gelling materials partially or fully.

c Optional Fibrous ("Dusting") Layer

[0023] An optional component for inclusion in the absorbent structure according to the present invention is a fibrous layer adjacent to, and typically underlying the storage layer. This underlying fibrous layer is typically referred to as a "dusting" layer since it provides a substrate on which to deposit absorbent gelling material in the storage layer during manufacture of the absorbent structure. Indeed, in those instances where the absorbent gelling material is in the form of macro structures such as fibres, sheets or strips, this fibrous "dusting" layer need not be included. However, this "dusting" layer provides some additional fluid-handling capabilities such as rapid wicking of fluid along the length of the pad.

d Other Optional Components of the absorbent structure

[0024] The absorbent structure according to the present invention can include other optional components normally present in absorbent webs. For example, a reinforcing scrim can be positioned within the respective layers, or between the respective layers, of the absorbent structure. Such reinforcing scrims should be of such configuration as to not form interfacial barriers to fluid transfer. Given the structural integrity that usually occurs as a result of thermal bonding, reinforcing scrims are usually not required for thermally bonded absorbent structures.

[0025] Another component which can be included in the absorbent structure according to the invention and preferably is provided close to or as part of the primary or secondary fluid distribution layer are odor control agents. Active carbon coated with or in addition to other odor control agents, in particular suitable zeolite or clay materials, are optionally incorporated in the absorbent structure. These components can be incorporated in any desired form but often are included as discrete particles.

Backsheet

[0026] The backsheet primarily prevents the exudates absorbed and contained in the absorbent structure from wetting articles that contact the absorbent product such as underpants, pants, pyjamas and undergarments. The backsheet is preferably impervious to liquids (e.g. menses and/or urine) and is preferably manufactured from a thin plastic film, although other flexible liquid impervious materials can also be used. As used herein, the term "flexible" refers to materials that are compliant and will readily conform to the general shape and contours of the human body. The backsheet also can have elastic characteristics allowing it to stretch in one or two directions.

[0027] The backsheet typically extends across the whole of the absorbent structure and can extend into and form part of or all of the peripheral edgings, cuffs wrapping elements or edges.

[0028] The backsheet can 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. Preferably, the backsheet is a polyethylene film having a thickness of from about 0.012 mm (0.5 mil) to about 0.051 mm (2.0 mils).

[0029] Exemplary polyethylene films are manufactured by Clopay Corporation of Cincinnati, Ohio, under the designation P18-0401 and by Ethyl Corporation, Visqueen Division, of Terre Haute, Indiana, under the designation XP-39385. The backsheet is preferably embossed and/or matte-finished to provide a more clothlike appearance. Further, the backsheet can permit vapours to escape from the absorbent structure, i.e. be breathable, while still preventing exudates from passing through the backsheet. Also breathable backsheets comprising nonwoven layers, e.g. film plus non-woven structures, can be used.

The topsheet

[0030] For multiple layer topsheets the term "joined" as used herein, encompasses configurations in which the first layer is directly secured to the second layer by affixing the first layer directly to the second layer' configurations in which the first layer is indirectly secured to the second layer by affixing the first layer to intermediate layer(s) which in turn are affixed to the second layer.

[0031] The layers of the topsheet can preferably be joined together by adhesives, stitching, heat and/or pressure bonds, dynamic mechanical bonds, ultrasonic bonds, intermingling or entanglement of structural elements comprising the layers of the topsheet, such as by extruding one layer onto another, or by any other means known in the art. It is, however, important that the joining does not create any harsh or irritating spots on the topsheet.

[0032] The topsheet as a whole and hence each layer individually needs to be compliant, soft feeling, and non-irritating to the wearer's skin. It also can have elastic characteristics allowing it to be stretched in one or two directions. The topsheet typically extends across the whole absorbent structure and can extend into and form part of or all of the preferred side flaps, side wrapping elements or wings.

[0033] According to the present invention preferably at least one layer of the topsheet is provided by a film material having apertures which are referred herein as "extra large apertures" "large apertures" "medium apertures" and "small apertures" These apertures are provided to facilitate liquid transport for liquids of various viscosities from the wearer facing surface towards the absorbent structure. The apertures may also be present in a fabric or non-woven layer of a topsheet. In the following reference to a film topsheet is by way of example and application of the present invention to a fabric or non-woven fibrous topsheet is considered within the scope of the present invention.

[0034] For all measurements regarding the apertures in the film passage layer the plane of the smallest cross sectional areas of the aperture should be used, unless otherwise mentioned. The term "aperture size" as used herein relates to the open area which an aperture provides in the film.

[0035] The "extra large apertures" have an individual open area of from more than 1.4 mm² to 3 mm² The total open area of the "extra large apertures" excluding all other liquid transport apertures should be in the range from 1 % to 55 %, preferably from 10 % to 20 % of the surface area of the topsheet.

[0036] The "large apertures" have an individual open area of from more than 0.5 mm² to 1.4 mm² The total open area of the "large apertures" excluding all other liquid transport apertures should be in the range from 1 % to 30 %, preferably from 5 % to 15 % of the surface area of the topsheet.

[0037] The "medium apertures" have an individual open area of from more than 0.1 mm² to 0.5 mm² The total open area of the "medium apertures" excluding all other liquid transport apertures should be in the range from 1 % to 35 %, preferably from 10 % to 25 % of the surface area of the topsheet.

[0038] The "small apertures" have an individual open area of from more than 0 mm² to 0.1 mm² The total open area of the "small apertures" excluding all other liquid transport apertures should be in the range from 0.1 % to 5 %, preferably from 0.5 % to 3 % of the surface area of the topsheet.

[0039] The apertures are preferably substantially circular or polygonal. Their shape is limited by having a ratio of the largest to the smallest inner diagonal length in the range between 1 and 6, preferably 1 and 3. The total open area of all liquid transport apertures is in the range of 3.1 % to 65 %, preferably 10 % to 50 %, most preferably 15 % to 40 % of the total area of the topsheet.

[0040] Topsheets according to the present invention have a non-homogeneous distribution of the liquid passage ways or apertures across the wearer facing surface of the topsheet. It recently has been found that a topsheet comprising large and extra large apertures have a higher tendency of being considered to a cause discomfort to some wearers of sanitary napkins comprising such topsheets.

[0041] While not wishing to be bound by theory it is considered that the following is an explanation of the reasons for the benefits obtained with the present invention. When creating apertures,e.g. by a thermic process the material initially filling the aperture is not eliminated and ultimately it is collected in the rim around the aperture. This is considered equally true for fibrous non-woven topsheet layers or film topsheet layers. This rim becomes more apparent to a wearer the larger the apertures are since the open area of an aperture increases faster than the length of the aperture rim with increasing aperture diameters. The additional material deposited in the rim of the aperture hence builds up more in larger apertures than in smaller apertures. However with increasing size material the rim also becomes harsher and harder. Therefore the rim of larger apertures is more prone to cause irritation to the wearer of an article comprising such an apertured topsheet than for small apertures.

[0042] The absorbent article and all main components have a longitudinal axis which is parallel to a plane which would bisect a wearer of such an article into right and left side. Also the absorbent article has a transverse axis which is perpendicular to the longitudinal axis and within the same plane as the article. The term "longitudinal center" as used herein refers to the center of the article and extends parallel to the longitudinal axis. The term "transverse center" as used herein refers to the center of the article and extends parallel to the transverse axis.

[0043] It hence has been found that a preferable distribution of the apertures should leave the longitudinal margins of

the topsheet free of extra large and large apertures. Hence the topsheet according to the present invention requires that the extra-large apertures mentioned above are only distributed in the longitudinal center 80 % of the largest transverse width of the absorbent structure. Preferably, these extra large apertures are distributed in the longitudinal center 80 %, most preferably 70 % of the largest transverse width of the absorbent structure.

[0044] In a preferred embodiment also the large apertures are eliminated from the longitudinal side margins of the topsheet such that the large apertures are only distributed in the longitudinal center 90 %, preferably 80 %, most preferably 70 % of the largest transverse width of the absorbent structure.

[0045] Optionally for ease of manufacturing of the apertured topsheet it is possible to only aperture the topsheet in the region of the longitudinal center to satisfy the specific requirement stated above for extra large and large apertures.

[0046] In a similar consideration it is also preferable that an embodiment of the present invention has the extra large apertures only distributed in the transverse center 92 %, preferably 85 %, most preferably 80 % of the largest longitudinal length of the wearer facing surface of the topsheet. Similarly large apertures are preferably only distributed in the transverse center 90 %, preferably 85 %, most preferably 80 % of the largest longitudinal length of the wearer facing surface of the topsheet.

[0047] As with the distribution in transverse direction for ease of manufacturing of a topsheet according to the present invention it is possible to provide the liquid transport apertures only in the transverse center of the topsheet in order to satisfy the above requirements for embodiments in the context of extra large and large apertures.

[0048] An additional benefit obtainable from the basic or preferred embodiments according to the present invention is the concentration of liquid apertures towards the center of the absorbent article such that more open area is placed where liquid acquisition is most probable. This then provides a benefit in absorbency of the respective absorbent article.

[0049] The liquid transport apertures can be simple holes but preferably are formed in the film such that the walls of the apertures extend beyond the plane of the surface of the basic film, i.e. the film surface, before the film is apertured. The direction of these extending walls in the absorbent article is towards the garment facing surface of the article. The amount of extension of the walls of the apertures should be at least 0.3 mm beyond the film surface from which the walls of the apertures depend. Preferably the walls of the apertures form funnels or Ventury channels as is well-known in the art.

[0050] To ensure material stability the smallest distance between neighbouring extra large and/or large apertures regardless of their particular shape and size is preferably at least 0.5 mm, preferably 1.5 mm. This distance is measured on the surface of the film on the side closest to the user facing surface of the absorbent article.

[0051] The film material is preferably rendered hydrophilic to such a degree that the contact angle is less than 90° with distilled water upon first contact with the water. For films this can be achieved by surfactant treatment. For surfactant treated polymeric films it has been found that it is beneficial to use films where the surfactant is permanently fixed on the film surface. These are so called film materials with resin integrated surfactant. For these films even repeated wetting by distilled water would provide approximately the same contact angle as the first contact with distilled water.

[0052] In another preferred execution the wearer facing surface of the topsheet is treated with an agent such that liquids are directed towards the apertures. Such agents can be silicone or teflon which provide the treated surface with a self-cleaning effect. This treatment can be in addition to the above-mentioned surfactant treatment.

[0053] Films such as those disclosed in EP-A-0 [illegible], EP-A-0 165 [illegible], EP-A-0 [illegible], EP-A-0 [illegible] or US-A-3,[illegible],135 are explicitly referred to as suitable for the topsheet provided the requirements for the aperture distribution is met. Other suitable formed films, also provided the requirements for the aperture distribution are met, are described in EP-A-[illegible], U.S. Patent 4,[illegible], U.S. Patent 4,[illegible],314, U.S. Patent 4,[illegible] and U.S. Patent [illegible]. Particularly preferred microaperturing of formed film is disclosed in U.S. patent 4,[illegible] and U.S. patent 4,[illegible]. These microapertures can also be included in the topsheet provided their surface is less than 0.15 mm² and hence they essentially provide breathability. Ways of making such films are well-known in the art and have also been disclosed in the above prior art references. Also films which are, prior to aperturing, water vapour permeable but liquid impermeable can be used in the context of the present invention.

[0054] If the topsheet comprises multiple layers the second and following layers can be of the same kind as the above described topsheet according to the present invention with an aperture distribution. They can also be provided by other film layers or by woven or non-woven layers.

[0055] It is recommendable that any additional layer presents no barrier for the liquid. This can be achieved by providing no hydrophilicity gradient or an absorbency driving hydrophilicity gradient such that a directing force for the liquid towards the absorbent structure is created. It is also considered desirable that all layers have about the same total open area.

[0056] While not wishing to be limited by theory it is believed that a constant Reynolds number could ensure optimum liquid passage rates. The optimum Reynolds number depends of course on the absorption speed of the absorbent core. Once this Reynolds number is established for a particular liquid viscosity, absorbent core and one apertures size, the theoretically ideal distribution of aperture sizes can be identified by the equation.

$$\text{Reynolds number} = \frac{\text{density} \cdot \text{flow speed} \cdot \text{hydraulic diameter}}{\text{viscosity}}$$

wherein

density is the density of the liquid to be absorbed in units of mass over volume,
flow speed is the velocity of the liquid to be absorbed in units of distance over time,
hydraulic diameter can be calculated from the area of the aperture as the square route of 4 times the aperture area over Pi,
viscosity is the dynamic viscosity of the liquid to be absorbed in units of pressure times time.

[0027] With density being approximately constant (about that of water) and flow speed being constant by desire the hydraulic diameter distribution becomes approximately linearly proportional to the viscosity and the aperture size distribution becomes approximately proportional to the square of the viscosity:

$$\text{aperture size} \sim \text{viscosity}^2$$

[0028] Following this theory it is easy to select for a viscosity profile, which is operated over the usage conditions for a certain topsheet the aperture size distribution which is theoretically ideal. From this theoretically ideal distribution a realistic approximation with at least 4 different aperture sizes can be selected to provide a topsheet according to the present invention.
[0029] Preferred topsheet according to the present invention can have a larger number than 4 apertures, preferably the "theoretically ideal distribution of apertures" is resembled by a distribution of 5, 6, 7, 8, 9 or even 10 different aperture sizes. The majority of benefits from an aperture size distribution are however already realised by 5, 6, 7 or 8 different aperture sizes. The distribution must still satisfy the distribution given for 4 apertures, preferably with a skew towards the center of the distribution.

Claims

1. Absorbent article having a longitudinal axis and a transverse axis, said article comprising a topsheet, a backsheet, and an absorbent structure placed between said topsheet and said backsheet, said topsheet having a wearer facing surface and a garment facing surface and said topsheet comprising a film passage layer having small, medium, large and extra-large apertures for liquid transport,

said small apertures having an individual area in the range bare more than 0 mm^2 to 0.1 mm^2
said medium apertures having an individual area in the range from more than 0.1 mm^2 to 0.8 mm^2
said large apertures having an individual area in the range bare more than 0.8 mm^2 to 1.4 mm^2
said extra-large apertures having an individual area in the range bare more than 1.4 mm^2 to 9 mm^2
said small apertures having a total open area in the range from 0.1 % to 8 % of the total area of said film passage layer,
said medium apertures having a total open area in the range from 1 % to 35 % of the total area of said film passage layer,
said large apertures having a total open area in the range from 1 % to 80 % of the total area of said film passage layer,
said extra-large apertures having a total open area in the range from 1 % to 83 % of the total area of said film passage layer,
said liquid transport apertures having a largest inner diagonal length and a smallest inner diagonal length, the ratio of said largest to said smallest inner diagonal length being in the range from 1 to 8,
said apertures following a distribution such that said extra large apertures are only distributed in the longitudinal center 80 % of the largest transverse width of said absorbent structure.

2. Absorbent article according to claim 1 wherein at least some of said liquid transport apertures have inner walls which depend at least 0.3 mm from the surface of said film passage layer said inner walls depend in a direction towards said absorbent structure of said article.

3. Absorbent article according to any of the preceding claims wherein the total open area of all said liquid transport apertures in said film passage layer is in the range from 15 % to 45 % of the total area of said film passage layer

4. Absorbent article according to any of the preceding claims wherein said topsheet comprises more than one passage layer.

5. Absorbent article according to any of the preceding claims wherein said extra large apertures are only distributed in the longitudinal center 80 %, preferably 70 %, of said largest transverse width of said absorbent structure.

6. Absorbent article according to any of the preceding claims wherein said large apertures are only distributed in the longitudinal center 80 %, preferably 60 %, most preferably 70 %, of said largest transverse width of said absorbent structure.

7. Absorbent article according to any of the preceding claims wherein said liquid transport apertures are only distributed in the longitudinal center of said topsheet.

8. Absorbent article according to any of the preceding claims wherein all said extra large apertures are only distributed in the transverse center 80 %, preferably 60 %, most preferably 50 %, of the largest longitudinal length of said wearer facing surface of said topsheet.

9. Absorbent article according to any of the preceding claims wherein said large apertures are only distributed in the transverse center 80 %, preferably 60 %, most preferably 50 %, of the largest longitudinal length of said wearer facing surface of said topsheet.

10. Absorbent article according to any of the preceding claims wherein said liquid transport apertures are only distributed in the transverse center of said topsheet.

Patentansprüche

1. Absorbierender Artikel mit einer Längsachse und einer Querachse, wobei der genannte Artikel ein Deckblatt, ein Rückenblatt und eine zwischen dem genannten Deckblatt und dem genannten Rückenblatt angeordnete Struktur umfaßt, das genannte Deckblatt eine zum Träger gerichtete Oberfläche und eine zur Kleidung gerichtete Oberfläche aufweist und das genannte Deckblatt eine Fallendurchgangsschicht umfaßt, die kleine, mittlere, große und extra-große Öffnungen für den Flüssigkeitstransport aufweist, wobei

die genannten kleinen Öffnungen eine Einzelfläche im Bereich von mehr als 0 mm^2 bis 0,1 mm^2 aufweisen,
die genannten mittleren Öffnungen eine Einzelfläche im Bereich von mehr als 0,1 mm^2 bis 0,8 mm^2 aufweisen,
die genannten großen Öffnungen eine Einzelfläche im Bereich von mehr als 0,8 mm^2 bis 1,4 mm^2 aufweisen,
die genannten extra-großen Öffnungen eine Einzelfläche im Bereich von mehr als 1,4 mm^2 bis 9 mm^2 aufweisen,
die genannten kleinen Öffnungen eine gesamte offene Fläche im Bereich von 0,1 % bis 8 % der gesamten Fläche der genannten Fallendurchgangsschicht aufweisen,
die genannten mittleren Öffnungen eine gesamte offene Fläche im Bereich von 1 % bis 35 % der gesamten Fläche der genannten Fallendurchgangsschicht aufweisen,
die genannten großen Öffnungen eine gesamte offene Fläche im Bereich von 1 % bis 80 % der gesamten Fläche der genannten Fallendurchgangsschicht aufweisen,
die genannten extra-großen Öffnungen eine gesamte offene Fläche im Bereich von 1 % bis 83 % der gesamten Fläche der genannten Fallendurchgangsschicht aufweisen,
die genannten Flüssigkeitstransportöffnungen eine größte innere diagonale Länge und eine kleinste innere diagonale Länge aufweisen, wobei das Verhältnis der genannten größten zu der genannten kleinsten inneren diagonalen Länge im Bereich von 1 bis 8 liegt,
wobei die genannten Öffnungen einer solchen Verteilung entsprechen, daß die genannten extra-großen Öffnungen nur in der Längsmitte auf 80 % der größten Querbreite der genannten absorbierenden Struktur verteilt sind.

2. Absorbierender Artikel nach Anspruch 1 in welchem mindestens einige der genannten Flüssigkeitstransportöffnungen innere Wände haben, die von der Oberfläche der genannten Fallendurchgangsschicht mindestens 0,3 mm herabhängen, wobei die genannten inneren Wände in einer Richtung zu der genannten absorbierenden Struktur des genannten Artikels herabhängen.

3. Absorbierender Artikel nach einem der vorhergehenden Ansprüche, in welchem die gesamte offene Fläche aller genannten Flüssigkeitstransportöffnungen in der genannten Fallendurchgangsschicht im Bereich von 15 % bis 45

% der gesamten Fläche der genannten Foliendurchgangsschichte liegt.

4. Absorbierender Artikel nach einem der vorhergehenden Ansprüche, in welchem das genannte Deckblatt mehr als eine Durchgangsschichte umfaßt.

5. Absorbierender Artikel nach einem der vorhergehenden Ansprüche, in welchem die genannten extra-großen Öffnungen nur in der Längsmitte auf 80 %, vorzugsweise 70 %, der genannten größten Querbreite der genannten absorbierenden Struktur verteilt sind.

6. Absorbierender Artikel nach einem der vorhergehenden Ansprüche, in welchem die genannten großen Öffnungen nur in der Längsmitte auf 90 %, vorzugsweise 80 %, am bevorzugtesten 70 %, der genannten größten Querbreite der genannten absorbierenden Struktur verteilt sind.

7. Absorbierender Artikel nach einem der vorhergehenden Ansprüche, in welchem die genannten Flüssigkeitstransportöffnungen nur in der Längsmitte des genannten Deckblatts verteilt sind.

8. Absorbierender Artikel nach einem der vorhergehenden Ansprüche, in welchem die genannten extra-großen Öffnungen nur in der Quermitte auf 80 %, vorzugsweise 65 %, am bevorzugtesten 50 %, der größten Längslänge der genannten zum Träger gerichteten Oberfläche des genannten Deckblatts verteilt sind.

9. Absorbierender Artikel nach einem der vorhergehenden Ansprüche, in welchem die genannten großen Öffnungen nur in der Quermitte auf 80 %, vorzugsweise 65 %, am bevorzugtesten 50 %, der größten Längslänge der genannten zum Träger gerichteten Oberfläche des genannten Deckblatts verteilt sind.

10. Absorbierender Artikel nach einem der vorhergehenden Ansprüche, in welchem die genannten Flüssigkeitstransportöffnungen nur in der Quermitte des genannten Deckblatts verteilt sind.

Revendications

1. Article absorbant ayant un axe longitudinal et un axe transversal, ledit article comprenant une feuille de dessus, une feuille de fond et une structure absorbante placée entre ladite feuille de dessus et ladite feuille de fond, ladite feuille de dessus ayant une surface faisant face à l'utilisateur et une surface faisant face au vêtement, et ladite feuille de dessus comprenant une couche pelliculaire de passage présentant des petits, moyens, grands et très grands orifices pour le transport de liquide,

lesdits petits orifices ayant une surface individuelle comprise dans la plage allant d'une valeur supérieure à 0 mm^2 à 0,1 mm^2
lesdits moyens orifices ayant une surface individuelle comprise dans la plage allant d'une valeur supérieure à 0,1 mm^2 à 0,5 mm^2
lesdits grands orifices ayant une surface individuelle comprise dans la plage allant d'une valeur supérieure à 0,5 mm^2 à 1,4 mm^2
lesdits très grands orifices ayant une surface individuelle comprise dans la plage allant d'une valeur supérieure à 1,4 mm^2 à 3 mm^2
lesdits petits orifices ayant une surface ouverte totale comprise dans la plage allant de 0,1 % à 5 % de la surface totale de ladite couche pelliculaire de passage,
lesdits moyens orifices ayant une surface ouverte totale comprise dans la plage allant de 1 % à 35 % de la surface totale de ladite couche pelliculaire de passage,
lesdits grands orifices ayant une surface ouverte totale comprise dans la plage allant de 1 % à 30 % de la surface totale de ladite couche pelliculaire de passage,
lesdits très grands orifices ayant une surface ouverte totale comprise dans la plage allant de 1 % à 35 % de la surface totale de ladite couche pelliculaire de passage,
lesdits orifices de transport de liquide ayant une longueur diagonale intérieure la plus grande et une longueur diagonale intérieure la plus petite, le rapport entre lesdites longueurs diagonales intérieures la plus grande et la plus petite étant compris dans la plage allant de 1 à 6,
lesdits orifices suivant une répartition telle que lesdits très grands orifices ne sont répartis que dans les 90% de la partie centrale longitudinale de la largeur transversale la plus grande de ladite structure absorbante.

2. Article absorbant selon la revendication 1 dans lequel au moins quelques-uns desdits orifices de transport de liquide ont des parois intérieures qui pendent au moins de 0,2 mm par rapport à la surface de ladite couche pelliculaire de passage, lesdites parois intérieures pendant dans une direction orientée vers ladite structure absorbante dudit article.

3. Article absorbant selon l'une quelconque des revendications précédentes, dans lequel la surface ouverte totale de tous lesdits orifices de transport de liquide ménagés dans ladite couche pelliculaire de passage est comprise dans la plage allant de 15 % à 40 % de la surface totale de ladite couche pelliculaire de passage.

4. Article absorbant selon l'une quelconque des revendications précédentes, dans lequel ladite feuille de dessus comprend plus d'une couche de passage.

5. Article absorbant selon l'une quelconque des revendications précédentes, dans lequel lesdits très grands orifices ne sont répartis que dans les 80 % de la partie centrale longitudinale, de préférence 70 %, de la largeur transversale la plus grande de ladite structure absorbante.

6. Article absorbant selon l'une quelconque des revendications précédentes, dans lequel lesdits grands orifices ne sont répartis que dans les 90 % de la partie centrale longitudinale, de préférence 80 %, de la manière la plus préférée 70 %, de la largeur transversale la plus grande de ladite structure absorbante.

7. Article absorbant selon l'une quelconque des revendications précédentes, dans lequel lesdits orifices de transport de liquide ne sont répartis que dans la partie centrale longitudinale de ladite feuille de dessus.

8. Article absorbant selon l'une quelconque des revendications précédentes, dans lequel tous lesdits très grands orifices ne sont répartis que dans les 80 % de la partie centrale transversale, de préférence 65 %, de la manière la plus préférée 50 %, de la longueur longitudinale la plus grande de ladite surface faisant face à l'utilisateur de ladite feuille de dessus.

9. Article absorbant selon l'une quelconque des revendications précédentes, dans lequel lesdits grands orifices ne sont répartis que dans les 80 % de la partie centrale transversale, de préférence 65 %, de la manière la plus préférée 50 %, de la longueur longitudinale la plus grande de ladite surface faisant face à l'utilisateur de ladite feuille de dessus.

10. Article absorbant selon l'une quelconque des revendications précédentes, dans lequel lesdits orifices de transport de liquide ne sont répartis que dans la partie centrale transversale de ladite feuille de dessus.

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Sanitary napkin with gross foramina overlying a low density, resilient structure.

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Description

Background of the Invention

Field of the Invention

This invention relates to devices designed to be used in contact with the human body to absorb bodily discharges. Such devices include sanitary napkins, diapers, bandages and the like.

Background art

Sanitary napkins, diapers, bandages, and the like intended for disposal after a single use are familiar items of modern commerce and are described in numerous articles and patents. For purposes of simplicity, the present invention will be described in terms of a sanitary napkin.

Mathews et al. in U.S. Patent 4,337,844 issued August 3, 1982, discuss a sanitary napkin comprising a cover (or topsheet), a resilient layer attached to the topsheet, an absorbent layer and a fluid baffle (or backsheet). These sanitary napkins are frequently intended to be supported adjacent the body through the agency of the user's undergarment (e.g. her panty). Mathews et al illustrate their sanitary napkin as being provided with garment fastening adhesive and an associated release liner. The cover is formed with pores having a particular size requirement designed to produce a "wet feeling surface" when the napkin is worn.

Fitzgerald in U.S. Patent No. 3,987,792 discloses a sanitary napkin formed of a three ply absorbent pad enclosed in a fluid-impermeable cover which is open on its body contacting surface. The uppermost ply of the absorbent pad is formed with large apertures to facilitate fluid transport into the interior plies of the pad.

Morse, in U.S. Patent 3,371,667 issued March 5, 1968 illustrates a conventional sanitary napkin having an outside foraminous cover (topsheet) and a highly absorbent, relatively dense core with a low density structure, such as a fibrous web of synthetic fibers, interposed between them. The foraminous cover is a woven or nonwoven fibrous material (usually cotton or rayon) having the normal random arrangement of apertures.

British Patent 1 [illegible], published August 8, 19[illegible], discusses a sanitary towel comprising an absorbent core member, an envelope (topsheet), and a wadding-like soft layer between them. The soft layer permits "liquid to pass directly therethrough to the absorbent core member without rendering possible, in any appreciable degree, absorption or lateral transportation of liquid in the soft fibrous layer." The envelope consists of a material "of a nature, such that liquid cannot be absorbed in or dispersed through the material of the envelope itself". It is provided with perforations on the side of the towel intended to face the body.

Summary of the Invention

According to the present invention there is provided a device for absorbing bodily fluids comprising a fluid pervious cover forming a topsheet having an inner surface and an outer body-contacting surface having an impact zone, said fluid porous topsheet being provided with a large number of small apertures and on the part of said topsheet forming said body-contacting surface, a smaller number of larger apertures, an absorbent layer underlying said cover a fluid impervious layer underlying said absorbent layer such that said absorbent layer is disposed between said fluid impervious layer and said body-contacting surface of said cover adhesive garment attachment means secured to the outer surface of said device on the surface thereof opposed to said body-contacting surface and an intermediate layer disposed between said cover and said absorbent layer, wherein

said topsheet is an apertured, formed, thermoplastic film;

the small apertures comprise fine foramina distributed over a major proportion of said body-contacting surface, each of said fine foramina having an equivalent hydraulic diameter defined as 4A/P where A is the area and P the perimetric dimension of the foramen, of from 0.12 to 1.25 mm;

the large apertures comprise gross foramina disposed in at least said impact zone and each having an equivalent hydraulic diameter of from 1.25 to 2.5 mm, wherein

the ratio of the number of said gross foramina to said fine foramina is less than 0.25 and the ratio of the equivalent hydraulic diameters of said gross foramina to said fine foramina is greater than 2;

the intermediate layer comprises a resilient layer of uniformly low density that is capable of recovery to at least 80% of its original volume after it is compressed to 20% of its original volume and the compressing forces are removed, said resilient layer being absorbent, at least as hydrophilic as said apertured topsheet, and unattached thereto; and

a wicking layer disposed between said intermediate layer and said topsheet, adjacent the inner surface of said topsheet, and being non-extant in register with the gross foramina thereof, said wicking layer being more hydrophilic than said apertured topsheet.

Preferably the ratio of the equivalent hydraulic diameters of the gross and fine foramina is greater than 3.

The absorbent device of the invention comprises a topsheet which is generally pervious to liquids and which is provided with gross foramina (large apertures) at least in the zone normally subject to impact by the bodily discharge the device is designed to absorb. The gross foramina constitute a minority in number as compared to the fine foramina which tend to render the topsheet generally pervious to liquids. The topsheet, which is sometimes referred to as an "apertured topsheet" is a formed thermoplastic film. The apertured topsheet is hydrophobic and requires a wicking layer which is in contact with the apertured topsheet. The wicking layer is hydrophilic

and has small absorbent capacity (at least in the impact zone discussed infra) as compared to other absorbent elements in the device. The wicking layer is nowhere in register with the gross foramina of the apertured topsheet, which is particularly important in those circumstances where the gross foramina are relatively large.

A resilient layer underlies the apertured topsheet. It is interposed between the apertured topsheet and the absorbent core described infra. While the resilient layer must exist in register with that region of the topsheet which is normally subject to impact by bodily discharges, it can extend over a major portion of the body-contacting surface of the absorbent device, and even along its sides; it preferably exists, however, only in the region subject to impact by bodily discharges. The resilient layer is formed primarily of a mass of hydrophobic, moisture insensitive, resilient fibers. Fiber dimensions are selected for both comfort and fluid transfer reasons and may take a range of values. In one embodiment the resilient fibers are bonded together to create a structure having even greater resilience. In another embodiment the resilient layer as a whole is actually hydrophilic, but is less hydrophilic than the absorbent core described infra.

In still another embodiment, the resilient layer comprises ancillary absorbent material such as the fibrous cellulosic fibers described in U.S. Patent 3,595,294 which issued to Dean and Ferguson on July 20, 1971 and the substantially insoluble acidic carboxymethylcellulose products described in U.S. Patent 3,678,031 which issued to Schoggen on July 18, 1972.

Other ancillary absorbent materials can include any of the so called super absorbent materials such as the cross-linked polyacrylates and cross-linked starch-acrylate polymers well known to those skilled in the art.

Fourth, there is an absorbent core which can be, in general, any absorbent material known to the art. Wood pulp fluff, comminuted sponge, superabsorbent materials, and the like, alone and in combination, can be used. A fibrous core can be bonded or unbonded. The absorbent core must be more hydrophilic than the resilient layer.

Fifth, there is a liquid impermeable moisture barrier which can be any material well known to those skilled in the art. It can be completely impermeable, as polyethylene film, or it can be liquid impermeable but vapor permeable, as any of the various breathable backsheets known to the art.

Brief description of the drawings

Figure 1 is a plan view of a generalized sanitary napkin.

Figure 2 is a cross sectional view of the sanitary napkin of Figure 1 taken along line 2—2 of Figure 1. (In all of the cross sectional views, the thicknesses of certain materials have been exaggerated for clarity.)

Figure 3 is an enlarged fragmentary plan view of a portion of an absorbent device.

Figure 4 is a fragmentary cross sectional view of the absorbent device shown in Figure 3 taken along line 4—4 of Figure 3.

Detailed description of the invention

While this specification concludes with claims particularly pointing out and distinctly claiming that which is regarded as the invention, it is believed that the invention can be better understood through a perusal of the following detailed description of the invention in connection with study of the associated drawings.

As noted supra, for purposes of simplicity, the present invention will be discussed in terms of a sanitary napkin.

Figure 1 is a plan view of a generalized sanitary napkin 10. Figure 2 is a cross sectional view of sanitary napkin 10 taken along line 2—2 of Figure 1. (In this specification, all the reference numerals are used consistently among the various figures to denote equivalent and similar elements.)

As illustrated in Figure 1 sanitary napkin 10 is an elongate absorbent device intended to be maintained in a woman's crotch region to absorb vaginal discharges such as menses. The version of sanitary napkin 10 illustrated in Figure 1 has generally straight longitudinal edges and rounded ends. It is to be emphasized that this design is used for illustrative purposes only; any convenient design known to those skilled in the art can be used in the practice of the present invention. The sanitary napkin can, for example, have a generally hourglass shape wherein the longitudinal edges are curvilinear and the central portion is narrower in the lateral direction than are the end portions. Such a design is generally illustrated in U.S. Patent 4,324,246 issued to Mullane and Smith on April 13, 1982. The present invention can also be used with the compound sanitary napkin described by Des Marais in U.S. Patent 4,425,130 issued January 10, 1984. Further the present invention can be used with the form of sanitary napkin having side panels described by McNair in U.S. Patent 4,285,343 issued August 25, 1981.

Likewise, the cross sectional view of sanitary napkin 10 shown in Figure 2 merely illustrates one typical configuration of a sanitary napkin employing the present invention. Skilled artisans can readily adapt the following teachings to other embodiments without departing from the scope and tenor of the present invention.

In this embodiment, panty fastening adhesive 16 is shown to be a single strip of adhesive which extends over a major portion of the longitudinal length of sanitary napkin 10 on the side of the device opposite body-contacting surface 21. Other configurations for the application of the panty fastening adhesive, such as multiple longitudinal stripes, can be used. Any of the pressure sensitive adhesives commonly used in the art, such as Century A-305IV adhesive manufactured by Century Adhesive Corporation and Instant Lok 34-2823 manufactured by National Starch Company, can be used. Panty fastening adhesive 16 is

usually covered, prior to the time the user affixes the sanitary napkin to her undergarment, with release liner 17. Release liner 17 serves to keep panty fastening adhesive 16 from drying out and to keep it from sticking to extraneous surfaces prior to use. Any release liner commonly used for such purposes can be used with this invention. Nonlimiting examples of suitable release liners are BL30MG-A Silox E1-0 and BL30MG-A Silox 4P/0 manufactured by Akrosil Corporation.

Embodiments of sanitary napkins designed to be supported adjacent the user's body by various belts and the like can likewise benefit from the practice of the present invention.

Two of the necessary elements of the present invention comprise an apertured topsheet which is generally pervious to liquids and which is provided with gross foramina at least in the zone normally subject to impact by the bodily discharges the device is designed to absorb, and a resilient layer underlying the apertured topsheet.

The topsheet is the part of an absorbent device which contacts the user's body. Frequently it is also an overwrap for the device as illustrated in Figure 2. The topsheet must be soft, conformable, and unirritating to the user's body.

Since the topsheet is the portion of the absorbent device which contacts the user's body, bodily discharges must pass through the topsheet into the body (or bulk) of the absorbent device. Bodily discharges such as menses frequently comprise fluids (of various viscosities), semi-fluid materials, and particulate materials. While many conventional prior art topsheets have been found to function adequately, many do not allow the efficient transport therethrough of semi-fluid and particulate materials. The present invention addresses this problem.

In Figures 1 and 2, apertured topsheet 11 is generally permeable to liquids and is provided with gross foramina in the zone subject to impact by the bodily discharges the device is designed to absorb.

In the first place, the apertured topsheet must be generally permeable to fluids over most of that surface of the device which contacts the user's body; the permeability must be separate, apart, and in addition to that provided by the gross foramina discussed infra. Thus a material such as polyethylene film which is normally impermeable to fluids is not suitable.

Suitable apertured topsheets comprise formed thermoplastic films. As used herein, the term "formed thermoplastic film" or "formed film" refers to sheets which are a continuous layer of polymeric material which has been provided with embossments and apertures. Preferred formed films include those described with particularity in U.S. Patent 4,324,246 issued to Mullane and Smith on April 13, 1982; U.S. Patent 4,342,314 issued to Radel and Thompson on August 3, 1982; U.S. Patent 4,323,069 issued to Ahr and Smith on April 6, 1982; and U.S. Patent 3,929,135 issued to Thompson on December 30, 1975.

Permeability of the formed thermoplastic films is provided by the multiplicity of apertures (sometimes referred to as "fine foramina" and denoted by reference numeral 31 in Figure 3).

Apertured topsheet 11 must be provided with a multiplicity of gross foramina 32. While the entire surface 21 of apertured topsheet 11 which contacts the user's body can be provided with gross foramina, only that portion of apertured topsheet 11 comprising impact zone 18 (as delineated by the dotted line in Figure 1) must of necessity be so provided.

Impact zone 18 is illustrated in connection with sanitary napkin 10 as falling generally in the central region of body contacting surface 21. The exact location and size of impact zone 18 will vary according to the precise design and intended positioning of the sanitary napkin, diaper, bandage, or the like and can be readily ascertained by skilled artisans.

One important function of the topsheet of a sanitary napkin, disposable diaper and the like is to present a dry surface in contact with the user's body even though bodily discharges have been absorbed by the device. In addition to relative surface hydrophobicity and the presence of the resilient layer as discussed infra, surface dryness is partially achieved by controlling the size of the fine foramina within specified limits. Exceeding these upper size limits normally destroys the ability of the topsheet to present a dry surface by allowing reverse flow of bodily discharges. It has been surprisingly discovered that the usual upper size limits of the fine foramina can be exceeded in a controlled fashion in an apertured topsheet provided the resilient layer discussed infra is also present in the device.

If the apertured topsheet achieves its general permeability through the presence of a major number of fine foramina having dimensions (such as Equivalent Hydraulic Diameters) in the range of from 0.005 to 0.050 inch (0.12 to 1.25 millimeters), then it may be provided with a minor number of gross foramina having dimensions of from 0.05 to 0.375 inch (1.25 to 9.53 millimeters). Preferably, the topsheet is provided with a major number of fine foramina having dimensions of from 0.010 to 0.035 inch (0.25 to 0.89 millimeter) and a minor portion of gross foramina having dimensions of from 0.050 to 0.375 inch (1.25 to 9.53 millimeters). The ratio of the dimensions of the gross foramina to the fine foramina should be greater than 2, preferably greater than 3. It is not necessary that all the fine foramina and all the gross foramina have equal sizes; a distribution of sizes is satisfactory. (Equivalent Hydraulic Diameter is defined as four times the quotient obtained when the area of a foramen is divided by its perimeter. In the case of circular foramina, the Equivalent Hydraulic Diameter is the diameter of the circle.)

The relationship between major and minor numbers depends upon the size distributions of the fine foramina and the gross foramina. Gross foramina should constitute no more than 20% of the total number of foramina in the apertured topsheet. Further, in general, if the fine foramina,

desirable to reduce the temperature of the macroscopically expanded web to its solid state temperature prior to subjecting it to high pressure liquid jetting to avoid damage, a low pressure liquid spray 740 is preferably applied to the web adjacent stationary baffle 730 by means of a low pressure liquid nozzle 735. As pointed out earlier herein, the need for such liquid-assisted cooling generally increases as the web production speed increases beyond about 50 feet per minute.

Fine scale aperturing and further cooling of the web are provided via high pressure liquid nozzle 790 located intermediate stationary baffles 730 and 780. The high pressure liquid jet nozzle 790 discharges a liquid jet 800 onto the exposed surface of the macroscopically conformed web 210. The liquid jet 800 creates apertures 211 corresponding to the small apertures 216 in the forming structure, as generally illustrated in FIG. 9B, which is substantially identical to the cross-section shown in FIG. 6B. In a preferred embodiment, the temperature of the liquid jet 800 is sufficiently low that it aids in further cooling the web 210, thereby better preserving the macroscopic cross-section imparted to the film by the suction emanating from within vacuum chamber 720.

Thus, the process embodiment of FIG. 9 functions in a manner generally similar to that of FIG. 6 utilizing a slightly different apparatus configuration, the chief difference involving the use of a single vacuum chamber 720 spanning both forming phases. The resultant web 210 shown in greatly enlarged cross-section in the inset of FIG. 9C is substantially identical to the web shown in FIG. 6C.

As with the earlier embodiments of the present invention, the web 210 is fed about an idler roll 795 and thereafter directed either to suitable rewind apparatus or to a converting operation.

The process embodiment shown in FIG. 10 is substantially identical to the process embodiment shown in FIG. 9 with one major exception, the configuration of the forming structure. In particular the forming structure 850 utilized in the embodiment of FIG. 10 is shown in greatly enlarged fragmentary perspective in FIG. 11. The forming structure 850 exhibits an overall cross-sectional pattern similar to that of forming structure 50 shown in FIG. 4, including a multiplicity of macroscopic cross-section apertures 855 which are generally similar to apertures 55 in forming structure 50. However the base of the apertures 855 is closed by means of a perforate wall 857. This perforate wall 857 includes a multiplicity of relatively small apertures 816, as generally shown in FIG. 11.

Techniques which may be readily adapted for making forming structures of the type generally disclosed in FIG. 11 are disclosed in commonly assigned U.S. Pat. No. 4,395,215 issued to Bishop on July 26, 1983 and hereby incorporated herein by reference.

In use, a web of soft heated resin 810 is preferably extruded from extruder 701 onto the surface of forming structure 850, as generally shown in FIG. 10. The influence of suction emanating from within vacuum chamber 720 causes the web 810 to assume the macroscopic profile of the forming structure 850, as generally shown in FIG. 10A. However, because of the relatively small size of apertures 816 in the end wall portions 857 of the forming structure 850, the fluid pressure differential applied by the vacuum chamber 720 is generally not sufficient to cause rupture of the web in those areas coinciding with apertures 816 in the forming structure.

As with the embodiment shown in FIG. 9, a low pressure liquid spray 740 may be applied adjacent stationary baffle 730 by means of a low pressure liquid nozzle 735. Since the web is not apertured at this point, the applied cooling liquid cannot pass directly through the web at the point of application. Accordingly, alternative liquid collection means may be provided adjacent the lateral edges of the web. Preferably cooling nozzle 735 is so repositioned adjacent the periphery of forming drum 718 that the bulk of the applied cooling liquid will drain toward high pressure liquid nozzle 790 by gravity.

To provide small scale aperturing in the end walls of the capillary networks 812, high pressure liquid nozzle 790 issues a jet of liquid 800 against the exposed surface 814 of the macroscopically expanded web 810. As with the embodiment of FIG. 9, the high pressure liquid jet 800 apertures the web 810 in those areas which are as yet unapertured, in this case those areas coinciding with apertures 816 in the forming structure. In addition, the liquid jet 800 preferably further assists in further cooling the web 810 in its fully conformed and maximally distended condition, since it is at this point still subject to the forming vacuum.

As a result, the finished web 810 passing from the forming structure 850 exhibits the cross-section generally shown in the greatly enlarged inset of FIG. 10C. Each capillary network 812 is formed by substantially continuous, interconnected, imperforate sidewalls 812a. Each capillary network 812 also includes an end wall portion 812b which contains a multiplicity of relatively small apertures 811 corresponding to apertures 816 in forming structure 850. As described earlier herein, the apertures 811 form small capillary networks, each resembling a volcano having small cusps 813 about its periphery on surface 817 of the web.

Macroscopically expanded, three-dimensional, apertured polymeric webs of the type generally disclosed in FIG. 10C are believed particularly well suited for use in those situations where it is desired to isolate the wearer's skin from a moist absorbent member adjacent the lowermost surface 817 of the web, yet provide vapor permeability through the small apertures 811 provided in the end walls 857 of the capillary networks 812.

FIG. 12 is a plan view photograph, enlarged many times actual size, of a macroscopically expanded, three-dimensional, apertured plastic web made via a process of the type generally disclosed in FIG. 1, but exhibiting a different macroscopic, three-dimensional pattern.

The web 1010 shown in FIG. 12 was formed from 1 mil thick polyethylene which was first apertured on a fine scale mesh screen comprised of wire monofilaments having a diameter of about 1.7 mils and a mesh count of 120 filaments by 120 filaments per square inch. The finely apertured web was thereafter reverse wrapped onto a macroscopic forming structure of the type generally similar to that disclosed in FIG. 4, but exhibiting a different macroscopic, three-dimensional pattern. The macroscopic forming structure exhibited an overall thickness of 16 mils and a regularly spaced pattern of substantially round apertures, each measuring approximately 24 mils at its point of maximum width, said apertures being spaced approximately 67 mils from one another center-to-center distance. The web was formed using a two-phase forming process of the type generally disclosed in FIG. 1 by applying a pressure of 1000 psig and a water flow rate of 10 gallons per minute per inch of web width at high pressure liquid nozzle 35 and a

pressure of 300 psig and a water flow rate of 8 gallons per minute per inch of web width at high pressure liquid nozzle 90. The vacuum at chamber 25 was maintained at 2 inches of mercury, and the vacuum at chamber 85 was maintained at 2 inches of mercury. The resultant web 1010 exhibited an overall caliper of approximately 20 mils, as measured under no load, and a soft and pleasing tactile impression, particularly in those non-debossed areas coinciding with the land areas of the forming structure.

FIG. 13 is a further enlarged photograph of a section of the web shown generally in FIG. 12. The tiny apertures 1011 the cusps of which are oriented out of the plane of the paper correspond to the void spaces at the interstices formed between the intersecting filaments of the first woven wire forming structure, while the macroscopic cross-section capillary networks 1012, which are oriented into the plane of the paper, correspond to the macroscopic cross-section apertures present in the macroscopic forming structure.

The specific conditions under which macroscopically expanded, three-dimensional web 1010 was produced and the apparatus utilized are more fully described in connection with Example I, which is described in detail near the end of the present specification.

FIG. 14 is a plan view photograph, enlarged many times actual size, of an alternative plastic web made utilizing a multi-phase web forming process generally similar to that disclosed in FIG. 6. This particular web 1110 exhibits fine-scale apertures in combination with macroscopic cross-section capillary networks of several different sizes. As can best be seen in the greatly enlarged segment of FIG. 15, the relatively small apertures 1111 which form tiny volcano-shaped capillary networks correspond to the fine-scale apertures which are present in the land areas of the macroscopic forming structure on which the web was formed, while the macroscopic cross-section capillary networks 1112 and 1115 correspond to the macroscopic cross-section apertures which are also present in the forming structure. The cusps associated with fine-scale apertures 1111 and the capillary networks 1112 and 1115 are all oriented into the plane of the paper.

The specific conditions under which macroscopically expanded, three-dimensional, apertured polymeric web 1110 was produced are more fully described in connection with Example II, which is described in detail near the end of the present specification.

Finally, FIG. 16 is a plan view photograph of a polymeric web of the type generally disclosed in FIG. 10, enlarged many times actual size.

The web 1210 was processed generally in accordance with the multi-phase process schematically shown in FIG. 10. It includes a multiplicity of capillary networks 1212 corresponding to the capillary networks present in the forming structure. The apertures 1211 located in the end walls of the capillary networks correspond to small apertures located in the end walls of the capillary networks contained in the forming structure.

The specific conditions under which web 1210 was produced are more fully described in connection with Example III, which is also described in detail near the end of the present specification.

As will be appreciated, it is not necessary that the entire surface of a polymeric web be processed in accordance with the present invention. It may, for example, be desirable to provide a pattern of tiny apertures across the entire surface of a web while macroscopically expanding and/or macroscopically aperturing the web only in discrete predetermined areas. One particularly preferred approach for carrying out such a process is disclosed in FIG. 17.

FIG. 17 is yet another simplified schematic illustration of a multi-phase polymeric web forming process of the present invention. Like the process generally illustrated in FIG. 1, the process shown in FIG. 17 is carried out in two discrete phases. Film supply roll 2001 is substantially equivalent to film supply roll 1 in FIG. 1; web 2010 is substantially equivalent to web 10 in FIG. 1; forming drums 2018 and 2058 are substantially equivalent to forming drums 18 and 58, respectively; vacuum chambers 2020 and 2080 are substantially equivalent to vacuum chambers 20 and 85 in FIG. 1, stationary baffles 2025 and 2030 are substantially equivalent to stationary baffles 25 and 30 in FIG. 1; forming structures 2015 and 2050 are substantially equivalent to forming structures 15 and 50 in FIG. 1, and first phase high-pressure nozzle 2035 which applies a high pressure liquid jet 2040 is substantially equivalent to high pressure liquid nozzle 35 which applies a high pressure liquid jet 40 in FIG. 1. However the process system illustrated in FIG. 17 employs a nip type transfer between forming structure 2015 and forming structure 2050. This permits transfer of the web 2010 without loss of register between the patterns on forming structures 2015 and 2050. This is possible because the nip transfer avoids machine direction stretching of the web until both phases of the process have been carried out.

The process system illustrated in FIG. 17 differs from that illustrated in FIG. 1 in one principal aspect. In particular the second phase high pressure liquid nozzle 2090, which is substantially equivalent to high pressure liquid nozzle 90 in FIG. 1, is located inside a third drum 2068 which carries a rotating mask element 2065 about its periphery. As with the embodiment shown in FIG. 1, a pair of stationary baffles 2070 and 2080 enclose high pressure nozzle 2090. However the latter baffles are located within the drum 2068.

High pressure liquid nozzle 2090 discharges a high pressure liquid jet 2100 substantially equivalent to high pressure liquid jet 100 in FIG. 1. However the presence of mask element 2065 permits the high pressure liquid jet 2100 to contact web 2010 only in those areas coinciding with the openings in the apertured mask element 2065.

As will be appreciated, the openings in the mask element 2065 can be of any desired shape and may, for example, include a logo or similar decorative pattern which will define the pattern of macroscopic expansion which will be carried out as liquid jet 2100 contacts web 2010 while it is supported on forming structure 2050. An exemplary mask pattern is illustrated in FIG. 18, which is taken along view line 18—18 of FIG. 17. This particular pattern comprises a multiplicity of apertures 2066, each resembling an infant with outstretched arms and legs.

As will be appreciated by those skilled in the art, the cross-section of web 2010 after high pressure water jetting by first phase nozzle 2035, if examined at the inset labeled "A" in FIG. 17, will be identical to that of web 10 shown in FIG. 1B. Similarly, the cross-section of that portion of the web 2010 which coincides with the apertures 2066 in mask element 2065, if examined at the inset labeled "B" in FIG. 17, will be substantially identical to that of web 10 in FIG. 1E. However, as will be appreciated from FIG. 18, which is a simplified sche-

matic view taken along view line 19—19 of FIG. 17 those portions of web 2010 which did not align with apertures 2068 in mask element 2065 will exhibit only the finely apertured pattern analogous to that of web 10 in FIG. 1C, while those portions of the web 2010 which coincided with apertures 2068 in masking element 2065 as it passed beneath nozzle 2090 i.e., coinciding with a section line such as "Z"—"Z" in FIG. 19, will exhibit both the fine-scale apertures 2011 and a multiplicity of capillary networks 2012 which correspond to capillary networks 12 in the web embodiment of FIG. 1. To more clearly differentiate portions 2010 from the balance of the web illustrated in the simplified schematic of FIG. 19, the fine scale apertures 2011 (which are present across the entire surface of the web) are not shown in the simplified schematic of FIG. 19 in those portions of the web 2010 which coincided with apertures 2068 in masking element 2065 as it passed beneath nozzle 2090.

As shown in FIG. 17 the finally processed web embodiment 2010 is preferably removed from forming structure 2060 about a series of idler rolls 2110, 2120 and 2130, from whence it is directed either to suitable rewind apparatus or to on-line converting operations, as desired.

Processing systems of the type generally shown in FIG. 17 are particularly preferred in those situations where it is desirable to hold close register between the pattern on forming structure 2015 and the pattern on forming structure 2060. Furthermore, the use of a mask element, such as 2065, permits the producer to utilize a wider range of liquid jetting pressures to issue from high pressure nozzle 2090 since there is no degradation of any characteristics initially imparted to those portions of the web which do not coincide with apertures 2068 in mask element 2065 as it passes beneath nozzle 2090.

It is recognized that the ability to accurately register patterns between adjacent forming structures makes it possible to produce webs exhibiting a wide range of effects. It is further recognized that because it is possible to adjust the registration of the patterns on adjacent forming structures relative to one another it is feasible to combine the selected patterns with one another to produce many different effects in the resultant web.

It is believed that the description contained herein will enable one skilled in the art to practice the present invention in many and varied forms. Nonetheless, the following exemplary embodiments are set forth for purposes of illustration:

EXAMPLE I

The macroscopically expanded, three-dimensional apertured web 1810 shown in FIGS. 12 and 13 was made in step-wise fashion, generally following the two stages of the process disclosed in FIG. 1. The input web (10) was polyethylene, 0.001 inches thick (Consolidated Thermoplastics, #24765, Harrington, Del. 19952). This web (10) was fed onto forming structure (15) at a speed of 500 feet per minute and subjected to the high pressure water jet (40). The water temperature was 165° F., the water pressure about 1000 psig, and the water flow about 10 gallons per minute per cross-machine direction inch of web width. The forming structure was a woven wire 120×120 mesh screen, having 0.0037 inch wires. (Cambridge Wire Cloth Co., Cambridge, Md. 21613.) This first stage produced a web containing a multiplicity of small apertures, approximately 0.004 inches in diameter, at a density of 120 such apertures per linear inch in both directions. This finely apertured web was then wound onto a take-up roll. The second stage was carried out by taping a 6 inch by 12 inch portion of the aforementioned finely apertured web onto a different forming structure. This forming structure contained apertures of approximately 0.036 inch in diameter spaced 0.087 inches center to center on a 60° array. The finely apertured web was reverse wrapped (small capillary networks oriented toward the second high pressure liquid nozzle) on the latter forming structure and subjected to a high pressure water jet at a web speed of approximately 300 feet per minute. The water temperature was 135° F., the water pressure was about 500 psig and the water flow was approximately 8 gallons per minute per cross-machine direction inch of web width. The resultant macroscopically expanded, three-dimensional, apertured web shown in FIGS. 12 and 13 contained small elliptically shaped apertures 1811 measuring approximately 0.004 inches across their major axis and elliptically shaped macroscopic cross-section capillary networks 1812 measuring approximately 0.022 inches across their major axis. The overall no load caliper of the expanded web was approximately 0.015 inches.

EXAMPLE II

The macroscopically expanded, three-dimensional, apertured polymeric web 1110 shown in FIGS. 14 and 15 was made by the type of process generally disclosed in FIG. 6. A National Rubber Machinery Co. Prodex III (NRM Process Systems, P.O. Box 25, Columbiana, Ohio 44408) extruder with a 12 inch die set at 0.010 inches and 500° F. was used to extrude low density polyethylene (USI, U.S. Industrial Chemicals, Division Nat'l Dist. of Chemicals, 11500 Northlake Drive, Cincinnati, Ohio 45249, type NA344 resin) onto a forming structure rotating about the first stage forming drum (718). Due to the drawing of the web between the extruder and the forming structure, the initial thickness of the web when subjected to the first fluid pressure differential was about 0.001 inches. The forming structure in question exhibited apertures of three different diameters; 0.030 inches; 0.015 inches; and 0.010 inches. Web speed was 150 feet per minute. In the first stage, the larger capillary networks (1112 and 1118) were substantially formed and apertured, obtaining a high quality three-dimensional image of the forming structure. The smallest apertures (1111) were not formed in the first stage, for reasons previously described herein. As the macroscopically expanded film entered the second stage, it was subjected to a high pressure water jet (408) at 900 psig, 160° F, and 10 gallons per minute per cross-machine direction inch of web width. The nozzle (408), Spraying Systems Co., North Avenue at Schmale Road, Wheaton, Ill. 60189, #2520, was about 4 inches from the surface of the film. The smallest apertures (1111) were formed at this time. The resultant film contained capillary networks having the following approximate diameters: large (1118) 0.065 inches, medium (1112) 0.025 inches; and small (1111) less than about 0.005 inches. The overall no load caliper of the resultant web was approximately 0.040 inches.

EXAMPLE III

The macroscopically expanded, three-dimensional, apertured polymeric web 1210 shown in FIG. 16 was also made by the type of process generally disclosed in FIG. 6, but using a forming structure of the type gener-

ally disclosed in FIG. 11. The extruder and resin type were the same as described in Example II, above. All process operating conditions were substantially the same as those described in Example II, above, the primary difference being the forming structure. The forming structure was similar to that of FIG. 11, but with square debossments (806) having a 0.125 inch long sidewall. The debossments were 0.025 inches deep. The land areas were 0.025 inches in width. The perforate end wall (807) contained a multiplicity of small apertures (816), each measuring approximately 0.008 inches in diameter with a density of 80 such apertures per linear inch in both directions. The film was macroscopically expanded in the first stage, forming approximately 0.025 inches deep capillary networks with closed end walls. The second stage of the process provided the small apertures (816) in the end walls of the capillary networks. The resultant macroscopically expanded, three-dimensional, apertured web exhibited square capillary networks (806) measuring approximately 0.120 inches on a side with apertures (816) measuring about 0.005 inches in their end walls.

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

What is claimed is:

1. A continuous, multi-phase process for debossing and perforating a substantially continuous web of substantially planar polymeric film to form a macroscopically expanded, three-dimensional, apertured polymeric web, said process comprising the steps of:

(a) continuously supporting said web of film on a forming structure exhibiting a multiplicity of fine-scale apertures which place the opposed surfaces of said forming structure in fluid communication with one another said forming structure moving in a direction parallel to the direction of travel of said web of film and carrying said web of film in said direction;

(b) substantially continuously applying a first fluid pressure differential across the thickness of said web of film along said direction of movement of said forming structure exhibiting said fine-scale apertures, said fluid pressure differential being sufficiently great to cause said web of film to rupture in those areas coinciding with said fine-scale apertures in said forming structure;

(c) continuously supporting said finely apertured web of film on a forming structure exhibiting a macroscopic, three-dimensional, cross-section defined by a multiplicity of macroscopic cross-section apertures which place the opposed surfaces of said forming structure in fluid communication with one another said forming structure moving in a direction parallel to the direction of travel of said web of film and carrying said web of film in said direction; and

(d) substantially continuously applying a second fluid pressure differential across the thickness of said web of film along said direction of movement of said forming structure, said second fluid pressure differential being sufficiently great to cause said web of film to be urged into substantial conformance with the macroscopic, three-dimensional cross-section of said forming structure while substantially maintaining the integrity of said fine-scale apertures formed by said first fluid pressure differential.

2. The process of claim 1, wherein said fine-scale aperturing of said web and said macroscopic conformance of said web are performed on separate forming structures.

3. The process of claim 2, wherein said fine-scale aperturing of said web is carried out across the surface of said web on a first forming structure, said finely apertured web being thereafter fed from said first forming structure onto a second forming structure, where it is urged into conformance with the three-dimensional, macroscopic cross-section of said second forming structure.

4. The process of claim 2, wherein said second fluid pressure differential is sufficiently great to rupture said web in those areas coinciding with said macroscopic cross-section apertures in said forming structure.

5. The process of claim 3, wherein said web is fed onto said second forming structure so that the surface of the web which contacted said first forming structure does not contact said second forming structure.

6. The process of claim 5, wherein said web is transferred from said first forming structure to said second forming structure by passing it through a nip formed between said first and second forming structures.

7. The process of claim 1 wherein said fine scale aperturing of said web is carried out by directing a high pressure liquid jet at said web.

8. The process of claim 1, wherein said web is urged into substantial compliance with said forming structure exhibiting a macroscopic, three-dimensional cross-section by directing a high pressure liquid jet at said web.

9. The process of claim 1, wherein said web is urged into substantial compliance with said forming structure exhibiting a macroscopic, three-dimensional cross-section by subjecting the non-web contacting surface of said forming structure to vacuum.

10. The process of claim 1, wherein said web of substantially planar polymeric film is initially formed by extrusion of a resin melt.

11. The process of claim 1, wherein only a predetermined portion of said web is caused to rupture in those areas coinciding with said fine scale apertures.

12. The process of claim 1, wherein only a predetermined portion of said web is caused to substantially conform to said macroscopic, three-dimensional cross-section of said forming structure.

13. The process of claim 11 or claim 12, wherein an apertured mask element is interposed between said fluid pressure differential and said web to limit the portions of said web to be subjected to said fluid pressure differential to those areas coinciding with said apertures in said mask element.

14. The process of claim 6, wherein said fine scale apertures imparted to said web and said macroscopic, three-dimensional cross-section imparted to said web are maintained in register with one another by avoiding stretching of said web as it is transferred from said first forming structure to said second forming structure.

15. A continuous, multi-phase process for debossing and perforating a substantially continuous web of substantially planar polymeric film to form a macroscopically expanded, three-dimensional, apertured polymeric web, said process comprising the steps of:

(a) continuously supporting said web of film on a first forming structure exhibiting a multiplicity of fine-scale apertures which place the opposed surfaces of said forming structure in fluid communication with one another said forming structure moving in a direction parallel to the direction of travel of said web of film and carrying said web of film in said direction;

(b) substantially continuously applying a first fluid pressure differential comprising a high pressure liquid jet across the thickness of said web of film along said direction of movement of said forming structure exhibiting said fine-scale apertures, the force applied by said fluid jet being sufficiently great to cause said web of film to rupture in those areas coinciding with said fine-scale apertures in said first forming structure;

(c) transferring said finely apertured web of film to a second forming structure exhibiting a macroscopic three-dimensional, cross-section defined by a multiplicity of macroscopic cross-section apertures which place the opposed surfaces of said second forming structure in fluid communication with one another said second forming structure moving in a direction parallel to the direction of travel of said web of film and carrying said web of film in said direction; and

(d) substantially continuously applying a second fluid pressure differential comprising a second high pressure liquid jet across the thickness of said web of film along said direction of movement of said second forming structure, said second fluid pressure differential being sufficiently great to cause said web of film to be urged into substantial conformance with the macroscopic, three-dimensional cross-section of said second forming structure and to rupture in those areas coinciding with said macroscopic cross-section apertures in said second forming structure while substantially maintaining the integrity of said fine-scale apertures formed by said first fluid pressure differential in the areas of said web which are outside said macroscopic cross-section apertures.

16. The process of claim 15, wherein said web is fed onto said second forming structure so that the surface of the web which contacted said first forming structure does not contact said second forming structure.

17. The process of claim 15, wherein said web is transferred from said first forming structure to said second forming structure by passing it through a nip formed between said first and second forming structures.

18. The process of claim 15, wherein only a predetermined portion of said web is caused to substantially conform to said macroscopic three-dimensional cross-section of said second forming structure.

19. The process of claim 18, wherein an apertured mask element is interposed between said second high pressure fluid jet and said web to limit the portions of said web to be subjected to said second high pressure liquid jet to those areas coinciding with said apertures in said mask element.

20. A continuous, multi-phase process for debossing and perforating a substantially continuous web of substantially planar polymeric film to form a macroscopically expanded, three-dimensional, apertured polymeric web, said process comprising the steps of:

(a) continuously supporting said web of film on a forming structure exhibiting a multiplicity of fine-scale apertures which place the opposed surfaces of said forming structure in fluid communication and a macroscopic, three-dimensional cross-section defined by a multiplicity of macroscopic cross-section apertures which also place the opposed surfaces of said forming structure in fluid communication with one another said forming structure moving in a direction parallel to the direction of travel of said web of film and carrying said web of film in said direction;

(b) substantially continuously applying a first fluid pressure differential comprising vacuum to the non-web contacting surface of said forming structure, thereby causing said web of film to be urged into substantial conformance with the macroscopic, three-dimensional cross-section of said forming structure and to rupture in those areas coinciding with said macroscopic cross-section apertures in said forming structure;

(c) substantially continuously applying a second fluid pressure differential comprising a high pressure liquid jet across the thickness of said web of film along said direction of movement of said forming structure, the force applied by said liquid jet being sufficiently great to cause said web of film to rupture in those areas coinciding with said fine-scale apertures in said forming structure while substantially maintaining the integrity of the macroscopic, three-dimensional configuration formed by said first fluid pressure differential.

21. The method of claim 20, wherein the temperature of said web is elevated to a molten state prior to subjecting said web to vacuum.

22. The process of claim 21, wherein said web of substantially planar polymeric film is initially formed by extrusion of a resin melt directly onto said forming structure.

23. The process of claim 21, wherein said web of film is cooled to its solid-state temperature prior to subjecting it to said second fluid pressure differential.

24. The process of claim 23, wherein said web is cooled by applying a low pressure liquid spray to the surface of said web while it is still subject to the vacuum utilized to apply said first fluid pressure differential.

25. A continuous, multi-phase process for debossing and perforating a substantially continuous web of substantially planar polymeric film to form a macroscopically expanded, three-dimensional, apertured polymeric web, said process comprising the steps of:

(a) continuously supporting said web of film on a forming structure exhibiting a macroscopic, three-dimensional cross-section defined by a multiplicity of macroscopic cross-section debossments having endwalls exhibiting a multiplicity of fine-scale apertures which place the opposed surfaces of said forming structure in fluid communication with one another said forming structure moving in a direction parallel to the direction of travel of said web of film and carrying said web of film in said direction;

(b) substantially continuously applying a first fluid pressure differential comprising vacuum applied to the non-web contacting surface of said forming structure across the thickness of said web of film along said direction of movement of said forming structure, said fluid pressure differential being sufficiently great to cause said web of film to be urged into substantial conformance with the macroscopic, three-dimensional cross-section of said forming structure;

(c) substantially continuously applying a second fluid pressure differential comprising a high pressure liquid jet across the thickness of said web of film along said direction of movement of said forming structure, the force applied by said high pressure liquid jet being sufficiently great to cause said web of film to rupture in those areas coinciding with said fine-scale apertures in the endwalls of said debossments in said forming structure while substantially maintaining the integrity of the macroscopic, three-dimensional configuration formed by said first fluid pressure differential.

26. The process of claim 25, wherein said web of film is subjected to said first pressure differential while at a temperature above its solid-state temperature.

27. The process of claim 26, wherein said macroscopically expanded web is cooled below its molten temperature prior to subjecting it to said second fluid pressure differential.

28. The process of claim 27, wherein said cooling of said web is carried out by applying a low pressure cooling liquid spray thereto while said web is still subject to the vacuum comprising said first fluid pressure differential.

29. A continuous, multi-phase apparatus for debossing and perforating a substantially continuous web of substantially planar polymeric film to form a macroscopically expanded, three-dimensional, apertured polymeric web, said apparatus comprising:

(a) a first forming structure for continuously supporting said web of film, said first forming structure exhibiting a multiplicity of fine-scale apertures which place the opposed surfaces of said forming structure in fluid communication with one another;

(b) means for moving said first forming structure in a direction parallel to the direction of travel of said web of film;

(c) means for substantially continuously applying a first fluid pressure differential across the thickness of said web of film along said direction of movement of said first forming structure, said fluid pressure differential being sufficiently great to cause said web of film to rupture in those areas coinciding with said fine-scale apertures in said first forming structure;

(d) a second forming structure for continuously supporting said fine-scale apertured web of film, said second forming structure exhibiting a macroscopic, three-dimensional, cross-section defined by a multiplicity of macroscopic cross-section apertures which place the opposed surfaces of said second forming structure in fluid communication with one another;

(e) means for moving said second forming structure in a direction parallel to the direction of travel of said web of film; and

(f) means for substantially continuously applying a second fluid pressure differential across the thickness of said web of film along said direction of movement of said second forming structure, said second fluid pressure differential being sufficiently great to cause said web of film to be urged into substantial conformance with the macroscopic, three-dimensional cross-section of said second forming structure and to rupture said web in those areas coinciding with said macroscopic cross-section apertures in said second forming structure while substantially maintaining the integrity of said fine-scale apertures formed by said first fluid pressure differential in the areas of said web which are outside said macroscopic cross-section apertures.

30. The apparatus of claim 29, including means for feeding said web onto said second forming structure so that the surface of the web which contacted said first forming structure does not contact said second forming structure.

31. The apparatus of claim 30, wherein said means for feeding said web from said first forming structure to said second forming structure comprises a nip formed between said first and second forming structures.

32. The apparatus of claim 29 wherein said means for applying said first fluid pressure differential across the thickness of said web comprises a high pressure liquid jet directed at said web.

33. The apparatus of claim 29, wherein said means for applying said second fluid pressure differential across the thickness of said web comprises a high pressure liquid jet directed at said web.

34. The apparatus of claim 32 or 33 wherein a vacuum chamber is positioned adjacent the non-web contacting surface of said forming structure, said vacuum chamber being aligned with said high pressure liquid jet to collect the liquid which penetrates said web.

35. The apparatus of claim 29, including extruder means for initially forming said substantially planar polymeric film from a resin melt.

36. The apparatus of claim 29, including an apertured mask element interposed between said second fluid pressure differential and said web to limit the portions of said web to be subjected to said second fluid pressure differential to those areas coinciding with said apertures in said mask element.

37. A continuous, multi-phase apparatus for debossing and perforating a substantially continuous web of substantially planar polymeric film to form a macroscopically expanded, three-dimensional, apertured polymeric web, said apparatus comprising:

(a) a forming structure for continuously supporting said web of film, said forming structure exhibiting a multiplicity of fine-scale apertures which place the opposed surfaces of said forming structure in fluid communication with one another and a macroscopic, three dimensional cross-section defined by a multiplicity of macroscopic cross-section apertures which also place the opposed surfaces of said forming structure in fluid communication with one another

(b) means for moving said forming structure in a direction parallel to the direction of travel of said web of film;

(c) means for substantially continuously applying a first fluid pressure differential across the thickness of said web of film along said direction of movement of said forming structure, the force applied by said fluid pressure differential being sufficiently great to cause said web of film to be urged into substantial conformance with the macroscopic, three-dimensional cross-section of said forming structure and to rupture said web in those areas coinciding with said macroscopic cross-section apertures in said forming structure; and

(d) means for substantially continuously applying a second fluid pressure differential across the thick-

sion of said web of film along said direction of movement of said forming structure, said second field pressure differential being sufficiently great to rupture said web in those areas embedding with said fine-scale apertures in said forming structure while substantially maintaining the integrity of the macroscopic, three-dimensional configuration formed by said first field pressure differential.

39. The apparatus of claim 37, wherein said means for applying said first field pressure differential across the thickness of said web comprises means for subjecting the non-web contacting surface of said forming structure to vacuum.

40. The apparatus of claim 37 wherein said means for applying said second field pressure differential across the thickness of said web comprises a high pressure liquid jet directed at said web.

41. The apparatus of claim 37, including means for elevating the temperature of said web to a molten state prior to subjecting said web to said first field pressure differential.

42. The apparatus of claim 41, wherein said means for elevating the temperature of said web to a molten state comprises an extruder

43. The apparatus of claim 40, including means for cooling said web to its solid-state temperature prior to subjecting it to said second field pressure differential.

44. The apparatus of claim 43, wherein said web cooling means comprises a low pressure liquid spray applied to the surface of said web while it is still subject to said first field pressure differential.

44. A continuous, multi-phase apparatus for debossing and perforating a substantially continuous web of substantially planar polymeric film to form a macroscopically expanded, three-dimensional, apertured polymeric web, said apparatus comprising:

(a) a forming structure for continuously supporting said web of film, said forming structure exhibiting a macroscopic, three-dimensional cross-section defined by a multiplicity of macroscopic cross-section debossments having sidewalls exhibiting a multiplicity of fine-scale apertures which place the opposed surfaces of said forming structure in fluid communication with one another

(b) means for moving said forming structure in a direction parallel to the direction of travel of said web of film;

(c) means for substantially continuously applying a first field pressure differential comprising vacuum to the non-web contacting surface of said forming structure across the thickness of said web of film along said direction of movement of said forming structure, said field pressure differential being sufficiently great to cause said web of film to be urged into substantial conformance with the macroscopic, three-dimensional cross-section of said forming structure; and

(d) means for substantially continuously applying a second field pressure differential comprising a high pressure liquid jet across the thickness of said web of film along said direction of movement of said forming structure, the forces applied by said high pressure liquid jet being sufficiently great to cause said web of film to rupture in those areas embedding with said fine-scale apertures in the sidewalls of said debossments in said forming structure while substantially maintaining the integrity of the macroscopic, three-dimensional configuration formed by said first field pressure differential.

45. The apparatus of claim 44, including means for elevating the temperature of said web above its solid-state temperature before it is subjected to said first field pressure differential.

46. The apparatus of claim 45, including means for cooling said macroscopically expanded web below to its solid-state temperature prior to subjecting it to said second field pressure differential.

47 The apparatus of claim 46, wherein said cooling means comprises a low pressure cooling liquid spray applied to said web while said web is still subject to said first field pressure differential.

* * * *

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United States Patent [19]

Osborn, III et al.

[11] Patent Number: 5,647,862

[45] Date of Patent: Jul. 15, 1997

[54] ABSORBENT ARTICLE WITH MEANS FOR DIRECTIONAL FLUID DISTRIBUTION

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

[21] Appl. No.: 513,690

[22] Filed: Aug. 10, 1995

Related U.S. Application Data

[63] Continuation of Ser. No. 340,913, Nov. 15, 1994, abandoned, which is a continuation of Ser. No. 05,[illegible], Jan. 28, 1993, abandoned.

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

[52] U.S. Cl. 604/378; 604/368; 604/372; 604/381; 604/382

[58] Field of Search 604/358, 368-369, 604/372, 378, 385.1

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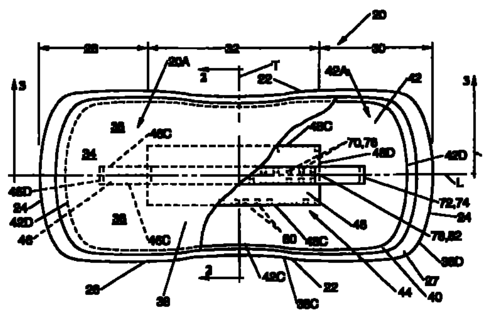
Primary Examiner—P. Zuttarelli

Attorney, Agent, or Firm—Edward J. Milbrada; Jeffrey V. Bamber; Steven W. Miller

[57] ABSTRACT

An absorbent article, such as a generally thin, flexible sanitary napkin with a topsheet, backsheet and absorbent core is provided. The absorbent article has a means for directional fluid distribution such as a fluid directing strip positioned between the topsheet and absorbent core, and an absorbent strip positioned between the topsheet and fluid directing strip. The relationships between the sizes of the fluid directing strip and the absorbent strip are such that the width of the fluid directing strip is greater than that of the absorbent strip and the length of the absorbent strip is greater than that of the fluid directing strip, so that bodily exudates may be directed toward the ends of the absorbent core even when the sanitary napkin assumes a body-conforming shape or is otherwise distorted during use.

33 Claims, 4 Drawing Sheets



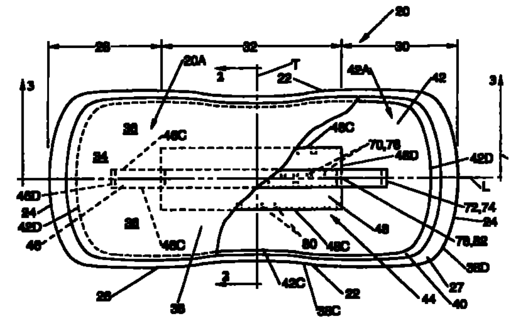


Fig 1

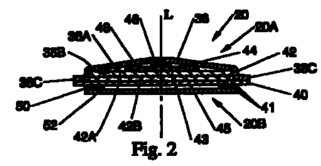


Fig. 2

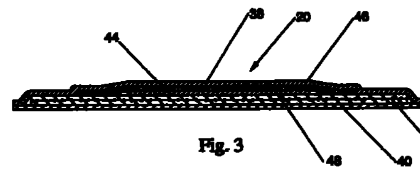


Fig. 3

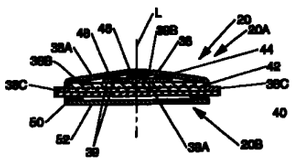


Fig. 4

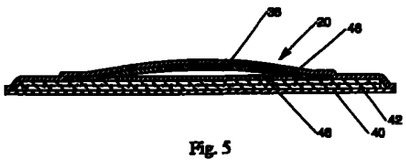


Fig. 5

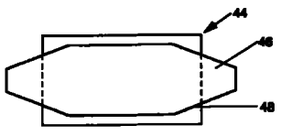


Fig. 6

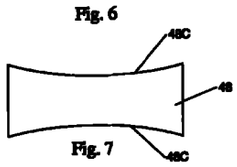


Fig. 7

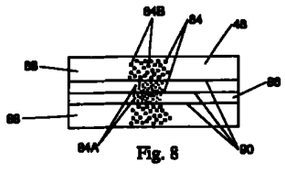


Fig. 8

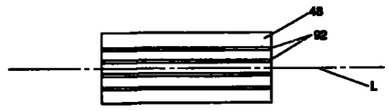


Fig. 9

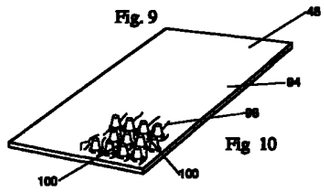


Fig 10

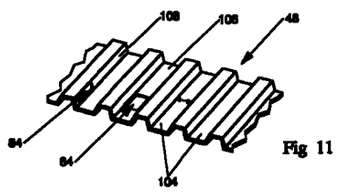


Fig 11

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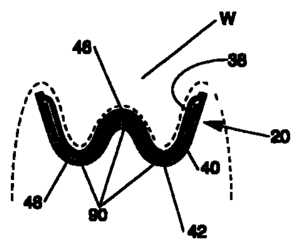

Fig 12

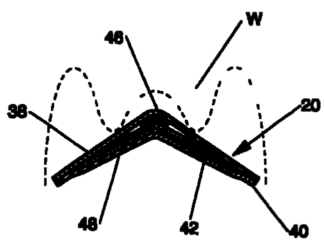

Fig 13

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ABSORBENT ARTICLE WITH MEANS FOR DIRECTIONAL FLUID DISTRIBUTION

This is a continuation of application Ser. No. 08/340,013, filed on Nov. 15, 1994 now abandoned, which is a continuation of application Ser. No. 08/083,425, filed on Jun. 28, 1993 now abandoned.

FIELD OF THE INVENTION

The present invention relates to absorbent articles, particularly sanitary napkins. More particularly, the present invention relates to a generally thin, flexible sanitary napkin with a means for directional fluid distribution.

BACKGROUND OF THE INVENTION

Absorbent articles, such as sanitary napkins, panty liners, and incontinence pads that are designed to absorb and retain liquids and other discharges from the human body and to prevent body and clothing soiling, having various different constructions are well known.

The current tendency has been to develop absorbent articles such as sanitary napkins which are increasingly thinner and conform better to the body. Recently, efforts have been directed to developing thinner sanitary napkins which have the capacity to absorb and contain medium to high menstrual discharges. Previously, such discharges could only be handled by relatively thick sanitary napkins. Examples of thin sanitary napkins having capacities great enough to handle medium to high menstrual flows are disclosed in U.S. Pat. Nos. 4,950,264 and 5,009,653, issued to Osborn, on Aug. 21, 1990 and Apr. 23, 1991, respectively.

One of the main objectives in developing absorbent articles is to utilize the entire capacity of the absorbent article. The utilization of the capacity for absorption of menses and other bodily exudates in the thin sanitary napkins described in the Osborn references is achieved at least in part by the presence of a "wipe acquisition sheet" that distributes the exudates more evenly over the underlying absorbent core. In general, products that are not provided with a structure like the wipe acquisition sheet described in the aforementioned patents, typically distribute liquids in a circular pattern, resulting in liquids reaching the longitudinal side edges of the absorbent article before the end regions of the absorbent article are utilized. When liquids come near the longitudinal side edges of the absorbent article, the chances for leakage from the sides of the product increases, despite available absorbent capacity in the end regions of the absorbent article.

In the past, a number of efforts have been made to direct exudates in an attempt to utilize more of the absorbent capacity of an absorbent article. A number of these efforts have used absorbent means or densification of absorbent means. Some of such efforts are described in U.S. Pat. No. 4,678,453 issued Jul. 7 1987 to Holtman and U.S. Pat. No. 4,624,666 issued Nov. 25, 1986 to DeRossett, et al. Absorbent articles which use absorbent means to direct fluid flow, however, are typically subject to the disadvantage that the absorbent means will tend to become saturated and interfere with its fluid directing capabilities.

Another series of patents teaches the use of baffles, barriers, and transfer members for liquid transport. For instance, U.S. Pat. No. 4,059,101 issued Jan. 14, 1977 to Chesky et al. discloses using an elongated baffle near the base of the pad. U.S. Pat. No. 3,736,931 issued Jun. 5, 1973 to Glassman discloses using a moisture impervious layer in the pad. However, in both of these examples, liquids may wick laterally before reaching the baffle or the moisture impervious layer. This may tend to cause side failure (or side leakage), particularly when the pad bunches during wear. In such cases, the barrier or transfer member may be distorted by the bunching of the pad, and body fluids may circumvent the barrier or transfer member and flow directly toward the longitudinal side edges of the product.

Thus, a need exists for an absorbent article, such as a sanitary napkin that has an improved means for directional fluid distribution that distributes bodily exudates so that the exudates will not reach the longitudinal side edges of the absorbent article before reaching the end regions of the article.

It is, therefore, an object of the present invention to provide an absorbent article such as a sanitary napkin with a means for enabling the entire absorbent capacity of the sanitary napkin to be utilized before liquids reach the longitudinal side edges of the napkin.

It is another object of the present invention to provide a generally thin, flexible sanitary napkin that conforms to the wearer's body.

SUMMARY OF THE INVENTION

The present invention is directed to an absorbent article, such as a sanitary napkin. More preferably, the present invention is directed to a generally thin, flexible sanitary napkin with a means for directional fluid distribution.

The sanitary napkin of the present invention has a longitudinal centerline, a transverse centerline, a body-facing surface, and a garment-facing surface. The sanitary napkin comprises a liquid pervious topsheet, a liquid impervious backsheet joined to the topsheet, an absorbent core positioned between the topsheet and backsheet, and a means for directional fluid distribution. The means for directional fluid distribution can, in one embodiment, comprise a liquid impervious or semi-pervious fluid directing strip positioned between the absorbent core and the topsheet and a liquid transporting structure such as an absorbent strip positioned between the fluid directing strip and the topsheet. The width of the absorbent strip is preferably less than the width of the fluid directing strip. The length of the absorbent strip is preferably greater than or equal to the length of the fluid directing strip so that it is capable of wicking liquids over the fluid directing strip toward the ends of the core.

There are a non-limiting number of embodiments of the means for directional fluid distribution. In one embodiment, the fluid directing strip comprises a hydrophobic film such as a polyethylene film. The fluid directing strip in this embodiment may be apertured or non-apertured. In another embodiment, the absorbent strip and the fluid directing strip can be replaced by a single component which serves the function of both strips. In other embodiments, the fluid directing strip may have a plurality of longitudinally-oriented channels formed therein. In another embodiment, the fluid directing strip can be comprised of a hydrophobic structure, such as a film which has a hydrophilic component dispersed thereon. The hydrophobic portion provides a bucket-like structure that has to be filled up before overflowing to the hydrophilic portion of the fluid directing strip. In still other embodiments, the fluid directing strip may comprise a structure such as a plastic film that has a plurality of troughs formed therein.

The sanitary napkin preferably has a caliper less than or equal to about 4 millimeters and is flexible enough to conform to the wearer's body. The components of the means for directional fluid distribution are sufficiently flexible and

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joined in such a way that they maintain the desired relationships with each other during wear, particularly when the sanitary napkin is laterally compressed. The sanitary napkin in different embodiments may be predisposed to bend so that it assumes a "W"-shaped cross-section, an inverted "V"-shaped cross-section, or other suitable cross-sectional configuration when worn.

BRIEF DESCRIPTION OF THE DRAWINGS

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

FIG. 1 is a top plan view of a preferred sanitary napkin embodiment of the present invention shown with a portion of the topsheet removed to show the underlying means for directional fluid distribution.

FIG. 2 is an enlarged cross-sectional view of the preferred sanitary napkin embodiment shown in FIG. 1 taken along line 2—2 of FIG. 1.

FIG. 3 is a cross-sectional view of the preferred sanitary napkin embodiment shown in FIG. 1 taken along line 3—3.

FIG. 4 is an enlarged cross-sectional view of a sanitary napkin taken from an angle similar to that of FIG. 2 which has a fluid directing strip that comprises an apertured film with tapered capillaries which is inverted so that the bottom openings of the capillaries face the topsheet of the sanitary napkin.

FIG. 5 is a cross-sectional view of a sanitary napkin taken from an angle similar to that of FIG. 2 in which the absorbent strip is attached only at its ends so it can "decouple" from the absorbent core.

FIG. 6 is a plan view of a means for directional fluid distribution that comprises a diamond-shaped absorbent strip and a rectangular fluid directing strip.

FIG. 7 is a plan view of a fluid directing strip that has concave longitudinal side edges.

FIG. 8 is a plan view of a fluid directing strip that comprises film which has areas provided with apertures of different sizes.

FIG. 9 is a plan view of a fluid directing strip that comprises foam which has longitudinally-oriented embossed lines formed therein.

FIG. 10 is a perspective view of a fluid directing strip that comprises a flexible, hydrophobic three dimensional apertured formed film with a hydrophilic component disposed thereon (only a portion of the apertures are shown).

FIG. 11 is an enlarged perspective view of a fluid directing component that comprises a plastic film formed with a plurality of troughs therein.

FIG. 12 is a simplified schematic cross-sectional view which shows how the sanitary napkin preferably fits adjacent to the wearer's body in a "W" shape.

FIG. 13 is a simplified schematic cross-sectional view which shows how the sanitary napkin preferably fits adjacent to the wearer's body in an inverted "V" shape.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

1. General Characteristics of the Absorbent Article.

FIG. 1 shows a particularly preferred embodiment of the disposable absorbent article of the present invention, sanitary napkin 20.

The term "absorbent article" as used herein, 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).

The term "sanitary napkin" as used herein, refers to an absorbent article which is worn by females adjacent to the pudendal region, generally external to the urogenital region, and which is intended to absorb and contain menstrual fluids and other vaginal discharges from the wearer's body (e.g., blood, menses, and urine). It should be understood, however, that the present invention is also applicable to other feminine hygiene or catamenial pads such as panty liners, or other absorbent articles such as incontinence pads, and the like.

The sanitary napkin 20 has two surfaces, a body-contacting surface or "body surface" 20A and a garment surface 20B. The sanitary napkin 20 is shown in FIG. 1 as viewed from its body surface 20A. The body surface 20A is intended to be worn adjacent to the body of the wearer while the garment surface 20B is on the opposite side and is intended to be placed adjacent to the wearer's undergarments when the sanitary napkin 20 is worn.

The sanitary napkin 20 has two centerlines, a longitudinal centerline L and a transverse centerline T. The terms "longitudinal" and "transverse" are defined in U.S. Pat. No. 5,007,906 entitled "Decoupled Sanitary Napkin" issued to Osborn, et al. on Apr. 16, 1991. (The term "lateral" is used herein interchangeably with the term "transverse".) The sanitary napkin 20 has a longitudinal dimension or length that runs in the general direction of the longitudinal centerline L, and a (typically shorter) transverse dimension or width that runs in the general direction of the transverse centerline T.

The sanitary napkin 20 has a periphery 26 which is defined by the outer edges of the sanitary napkin 20 in which the longitudinal edges (or "side edges") are designated 22 and the end edges (or "ends") are designated 24, and the corners of the sanitary napkin are designated 27. The sanitary napkin has two end regions, which are designated first end region 28 and second end region 30. A central region 32 is disposed between the end regions 28 and 30. The end regions 28 and 30 extend outwardly from the edges of the central region 32 about ⅛ to about ⅓ of the length of the sanitary napkin. A detailed description of the central region 32 and the two end regions 28 and 30 is contained in U.S. Pat. No. 4,690,680 issued to Higgins on Sep. 1, 1987.

FIG. 2 shows that the sanitary napkin 20 preferably comprises a liquid pervious topsheet 38, a liquid impervious backsheet 40, an absorbent core 42 positioned between the topsheet 38 and backsheet 40, and a means for directional fluid distribution (or means for directional liquid distribution) 44 positioned between the topsheet 38 and the absorbent core 42. The means for directional fluid distribution 44 shown in FIGS. 1 and 2 comprises a liquid transporting component such as an absorbent strip 46 positioned between the topsheet 38 and the absorbent core 42, and a liquid directing component such as a liquid impervious fluid directing strip 48 positioned between absorbent strip 46 and the absorbent core 42.

2. The Individual Components of the Sanitary Napkin.

A. The Topsheet.

Examining the components of the sanitary napkin in more detail with continuing reference to FIGS. 1 and 2, the topsheet 38 is the component which is oriented towards and contacts the body of the wearer, and receives bodily discharges.

The topsheet 38 is liquid pervious and should be flexible and non-irritating to the skin. As used herein the term "flexible" refers to materials which are compliant and readily conform to the shape of the body or respond by easily deforming in the presence of external forces. The topsheet 38 should exhibit good strikethrough and low rewet characteristics, permitting bodily discharges to rapidly penetrate the thickness of the topsheet 38 and move into the absorbent strip 46 and sequentially into the absorbent core 42, but not flow back through the topsheet 38 to the skin of the wearer. Preferably, the topsheet 38 is not noisy, to provide discretion for the wearer. The topsheet 38 should be sanitary, clean in appearance and somewhat opaque to hide bodily discharges collected in and absorbed by the absorbent strip 46 and absorbent core 42.

FIG. 2 shows that the topsheet 38 has two sides (or faces or surfaces), including a body-facing side 38A and a garment-facing side (or core-facing side) 38B. The body-facing side 38A of the topsheet 38 generally forms at least a portion of the body-contacting surface ("body surface") 20A of the sanitary napkin 20. The topsheet 38 has, as shown in FIG. 1, two longitudinal edges 38C and two end edges 38D.

(A similar numbering system can be used for the other components of the sanitary napkin. That is, the side of the component facing the wearer's body can be designated by the number of the component and a reference letter "A". The side of the component facing the wearer's undergarments can be designated by the number of the component and the letter "B". The side and end edges can be designated by the number of the component and the reference letters "C" and "D" respectively.)

A suitable topsheet 38 may be manufactured from a wide range of materials such as woven and nonwoven materials; polymeric materials such as apertured formed thermoplastic films, apertured plastic films, and hydroformed thermoplastic films; porous foams; reticulated foams; reticulated thermoplastic films; and thermoplastic scrims. Suitable woven and nonwoven materials can be comprised of natural fibers (e.g., wood or cotton fibers), synthetic fibers (e.g., polymeric fibers such as polyester, polypropylene, or polyethylene fibers), or from a combination of natural and synthetic fibers.

A preferred topsheet 38 comprises an apertured formed film. Apertured formed films are preferred for the topsheet because they are pervious to body exudates and yet non-absorbent and have a reduced tendency to allow liquids to pass back through and rewet the wearer's skin. Thus, the surface of the formed film which is in contact with the body remains dry, thereby reducing body soiling and creating a more comfortable feel for the wearer.

Suitable formed films are described in U.S. Pat. No. 3,929,135, issued to Thompson on Dec. 30, 1975; U.S. Pat. No. 4,324,246 issued to Mullane, et al. on Apr. 13, 1982; U.S. Pat. No. 4,342,314 issued to Radel, et al. on Aug. 3, 1982; U.S. Pat. No. 4,463,045 issued to Ahr et al. on Jul. 31, 1984; U.S. Pat. No. 4,629,643 issued to Curro, et al. on Dec. 16, 1986; and U.S. Pat. No. 5,006,394 issued to Baird on Apr. 9, 1991. The preferred topsheet for the present invention is the formed film described in one or more of the above patents and marketed on sanitary napkins by The Procter & Gamble Company as "DRI-WEAVE".

The topsheet 38 has a plurality of apertures to permit liquids deposited thereon to pass through to the core 42. An apertured polyethylene film topsheet 38 having about 5 to about 60 percent open area, typically about 25 percent open area, and a thickness of about 0.01 to about 0.05 millimeters prior to aperturing and about 0.42 to about 0.51 millimeters after aperturing is suitable. A particularly suitable topsheet 38 may be made in accordance with U.S. Pat. No. 4,342,314 issued Aug. 3, 1982 to Radel et al. and U.S. Pat. No. 4,463,045 issued Jul. 31, 1984 to Ahr, et al. A topsheet 38 made of model X-3265 or model P1552 apertured formed film sold by Tredegar Corporation of Terre Haute, Ind. has been found to work well.

Preferably, the topsheet 38 is sprayed or otherwise treated with a surfactant to enhance liquid penetration to the absorbent strip 46 and underlying absorbent core 42. Suitable methods for treating the topsheet with a surfactant are described in U.S. Pat. Nos. 4,950,264 and 5,009,653 issued to Osborn. The surfactant is typically nonionic and should be non-irritating to the skin. A surfactant density of about 0.01 milligrams per square centimeter of topsheet 38 area is suitable. A suitable surfactant is sold by Glyco Chemical, Inc. of Greenwich, Conn. as Pegosperse 200ML.

B. The Absorbent Core.

The absorbent core 42 is one of the means for collecting and containing bodily discharges, particularly menses, deposited thereon or which otherwise traverse through the liquid permeable topsheet 38.

The absorbent core 42 may be manufactured in a wide variety of sizes and shapes (e.g., rectangular, oval, hourglass, dog bone, asymmetric, etc.). The absorbent core 42 has a body surface 42A, a garment surface 42B, side edges 42C, and end edges 42D. The core 42 is preferably conformable and non-irritating to the skin. The absorbent core 42 of the preferred sanitary napkin 20 shown in FIGS. 1-3 comprises a modified hourglass-shaped laminate comprising two layers of tissue, upper layer 43 and lower layer 45 with absorbent gelling material particles 41 sandwiched between the tissue layers. The absorbent core 42 can, in other embodiments, be made of a number of other suitable materials.

Suitable materials for the absorbent core 42 include but are not limited to: comminuted wood pulp which is generally referred to as airfelt; creped cellulose wadding; tissue including tissue wraps and tissue laminates; synthetic fibers, especially polymeric fibers, such as crimped polyester fibers; meltblown polymers including coform; chemically stiffened, modified or cross-linked cellulosic fibers; fibers have intra-fiber capillary channels preferably on their exterior surfaces (capillary channel fibers); peat moss; absorbent foams; absorbent sponges; superabsorbent hydrogel-forming polymeric gelling agents; or any equivalent material or combination of materials, or mixtures of these materials.

Polymeric gelling agents are particularly preferred absorbent materials for use in the absorbent core 42. Polymeric gelling agents are those materials which, upon contact with fluids (i.e., liquids) such as water or body fluids, imbibe such fluids and thereby form hydrogels. In this manner, fluid discharged into the absorbent core 42 can be acquired and held by the polymeric gelling agent, thereby providing the absorbent articles described herein with enhanced absorbent capacity and/or improved fluid retention performance. Sub-

able absorbent gelling materials are described in U.S. Pat. No. Re. 32,649 issued Apr. 19, 1988 to Brandt et al. and U.S. Pat. No. 5,102,597 issued to Roe, et al. on Apr. 7, 1992. A suitable laminate of absorbent gelling materials and tissue may be purchased from Grain Processing Corporation of Muscatine, Iowa under Model Number L535.

Suitable cross-linked cellulose fibers for the absorbent core are described in U.S. Pat. No. 4,888,093, issued Dec. 19, 1989 to Cook, et al., U.S. Pat. No. 4,822,543, issued Apr. 18, 1989 to Dean, et al., U.S. Pat. No. 4,889,595, issued Dec. 26, 1989 to Schoggen, et al., U.S. Pat. No. 4,898,642, issued Feb. 6, 1990 to Moore, et al., U.S. Pat. No. 4,935,022 issued Jun. 19, 1990 to Lash et al., and, U.S. Pat. No. 5,183,707 issued Feb. 2, 1993 to Herron, et al., U.S. Pat. No. 5,217,445 issued Jun. 8, 1993 to Young, et al., in EPO Patent Application Publication Nos. 0 427 316 A2 and 0 427 317 A2 published in the name of Herron, et al. on May 15, 1991, and in EPO Patent Application Publication No. 0 429 112 A2 published in the name of Herron, et al. on May 29, 1991.

Capillary channel fibers are described in the following patent applications which were filed on Jul. 23, 1991: U.S. patent application Ser. No. 07/734,404 filed in the names of Thompson, et al. and U.S. patent application Ser. No. 07/734,392 filed in the names of Thompson, et al. (combined in PCT Publication No. WO 93/01779 published Feb. 4, 1993); and in U.S. patent application Ser. No. 07/734,405 filed in the names of Buenger, et al. (PCT Publication No. WO 93/02251 published Feb. 4, 1993). These patent applications may be referred to collectively as the "Capillary Channel Fiber" patent applications. Suitable capillary channel fibers are also described in PCT International Patent Publication No. WO 92/00407 and PCT Publication No. WO 93/02235 published in the name of Phillips, et al. on Feb. 4, 1993 and assigned to Eastman Kodak Company, and in U.S. Pat. No. 5,200,248 issued to Thompson, et al. on Apr. 6, 1993. Suitable capillary channel fibers are those designated SW173 available from Eastman Chemical Company.

Suitable foam materials are described in U.S. Pat. No. 5,147,345 entitled "High Efficiency Absorbent Articles for Incontinence Management" issued to Young, et al. on Sep. 15, 1992, U.S. Pat. No. 5,198,472 entitled "Process for Preparing Emulsions That are Polymerizable to Absorbent Foam Materials" issued to DesMarais, et al. on Mar. 30, 1993, and in PCT Publication No. WO 93/04113 entitled "Method for Hydrophilizing Absorbent Foam Materials" published in the name of DesMarais on Mar. 4, 1993.

The configuration and construction of the absorbent core 42 may be varied (e.g., the absorbent core may have varying caliper zones, for example, the core may be profiled so as to be thicker in the center; hydrophilic gradients; superabsorbent gradients; or lower density and lower average basis weight acquisition zones; or it may comprise one or more layers or structures). The total absorbent capacity of the absorbent core 42 should, however, be compatible with the design loading and the intended use of the sanitary napkin 20. Further, the size and absorbent capacity of the absorbent core 42 may be varied to accommodate different uses such as incontinence pads, pantiliners, regular sanitary napkins, or overnight sanitary napkins.

Some examples of absorbent structures that can be used as the absorbent core in the sanitary napkin of the present invention are described in U.S. Pat. No. 4,578,068 entitled "Absorbent Laminate Structure" issued to Kramer, et al. on Mar. 25, 1986; U.S. Pat. No. 4,640,810 entitled "System for Producing an Airlaid Web" issued to Laursen, et al. Feb. 3, 1987 (or airlaid structures made by different processes); U.S. Pat. Nos. 4,950,264 and 5,009,653 entitled "Thin, Flexible Sanitary Napkin" issued to Osborn on Aug. 21, 1990 and Apr. 23, 1991; U.S. Pat. No. 4,610,678 entitled "High-Density Absorbent Structures" issued to Weisman et al. on Sep. 9, 1986; U.S. Pat. No. 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; European Patent Application No. 0 198 683, published Oct. 22, 1986 in the name of Duenk, et al. and in U.S. patent application Ser. No. 07/810,774 and its continuation-in-part, Ser. No. 07/944,764 both entitled "Absorbent Article Having Fused Layers" filed in the name of Cree, et al. on Dec. 17, 1991 and Sep. 14, 1992, respectively.

C. The Means for Directional Fluid Distribution.

The means for directional fluid distribution 44, as shown in FIGS. 1–3, is positioned between the topsheet 38 and absorbent core 42. The means for directional fluid distribution is intended to preferentially distribute bodily exudates toward the ends of the sanitary napkin. The exudates are preferably distributed so that exudates will not reach the longitudinal side edges of the sanitary napkin at least until exudates are transported so as to substantially use any available absorbent capacity in the end regions of the absorbent core of the sanitary napkin.

The means for directional fluid distribution 44 is preferably centered along the longitudinal centerline of the sanitary napkin. The means for directional fluid distribution 44 can also either be centered along the transverse centerline, or it can be offset from the transverse centerline (that is, positioned forward or rearward of the transverse centerline). If the means for directional fluid distribution 44 is offset from the transverse centerline, it is preferably positioned so that it at least partially lies in the central region 22 of the sanitary napkin 20.

The means for directional fluid distribution 44 comprises: (1) a liquid transporting component such as an absorbent strip 46 positioned between the topsheet 38 and the absorbent core 42, and (2) a fluid directing component (i.e., a liquid directing component) such as a liquid impervious fluid directing strip 48 positioned between absorbent strip 46 and the absorbent core 42.

(1) The Liquid Transporting Component.

The liquid transporting component, absorbent strip 46, is intended to collect bodily discharges, particularly menses, deposited thereon or which otherwise traverse through the topsheet 38 and transport these bodily discharges to the underlying fluid directing strip 48 and toward the ends 42D of the absorbent core 42. The absorbent strip 46 can also be used to draw some of these bodily discharges away from the topsheet 38 and absorb some of such discharges.

The absorbent strip 46 shown in FIG. 1 is a rectangular strip that has dimensions that are narrower in width and longer in length than the fluid directing strip 48 (described below). The dimensions of the absorbent strip 46 can vary between certain limits. The preferred dimensions range from between about 0.4–0.5 inches (about 1 cm.) and about 1.75 inches (about 4–4.4 cm.) in width and between about 2.75 inches (about 7 cm.) and about 6 inches (about 15 cm.) in length. The dimensions can, however, be less than or greater than these preferred dimensions as long as the relationship between the sizes and boundaries of the absorbent strip, the fluid directing strip, and the absorbent core described herein are maintained.

The absorbent strip 46 is preferably conformable and non-irritating to the skin. Suitable materials for the absorbent strip 46 include, but are not limited to any of those materials used in the absorbent core such as tissue paper

creped cellulose wadding, cross-linked cellulose fibers, capillary channel fibers, absorbent foams, synthetic staple fibers, polymeric fibers, superabsorbent hydrogel-forming polymer gelling agents in particle or fibrous form or as laminates, peat moss, or any equivalent materials or combination of materials.

The terms "strip" and "layer" as used herein, are not limited to single unfolded sheets. These terms are also intended to include, but not be limited to folded sheets, multiple strips of material, loose or bonded fibers, multiple layers or laminates of such material, or other variations and combinations of such structures.

The absorbent strip 46 may be joined to the topsheet 38 (or it may be joined to any optional secondary topsheet or other optional layer positioned between the topsheet 38 and the absorbent strip 46). Alternatively, the absorbent strip 46 may be unattached to the topsheet. Preferably, however, the absorbent strip 46 is in close contact with or attached to the topsheet 38 or other overlying component. This will facilitate the transport of bodily exudates through the topsheet 38 (i.e., will draw exudates through the topsheet) due to the higher capillarity of the absorbent strip 46. The absorbent strip 46 can be joined to the overlying component in any suitable manner, including but not limited to by adhesives, heat and/or pressure bonds, meltblowing, ultrasonic bonds, extruding it onto the overlying component, or any of the other manners described in Section 2D below.

Preferably, if the absorbent strip 46 is joined to the topsheet 38, it is intermittently joined to the topsheet 38 by topsheet/liquid transporting component bonds 70 located along the longitudinal side margins of the absorbent strip near the side edges 46C of the absorbent strip 46 (several examples of these bonds are shown in FIG. 1). This type of attachment provides a structure in which the bonds between the absorbent strip 46 and the topsheet 38 will not interfere with the transfer of liquids through the topsheet 38 to the absorbent strip 46. It also provides the absorbent strip 46 with greater flexibility than if, for example, the absorbent strip were bonded to the topsheet over its entire surface by adhesives. This greater flexibility provides the sanitary napkin with enhanced conformability to the wearer's body. In other embodiments (which are also shown in FIG. 1), the absorbent strip 46 can be attached to the topsheet 38 near the ends 46D of the absorbent strip 46 by topsheet/liquid transporting component end bonds 72. In a particularly preferred embodiment, the absorbent strip 46 is integrally formed onto the underside of the topsheet 38 or other overlying component.

The absorbent strip 46 may also be attached to the underlying components of the sanitary napkin. For instance, the ends 46D of the absorbent strip 46 can be attached to the absorbent core 38 by liquid transporting component/core end bonds 74. In these alternative embodiments, if the absorbent strip 46 is unattached to an underlying component between its ends, as shown in FIG. 5, the portion of the absorbent strip 46 between the areas at its ends where it is bonded can move apart from or "decouple from" the underlying component during wear to come into more intimate contact with the wearer's body. In a variation of this alternative embodiment, the absorbent strip 46 and fluid directing strip 48 can be secured to each other and the fluid directing strip 48 unattached to the underlying component (such as the absorbent core) so both the absorbent strip 46 and fluid directing strip 48 or at least portions thereof, can decouple from the absorbent core 42.

(2) The Fluid Directing Component.

The fluid (that is, liquid) directing component 48, as shown in FIGS. 1–3, is a structure that is positioned between the absorbent core 42 and the absorbent strip 46.

The purpose of the fluid directing component 48 is to direct bodily fluids (i.e., liquids) such as blood, menses and urine received from the absorbent strip 46 towards the ends 42D of the absorbent core 42. The fluid directing component 48 can direct bodily discharges laterally, but it preferably does not direct such discharges all the way to the side edges 42C of the absorbent core. The fluid directing component 48 can also transport some of the bodily discharges through its thickness to the underlying absorbent core 42 (if the fluid directing component 48 is semi-pervious).

A particularly preferred fluid directing component is the fluid directing strip 48 shown in FIG. 1. The fluid directing strip 48 is a thin, flexible, liquid resistant, preferably liquid impervious strip of material, such as polyolefinic film. The fluid directing component 48 can, however, be an element of many other materials and configurations, including nonwoven materials, and is not limited to thin strips of film or other material.

The fluid directing strip 48, as shown in FIG. 1 has a rectangular configuration. FIG. 1 shows a preferred embodiment in which the width of the fluid directing strip 48 is greater than the width of the absorbent strip 46 and the length of the fluid directing strip 48 is less than the length of the absorbent strip 46. The dimensions of the absorbent core 42 are greater than those of both the absorbent strip 46 and the fluid directing strip 48. The preferred dimensions of the fluid directing strip 48 can range from between about 0.3 cm. to about 0.7 cm. wider than the absorbent strip 46 and between about 0.3 cm. and 2 cm. shorter than the absorbent strip 46. The dimensions can, as in the case of the absorbent strip, be less than or greater than these preferred dimensions as long as the relationship between the sizes and boundaries of the absorbent strip, the fluid directing strip, and the absorbent core described herein are maintained.

The fluid directing strip 48 can be impervious to liquid bodily exudates, or semi-pervious (or, in other words, semi-impervious). If the fluid directing strip 48 is semi-pervious, its degree of perviousness should be sufficiently limited that the fluid directing strip is still capable of carrying out its function of directing liquids toward the ends of the sanitary napkin. The fluid directing strip 48 can be provided with a degree of perviousness in a number of ways. The fluid directing strip 48 can, for instance, be made of a semi-pervious material. Alternatively, the fluid directing strip 48 can be comprised of a normally impervious material such as a polyethylene film that is provided with apertures. The apertures should be either of such a size or such a limited distribution that liquids are not able to proceed immediately through the fluid directing strip without being directed toward the ends of the core 42.

The fluid directing strip 48 can comprise any material suitable for the above purposes. For instance, the fluid directing strip 48 can comprise a polyolefinic film (e.g., polyethylene) that is apertured or non-apertured, or even an adhesive film that could be used to secure some of the components of the sanitary napkin together (such as to secure the absorbent strip 46 to the absorbent core 42). The fluid directing strip 48 can comprise a material similar to those materials used for the topsheet 38 or the backsheet 40. If the fluid directing strip 48 is comprised of a material similar to those used in the topsheet 38, however, it should typically be provided with fewer apertures or smaller apertures than would customarily be used in a topsheet. This will enable the fluid directing strip 48 to transport liquids along its surface rather than solely through its thickness. In addition, as shown in FIG. 4, the fluid directing strip 48 can comprise a material similar to one of those used for the

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topsheet that is provided with tapered capillaries 39 (to prevent rewet) which is then turned upside down for use as the fluid directing strip 48 so that the smaller bottom openings 39B of the capillaries face the topsheet 38.

The fluid directing strip 48 and the absorbent strip 46 can either be formed into an integral structure, joined to each other, or be unattached. If the absorbent strip 46 and the fluid directing strip 48 are joined together they can be joined in any suitable manner. The absorbent strip 46 and the fluid directing strip 48 can be affixed by any of the means described herein which are used to secure the components of the sanitary napkin. The absorbent strip 46 and the fluid directing strip 48 may, for example, be laminated together by adhesives if the fluid directing strip comprises an adhesive film, or they may be thermally bonded if the fluid directing strip comprises a thermoplastic film. If the absorbent strip 46 and the fluid directing strip 48 are laminated together, they can be laminated together either before or during the assembly of the components of the sanitary napkin.

Preferably, if the absorbent strip 46 is joined to the fluid directing strip 48, it is intermittently joined to the fluid directing strip 48 by liquid transporting component/fluid directing component bonds 76 located along the longitudinal side margins of the absorbent strip 46 near the longitudinal side edges 46C of the absorbent strip 46. This enhances the flexibility of these components and provides a structure in which the bonds between the two components will not interfere with the transfer of liquids from the absorbent strip 46 to the fluid directing strip 48. In other embodiments, the absorbent strip 46 can be attached to the fluid directing strip 48 near the ends of the fluid directing strip 48D by liquid transporting component/fluid directing component end bonds 78.

The fluid directing strip 48 can also be formed into an integral structure with the absorbent core 42, or the fluid directing strip and the absorbent core can be joined to each other or these two components can be unattached. If the fluid directing strip 48 is joined to the core 42, the fluid directing strip 48 can be joined to the core 42 by any of the means used to secure the components of the sanitary napkin described herein. Preferably, if the fluid directing strip 48 is joined to the core 42, it is intermittently joined to the core by fluid directing component/core side bonds 80 along the longitudinal side margins of the fluid directing strip 48 to enhance the flexibility of the sanitary napkin. Additionally or alternatively, the ends of the fluid directing strip 46 can also be attached to the absorbent core 42 by fluid directing component/core end bonds 82.

The relationship between the sizes and boundaries of the fluid directing strip 48 and the absorbent strip 46 provides the advantage that the longitudinal sides 48C of the fluid directing strip 48 extend beyond the longitudinal sides 46C of the absorbent strip 46, and the end edges 46D of the absorbent strip 46 extend beyond the end edges 48D of the fluid directing strip 48. This forces the liquid in the absorbent strip 46 to wick and be distributed to the ends of the absorbent core 42. Prior attempts did not have components with these relationships and were subject to liquids reaching the longitudinal side edges before the ends of the sanitary napkin 20. These problems were particularly evident when the prior sanitary napkins were distorted during wear.

The relationship between the component parts of the means for directional fluid distribution of the present invention is intended to remain the same even when the sanitary napkin is subjected to pressures which tend to distort the napkin during wear. The sanitary napkin will, thus, preferably continue to preferentially direct liquids toward the ends of the core even when subjected to these forces.

(5) Alternative Embodiments of the Means for Directional Fluid Distribution.

There are numerous possible alternative embodiments of the means for directional fluid distribution 44 described herein. For example, the shapes of the absorbent strip 46 and the fluid directing strip 48 can be varied in other embodiments. The shape of these components may be used to provide the sanitary napkin with certain fluid directing properties or to provide the sanitary napkin with particular functional, perceptual, or aesthetic characteristics.

For example, in the preferred embodiment described above, the fluid directing strip 48 is both wider and shorter than the absorbent strip 46. In this preferred embodiment, both ends of the absorbent strip 46 extend beyond the ends of the fluid directing strip 48. Some of the benefits of the means for directional fluid distribution of the present invention will, however, still be achieved even if the absorbent strip 46 extends at least to, and preferably, beyond only one end of the fluid directing strip 48. The absorbent strip 46 can have one end that extends beyond the end of the fluid directing strip 48 to allow the absorbent strip 46 to preferentially transport liquids to at least one end of the sanitary napkin. This arrangement can even be present when the length of the absorbent strip 46 is less than the length of the fluid directing strip 48 if the absorbent strip 46 is offset from the transverse centerline more toward one end of the fluid directing strip 48 than the other. Thus, the absorbent strip 46 may extend at least to, and preferably, beyond at least one end edge of the fluid directing strip 48.

The same applies to the relationship between the widths of the two components of the means for direction fluid distribution 44. That is, some of the benefits of the means for directional fluid distribution of the present invention will still be achieved even if the fluid directing strip 48 extends laterally outward to, and preferably, beyond only one longitudinal side edge of the absorbent strip 46. The fluid directing strip may extend beyond one longitudinal side edge of the absorbent strip 46 even when the absorbent strip 46 is wider than the fluid directing strip 48, if the fluid directing strip is offset from the longitudinal centerline more toward one side of the absorbent strip 46 than the other.

In another example, as shown in FIG. 6, the absorbent strip 46 can comprise a diamond-shaped polygon. The absorbent strip 46 shown in FIG. 6 can be used to attempt to create essentially a single point introduction of liquids into the absorbent core 42 at the ends of the absorbent strip 46. This may be used in an attempt to acquire more control over the distribution of exudates and, thus, the soiling pattern in the sanitary napkin.

FIG. 7 shows an example of a fluid directing strip 48 having concave longitudinal side edges. A fluid directing strip 48 having this shape can be used for improved wearer comfort (such as to provide room for the wearer's thighs), allowing controlled bunching of the sanitary napkin at these longitudinal edges while preventing bunching of the sanitary napkin.

FIG. 8 shows that in other alternative embodiments, the aperturing of the fluid directing strip 48 may also be used to provide the sanitary napkin with specific fluid directing properties. For example, as shown in FIG. 8, the fluid directing strip 48 may have different regions that are provided with apertures of different sizes. The fluid directing strip 48 shown in FIG. 8 has a central region 86 that may correspond to the location of the overlying absorbent strip 46 and side regions 88 that lie laterally outboard of the side edges 46C of the absorbent strip 46. The central region 86 can be provided with smaller apertures 84A (or fewer apertures per area) than the side regions 88 of the fluid directing strip. Such a structure can be used to vary the distribution of liquids to different portions of the absorbent core 42. In alternative embodiments, the apertures 84 in the fluid directing strip 48 may be of numerous different shapes.

FIG. 8 also shows that the fluid directing strip 48 may be provided with bending axes 90 to assist the means for directional fluid distribution 44 in assuming certain configurations when the sanitary napkin 20 is worn. The bending axes 90 may be formed by fold lines, score lines, densification lines, stitching lines, or any other means known in the art for providing an absorbent article with bending axes.

FIG. 9 shows that the fluid directing strip 48 may additionally be embossed or otherwise provided with channels 92 for directing liquids in a particular direction, such as toward the ends of the absorbent core. In one preferred embodiment, the fluid directing strip 48 comprises a soft foam piece that is embossed with a plurality of longitudinal channels 92. Additionally, or alternatively, the fibers or other structural elements comprising the absorbent strip 46 or the fluid directing strip 48 may be oriented in a particular manner (such as in the longitudinal direction) to facilitate wicking of liquids in the longitudinal direction.

FIG. 10 shows another preferred embodiment of the fluid directing strip 48. The fluid directing strip 48 is a hydrophobic structure such as a flexible, hydrophobic formed film structure 94, preferably a three dimensional apertured film, with a hydrophilic component 96 such as fibers or a surfactant dispersed thereon. The hydrophobic formed film structure 94 provides an interconnecting network 100 comprising a plurality of bucket-like structures that have to be filled up before overflowing to the core or before liquids flow toward the ends of the absorbent core.

FIG. 11 shows that in still another alternative embodiment, the fluid directing component 48 may comprise a structure such as a plastic film formed with a plurality of troughs 104 therein. Preferably, the bases 106 of the troughs 104 are less than or equal to about 100 mils (about 2.54 mm) wide to assist in the flow of menses. The structure shown in FIG. 11 can be provided with apertures 84 on the sides 108 of the troughs 104, the bases 106 of the troughs, or both. The cross-sectional shape of the troughs 104 is not limited to the shape shown in FIG. 11. The cross-section of the troughs 104 can be of any suitable configuration. The structure shown in FIG. 11 can also be used to provide the sanitary napkin with bending axes, and/or a degree of resilience, or lateral stability, or both.

In one especially preferred alternative embodiment (which will be discussed with reference to FIG. 1), the absorbent strip 46 comprises a low density material to provide the liquid transporting component with greater acquisition capabilities. The term "low density" as used herein, refers to materials having a density less than or equal to about 0.1 g/cc, and more preferably less than or equal to the following amounts: 0.09 g/cc, 0.08 g/cc, 0.07 g/cc, 0.06 g/cc, and 0.05 g/cc. Such low density materials will, however, typically sacrifice liquid distribution capabilities in comparison to higher density materials because of their lower capillarity. Materials having such low densities are typically most beneficial when they have relatively high calipers. This preferred embodiment is able to function, however, even when low caliper low density materials are used for the absorbent strip to make thin or "ultra-thin" product because the liquid distribution function of the means for directional fluid distribution can be separately handled by the fluid directing strip 48.

In alternative embodiments of this especially preferred embodiment, the absorbent strip 46 need not be used with a liquid impervious fluid directing strip 48. For instance, the absorbent strip can be used in conjunction with a fluid directing strip 48 having a higher density. Any suitable combination of these components can be used provided there is a density differential between the absorbent strip 46 and the fluid directing strip 48. This allows a liquid pervious strip to be used for the fluid directing strip 48. Such a combination has the advantage that it will preferentially distribute liquid exudates toward the ends of the absorbent core with the fluid directing strip 48 only causing limited interference with the penetration of exudates into the core.

In other alternative embodiments, the absorbent strip 46 and fluid directing strip 48 can be replaced by a means for directional fluid distribution 44 that comprises a single component. In such an alternative embodiment, the liquid transporting component and fluid directing component are integral components (i.e., portions or features) of a single component means for directional fluid distribution 44 (rather than two separate components).

Several non-limiting examples of such single component means for directional fluid distribution are described below. The single component means for directional fluid distribution can be similar in appearance to any of the means for directional fluid distribution shown in the drawings. However, the single component will typically comprise a structure in the form of a single layer with different regions that serve the various functions of the means for directional fluid distribution rather than in the form of a separate liquid transporting component placed on top of a liquid directing component.

The single component means for directional fluid distribution 44 can, for example, comprise a perforated film like one of the films specified as being useful as a topsheet. This perforated film is rendered hydrophilic by the incorporation of a surfactant (e.g., 1% Brij 76 formerly available from ICI Americas Company of Wilmington, Del.) and oriented with the cones (i.e., capillaries) facing toward the topsheet similar to the arrangement shown in FIG. 4. This will provide an impervious or semi-pervious component that is capable of transporting liquids on its surface. In variations of this embodiment, selected portions of the means for directional fluid distribution 44 can be rendered more or less hydrophilic than other portions thereof. For example, a central strip of the film similar to the central region 86 of the fluid directing strip shown in FIG. 8 can be made more hydrophilic than the regions laterally outboard of the central region, side regions 88, by applying a surfactant thereon to wick liquids along this central region.

In another preferred single component embodiment, the functions of both the absorbent strip and fluid directing strip can be carried out by a porous fibrous structure (or fibrous web) in which the finish on the fibers is varied to provide at least two regions of different hydrophilicity. These regions preferably comprise a first region, such as a fluid directing region, and an adjacent second, non-fluid directing (or less hydrophilic), region. These respective regions can be regions of a nonwoven material that have configurations resembling the central region 86 and the side regions 88 shown in FIG. 8, without the different sized apertures (or these regions could resemble various other structures shown herein).

The term "hydrophilic" as used herein, describes surfaces which are wetted by the liquid in question. The wetting of materials is generally defined in terms of contact angles and the surface tension of the liquids and solids involved. These properties are discussed in greater detail in The American Chemical Society Publication entitled, "Contact Angle,

Wettability, and Adhesion" edited by Robert F. Gould and copyrighted in 1964, and in the following TRI/Princeton Publications edited by Dr. H. G. Heilweil, Publication Number 459 entitled "A Microtechnique for Determining Surface Tension" published in April 1992, and in Publication Number 468 entitled "Determining Contact Angles Within Porous Networks" published in January 1993 which are incorporated by reference herein.

The fibrous material can be a single layer fibrous web that has been produced using known processes. Typically, such processes could be carded or spunbond nonwoven processes, or a combination thereof. The fibrous structure preferably has average wet pore radii between about 40 microns and about 180 microns. A suitable method for determining pore size of fibrous structures is described in TRI/Princeton of Princeton, N.J. Publication Number 464 entitled "Automated Determination of Pore Volume Distributions and Related Properties" edited by Dr. H. G. Heilweil published in September 1992, which publication is incorporated by reference herein. The fibers of such material preferably have a denier of between about 0.1 and about 6 dpf. The fibrous structure can be made of natural or synthetic fibers.

In a fibrous structure that is made with synthetic fibers, the different regions can be provided by rendering the contact angle (specifically, the advancing contact angle) of the layer about 85 degrees to about 89 degrees in the overall structure except in the region used for directing liquids. In the region used for directing fluids, the material is subjected to another hydrophilic treatment (such as by treating it with additional surfactant) to further reduce the advancing contact angle to as low as 55 degrees. One way to achieve this is by coating the fibers of the material in the fluid directing region with a semi-durable hydrophilic surfactant such as Silwet available from ICI (Middlesbrough, U.K.).

If a cellulose base material is chosen for this latter single component execution, the starting material typically has a contact angle of between about 30 degrees and about 55 degrees. The distinct regions are preferably created in the cellulose material by coating the non-fluid directing area with a partially hydrophobic surfactant that raises the advancing contact angle of the non-fluid directing region to about 80–89 degrees. A suitable surfactant for use in such an embodiment is SCOTCHBAN L12053 available from 3M of Minneapolis, Minn.

It should be understood, however, that this embodiment of the present invention is not limited to structures having the particular contact angles within the different regions described above. This is particularly true since the effect of the contact angle is dependent upon the liquid in issue. This embodiment of the present invention will function if there is a difference in hydrophilicity between the liquid directing region and the non-liquid directing region(s). This difference in hydrophilicity is preferably established so that: (1) the advancing contact angle of the liquid directing region is less than or equal to 89 degrees; and, (2) the advancing contact angle of the non-liquid directing region(s) is greater than or equal to 10 degrees more than the advancing contact angle of the liquid directing region.

The function of these structures can be described in the following manner with reference to the regions of the structure shown in FIG. 6. In this embodiment, the central fluid directing region 86 has a lower contact angle than the adjacent side regions 88. The difference in contact angles between these regions will reduce the tendency for liquids to flow laterally from the central region 86 into the side regions 88. This will facilitate the flow of liquids in the longitudinal direction through the fluid directing region 86 since the liquids will not have anywhere else to move. The liquids can flow on the surface of the central fluid directing region 86, or between the surfaces of fluid directing region (i.e., through the thickness of the fluid directing region). Another place liquids can flow in the central fluid directing region 86 is along any basal interface below the central fluid directing region 86 and the material or layer that lies beneath the central fluid directing region.

E. The Backsheet.

The backsheet 40 prevents the exudates absorbed and contained in the absorbent core 42 from wetting articles which contact the sanitary napkin 20 such as pants, pajamas and undergarments. The backsheet 40 is impervious to liquids (e.g., menses and/or urine). The backsheet 40 is preferably manufactured from a thin plastic film, although other flexible liquid impervious materials may also be used.

The backsheet 40 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. Preferably, the backsheet 40 is a polyethylene film having a thickness of from about 0.012 mm (0.5 mil) to about 0.051 mm (2.0 mils). Exemplary polyethylene films are manufactured by Clopay Corporation of Cincinnati, Ohio, under the designation P18-0401 and by Tredegar Film Products of Terre Haute, Ind., under the designation XP-39385.

The backsheet 40 is preferably embossed and/or matte finished to provide a more clothlike appearance. Further, the backsheet 40 may permit vapors to escape from the absorbent core 42 (i.e., the backsheet 40 may be breathable) while still preventing exudates from passing through the backsheet 40. Flushable or biodegradable backsheets can also be used, e.g., such as with the pantiliner devices described herein.

F. Fasteners for Attaching the Sanitary Napkin to the Wearer's Panties.

The outwardly-oriented face of the backsheet 40 may, as shown in FIG. 2, further comprise a means for attaching the sanitary napkin 20 to the undergarment of the wearer (such as a fastener) 50.

Fasteners comprising adhesives have been found to work well for this purpose. Any adhesive or glue used in the art for such purposes can be used, with pressure-sensitive adhesives being preferred. Suitable adhesives are Century A-305-IV manufactured by the Century Adhesives Corporation, Instant Lock 34-2823 manufactured by the National Starch Company, 3 Sigma 3153 manufactured by 3 Sigma, and Fuller H-2238ZP manufactured by the H. B. Fuller Co. Suitable adhesive fasteners are also described in U.S. Pat. No. 4,917,697.

The fastener 50 can be in many possible configurations depending on the characteristics desired for the sanitary napkin. FIG. 2 shows one preferred arrangement which utilizes two longitudinally oriented strips of adhesive, one on each side of the longitudinal centerline L. Particularly suitable fastener configurations are shown in PCT International Patent Publication No. WO 92/04000 entitled "Straps and Adhesive Fastening Means for an Absorbent Article" published in the name of Papa, et al. on Mar. 19, 1992, and in the Capillary Channel Fiber patent applications, the Curved Bun patent applications, and the Stretchable Absorbent Article patent application described in greater detail in Section 2H below.

In addition, other types of fasteners can be used instead of, or in addition to adhesives. These other types of fasteners are preferably arranged in patterns similar to those in the patent publications referred to above. Such fasteners include, but

are not limited to conventional VELCRO hook material, the fasteners described in: U.S. Pat. No. 4,946,527 issued to Battrell on Aug. 7, 1990; U.S. Pat. Nos. 5,058,247 and 5,116,563 issued to Thomas, et al. on Oct. 22, 1991 and May 26, 1992, respectively; and EPO Patent Application Publication No. 0 381 087 published Aug. 8, 1990; or, high coefficient of friction foams and other high coefficient of friction materials in the same category as those described in U.S. Pat. No. 4,166,464 issued to Korpman, U.S. Pat. No. 4,834,739 issued to Linker, III, et al. and U.S. Pat. No. 5,011,480 issued to Gossens, et al.

Before the sanitary napkin 20 is placed in use, if an adhesive fastener is used, the adhesive is typically covered with a removable cover strip or release liner 52 in order to keep the adhesive from sticking to a surface other than the crotch portion of the panty prior to use. Suitable release liners are also described in the above-referenced U.S. Pat. No. 4,917,697. Any commercially available release liners commonly used for such purposes can be utilized herein. Non-limiting examples of suitable release liners are BL30MG-A Silox E1/0 and BL30MG-A Silox 4P/0, both of which are manufactured by the Akrosil Corporation.

In one particularly preferred embodiment, the adhesive fastener 50 is protected with a wrapper that not only covers the adhesive, but also provides both an individually packaged sanitary napkin and a container for disposing the sanitary napkin after use, such as is described in U.S. Pat. No. 4,556,146 issued to Swanson, et al. on Dec. 3, 1985.

The sanitary napkin 20 of the present invention is used by removing any release liner 52 and thereafter placing the sanitary napkin 20 in a panty so that the adhesive (or other fastener) 50 contacts the panty and maintains the sanitary napkin in position within the panty during use.

G. Assembly of the Components of the Sanitary Napkin.

The components of the sanitary napkin such as the topsheet, the backsheet, the absorbent core, and any other components, may be assembled in a variety of well known configurations (including so called "tube" products or side flap products).

The components of the sanitary napkin are preferably assembled in a "sandwich" configuration with the topsheet, backsheet, and absorbent core each comprising a layer and the absorbent core positioned between the topsheet and backsheet. The topsheet 38 and the backsheet 40 are preferably peripherally joined using known techniques. The topsheet 38 and backsheet 40 can be joined either entirely peripherally so that the entire perimeter of the sanitary napkin 20 is circumscribed by the joinder of the components, or these two components can be only partially peripherally joined at the perimeter.

The components of the sanitary napkin 20 can be secured together by adhesives, stitching, heat and/or pressure bonds, dynamic mechanical bonds, ultrasonic bonds, intermingling or entanglement of the fibers or other structural elements comprising the components of the sanitary napkin, such as by meltblowing the fibers comprising one component onto another component, extruding one component onto another, or by any other means known in the art. Suitable means for attaching the components of the sanitary napkin are described in the patent applications described above filed in the name of Cree, et al.

H. Alternative Embodiments and Optional Features.

The sanitary napkin 20 may also be provided with a pair of flaps, each of which are adjacent to and extend laterally outward from a side edge of the main body portion of the sanitary napkin. (The main body portion is the portion of the sanitary napkin without the flaps.) The flaps are preferably configured to drape over the edges of the wearer's panties in the crotch region so that they are disposed between the wearer's panties and the wearer's thighs.

Such flaps can serve at least two purposes. First, the flaps help to prevent soiling of the wearer's body and panties by menstrual fluid. Second, the flaps are preferably provided with attachment means on their garment surface so that the flaps can be folded back under the panty and attached to the garment-facing side of the panty. In this way, the flaps serve to keep the sanitary napkin 20 properly positioned in the panty. Alternatively, the flaps may be attached to each other on the underside of the panty by the attachment means with or without also being affixed to the panty.

A number of sanitary napkins having flaps suitable or adaptable for use with the sanitary napkin 20 of the present invention are known. Such flaps are disclosed in U.S. Pat. No. 4,285,343 entitled "Sanitary Napkin" issued to McNair on Aug. 25, 1981, U.S. Pat. No. 4,589,876 entitled "Sanitary Napkin" issued to Van Tilburg on May 20, 1986; U.S. Pat. No. 4,608,047 entitled "Sanitary Napkin Attachment Means" issued to Mattingly on Aug. 26, 1986; U.S. Pat. No. 4,687,478, entitled "Shaped Sanitary Napkin With Flaps" issued to Van Tilburg on Aug. 18, 1987 and in Reexamination Patent B1 4,589,876 issued Apr. 27, 1993. Some particularly preferred types of flaps are described in the following U.S. patent applications: Ser. No. 07/769,891 entitled "Absorbent Article Having Flaps and Zones of Differential Extensibility" filed in the name of Lavash, et al. on Oct. 1, 1991 (PCT Publication No. WO 93/06805, published Apr. 15, 1993); and in Ser. No. 07/906,593 entitled "Absorbent Article Having Unitary Release Material" filed in the name of Lavash, et al. and Ser. No. 07/906,629 entitled "Absorbent Article Having Tucked Flaps" filed in the name of Osborn, et al., both filed Jun. 30, 1992.

While preferred sanitary napkin embodiments of the present invention have been described, numerous other sanitary napkin embodiments are disclosed in the literature. These could also be provided with the means for directional fluid distribution of the present invention. Several such sanitary napkins are disclosed in U.S. Pat. No. 4,425,130, "Compound Sanitary Napkin" issued to DesMarais on Jan. 10, 1984; U.S. Pat. No. 4,321,924, "Bordered Disposable Absorbent Article" issued to Ahr on Mar. 30, 1982; the aforementioned U.S. Pat. No. 4,950,264 issued to Osborn on Aug. 21, 1990; U.S. Pat. No. 5,007,906 entitled "Decoupled Sanitary Napkin" issued to Osborn, et al. on Apr. 16, 1991, the aforementioned U.S. Pat. No. 5,009,653 issued to Osborn on Apr. 23, 1991, U.S. Pat. No. 4,917,697 entitled "Sanitary Napkin Having Flaps and Stress Relief Means" issued to Osborn et al. on Apr. 17, 1990, U.S. Pat. No. 5,171,302 entitled "Absorbent Article With Central Hinge" issued to Buell on Dec. 15, 1992, U.S. Pat. No. 5,197,959 entitled "Absorbent Article" issued to Buell on Mar. 30, 1993; and in U.S. patent application Ser. No. 07/605,583 entitled, "Sanitary Napkin Having Components Capable of Separation in Use" filed in the name of Visscher, et al. on Oct. 29, 1990 (PCT Publication No. WO 92/07537 published May 14, 1992); U.S. patent application Ser. No. 07/630,451 entitled "Sanitary Napkin Having Transversely Segmented Core" filed in the name of Osborn et al. on Dec. 19, 1990 (PCT Publication No. 92 WO/10984, published Jul. 9, 1992); U.S. patent application Ser. No. 07/707,233 entitled "Sanitary Napkin Having Laterally Extensible Means for Attachment to the Undergarment of the Wearer" filed May 21, 1991 in the name of Osborn et al. (EPO Application No. 92202226.5); and in U.S. patent application Ser. No. 07/874,872 entitled "Generally Thin, Flexible Sani-

tary Napkin Having Stiffened Center" filed in the name of Osborn on Apr. 28, 1992.

The sanitary napkin described herein can be comprised of one or more extensible components. In one preferred embodiment, most or all of the components are extensible to provide a degree of extensibility (on the order of 15%–40%) to the absorbent article. This extensibility may provide better in-use fit and comfort. In a particularly preferred alternative embodiment, the sanitary napkin 20 is comprised of components that are extensible (preferably, capable of stretching), particularly in the longitudinal direction when the sanitary napkin is worn. Suitable extensible absorbent articles are described in U.S. patent application Ser. No. 07/915,133 entitled "Stretchable Absorbent Articles" filed in the name of Osborn, et al. on Jul. 23, 1992 (PCT Publication No. WO 93/01785 published Feb. 4, 1993).

In addition, other sanitary napkins that may be provided with the means for directional fluid distribution of the present invention are described in the following pending U.S. patent applications which were filed on Jul. 23, 1992: U.S. Patent application Ser. No. 07/915,202, entitled "Curved, Shaped Absorbent Article" filed in the name of Thomas L. Johnson, et al. (PCT Publication No. WO 93/01781); U.S. patent application Ser. No. 07/915,285, entitled "Absorbent Article Having Resilient Center" filed in the name of Thomas W. Osborn, et al. (PCT Publication No. WO 93/01782); U.S. patent application Ser. No. 07/915,201 entitled "Absorbent Article Fastener Pattern" filed in the name of Robb E. Olson, et al. (PCT Publication No. WO 93/01783); and, U.S. patent application Ser. No. 07/915,134, entitled "Method of Making Curved, Shaped Absorbent Articles" filed in the name of Lothe M. Hines, et al. (PCT Publication No. WO 93/01784).

The terms "panty liner" or "pantiliner" refer to absorbent articles that are less bulky than sanitary napkins which are generally worn by women between their menstrual periods. Suitable absorbent articles in the form of pantiliners which could be provided with the means for directional fluid distribution of the present invention are disclosed in U.S. Pat. No. 4,738,676 entitled "Pantiliner" issued to Osborn on Apr. 19, 1988.

The term "incontinence article" refers to pads, undergarments (pads held in place by a suspension system of same type, such as a belt, or the like), inserts for absorbent articles, capacity boosters for absorbent articles, briefs, bed pads, and the like, regardless of whether they are worn by adults or other incontinent persons. Suitable incontinence articles that can be provided with the means for directional fluid distribution described herein are disclosed in U.S. Pat. No. 4,253,461 issued to Strickland, et al. on Mar. 3, 1981; U.S. Pat. Nos. 4,597,760 and 4,597,761 issued to Buell; U.S. Pat. No. 4,704,115; U.S. Pat. No. 4,909,802 issued to Ahr, et al.; U.S. Pat. No. 4,964,860 issued to Gipson, et al. on Oct. 23, 1990; and in U.S. patent application Ser. No. 07/637,090 and 07/637,571 filed respectively by Noel, et al. and Feist, et al. on Jan. 3, 1991 (PCT Publication No. WO 92/11830 entitled "Absorbent Article Having Rapid Acquiring, Multiple Layer Absorbent Core" published in the name of Noel, et al. and PCT Publication No. WO 92/11831 entitled "Absorbent Article Having Rapid Acquiring, Wrapped Multiple Layer Absorbent Body" published in the name of Feist, et al., both published on Jul. 23, 1992).

The focus of the present invention is on absorbent articles that are intended to be worn in the crotch region of the wearer's undergarments. However, the features of the present invention could also be used in absorbent articles such as diapers. Diapers are absorbent articles worn by

infants and incontinent persons that are fastened about the waist of the wearer. Suitable diapers that can be provided with the means for directional fluid distribution of the present invention are disclosed in U.S. Pat. No. 3,860,003 issued to Buell on Jan. 14, 1975, and U.S. Pat. No. 5,151,092 issued to Buell, et al. on Sep. 29, 1992.

I. Flexibility of the Sanitary Napkin and Configurations the Sanitary Napkin May Take When Worn.

The components of the means for directional fluid distribution 44 have the specific relationships between their lengths and widths described herein, and are sufficiently flexible and joined in such a way that they maintain the desired relationships with each other during wear, particularly when the sanitary napkin 20 is laterally compressed. FIGS. 1, 12, and 13 show how this is accomplished.

FIG. 1 shows that the absorbent strip 46 and the fluid directing strip 48 lie along the longitudinal centerline of the sanitary napkin 20. The absorbent strip 46 and the fluid directing strip 48, being additional layers, provide the sanitary napkin with a stiffened region along the longitudinal centerline of the sanitary napkin 20 (i.e., a longitudinal central region 34). The longitudinal central region 34, in other words, is stiffer than the surrounding longitudinal side regions 36.

The flexibility of the various regions of the sanitary napkin is expressed in terms of flexure-resistance. The flexibility is measured according to the Circular Bend Procedure (described in greater detail below). The longitudinal central region 34 preferably has a flexure-resistance of up to: less than or equal to about 1,000 grams, more preferably less than or equal to about 700 grams, even more preferably less than or equal to about 500 grams, and most preferably less than or equal to about 400 grams. The surrounding longitudinal side regions 36 preferably have flexure resistances that are less than that of the longitudinal central region 34 and less than or equal to about 700 grams, more preferably less than or equal to about 600 grams, more preferably less than or equal to about 500 grams, more preferably less than or equal to about 400 grams, more preferably less than or equal to about 300 grams, and most preferably less than or equal to about 250 grams. The flexure-resistance of the longitudinal side regions 36 may also be any of those figures specified for the sanitary napkin described in U.S. Pat. No. 5,009,653 issued to Osborn.

The flexure-resistance of the different regions of the sanitary napkin is measured as peak bending stiffness. Peak bending stiffness is determined by a test which is modeled after the ASTM D 4032-82 Circular Bend Procedure. The ASTM procedure is modified for use herein. The Circular Bend Procedure as modified and used for the purposes of the present invention is hereinafter simply referred to as the "Circular Bend Procedure." One version of the Circular Bend Procedure is described in U.S. Pat. No. 5,009,653 issued to Osborn. The Circular Bend Procedure is a simultaneous multi-directional deformation of a material in which one face of a specimen becomes concave and the other face becomes convex. The Circular Bend Procedure gives a force value related to flexure-resistance, simultaneously averaging stiffness in all directions.

In the case of the present invention when carrying out the Circular Bend Procedure, rather than using one set of samples taken from the sanitary napkins as described in U.S. Pat. No. 5,009,653, separate samples are taken from longitudinal central region 34 and from the longitudinal side regions 36 of the sanitary napkins. The samples are tested and averaged separately so a flexure-resistance value is obtained for the longitudinal central region 34, and a separate value is obtained for the surrounding regions 36.

Apparatus:

The apparatus necessary for the CIRCULAR BEND PROCEDURE is a modified Circular Bend Stiffness Tester, having the following parts:

- A smooth-polished steel plate platform which is 102.0×102.0×6.35 millimeters having an 18.75 millimeter diameter orifice. The lap edge of the orifice should be at a 45 degree angle to a depth of 4.75 millimeters.
- A plunger having an overall length of 72.2 millimeters, a diameter of 6.25 millimeters, a ball nose having a radius of 2.97 millimeters and a needle-point extending 0.88 millimeter therefrom having a 0.33 millimeter base diameter and a point having a radius of less than 0.5 millimeter, the plunger being mounted concentric with the orifice and having equal clearance on all sides. Note that the needle-point is merely to prevent lateral movement of the test specimen during testing. Therefore, if the needle-point significantly adversely affects the test specimen (for example, punctures an inflatable structure), than the needle-point should not be used. The bottom of the plunger should be set well above the top of the orifice plate. From this position, the downward stroke of the ball nose is to the exact bottom of the plate orifice.
- A force-measurement gauge and more specifically an Instron inverted compression load cell. The load cell has a load range of from about 0.0 to about 2000.0 grams.
- An actuator, and more specifically the Instron Model No. 1122 having an inverted compression load cell. The Instron 1122 is made by the Instron Engineering Corporation, Canton, Mass.

Number and Preparation of Specimens

In order to perform the procedure for this test, as explained below, five representative sanitary napkins are necessary. From one of the five napkins to be tested, some number "Y" of 37.5×37.5 millimeter test specimens are cut. At least one specimen is cut from the portion of the sanitary napkin containing any means for directional liquid distribution (such as along the longitudinal centerline of the sanitary napkin), and at least one specimen is cut from the adjacent regions of the sanitary napkin that are outboard of any means for directional liquid distribution. If due to the plan view shape of the region to be tested, it is not possible to cut a square 37.5×37.5 mm. specimen, any other 1,400 square millimeter size specimen may be used, provided the specimen adequately covers the orifice in the test platform to properly carry out the test.

Specimens having portions in which a topsheet is joined directly to a barrier sheet or which are a laminate of a topsheet and a barrier sheet, should also not be tested. The reason that these specimens are not tested is due to the realization that prior art napkins exist in which a topsheet is joined to a barrier sheet beyond the edges of an absorbent core in the periphery of the napkin, such portions of which are highly flexible. The present invention is more concerned with the flexibility of the significant absorbent portions of the sanitary napkin. If any of the significant absorbent portions of the sanitary napkin meet the parameters set forth in the appended claims for the particular regions, then the sanitary napkin falls within the scope of the appended claims. A number of different specimens should be tested from each sanitary napkin. In particular, the structurally least flexible portions in the center of the sanitary napkin should be tested as the longitudinal central region. The most flexible portions of the sanitary napkin should be tested when samples of the longitudinal side regions of the napkin are measured.

The test specimens should not be folded, bent, or compressed by the test person, and the handling of specimens must be kept to a minimum and to the edges to avoid affecting flexural-resistance properties. From the four remaining sanitary napkins, an equal number "Y" of specimens, identical to the specimens cut from the first napkin, are cut. Thus, the test person should have "Y" number of sets of five identical specimens.

Procedure

The procedure for the CIRCULAR BEND PROCEDURE is as follows. The specimens are conditioned by leaving them in a room which is 21±1° C. and 50±2% relative humidity for a period of two hours. The test plate is leveled. The plunger speed is set at 50.0 centimeters per minute per full stroke length. A specimen is centered on the orifice platform below the plunger such that the body surface 20A of the specimen is facing the plunger and the garment surface 20B of the specimen is facing the platform with the release paper removed from any adhesive on the garment surface of the specimen and the adhesive sprinkled with corn starch to eliminate the adhesive tack. The indicator zero is checked and adjusted, if necessary. The plunger is actuated. Touching the specimen during the testing should be avoided. The maximum force reading to the nearest gram is recorded. The above steps are repeated until all five of the identical specimens have been tested.

Calculations

The peak bending stiffness for each specimen is the maximum force reading for that specimen. Each set of five identical specimens is tested and the five values received for that set are averaged. Thus, the test person now has an average value for each of the "Y" identical sets of specimens tested. If any of the significant absorbent portions of the sanitary napkin have a longitudinal central region and surrounding regions with average for each identical specimen with the requisite flexure-resistance, then the napkin satisfies the parameters of this test.

FIGS. 12 and 13 are simplified schematic cross-sectional views which show two possible configurations that the sanitary napkin 20 of the present invention may take when worn. The means for directional fluid distribution 44 provides the sanitary napkin 20 with a stiffer longitudinal central region 34 that may bend as indicated, but does not "rope" or distort in such an amount as to interfere with the fluid directing function of the means for directional fluid distribution 44.

FIG. 12 shows an embodiment in which the sanitary napkin fits adjacent to the wearer's body (particularly the insides of the upper portions of the wearer's thighs and the wearer's labia majora) in a "W" shape. (The wearer's body is designated "W" in the drawings.) FIG. 12 also shows how the optional bending axes 50 provided in the sanitary napkin 20 can be used to assist the sanitary napkin in assuming the desired in-use cross-sectional configuration. If the fluid directing strip 48 comprises a thin strip of film, it is typically flexible enough that the sanitary napkin can assume such a configuration even without providing the fluid directing strip 48 with such bending axes, however.

FIG. 13 shows an embodiment in which the sanitary napkin fits adjacent to the wearer's body (particularly the insides of the upper portions of the wearer's thighs and the wearer's labia majora) in an inverted "V" shape.

In alternative embodiments, the sanitary napkin 20 of the present invention may assume any of the other different configurations in the above-referenced U.S. patent application Ser. No. 07/832,797 entitled "Sanitary Napkin With Stiffened Center" filed in the name of Osborn on Jan. 22, 1992.

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The disclosures of all patents, patent applications (and any patents which issue thereon, as well as any corresponding published foreign patent applications), and publications mentioned throughout this patent application are hereby incorporated by reference herein. It is expressly not admitted, however, that any of the documents incorporated by reference herein teach or disclose the present invention. It is also expressly not admitted that any of the commercially available materials or products described herein teach or disclose 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.

What is claimed is:

1. A sanitary napkin comprising:

a liquid pervious topsheet;

a liquid impervious backsheet joined to said topsheet;

an absorbent core having a length, a width, and a pair of end edges positioned between said topsheet and said backsheet;

a means for directional liquid distribution positioned between said absorbent core and said topsheet, said means for directional liquid distribution comprising:

a liquid transporting component positioned between said topsheet and said absorbent core, said liquid transporting component having a length, a width, a pair of side edges, and a pair of end edges wherein the length of said liquid transporting component is less than the length of said absorbent core; and

a liquid directing component for directing liquid exudates toward the end edges of said absorbent core by controlling the flow of the liquid exudates being transported by said liquid transporting component into said absorbent core, said liquid directing component being positioned between said liquid transporting component and said absorbent core, and having a length, a width, a pair of side edges, and a pair of end edges, wherein:

at least one of the end edges of said liquid transporting component extends beyond one of the end edges of said liquid directing component so that said liquid transporting component transports liquid exudates beyond the end edges of said liquid directing component.

2. The sanitary napkin of claim 1 wherein said liquid transporting component comprises a strip of absorbent material.

3. The sanitary napkin of claim 1 wherein said liquid transporting component comprises a laminate of two tissue layers with absorbent gelling material therebetween.

4. The sanitary napkin of claim 1 wherein both ends of said liquid transporting component extend beyond the ends of said liquid directing component, and said liquid transporting component is joined to the underlying absorbent core only at the ends of said liquid transporting component and is unattached to any underlying element between said ends to provide an unattached portion of said liquid transporting component that can separate from said absorbent core when said sanitary napkin is worn.

5. The sanitary napkin of claim 1 wherein said liquid directing component is hydrophilic.

6. The sanitary napkin of claim 1 wherein said liquid directing component is hydrophobic.

7. The sanitary napkin of claim 1 wherein said liquid directing component comprises a liquid impervious structure.

8. The sanitary napkin of claim 7 wherein said liquid directing component comprises a strip of film.

9. The sanitary napkin of claim 1 wherein said sanitary napkin has a longitudinal centerline that extends in a longitudinal direction and said liquid directing component comprises a structure with a plurality of liquid directing channels extending in the longitudinal direction formed therein.

10. The sanitary napkin of claim 9 wherein said liquid directing component comprises a piece of foam.

11. The sanitary napkin of claim 9 wherein said liquid directing component comprises a strip of material having liquid directing channels with trapezoidal cross-sections.

12. The sanitary napkin of claim 11 wherein said trapezoidal-shaped channels have a base and walls, and at least one of said base and said walls have apertures provided therein.

13. The sanitary napkin of claim 1 wherein said liquid directing component comprises a semi-liquid impervious structure.

14. The sanitary napkin of claim 13 wherein said liquid directing component comprises an apertured film.

15. The sanitary napkin of claim 1 wherein both end edges of said liquid transporting component extend beyond the end edges of the liquid directing component.

16. The sanitary napkin of claims 1 or 15 wherein at least one side edge of said liquid directing component extends laterally outward beyond one of the side edges of the liquid transporting component.

17. The sanitary napkin of claim 1 wherein the width of said liquid transporting component is between about 1 cm and about 4 cm and the length of said liquid transporting component is between about 7 cm and about 15 cm.

18. The sanitary napkin of claims 1, 15, or 17 wherein the width of said liquid directing component is between about 0.3 cm to about 0.7 cm wider than said liquid transporting component, and the length of said liquid directing component is between about 0.5 cm to about 2 cm shorter than said liquid transporting component.

19. The sanitary napkin of claim 1 wherein said liquid directing component has curved, concave inward side edges.

20. The sanitary napkin of claim 1 wherein said liquid transporting component and said liquid directing component comprise two separate elements.

21. The sanitary napkin of claim 1 wherein said liquid transporting component and said liquid directing component comprise an integral structure of two separate elements.

22. The sanitary napkin of claim 1 wherein said liquid transporting component has a density of less than or equal to about 0.1 g/cc.

23. The sanitary napkin of claim 22 wherein said liquid directing component has a higher density than said liquid transporting component.

24. The sanitary napkin of claim 1 wherein said liquid directing component comprises a hydrophobic structure with a hydrophilic component disposed thereon wherein said hydrophilic component is positioned between said liquid transporting component and said hydrophobic structure.

25. The sanitary napkin of claim 1 wherein said means for directional liquid distribution further has a longitudinal centerline defining a longitudinal direction and a lateral centerline defining a lateral direction and comprises a single layer structure with a longitudinally oriented central portion juxtaposed with said longitudinal centerline and a pair of longitudinally oriented outer portions lying laterally outboard of said central portion, said central portion and said outer portions having different levels of hydrophilicity.

26. The sanitary napkin of claim 1 wherein said sanitary napkin has a longitudinal centerline extending in a longitudinal direction and a transverse centerline extending in a transverse direction, and said means for directional liquid distribution transports liquid exudates more rapidly in the longitudinal direction than in the transverse direction.

27. The sanitary napkin of claim 1 wherein the caliper of the napkin is less than or equal to about 4 millimeters.

28. A sanitary napkin having a length, a width, two longitudinal edges that define the width of the napkin, two transverse end edges that define the length of the napkin, a body-facing surface, a garment-facing surface, said sanitary napkin comprising:

a liquid pervious topsheet;

a liquid impervious backsheet joined to said topsheet;

an absorbent core positioned between said topsheet and said backsheet, said absorbent core having a length, a width, a pair of longitudinal side edges, and a pair of end edges;

a means for directional liquid distribution positioned between said absorbent core and said topsheet, said means for directional liquid distribution comprising:

a liquid transporting component for transporting liquid exudates which penetrate said topsheet toward the end edges of said absorbent core, said liquid transporting component being positioned between said topsheet and said absorbent core, and having a length and a width; and

a liquid directing component for directing liquid exudates toward the end edges of said absorbent core by controlling the flow of the liquid exudates being transported by said liquid transporting component into said absorbent core, said liquid directing component being positioned between said liquid transporting component and said absorbent core, and having a length, a width, a pair of side edges, and a pair of end edges, wherein:

the length and width of both said liquid transporting component and liquid directing component are less than the respective length and width of said absorbent core; the width of said liquid transporting component is less than the width of said liquid directing component; and, the length of said liquid transporting component is greater than the length of said liquid directing component so that said liquid transporting component transports liquid exudates beyond the end edges of said liquid directing component.

29. The sanitary napkin of claim 28 wherein the width of said absorbent strip is between about 0.3 cm to about 0.7 cm less than the width of said liquid directing component; the length of said liquid transporting component is between about 0.5 cm to about 2 cm greater than the length of said liquid directing component; and, said sanitary napkin has a flexure resistance as measured through the portions of said sanitary napkin that include said means for directional liquid distribution that is greater than the flexure resistance of said sanitary napkin as measured through the portions of said sanitary napkin that extend beyond said means for directional fluid distribution, and the flexure resistance of said sanitary napkin as measured through the portions of said sanitary napkin that extend beyond said means for directional fluid distribution is less than or equal to about 700 grams force.

30. The sanitary napkin of claim 29 wherein said napkin is predisposed to assume a W-shaped cross-sectional configuration when worn.

31. The sanitary napkin of claim 29 wherein said napkin is predisposed to assume an inverted V-shaped cross-sectional configuration when worn.

32. A sanitary napkin having a length, a width, a longitudinal centerline, a transverse centerline, two longitudinal edges that define the width of the napkin, two transverse end edges that define the length of the napkin, a body-facing surface, a garment-facing surface, said sanitary napkin comprising:

a liquid pervious topsheet;

a liquid impervious backsheet joined to said topsheet;

an absorbent core positioned between said topsheet and said backsheet, said absorbent core having a length, a width, a pair of longitudinal side edges, and a pair of end edges;

a means for directional liquid distribution positioned between said absorbent core and said topsheet, said means for directional liquid distribution comprising a single element positioned between said topsheet and said absorbent core and being oriented along said longitudinal centerline, said single element having a length, a width, a central region disposed along and adjacent said longitudinal centerline and a pair of side regions disposed laterally outboard of said central region, said single element comprising:

a liquid transporting portion for transporting liquid exudates which penetrate said topsheet toward the end edges of said absorbent core, said liquid transporting portion forming said central region of said single element and having a length and a width; and

a liquid directing portion for directing said exudates toward the end edges of said absorbent core by controlling the flow of the liquid exudates from said liquid transporting component into said absorbent core, said liquid directing portion being positioned between said liquid transporting portion and said absorbent core, and having a length, a width, a pair of side edges, and a pair of end edges, wherein:

the length and width of both said means for directional liquid distribution is less than the respective length and width of said absorbent core; the width of said liquid transporting portion is less than the width of said liquid directing portion; and, the length of said liquid transporting portion is greater than the length of said liquid directing portion so that said liquid transporting portion transports liquid exudates beyond the end edges of said liquid directing portion.

33. A sanitary napkin comprising:

a liquid pervious topsheet;

a liquid impervious backsheet joined to said topsheet;

an absorbent core positioned between said topsheet and said backsheet;

a means for directional liquid distribution having average wet pore radii ranging from about 40 microns to about 130 microns and positioned between said absorbent core and said topsheet, said means for directional liquid distribution comprising a component having:

a liquid directing region wherein a liquid disposed on said liquid directing region has a first advancing contact angle of less than or equal to about 80 degrees; and

an adjacent region laterally outboard of said liquid directing region, wherein a liquid disposed on said adjacent region has a second advancing contact angle and said second advancing contact angle is equal to or greater than about 10 degrees more than said first advancing contact angle.

* * * * *

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(54) SURFACE MATERIAL WITH SLITS

(57) A liquid-permeable surface material for an absorbent article such as a diaper, an incontinence protector, a sanitary napkin, or the like, comprising a flexible, skin friendly material layer (1), and having at least one penetrating opening (3'). The opening (3') is formed by a slit (3) in the material layer (1) whereby the slit (3) has two longitudinal edges. Elongate elastic means (2) are pre-tensioned and arranged on both sides of the slit (3), substantially perpendicular to the edges of the slit (3), and act contractingly on the material on both sides of the slit (3) so that the edges of the slit (3) are pulled apart and the contracted material exhibits wrinkles (34) running substantially parallel to the slit (3). A method of manufacture, and absorbent articles including the surface material are also disclosed.

FIG 3

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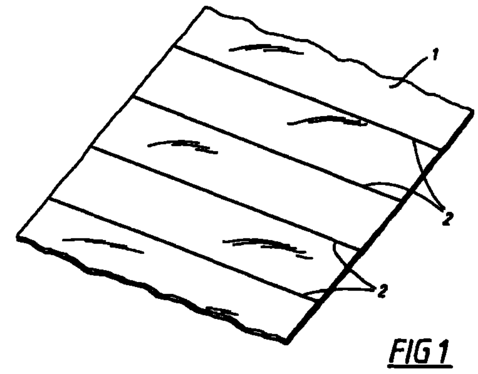

FIG 1

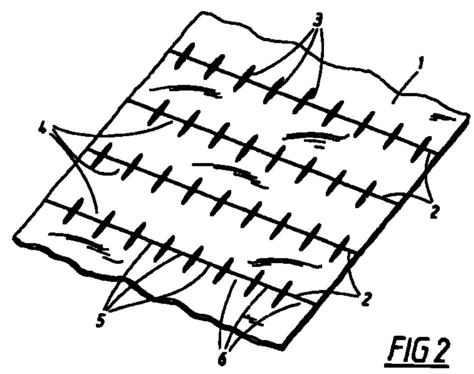

FIG 2

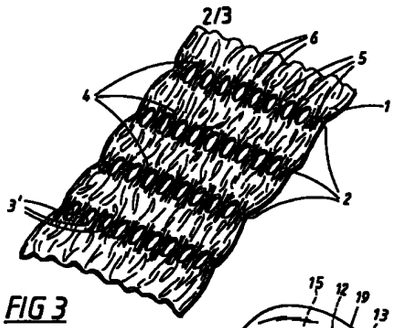

FIG 3

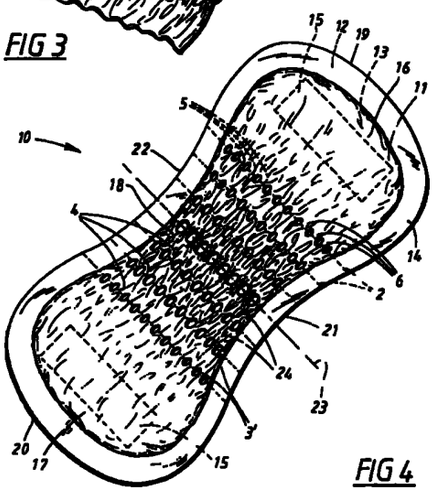

FIG 4

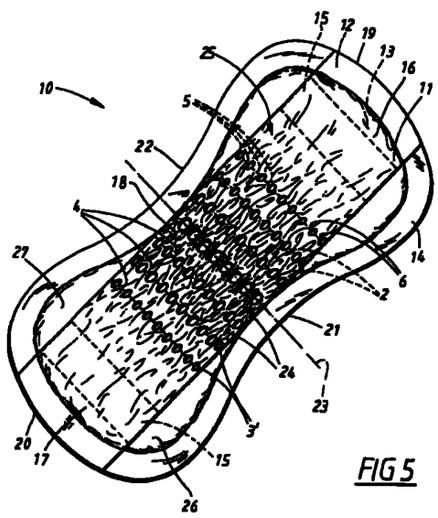

FIG 5

TITLE: A LIQUID PERMEABLE SURFACE MATERIAL FOR AN ABSORBENT ARTICLE, AND A METHOD FOR ITS MANUFACTURE

TECHNICAL AREA :

The invention relates to a liquid permeable surface material for an absorbent article such as a diaper, an incontinence protector, a sanitary napkin, or similar, comprising a flexible, skin-friendly material layer, and exhibiting at least one penetrating opening The invention also relates to a method of manufacturing the surface material, and an article having the surface material

BACKGROUND OF THE INVENTION:

With absorbent articles such as, primarily, incontinence protectors for grown-up incontinent persons, there has long been a considerable problem associated with creating a surface layer which, during a very short period of time, is capable of admitting a comparatively large volume of body fluids to an absorption body arranged inside the surface layer For grown-up incontinent persons, the emptying of the bladder is often both fast and sudden, resulting in a considerable risk of discharged urine flowing on the outer surface of the surface layer and running out over the edges of the incontinence protector instead of penetrating the surface layer and being absorbed by the absorption body Since grown-up incontinent persons often lead an active life, with work and social interactions, it is certainly very inconvenient not to be able to rely on the leakproof safety of incontinence protectors Additionally, soiling of clothes, bedclothes and furniture results in unnecessary extra work for the incontinent person, or for his or her caretaker

THE OBJECT OF THE INVENTION:

It is thus an object of the present invention to provide a surface material of the type specified above, which exhibits a rapid inlet of discharged body fluid and which substantially lowers the risk of the body fluid streaming out over the surface of the layer instead of passing down through the layer

SHORT DESCRIPTION OF THE INVENTION:

The surface material according to the invention is characterised primarily in that it has at least one opening which is formed by a slit in the material, wherein the slit has two longitudinal edges, and wherein elongated elastic means are pre-tensionally arranged on both sides of the slit, substantially perpendicularly to the edges of the slit, whereby the elastic means act contractingly on the material on both sides of the slit so that the edges of the slit are pulled apart and the contracted material exhibits wrinkles extending substantially parallel to the slit

According to a preferred embodiment of the invention, the surface material has a plurality of openings formed by a row of slits arranged substantially parallel to each other The elastic means are here arranged between the slits and extend along the row of slits substantially perpendicularly to the edges of the slits, whereby the material between the slits is wrinkled and the edges of the slits are pulled apart

Further, it is possible, within the scope of the invention, to arrange two or more rows of slits with intermediate elastic means In this manner, the length of the slits can vary between the different rows It is further possible to vary the length of the slits within one single row

The mutual distance between the slits of two different rows can be different, as well as the mutual distance between the slits along one and the same row It is also possible to vary the pre-tension of the elastic means between the

different rows as well as within the same row Obviously, the distance between different rows can also vary across the surface of the layer It is further possible, if desirable, to arrange the elastic means and the slits along one or more curve-shaped rows

One method of manufacturing the surface material involves stretching a plurality of parallel elongated elastic means, placing and affixing the elastic means on a pliable, skin friendly material layer which is kept stretched in a planar condition during the affixating of the elastic means The method is characterized primarily in that slits are made through the material layer whilst the material is kept stretched Thereby, the slits are caused to extend substantially perpendicularly across the elastic means whereby the elastic means are severed at the slits whereafter the stretching of the material layer is discontinued and the elastic means are allowed to contract, whereby the material between the slits is wrinkled and the slits are widened through the pulling apart of the edges of the slits by the contracting force of the elastic means,

When the surface material is used as a liquid permeable top sheet on an absorbent article, such as an incontinence protector, a diaper, or a sanitary napkin, it is important that the layer is oriented in such a way that the elastic means run substantially perpendicularly across the product, whereby the wrinkles in the surface material formed during the contraction of the elastic means run in the longitudinal direction of the product In this manner, the wrinkles act as liquid-dispersing channels which receive and transport body fluid out towards the end parts of the product, whereby the absorption capacity of the product can be better used Furthermore, the wrinkles and the folds in the surface material act as barriers against liquid transport transversely across the product Since absorbent

articles of the intended type practically without exception have a smaller dimension in the transverse direction than in the longitudinal direction, the risk of leakage is greatest at the longitudinal side edges The use of the surface material according to the invention substantially reduces the risk of edge leakage, partly because the liquid is dispersed in the longitudinal direction of the product, and partly because liquid flow in the transverse direction is counteracted

For an absorbent article having two end portions, and an intermediate crotch portion, it may be advantageous to arrange elastic means and openings in the liquid permeable cover layer substantially only within the area which is situated at the crotch portion of the article The size and location of the crotch portion in the longitudinal direction of the article cannot be specified in absolute terms, since they may vary somewhat depending on different factors such as the shape of the article, the relevant category of use, how the product is applied inside the users underwear and the body shape of the user By arranging openings only within the area which is intended to be the crotch portion of the article, the end parts of the article are left smooth, whereby the article is thinner within these portions and it is easier for a user to conceal the article under ordinary clothes

It may also be advantageous to provide the area of the product which is intended to first be wetted by discharged body fluid with more and/or larger openings than the surrounding portions of the liquid permeable surface layer of the article Further, the degree of wrinkling in the surface layer may conveniently be controlled by varying the tension in the elastic means and by varying the distance between the openings in the material layer With increased tension in the elastic means and with an increasing

distance between the openings a larger degree of wrinkling is achieved Since a heavy wrinkling is advantageous for the liquid receiving capacity of the article and for the liquid dispersion in the article, the formation of wrinkles should be most pronounced within the area of the article which is intended to be primarily wetted by the body fluid This thus coincides with the area of the surface layer of the article which should be provided with the largest number of openings and/or the largest openings

The invention will now be described more closely with reference to an embodiment which is shown in the attached drawings

SHORT DESCRIPTION OF THE DRAWINGS:

Fig 1 of the drawings shows a material layer with affixed elastic means

Fig 2 shows the surface material of Fig 1 after it has been slit

Fig 3 shows a completed surface material

Fig 4 shows how the surface material will look when it is applied to an incontinence protector

Fig 5 shows a further embodiment of an incontinence protection having a surface material according to the invention

DESCRIPTION OF THE EMBODIMENTS:

The material layer 1 shown in Fig 1, comprises a thin layer of skin friendly, flexible material Suitable materials for this purpose are, for example, perforated or unperforated plastic films, textile or plastic nets, or non-woven textile materials, henceforth called non-woven

material Furthermore, conventional textile materials, manufactured, for example, by weaving or knitting can, of course, be used if this is deemed suitable

The material layer 1 is shown as a part of a continuous web of material Elongate elastic means 2 are pre-tensioned and arranged transversely across the web of material The elastic means 2 may, for example, consist of elastic threads, ribbons, or bands of elastic non-woven material, nettings, films or similar In addition, elastic means consisting of two or more parallel elastic ribbons or threads are within the scope of the invention The web of material is shown in a flat condition, i e with the elastic means stretched out During the manufacturing of the surface material, the web of material is kept stretched out whilst applying the elastic means 2 The stretching out is achieved by some form of known stretching means, such as clamps, pins or the like The stretching means are not shown in the drawings The elastic means 2 can be affixed to the material layer 1 by gluing, or by welding with heat or ultrasonic sound It is further conceivable that the elastic means are laminated between two layers which together form the web of material

In Fig 2, the web of material is provided with a plurality of longitudinal slits 3 The slits 3 are arranged in rows 4 transversely across the web of material 1 and are oriented so that each slit 3 is arranged perpendicularly over a transverse elastic means 2 The web of material 1 and the elastic means 2 are kept stretched out, so that the web of material is flat when the slits 3 are formed The slits 3 can be formed in numerous different ways, for example by cutting using edge rollers, using ultrasonic sound, high pressure water jets, or by heating the material When the web of material 1 is slit, the elastic