ESCOBAR – URIBE ASOCIADOS
A B O G A D O S
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292

As. 2726/P.

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

Ref.: Expediente No. **04-084.677**
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 Nos. 06 - 24,698 de 29 de marzo de 2006, 06 - 22,993 de 22 de marzo de 2006, 06 -1,077 de 5 de enero de 2006 y 06 - 1,076 de 5 de enero de 2006, por la suma de $388.000.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.

253

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO

2726

NIT : 800176089-2

RECIBO OFICIAL DE CAJA : 06 - 24,698
FECHA : MARZO 29 DE 2006

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO
Rad: 04-084677--00003-0000 Fec: 2006-04-21 15:06:43
Dep: 2020 NUEVOCREACIONES
Tra: 2 PATENTES Eva 1 REGDEPOSITO
Act 538 PETICION Folios: 4

***** 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	51162175	29/03/2006	8,899,500.00

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

CANT.	RENTISTICO	CONCEPTO		TOTAL CONCEPTO
1	50005-01-01 SOLICITUDES	91 TASA ANUAL DE MANTENIMIENTO DE PA		240,000.00
		TOTAL :	$	240,000.00

SON: DOSCIENTOS CUARENTA MIL PESOS

RESPONSABLE : _____

RECIBO DE CAJA APLICADO AL EXPEDIENTE No._____

3

3+16

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO
Rad: 04-084677-00003-0000 Fec: 2006-04-21 15:06:43
Dep: 2020 NUEVAS CREACIONES
Tra: 2 PATENTES Eva 1 REGDEPOSITO
Act 538 PETICION Folios: 4

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO

NIT : 800176089-2

RECIBO OFICIAL DE CAJA : 06 - 22.993
FECHA : MARZO 22 DE 2006

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	51163432	22/03/2006	6,412,000.00

C O N C E P T O

CANT.	RENTISTICO	CONCEPTO		TOTAL CONCEPTO
1	50005-01-09 OTROS SERVICIOS DE PROPIEDAD I	16	INFORME SOBRE EL ESTADO DE LA TEC	146,000.00
			TOTAL : $	146,000.00

SON: CIENTO CUARENTA Y SEIS MIL PESOS

RESPONSABLE : _____

RECIBO DE CAJA APLICADO AL EXPEDIENTE No._____

2726

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO

NIT : 800176089-2

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO
Rad: 04-084677-.00003-0000 Fec: 2006-04-21 15:06:43
Dep. 2020 NUECREACIONES
Tra: 2 PATENTES Eve: 1 REGDEPOSITO
Act 538 PETICION Folios: 4

RECIBO OFICIAL DE CAJA : 06 - 1,077
FECHA : ENERO 5 DE 2006

***** 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	35418876	05/01/2006	1,434,500.

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

CANT.	REMTISTICO	CONCEPTO		TOTAL CONCEPTO
1	50005-01-09 OTROS SERVICIOS DE PROPIEDAD I	998	VALOR COMPLEMENTO TARIFA AÑO ANTR	1,000.00
			TOTAL : $	1,000.00

SON: MIL PESOS

RESPONSABLE : _____

RECIBO DE CAJA APLICADO AL EXPEDIENTE No._____

256

DIVISION DE NUEVAS CREACIONES

RADICACIÓN EXPEDIENTE No. **04-84677**

EL EXTRACTO DE LA PRESENTE SOLICITUD DE **PATENTE DE INVENCION**

FUE PUBLICADO EN LA GACETA DE PROPIEDAD INDUSTRIAL No **557**, DE

FECHA **31** DE **OCTUBRE** DE **2005**, EL TERMINO HABIL SEÑALADO POR LA

LEY EXPIRA EL **27** DE **ENERO** DE **2006**.

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

SUPERINTENDENCIA DE INDUSTRIA Y C MERCI
DIVISIÓN DE NUEVAS CREACI NES

2020
Bogotá, D. C., 31 de Agosto de 2006

Doctora
JIMERNA ESCOBAR URIBE
Representante Mc NEIL – PPC, INC.

ASUNTO	Radicación No.	**04-84677**
	Trámite	002
	Evento	001
	Actuación	430
	Oficio	10152
	Folios	075

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 7 a 69 de la solicitud en estudio.

b) Para el presente estudio se tendrán en cuenta los dibujos comprendidos en los folios 73 a 106 de la solicitud en estudio.

c) Para el presente estudio se tendrá en cuenta el capítulo reivindicatorio que comprende 10 reivindicaciones en los folios 70 a 72 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 30 de Agosto de 2004, y en el momento de la radicación SI se reclamo prioridad de la primera solicitud presentada en Estados Unidos US 10/651676

2) **Objeto de la invención**

a) Las reivindicaciones 1 a 10 de la solicitud en estudio se refieren a una estructura con dos capas para utilizarse en artículos absorbentes, que comprende: una primera capa permeable a un fluido; una segunda capa permeable a un fluido en comunicación fluida con la primera capa, la segunda capa tiene una superficie sustancialmente plana y una primera pluralidad de macrocaracterísticas separadas que se extienden desde la superficie plana; en donde la primera capa y la segunda capa están estructuradas y arregladas de manera que la primera capa entra en contacto con la segunda capa en cada una de las macrocaracterísticas y la primera capa entra en contacto con la superficie sustancialmente plana de la segunda capa, en áreas seleccionadas localizadas entre las macrocaracterísticas.

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

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

3) **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 errores de traducción. Por ejemplo, en español no existen las "fotomicrografías". Deben estarse refiriendo a las "microfotografías". En español no existe el término "macrocaracterísticas"... y un largo etcétera. Por lo anterior, la solicitud debe ser revisada y traducida por alguien que entienda del arte.

También, la solicitud presenta espacios en blanco que no revelan información que debe contener la solicitud. Por ejemplo, el folio 24 no muestra un número de una solicitud de patente de Estados Unidos que debería venir allí.

Por lo anterior, la presente solicitud no cumple con el Art. 28 de la Decisión 486.

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) Los errores enumerados en el punto 3) a) son también aquí aplicables.

II) No se precisa la materia sobre la cual se solicita protección. Cómo se explicará en el punto 4), la presente solicitud no posee unidad de invención, por lo que no está definida la materia sobre la cual se solicita protección.

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) Evaluación de la Unidad de Invención

El artículo 25 de la Decisión 486 de la Comisión de la Comunidad Andina establece

> *"La solicitud de patente sólo podrá comprender una invención o un grupo de invenciones relacionadas entre sí, de manera que conformen un único concepto inventivo"*

La presente solicitud carece de unidad de invención toda vez que configura **DOS** diferentes objetos. La definición de la materia que caracteriza a cada una de las reivindicaciones independientes es muy diferente entre sí. Esto permite afirmar que no se trata del mismo producto. Todo el problema radica en configurar varias reivindicaciones independientes con materia diferente. El solicitante debe establecer una sola reivindicación independiente dirigida al producto en la forma más simple de la solicitud de invención. Partiendo de allí establecer reivindicaciones dependientes que amplíen esa forma más simple hasta su forma más compleja.

De acuerdo a lo anterior, la presente solicitud no cumple con el requisito de unidad de invención de acuerdo al Art. 25 de la Decisión 486. De continuar con el impedimento, está oficina procederá a estudiar solo el primer grupo de invenciones que conformen un único concepto inventivo.

5) Determinación del Estado de la Técnica

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

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

Consultadas las bases de datos y los archivos con que cuenta la entidad, especialmente bajo las clasificaciones **A 61 F 13/15** y las más cercanas a ellas, se encontró que antes del 29 de agosto de 2003 (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 estructuras absorbentes.

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

Nº	Documento	Título	Fecha de Publicación
D1	WO 03/068123	Two layers structure for absorbent articles	2003.08.21
D2	US20030118782	Sheet of creped and embossed absorbent paper, an embossing roll for one such sheet and an embossing method	2003.06.26
D3	US 63951333	Process for producing embossed multiply cellulosic fibrous structure having selective bond	2002.05.28
D4	WO 0117475	Embossed liner for absorbent article	2001.03.15

6) 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."

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".

Los documentos D2, D3 y D4 muestran productos que incorporan dos capas y que comprenden: una primera capa permeable a un fluido; una segunda capa permeable a un fluido en comunicación fluida con la primera capa, la segunda capa tiene una superficie sustancialmente plana y una primera pluralidad de elementos tridimensionales separados que se extienden desde la superficie plana; en donde la primera capa y la segunda capa están estructuradas y arregladas de manera que la primera capa entra en contacto con la segunda capa en cada una de los elementos tridimensionales y la primera capa entra en contacto con la superficie sustancialmente plana de la segunda capa, en áreas seleccionadas localizadas. Como se observa es prácticamente lo mismo que quiere proteger el solicitante para Colombia.

Ahora bien, el documento D1, corresponde prácticamente al mismo documento que se está presentando en Colombia. Se encuentran los mismos dibujos, largos apartes de la descripción exactamente iguales (incluyendo ciertos errores) y prácticamente las mismas reivindicaciones. Como se observa D1 fue publicado antes de la fecha de prioridad reivindicada.

Por lo anterior, la presente solicitud no tendría los requisitos 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	Reivindicaciones afectadas	Requisito que afecta
D1	WO 03/088123	1 - 10	Novedad
			Nivel inventivo
D2	US20030118782	1 - 10	Novedad
			Nivel inventivo
D3	US 63951333	1 - 10	Novedad
			Nivel inventivo
D4	WO 0117475	1 - 10	Novedad
			Nivel inventivo

7) 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

07. SET. 2006

Concepto Técnico Nº	EXAMINADOR TÉCNICO Código No.	EXAMINADOR JURÍDICO Código No.
1407	202003	

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
21 August 2003 (21.08.2003)

PCT

(10) International Publication Number
WO 03/068123 A2

(51) International Patent Classification[7]: A61F 13/15, [illegible] 3/28

(21) International Application Number: PCT/US03/04434

(22) International Filing Date: 13 February 2003 (13.02.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/356,833 14 February 2002 (14.02.2002) US

(71) Applicant: MCNEIL-PPC, INC. [US/US]; Grandview Road, Skillman, NJ 08558 (US).

(72) Inventors: JAMES, William, A.; 41 Aunt Molly Road, Hopewell, NJ 08525 (US). JONES, Archie; 1 Rhein Avenue, Somerset, NJ 08873 (US). KELLY, William, G. F.; 110 Wilton Avenue, Middlesex, NJ 08846 (US).

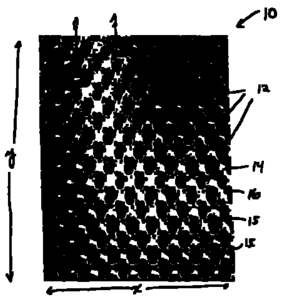
(74) Agents: JOHNSON, Philip, S. et al.; Johnson & Johnson, One Johnson & Johnson Plaza, New Brunswick, NJ 08933 (US).

(81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: TWO-LAYER STRUCTURE FOR ABSORBENT ARTICLES



(57) Abstract: A two layer structure comprising fluid permeable, first layer in fluid communication with fluid permeable second layer is provided. The two layers contact one another substantially only through plurality of discontinuous macrofeatures that project either from the first layer or the second layer. The structure has particular utility as cover/transfer layer for use in absorbent articles.

WO 03/068123 A2

Published:
— without international search report and to be republished upon receipt of that report

TWO LAYER STRUCTURE FOR ABSORBENT ARTICLES

This invention provides two layer structure for use in absorbent arti les The tructure comprises a fluid permeable fi st layer in fluid communication with fluid permeable second laye said layers contacting one another substantially only through plurality of disconnected macrofeatures The tructure i particularly useful as cover/transfer layer for use in absorbent article

BACKGROUND OF THE INVENTION

Transfer layers are commonly used in absorbent article to aid in the transport of fluid away from a bodyfacing layer or cover towards the absorbent core Conventional transfer layers are often made of nonwovens They typically function by pumping or wicking fluid away from the body facing layer directly downward into the underlying absorbent core Combination cover/transfer layers are al known See for exampl US Patent Nos 5 665 082; 5 797 894; and 5 466 232

Applicant have discovered that a two layer tructure comprising a fluid permeable first layer in fluid communication with a fluid permeabl second layer said layers contacting one another substantially only through a plurality of disconnected macrofeatures functions efficiently among other thing as a body facing layer or cover/transfer layer Upon insult of the first layer of this structure by fluid the tructure moves and/or transfers the fluid both through and across the tructure thereby allowing the fluid to be transported more quickly through the tructure in the direction i e through the first and second layers toward the absorbent core

SUMMARY OF THE INVENTION

The invention provides two layer structure for use in absorbent article comprising fluid permeable first layer in fluid communication with a fluid permeable second layer wherein the layers contact one another substantially only through a plurality of disconnected macrofeatures projecting from either the first layer or the second layer

The invention also provides two layer structure for use in absorbent articles compri ing a fluid permeable first layer compri ing a three dimensional apertured film in fluid communication with a fluid permeable second layer The three dimensional film of the first layer comprises a plurality of apertures and a plurality of apertured macrofeature projecting in the direction of the second layer each apertured macrofeature being disconnected from other apertured macrofeatures and wherein the first and scond layers contact one another sub tantially only through said apertured macrofestures

The invention further provides a two layer tructure for use in absorbent articles compri ing fluid permeable body contacting layer in fluid communication ith fluid permeable second layer The second layer compri plurality f macrofeature projecting in tha direction of the body contacting layer and the macrofeatures are disconnected from one another Additionally the body contacting and second layer contact one another subetantially only through the macrofatures

Finally the invention relates to absorbent articles comprising such two layer structures

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a photomicrograph of an embodiment of a three dimensional film of the present invention

Figure 1A is an illustration of a cro section of the film of Figure 1 along line A-A

Figure 2 is photomicrograph of another embodiment of a three dimensional film of the present invention

Figure 2A i an illustration of a cross section of the film of Figure 2 along line A-A

Figure 2B is an illustration of a cross section of the film of Figure 2 along line B B

Figure 3 i photomicrograph of yet another embodiment of three dimensional film of the present invention

Figure 3A i an illustration of a cross section of the film of Figure 3 along line A A

Figure 4 is a photomicrograph of another embodiment of three dimensional film of the present invention

Fig 5 is schemati illustration of one type of three dimensional topographical support member useful to make a film of the present invention

Fig 6 is schematic illustration of an apparatus for l ser sculpting workpiece to form three dimensional topographical support member useful to make a film of the present invention

Fig 7 is chematic illustration of a computer control system for the apparatus of Figure 6

Fig 8 is a graphical enlargement of an example of a pattern file to raster drill workpiece to produce support member for apertured film

Fig 9 i photomicrograph of workpiece after it has been laser drilled using the file of Fig 8

Fig 10 is graphical represent tion of file to laser sculpt a workpiece to produce the film of Figure 2

Fig 11 is a graphi al representation of file to laser sculpt a workpiece to produce three dimensional topographical support member useful to make film of this invention

Fig 12 is a photomi rograph of workpiece that was laser sculpted utilising the fil of Fig 11

Fig 12A is photomicrograph of cro section of the laser sculpted workpiece of Fig 12

Fig 13 is a photomicrograph of an apertured film produced using the laser sculpted support member of Fig 12

Fig 13A is another photomicrograph of an apertured film produced using the laser sculpted support member of Fig 12

Fig 14 is an exampl of a fil which may be used to produce a support member by laser modulation

Fig 14A i a graphical representation of serie of repeats of the file of Fig 14

Fig 15 i an enlarged view of portion B f the file f Fig 14

Fig 16 is a graphical enlargement of a pattern fil used to create portion C of Fig 14

Fig 17 i photomicrograph of support member produced by laser modulation using the file of Fig 14

Fig 18 i a photomicrograph of portion of the support member of Fig 17

Fig 19 is a photomicrograph of a film produced by utili ing the support member of Fig 17

Fig 20 is a photomicrograph of portion of the film of Fig 19

Fig 21 i a view of a support member used to make film according to the invention in place on film forming apparatus

Fig 22 is schematic view of an apparatus for producing an apertured film according to the present invention

Fig 23 i a chematic view of the circled portion of Fig 22

Fig 24 is photomicrograph of an apertured film of the prior art

Fig 25 is a photomicrograph of another example of an apertured film of the prior art

Fig 26 is photomicrograph of another example f an apertured film of the present invention

Fig 27 depicts a cross section of a two layer structure according to the invention

Fig 28 depict a cross-section of an absorbent article comprising a two layer tructure according to the invention

DETAILED DESCRIPTION OF THE INVENTION

The present invention is directed to two layer tructures particularly us ful in personal care product These structures may be used as body-contacting facing or cover layers as transfer or fluid handling layers or as other component of personal care products The tructures of the invention have been found to exhibit improved fluid handling properties when used in disposabl absorbent articles such for instance feminine sanitary protection products

The first layer which i in one embodiment a body contacting layer may be made from any one of a variety of fluid permeable material As body contacting layer the first layer is preferably compliant soft feeling and non irritating to a user skin The fi t layer should further exhibit good trikethrough and a reduced tendency to rewet permitting bodily discharges to rapidly penetrate it and flow toward subsequent underlying layers while not llowing such discharges to flow back through the body contacting layer to the skin of the user

The first layer may be made from a wide range of material including but not limited to woven or knitted fabric nonwovens apertured films hydro formed films porous foams reticulated foams reticulated thermoplastic films and thermoplastic scrims In addition the first layer may be constructed from a combination of one or more of the above materials such as a composite layer of a nonwoven and apertured film

Likewise the econd layer may also be made from a variety of fluid permeable materi ls including but not limited to woven or knitted fabric nonwovens apertured films hydro-formed films porous foams reticulated foams reticulated thermoplasti films thermoplasti scrims and combinations thereof

Nonwovens and apertured films are preferred for use as both the first layer and the second layer Suitable nonwovens may be made from any of a variety of fibers as known in the art The fibers may vary in length from quarter of an inch or les to an inch and a half or more It is preferred that when using shorter fibers (including wood pulp fiber) the short fibers be blended with longer fibers The fibers may be any of the well known artificial

natural or synthetic fiber such as cotton rayon nylon polyester polyolefin or the like The nonwoven may be formed by any of the various technique known in the art such as carding air laying wet laying melt blowing spunbonding and the like

Apertured films are typically made from a starting film that is a thin continuous uninterrupted film of thermoplasti polymeric material Thi film may be vapor permeable or vapor impermeable; it may be embossed or unembossed; it may be corona-discharge treated on one or both of its major surfaces or it may be free of such corona discharge treatment; it may be treated with surface active agent after the film is formed by coating spraying or printing the surface active agent onto the film or the surface active agent may be incorporated a blend into the thermoplasti polymeri material before the film is formed The film may compri any thermoplastic polymeri material including but not limited to polyolefins such as high density polyethylene linear low density polyethylene low density polyethylene polypropylene; copolymers of olefins and vinyl monomers such as copolymers of ethylene and vinyl acetate or vinyl chloride; polyamides; polyesters; polyvinyl alcohol and copolymers of ol fins and acrylate monomers such as copolymers of ethylene and ethyl acrylate and ethylenemethacryl te Films comprising mixtures of two or more of such polymeric material may also be used The machine direction (MD) and cross direction (CD) elongation of the tarting film to be apertured should be t least 1000 as determined according to ASTM Test No D-882 as performed on an Instron test apparatus with a jaw speed of 50 inches/minute (127 cm/minut) The thickness of the

starting film i preferably uniform and may range from about 0 5 to about 5 mil or about 0 0005 inch (0 0013 cm) to about 0 005 inch (0 076 cm) Coextruded films can be used as can films that have been modified g by treatment with surface active agent The starting film can be made by any known technique such as casting extrusion or blowing

Aperturing methods are known in the art Typically starting film is placed onto the surface of patterned support member The film i subjected to high fluid pressure differential while on the support member The pressure differential of the fluid which may be liquid or gaseous causes the film to assume the surface pattern of the patterned support member Portions of the film overlying apertures in the support member are ruptured by the fluid pressure differential to create an apertured film A method of forming an apertured fibrous film is described in detail in commonly owned US 5 827 597 to James et al incorporated herein by reference

According to the invention the first layer and the second layer contact one another substantially only through plurality of spaced apart disconnected macrofeatures By thi is meant the layers are joined to one another substantially only at macrofeature The macrofeatures may be located on the first layer or the second layer When the macrofeature are located on the first layer they project in the direction of the second layer When the macrofeatures are located on the second layer they proj t in the direction of the first layer

As used herein the term macrofeature means a surface projection vi ihl to the normal unaided human eye t perpendicular di tance of about 300 mm between the eye

and the surface Pref rably the macrofeatures each have maximum dimension of at least about 0 15 mm More preferably the macrofeatures each have a maximum dimension of t least about 0 305 mm Most preferably the macrofeatures each have a maximum dimension of at least about 0 50 mm The macrofeature are discrete and disconnected from one another That is if an imaginary plane i e first plane were lowered onto the first surface of the three dimensional layer it would touch the layer t the top of the macrofeatures in multiple discret areas separated from one another It is not necessary for each and every macrofe ture to touch the imaginary plane rather the first plane i thus defined by the uppermost portions of the macrofeature that i those part of the macrofeature projecting the farthest from the second surface of the layer

Where the layer with macrofeatures comprises an apertured film the film has first surface a second surface and a caliper defined by a first plane and second plane The film comprises plurality of disconnected macrofe tures and plurality of apertures The apertures are defined by sidewall that originate in the film first surface and extend generally in the direction of the film second surfac to terminate in the econd plane The fi st surface of the film i coincident with the first plane at the disconnected macrofeatures

Where the layer with macrofeatures comprises a nonwoven the nonwoven has a first surface a second surface and a caliper defined by first plane and econd plane The nonwoven furthe comprises plurality of di connected macrofeatures wherein the first surface of

the nonwoven is coincident with the first plane t the disconnected macrofeature

In one embodiment the macrofeatures are arranged in a regular pattern relative to each other Moreover if the macrofeature project from layer that i an apertured film the macrofeatures and the apertures are arranged in regular configuration relative to each other on said layer The aperture and macrofeatures recur at fixed or uniform interval with respect to one another The spatial relationship between the aperture and the macrofeature defins a geometri pattern that i consistently repeated throughout the surface area of the film The apertures and macrofeatures are arranged in a regular defined pattern uniformly repeated throughout the film

The apertures and macrofeatures may be arranged so that there are more apertures than macrofeature although the rel tive arrangement of apertures and macrofeatures i regular The exact i es and shapes of the apertures and macrofeatures are not critical as long as the macrofeatures are large enough to be visible to normal unaided human eye at di tance of about 300 mm and as long as the macrofeatures are discrete and disconnected from one anothe

The first layer and the second layer contact one another substantially only though the macrofeature That i the macrofeatures function much like spacers to hold the first layer way from the surface of the second layer except where they contact one another at the macrofeatures Accordingly fluid communication is provided around the macrofeatures Fluid entering the space between the first layer and the second laye is directed around the macrofeatures This advantageously distributes the fluid

in the X Y direction across the surface of the second layer As consequence the fluid is al more readily transported downward through the structure in the Z direction since the X Y spread provides more surface area through which the fluid can penetrate into the lower layers in the Z direction

In another embodiment of the invention the first layer compri es nonwoven while the second layer comprises ithsr a nonwoven or an apertured film The macrofeatures may be located on either the first layer or the second layer

In yet another embodiment the first layer comprises an apertured film while the second layer comprises ither nonwoven or an apertured film In this embodiment the macrofeature may also be located on ithe the first layer or the second layer However when the macrofeatures are present on the first layer the macrofeatures on the first layer preferably contain apertures i e apertured macrofeatures and are disconnected from all other apertured macrofeatures on the first layer Each apertured macrofeature is discrete physical element FIG 13 shows film of thi embodiment an apertured film with apertured macrofeature

In preferred embodiment of the invention shown in FIG 27 the macrofeatures project from the second layer which i a three dimensional apertured film as disclosed in commonly assigned copending US Application Serial No _____ (attorney docket no CMI 858) Such a second layer 801 can be used in combination with first layer 800 that i nonwoven or an apertured film Preferably it is used in combination with a first layer that i a nonwoven The three dimensional apertured film has a first surface and a

second surface The film additionally has a caliper defined by a first plane and a ecnd plane The film has a plurality of apertures defined by sidewall that originat in the first surface and extend generally in the direction of the ecnd surface to terminat in the second plane The film also comprises plurality of disconnected macrofeatures 14 The first surface of the film coincides with the first plane at these macrofeatures

Figure 1 i a photomicrograph of an embodiment of such three dimensional apertured film The film 10 of Figure 1 has apertures 12 and macrofeatures 14 The apertures are defined by idewall 15 The macrofeatures are discrete projections in the film and can be seen to project above lower regions 16 of the first surface If an imaginary plane i first plane were lowered onto the first surf ce of the three dimensional apertured film it would touch the film t the top of the macrofeatures in multipl di crete areas separated from one another It i not necessary for each and every macrofeature to touch the imaginary plane; rather the first plane is thus defined by the uppermost portions of the macrofeature that i those part of the macrofeatures projecting the farthest from the ecnd surface of the film

In the embodiment of Figure 1 the aperture alternate with the macrofeatures in both the x direction and the y-direction and the ratio of apertures to macrofeatures is one

Figure 1A i an illustration of cros section of the film 10 of Figure 1 along line A-A of Figure 1 As Figure 1A shows the macrofeatures 14 are di connected from one another in first plane 17 and are separated from one

another by lower regions 16 of the first surface of the film and by apertures 12 The apertures 12 are defined by sidewalls 15 which originat in the first surface and extend generally in the direction of the second surface to terminate in second plane 19 It is not necessary for all of the aperture to terminate in the second plane 19; rather the second plane i defined by the lowermost extending sidewalls 15

In one embodiment of the invention t least a portion of the apertures have sidewall having first portion that originates in the first plane of the film and a second portion that originates in a plane located between the first and second planes of the film that i a plane intermediate the first and second plane

In preferred embodiment in addition to having apertures with idewall having first portions originating in the first plane and second portions originating in an intermediate plane the film comprisee apertures whos sidewalls originate completely in an intermediate plane That i the film contains apertures that originate in a plane other than the plane defined by the uppermost surface of the macrofeatures

In particularly preferred embodiment of the present invention the three dimensional apertured film comprises a combination of several different types of apertures The film comprises apertures whose sidewall originate in the first plane f the film The film also comprises apertures having sidewall a portion of which originate in the first plane and a portion of which originate in an intermedi te plane Finally the film also comprises apertures whose idewalls originat completely in an intermediate plane

In Figure 2 aperture 12 are defined by idewall 15 The macrofeatures 14 project above lower regions 16 of the first urface of the film 20 The macrofeatures and apertures are shaped differently from the macrofeature and apertures of the film of Figure 1 In Figure 2 the macrofeature are separated from one another by apertures in the x-direction and in the y-direction However some of the apertures are sparated from one another by lower regions 16 of the first surface in both the x-direction and the y-direction In the film 20 of Figure 2 the ratio of apertures to macrofeatures is 2 0 Moreover each aperture in the film 20 of Figure 2 has portion f its idewall originating in the first plane 17 i at an edge 18 of a macrofeature and a portion of its idewall originating in lower region 16 of the first surface

Figure 2A shows cros section of the film 20 of Figure 2 along line A A The macrofeatures 14 are separated from one another in the first plane 17 by aperture 12 which are defined by sidewall 15 that originate in the first surface of the film and extend generally in the direction of the second surface to terminate in the second plane 19 It can be seen in Figure 2A that the portions of the idewall 15 shown in this cross section originate in the first plane 17 t the edges 18 of the macrofeatures 14

Figure 2B shows a cross section of the film 20 of Figure 2 taken along line B B In thi particular cross section no macrofeatures are visible and the aperture 12 are separated from one another by lower regions 16 of the first surface of the film The lowe regions 16 of the film lie between the first plane 17 and the second plane 19 said plane defining the caliper of the three-dimensional

apertured film shown The sidewalls 15 terminate in the second plane 19

Figure 3 shows a photomicrograph of a further embodiment of a three dimensional apertured film with yet another arrangement of apertures and macrofeatures The film 30 of Figure 3 has apertures 12 arranged with macrofeatures 14 and apertures 22 arranged with macrofeature 24 All of the apertures 12 22 and macrofeatures 14 24 are arranged together so that their relative positions to one another are regular

Figure 2A is a cross section of the film 30 of Figure 3 taken along line A A of Figure 3 This particular cross section shows macrofeature 24 and macrofeature 14 disconnected from one another in first plane 17 and separated from one another by apertures 12 The apertures 12 are defined by sidewalls 15 that terminate in the second plane 19 The portions of the sidewall 15 shown in this particular cross section originate in the first plane 17 at the edges 18 of the macrofeatures 14 and 24

Figure 4 is a photomicrograph of yet another embodiment of a three dimensional apertured film according to the present invention The film 40 shown in Figure 4 has a regular arrangement of apertures 12 and macrofeatures 14

A suitable starting film for making a three dimensional apertured film is a thin continuous uninterrupted film of thermoplastic polymeric material This film may be vapor permeable or vapor impermeable; it may be embossed or unembossed; it may be corona discharge treated on one or both of its major surfaces or it may be free of such corona discharge treatment; it may be treated with a surface active agent after the film is formed by coating spraying or printing the surface active agent

onto the film, or the surface active agent may be incorporated as a blend into the thermoplastic polymeric material before the film is formed The film may comprise any thermoplastic polymeric material including but not limited to polyolefins such as high density polyethylene linear low density polyethylene low density polyethylene polypropylene; copolymers of olefins and vinyl monomers such as copolymers of ethylene and vinyl acetate or vinyl chloride; polyamides; polyesters; polyvinyl alcohol and copolymer of olefins and acrylate monomers such as copolymers of ethylene and ethyl acrylate and ethylenemethacrylate Films comprising mixture of two or more of such polymeric material may also be used The machine direction (MD) and cross direction (CD) elongation of the starting film to be apertured should be at least 100% as determined according to ASTM Test No D-882 as performed on an Instron test apparatus with a jaw speed of 50 inches/minute (127 cm/minute) The thickness of the starting film is preferably uniform and may range from about 0 5 to about 5 mil or about 0 0005 inch (0 0013 cm) to about 0 005 inch (0 076 cm) Coextruded films can be used as can films that have been modified or by treatment with surface active agent The starting film can be made by any known technique such as casting extrusion or blowing

A method of aperturing the film involves placing the film onto the surface of a patterned support member The film is subjected to a high fluid pressure differential as it is on the support member The pressure differential of the fluid which may be liquid or gaseous causes the film to assume the surface pattern of the patterned support membe If the patterned support member has apertures

therein portions of the film overlying the apertures may be ruptured by the fluid pressure differential to create an apertured film A method of forming an apertured film is described in detail in commonly owned US 5 827 597 to James et al incorporated herein by reference

Such a three dimensional apertured film is preferably formed by placing thermoplastic film across the surface of an apertured support member with pattern of macrofeature and aperture A stream of hot air is directed against the film to raise its temperature to cause it to be softened A vacuum is then applied to the film to cause it to conform to the shape of the surface of the support member Portions of the film lying over the apertures in the support member are ruptured to create aperture in the film

A suitable apertured support member for making these three dimensional apertured films is a three-dimensional topographical support member made by laser sculpting a workpiece A schematic illustration of an exemplary workpiece that has been laser sculpted into three dimensional topographical upport member is shown in Figure 5

The workpiece 102 comprises a thin tubular cylinder 110 The workpiece 102 has non-processed surface areas 111 and laser sculpted center portion 112 A preferred workpiece for producing the support member of thi invention is a thin-walled seamless tube of acetal which has been relieved of all residual internal stresses The workpiece has a wall thickness of from 1 8 mm more preferably from 2 5 6 5 mm Exemplary workpieces for use in forming support members are one to six feet in diameter and have length ranging from two to sixteen feet However

these sizes are a matter of de ign choice Other shapes and material compositions may be used for the workpiece such as acrylic urethanes polyesters high molecular weight polyethylene and other polymers that can be processed by laser beam

Referring now to Fig 6 schemati illustration of an apparatus for laser sculpting the support member is shown A tarting blank tubular workpiece 102 is mounted on an appropriate arbor or mandrel 121 that fixes it in cylindrical shape and allows rotation about it longitudinal axi in bearings 122 A rotational drive 123 is provided to rotate mandrel 121 t a controlled rate Rotational pulse generator 124 is connected to and monitors rot tion f mandrel 121 o that it precise radial position is known t all times

Parallel to and mounted out ide the swing of mandrel 121 is one or more guide ways 125 that allow carriage 126 to traverse the entire length of mandrel 121 while maintaining a constant clearance to the top surface 103 of workpiece 102 Carriage drive 133 moves the carriage along guide ways 125 while carriage pulse generator 134 notes the lateral position of the carriage with respect to workpiece 102 Mounted on the carriage is focusing tage 127 Focusing stage 127 is mounted in focus guide ways 128 Focusing stage 127 allows motion orthogonal to that of carriage 126 and provides a means of focusing lens 129 relative to top surface 103 Focus drive 132 is provided to position the focusing stage 127 and provide the focusing of lens 129

Secured to focusing stage 127 is the lens 129 which is secured in nos le 130 Nozzle 130 has means 131 for introducing pressurized gas into nos le 130 for cooling

and maintaining cleanliness of lens 129 A preferred nos le 130 for this purpose i described in US Patent 5 756 962 to Jones et al which is incorporated herein by reference

Also mounted on the carriage 126 i final bending mirror 135 which directs the laser beam 136 to the focusing lens 129 Remotely located is the laser 137 with optional beam bending mirror 138 to direct the beam to final beam bending mirror 135 Whil it would be possible to mount the laser 137 directly on carriage 126 and eliminate the beam bending mirrors space limitations and utility connections to the laser make remote mounting far preferable

When the laser 137 i powered, the beam 136 emitted is reflected by first beam bending mirror 138 then by final beam bending mirror 135 which directs it to lens 129 The path of laser beam 136 is configured such that if lens 129 were removed the beam would pas through the longitudinal center line of mandrel 121 With lens 129 in position the beam may be focused above below t or near top surface 103

Whil thi apparatus could be used with a variety of lasers the preferred laser i fast flow CO_2 laser capable of producing beam rated at up to 2500 watts However slow flow CO_2 lasers rated at 50 watts could also be used

Figure 7 is a schematic illustration of the control system of the laser sculpting apparatus of Figure 6 During operation of the laser culpting apparatus control variables for focal position rotational speed and trevers speed are ent from a main computer 142 through connection 144 to a drive compute 140 The drive computer 140 control focus position through focusing tage drive

132 Drive computer 140 control the rotational speed f the workpiece 102 through rotational drive 133 and rotational pulse generator 134 Drive computer 140 control the traverse speed of the carriage 126 through carriage drive 133 and carriage pulse generator 134 Drive computer 140 also report drive status and possible errors to the main computer 142 Thi system provide positive position control and in effect divides the surface of the workpiece 102 into small areas called pixel where each pixel consists of fixed numbe of pulse of the rotational drive and a fixed number of pulses f the traverse drive The main computer 142 al controls laser 137 through connection 143

A laser sculpted three dimensional topographical support member may be made by several methods One method of producing such a support member i by combination of laser drilling and laser milling of the surface f workpiece

Methods of laser drilling workpiece include percuss ion drilling fire on the fly drilling and raster can drilling

A preferred method i raster scan drilling In thi approach the pattern is reduced to a rectangular repeat element 141 as depicted in FIG 8 Thi repeat element contains all of the information required to produce the desired pattern When used like tile and placed both end-to end and ide by side the larger desired pattern i the result

Thi repeat element is further divided into a grid of smaller rectangular units or "pixels 142 Though typically square for some purposes it may be more convenient to employ pixel of unequal proportions The pixel themselves

are dimensionles and the actual dimensions of the image are set during proce ing that i the width 145 of a pixel and the length 146 of a pixel are only set during the actual drilling operation During drilling the length of a pixel is set to dimension that corresponds to a selected number of pulses from the carriage pulse generator 134 Similarly the width of pixel is set to dimension that corresponds to the number of pulses from the rotational pulse generator 124 Thus for ease f explanation the pixels are shown to be square in Figure 8; however it i not required that pixel be square but only that they be rectangular

Each column of pixel represent one pas of the workpiece past the focal position of the laser Thi column is repeated as many times as is required to reach completely around workpiece 102 Each white pixel represents an off instruction to the laser that is the laser i emitting no power and each black pixel represent an on instruction to the laser that the laser is emitting a beam This results in a impl binary fil f 1 s and 0 s where a 1 or white i an instruction for the laser to shut off and 0 or black is an instruction for the laser to turn on Thus in Figure 8 area 147 148 and 149 correspond to instructions for the laser to emit full power and will result in holes in the workpiece 102

Referring back to Figure 7 the contents of an engraving fil are sent in a binary form where 1 is off and 0 i on by the main computer 142 to the laser 137 via connection 143 By varying the time between each instruction the duration of the instruction is adjusted to conform to the i e of the pixel After each column of the file is completed, that column is again processed or

repeated until the entire circumference i completed While the instructions of column are being carried out the traverse drive i moved slightly The speed of traverse is set so that upon completion f irumferential engraving the traver drive ha moved the focusing lens the width of a column of pixel and the next colusn of pixel i processed Thi continues until the end of the file i reached and the file is again repeated in the axial dimension until the total desired width is reached

In this approach each pass produces number of narrow cuts in the material rather than a large hole Because these cut are precisely regi tered to line up ide by- ide and overlap somewhat the cumulative ffect i hol

Figure 9 i a photomicrograph of a portion of support member that has initially been raster scan drilled utili ing the file of Figure 8 The surface of the support membe is a smooth planar surface 152 with a series of ne ted hexagonal holes 153

A highly preferred method for making the laser sculpted three dimensional topographical support members i through laser modulation Laser modulation is carried out by gradually varying the laser power on a pixel by pixel basis In laser modulation the simple on or off instructions of raster scan drilling are replaced by instructions that adjust on gradual scale the laser power for each individual pixel of the laser modulation file In this manner a three dimensional tructure can be imparted to the workpiece in a single pass over the workpiece

Laser modulation has everal advantages over other methods of producing three dimensional topographical support member Lase modulation produces a one piece

seamless support member without the pattern mismatches caused by the presence of a seam With laser modulation the support member is completed in single operation instead of multiple operations thus increasing efficiency and decreasing cost Laser modulation eliminates problems with the registration of patterns which can be problem in multi step sequential operation Laser modulation also allows for the creation of topographical features with complex geometries over a substantial distance By varying the instructions to the laser the depth and shape of a feature can be precisely controlled and feature that continuously vary in cross section can be formed The regular positions of the apertures and macrofeatures relative to one another can be maintained

Referring again to Figure 7 during laser modulation the main computer 142 may send instructions to the laser 137 in other than a simple on or off format For example the simple binary file may be replaced with an 8 bit (byte) format which allows for variation in power emitted by the laser of 256 possible level Utilizing a byte format the instruction 11111111 instruct the laser to turn off 00000000 instructs the laser to emit full power and an instruction such as 10000000 instruct the laser to emit one half of the total available laser power

A laser modulation file can be created in many ways One such method is to construct the file graphically using gray scale of a 256 color level computer image In such gray scale image black can represent full power and white can represent no power with the varying levels of gray in between representing intermediate power level A number of computer graphics programs can be used t visualize or

create such a laser-sculpting file Utilizing such file the power emitted by the laser is modulated on pixel by pixel basis and can therefore directly sculpt a three dimensional topographical support membe While an 8 bit byte format is described here other level such as 4 bit 16 bit 24 bit or other formats can be substituted

A suitable laser for use in laser modulation system for laser sculpting is fast flow CO_2 laser with a power output of 2500 watt although laser of lower power output could be used Of primary concern is that the laser must be able to switch power level as quickly as possible A preferred switching rate is at least 10 kHz and even more preferred is a rate of 20 kHz The high power-switching rate is needed to be able to process as many pixel per second as possible

Figure 10 shows graphical representation of a laser modulation file to produce a support member using laser modulation The support member made with the file of Figure 10 is used to make the three-dimensional apertured film shown in Figure 2 In Figure 10 the black areas 154 indicate pixels where the laser is instructed to emit full power thereby creating a hole in the support member which corresponds to apertures 12 in the three dimensional apertured film 20 illustrated in Figure 2 Likewise white areas 155 in Figure 10 indicate pixel where the laser receives instructions to turn off thereby leaving the surface of the support member intact These intact areas of the support member correspond to the macrofeatures 14 of the three-dimensional apertured film 20 of Figure 2 The gray area 156 in Figure 10 indicates pixels where the laser is instructed to emit partial power and produce lower region on the support member This lower region on the

support member corresponds to lower region 16 on the three dimensional apertured film 20 of Figure 2

Figure 11 shows a graphical representation of laser modulation file t produce support member using laser modulation As in the laser-drilling file of Figure 8 each pixel represents position on the surface of the workpiece Each row of pixels repre ent a position in the axial direction of the workpiece to be sculpted Each column of pixel represents position in the irouf rential position of the workpiece Unlike the fil of Figure 8 however each of the laser instructions represented by the pixels is no longer binary instruction but has been replaced by 8 bit or gray scale instructions That i each pixel has an 8 bit value which transl tes to a specifi power level

Figure 11 i a graphical representation of a laser modulation file to produce support member using laser modul tion The fil shows a serie of nine leaf like structures 159 which are shown in white The leave are series of white pixels and are instructions for the laser to be off and emit no power Leaves of these shapes therefore would form the uppermost surface of the support member fter the pattern has been sculpted into it Each leaf structure contains a serie of ix holes 160 which are defined by the stem like structures of the leaves and extend through the thickness f the workpiece The hole 160 consist of an area of black pixel which are in tructions for the laser to emit full power and thus drill through the workpiece The leaves are discrete macrofeatures i e by themselves they do not form a flat planar structure as no leaf interconnects with any other leaf The background pattern of thi structure consist of

a close packed taggered pattern of hexagonal black areas 161 which are al o instructs for the laser to emit full power and drill hole through the workpiece The field 162 which defines hole 161 i at a laser power level that i neither fully on nor fully off Thi produces a second planar rea which i below the uppermost surface of the workpiece as defined by the off instructions of the white areas of the leaves

Figure 12 i photomicrograph of a lase sculpted three dimensional topographical support member produced by laser modul tion utili ing the laser modul tion fil depicted in Figure 11 Figure 12A is a cross sectional view of the support member of Figure 12 Regions 159 of Figure 12 and 159 of Figure 12A correspond to the leaf 159 of Figure 11 The white pixel instructions of areas 159 of Figure 11 have resulted in the laser emitting no power during the processing of those pixel The top surface of the leaves 159 and 159 correspond to the original surface of the workpiece Holes 160 in Figure 12 correspond to the black pixel areas 160 of Figure 11 and in processing these pixel the laser emits full power thus cutting hole completely through the workpiece The background film 162 of Figure 12 and 162 of Figure 12A correspond to the pixel area 162 of Figure 11 Region 162 results from processing the pixels of Figure 11 with the laser emitting partial power This produce an area in the support membe that is lower than the original surface of the workpiece and that is thus lower than the top surface of the leave Accordingly the individual leaves are discrete macrofeatures unconnected to each other

Figures 13 and 13A are photomicrographs of a three dimensional apertured film that has been produced on the

support member of Figures 12 and 12A The apertured film has raised apertured leaf shaped macrof atures 176 and 176 which correspond to the leave 159 and 159 of the support member of Figures 12 and 12A Each of the leaves is di cret and disconnected from ll the other leave Each leaf contains apertures i each leaf i an apertured macrofeature The plane defined by the uppermost surfaces of all the leaf shaped regions 176 and 176 is the uppermost surface of a plurality of disconnected macrofe tures The background apertured regions 177 and 177 define a region that is t lower depth in the film than the leaf shaped regions Thi gives the visual impres ion that the leaves are embossed into the film

The laser sculpted support member f Figures 9 12 and 12A have simple geometries That i successive cros sections taken parallel to the uppermost surface of the support member are essentially the same for a significant depth through the thickness of the support member For example referring to Figure 9 successive cross sections of this support member taken parallel to the surface of the support member are essentially the same for the thickness of the support member Similarly cros sections f the support member of Figures 12 and 12A are essentially the same for the depth of the leaves and are essentially the same from the base of the leaves through the thickness of the support member

Figure 14 i graphical representation of another laser modulation fil to produce las sculpted support member using laser modulation The file contains a central floral element 178 and four element 179 each of which constitutes a quarter of a floral element 178 which combine when the file is repeated during laser sculpting

Figure 14A is a 3 repeat by 3 repeat graphical representation of the resulting pattern when the fil of Figure 14 is repeated

Figure 15 is a magnified view of the area B of Figure 14 The gray area represents a region of pixels instructing the laser to emit partial power This produces a planar area below the surface of the workpiece Contained in gray region 180 is a series of black areas 181 which are pixels instructing the laser to emit full power and drill aries of hexagonal shaped holes through the thickness of the workpiece Central to Figure 15 is the floral element corresponding to the floral element 178 of Figure 14 The floral element consists of center region 183 and six petal shaped regions 182 which again represent instructions for the laser to emit full power and drill hol through the thickness of the workpiece Defining the out ide edge of the cente region 183 is region 184 Defining the out ide edge of the petal regions 182 i region 184 Regions 184 and 184 represent a series of instructions for the laser to modulate the emitted power The central black region 183 and its outside edge region 184 are joined to the region 184 by region 185 which represents instructions for the laser to emit the same power level as the background area 180

Figure 16 i an enlarged graphical representation of portion C of region 184 of Figure 15 which forms the outline of the center region 183 of Figure 15 The portion C contains a single row of white pixel 186 which instruct the lase to turn ff This defines part of the uppermost surface of the support member that remains after processing The rows f pixel 187 and 187 instruct the laser to emit partial power The rows 188 189 190 and

191 and the rows 188 189 190 and 191 instruct the laser to emit progressively increased level of power Rows 192 and 192 instruct the laser to emit the power level also represented by region 185 of Figure 15 Rows 194 194 and 194 instruct the laser to emit full power and form part of region 183 of Figure 15

As each column of Figure 16 is processed the laser emit the partial power represented by rows 192 and 192 Rows 191 190 189 188 and 187 instruct the laser to progressively decrease the power emitted until row 186 is processed and the laser is instructed to not emit power The rows 187 188 189 190 and 191 then instruct the laser to again progressively increase the power emitted Rows 194 194 and 194 instruct the laser to again emit full power to begin drilling through the workpiece This results in the creation of a disconnected macrofeature which slopes from the background plane to the surface of the workpiece and then slopes back to the hole area thus producing a radiused shape

Depending on the size of the pixel as defined during processing and the variation in emitted laser power for each row the size and shape of the resulting laser sculpted feature can be changed For example if the variation in power level for each row of pixels is small then a relatively shallow rounded shape is produced; conversely if the variation in power level for each row of pixel is greater than deeper step shape with more triangular cross section is produced Changes in pixel size also affect the geometry of the features produced If the pixel is kept smaller than the actual diameter of the focused laser beam emitted then smooth blended shape will be produced

Figure 17 is a photomicrograph of the laser sculpted support member resulting from the processing of the file of Figure 14 by laser modulation The photomicrograph shows raised floral element 195 which corresponds to the floral element 178 of Figure 14 and the floral element of Figure 15 The photomicrograph also shows portions of additional floral elements 195 Raised floral element 195 originate in the planar region 196 which contains holes 197 Floral element 195 and 195 are disconnected from one another and thus do not form a continuous planar region

Figure 18 is an enlarged photomicrograph of portion of the floral element 195 of Figure 17 The center circular element 198 is the area produced by the laser modulation instructions contained in region 184 of Figure 15 The elements 199 are parts of the petal elements of the floral element 195 of Figure 17 These petal elements are produced by pixel instructions depicted in region 184 of Figure 15 These elements demonstrate an example of type of complex geometry that can be created by laser modulation The central circular element has a semicircular cross section That is any one of series of cross sectional planes taken parallel to the original surface of the workpiece i e through the depth will differ from any other of such cross sectional planes

Figure 19 is a photomicrograph of the upper surface of film produced on the support member of Figure 17 The film has an apertured planar area 200 containing holes 201 that corresponds to planar region 196 of Figure 17 Extending above the planar area are floral areas 202 and 202 which correspond to floral element 195 and 195 respectively of Figure 17 The floral areas 202 and 202 give the resulting apertured film an embossed appearance in

a single operation In addition the floral areas define additional larger holes 203 and 204 to improve fluid transmission properties

Figure 20 is an enl rgement of the floral area 202 of Figure 19 The floral area comprises hole 204 and the surrounding circular element 205 Element 205 of Figures 19 and 20 has complex geometry in that it has semicircular cros se tion Again successive cros sections taken parallel to the surface of the film taken through its depth are different

Upon completion of the laser sculpting of the workpiece it can be assembled into the tructure shown in Figure 21 for use as a support member Two end bell 235 are fitted to the interior of the workpiec 236 with laser sculpted area 237 These end bell can be shrink fit press fit ttached by mechanical means such as straps 238 and screws 239 as shown; or by other mechanical means The end bell provide a method to keep the workpiece circular to drive the finished assembly and t fix the completed structure in the aperturing apparatus

A preferred apperatus for producing such three dimensional apertured films i schematically depicted in Figure 22 As shown here the support member is a rotatable drum 753 In this particular apparatus the drum rotates in a counterclockwise direction Positioned outside drum 753 i hot ai nozzle 759 positioned to provide curtain f hot ai to impinge directly on the film supported by the laser sculpted support member Means i provided to retract hot ai nozzle 759 to avoid exce sive heating of the film when it i stopped or moving at slow speed Blower 757 and heate 758 cooperat to upply hot air to nozzle 759 Po itioned inside the drum 753 directly opposite the

nozzle 759 is vacuum head 760 Vacuum head 760 is radially adjustable and positioned so as to contact the interior surface of drum 753 A vacuum ource 761 is provided t continuously exhaust vacuum head 760

Cooling zone 762 is provided in the interior of and contacting the inner surfac of drum 753 Cooling zone 762 is provided with cooling vacuum source 763 In cooling zone 762 cooling vacuum source 763 draws ambient air through the apertures made in the film to set the pattern reated in the aperturing zone Vacuum source 763 also provide means of holding the film in place in cooling zone 762 in drum 753 and provides means to isol te the film from the effects of tension produced by winding up the film after it aperturing

Placed on top of laser sculpted support member 753 is a thin continuous uninterrupted film 751 of thermoplastic polymeric material

An enlargement of the circled area of Figure 22 i shown in Figure 23 As shown in this embodiment vacuum head 760 has two vacuum lots 764 and 765 extending across the width of the film However for some purposes it may be preferred to us separate vacuum sources for each vacuum slot As shown in Figure 23 vacuum slot 764 provides a hold down zone for the starting film as it approache air knif 758 Vacuum lot 764 is connected to a source of vacuum by a passageway 766 This anchors the incoming film 751 ecurely to drum 753 and provides isolation from the ffects of tension in the incoming film induced by the unwinding of the film It also flattens film 751 on the outer surface of drum 753 The second vacuum slot 765 defines the vacuum aperturing zone Immedi tely between lot 764 and 765 i intermediate support bar 768 Vacuum

head 760 i positioned such that the impingement point of hot air curtain 767 is directly above intermedi te support bar 768 The hot air is provided at a suffi ient temperature sufficient angle of incidence to the film and at a suffi ient di tance from the film to cause the film to become softened and deformable by force applied thereto The geometry f the apparatus ensure that the film 751 when softened by hot air curt in 767 is isolated from tension effects by hold down slot 764 and cooling zone 762 (Figure 22) Vacuum aperturing zone 765 i immedi tely adjacent hot air curtain 767 which minimize the time that the film i hot and prevents excessive heat transfer to support member 753

Referring to Figures 22 and 23 thin flexibl film 751 is fed from a supply roll 750 over idler roll 752 Roll 752 may be ttached to load cell or other mechanism to control the feed tension of the incoming film 751 The film 751 i then placed in intimate contact with the support member 753 The film and support member then pass to vacuum zone 764 In vacuum zone 764 the differential pressure further force the film into intimate contact with support member 753 The vacuum pres ure then isol tes the film from the supply tension The film and support member combination then passes under hot air curtain 767 The hot air curt in heat the film and support member combination thus softening the film

The heat softened film and the support member combination then pas into vacuum zone 765 where the heated film i deformed by the differential pre ure and assumes the topography of the support member The heated film areas that are located over open areas in the support member are furthe deformed into the open areas of the support member

If the heat and deformation force are sufficient the film over the open areas of the support member is ruptured to create apertures

The till hot apertured film and support member combination then passes to cooling zone 762 In the cooling zone a sufficient quantity of ambient air i pulled through the now-apertured film to cool both the film and the support member

The cooled film is then removed from the support member around idler roll 754 Idler roll 754 may be attached to a load cell or other mechanism to control winding tension The apertured film then passes to finish roll 756 where it i wound up

Figure 24 is a photomicrograph of an apertured film 800 of the prior art that was produced on a support member that has been raster scan drilled utilising the file of Figure 9 The surface of thi apertured film is a planar surface 852 with a series of nested hexagonal holes 853

Figure 25 is photomicrograph of another apertured film of the prior art that was produced on another support member that was produced by raster scan drilling The surface of thi apertured film i also characterised by a planar surface and a eries of nested hexagonal holes that are larger than those shown in Figure 24

Figure 26 i a photomicrograph of a further embodiment of three dimensional apertured film of the present invention with an arrangement of apertures and macrofeatures The film 900 of Figure 26 has apertures 12 arranged with macrofeatures 14 All of the apertures 12 and macrofeatures 14 are arranged together o that their relative po itions to one another are regular

While the method of forming a three dimensional apertured film has been described using hot air curtain as the mechanism to heat the film any suitable method such as infrared heating heated roll or the like may be employed to produc an apertured film using the laser sculpted three dimensional topographical support member of this invention

In another method for producing an apertured film the incoming film upply system can be replaced with a suitable extrusion system In this case the extrusion system provides a film extrudate which depending on the extrudate temperature can either be cooled to suitable temperature by various means such as cold air blast or chilled roll prior t contacting the three dimensional topographical support or be brought in direct contact with the three dimensional topographical support The film extrudate and forming surface are then subjected to the same vacuum forming forces as described above without the need to heat the film to soften the film to make it deformable Figure 27 is cross section of a two layer tructure according to the invention The structure comprises body contacting layer 500 in thi case nonwoven overlying a econd layer 501 also nonwoven Second layer 501 comprises plurality of macrofeatures 14 projecting in the direction f the body contacting layer 500

The two layer tructure may advantageously be used as a cover/transfer layer of an absorbent article such as sanitary napkin pantiliner diaper incontinence pad or other imilar product for absorbing exudates from the body such as menses urina fece or sweat Preferably the absorbent article is a sanitary napkin or a pantiliner

Such sanitary napkin or pantiliner may have an approximat ly rectangular oval dogbone or peanut shape Depending on the nature of the absorbent articl it i e may vary For example anitary napkins typically have caliper of about 1 4 to about 5 mm a length of about 8 to about 41 centimeters (cm) and a width of about 2 5 to about 13 cm Pantilinars typically have a caliper of l s than about 5 mm length of less than about 20 cm and a width of less than about 5 cm

The two layer tructure i placed over suitable absorbent core which is typically comprised of loosely associated absorbent hydrophili material such as cellulos fibers including wood pulp regenerated cellulose fibers or cotton fibers or other absorbent materials generally known in the art including acryli fibers polyvinyl alcohol fibers peat moss and superabsorbent polymers

The absorbent articl may further comprise a backsheet that is substantially or completely impermeable to liquids the exterior of which forms the garment facing surface of the article The backsheet may comprise any thin flexible body fluid impermeabl material such as a polymeric film for example polyethylene polypropylene or cellophane Alternatively the backsheet may be a normally fluid permeable material that has been treated to be impermeabl such as impregnated fluid repellent paper or non-woven fabric material or a flexibl foam such as polyurethane or cross linked polyethylene The thickness of the backsheet when formed from a polymeric film typically is about 0 025 mm to 0 051 mm A variety of materials are known in the art for use as backsheet and any of these may be used The backsheet may be breathable i film that is a barrie t liquids but permits gases

to transpire Materials for this purpose include microporous films in which microporosity is created by tretching an oriented film Singl or multiple layers of permeabl films fabrics and combinations thereof that provide a tortuous path and/or whose surface characteri tics provide a liquid surface repellent to the penetration of liquids may also be used to provide a breathable backsheet

A cross sectional view of an absorbent articl comprising a two layer tructure according to the invention is shown in Figure 28 The two layer tructure is used as a cover/transfer layer The absorbent article comprise backsheet 503 Overlying the backsheet is an absorbent core 502 Overlying the absorbent core i the two layer structure 504 Two layer tructure 504 comprises nonwoven first or body contacting layer 500 over a econd layer 501 that is an apertured film The apertured film comprises a disconnected macrofeatures 14 and apertures 12

The absorbent articl may compri other known material layers and additives such as adhesive release paper foam layers net like layers perfumes medi aments moisturisers and the like many exampl of which are known in the art

Examples

Structures of the present invention comprising fluid permeable first layer in fluid communication with fluid permeable second layer wherein the layers contact one another substantially only through a plurality of disconnected macrofeature have favorable fluid handling properties In particular disposabl absorbent products

with component layer having a plurality of disconnected macrofeatures have low Fluid Penetration time Additionally disposable absorbent product comprising apertured film having a plurality of disconnected macrofeatures exhibit Repeat Insult Time that increases less than about 40% over six insult

Structures according to the present invention comprising an apertured film having a plurality of di connected macrofeatures (Examples 1 2 and 3) and tructures containing ample of conventional) apertured film (Prior Art 1 and 2 were compared as transfer layers using tha Fluid Penetration Test and the Repeat Insult Te t The test fluid used for the Fluid Penetration Test and the Repeat Insult Te t was synthetic menstrual fluid having a viscosity of 30 centipoise at 1 radian per second

Test assemblies were made from Examples 1 3 and Prior Art 1 and 2 using cover layer absorbent core and barrier from the commercially available sanitary napkin Stayfree Ultra Thin Long with Wings distributed by Personal Product Company Divi ion of McNeil PPC Inc Skillman NJ The cover layer is thermally bonded polypropylene fabric; the absorbent core i material containing superabsorbent polymer and the barrier is pigmented polyethylene film The cover layer and transfer layers were each carefully peeled away from the product exposing the absorbent core which remained adhesively ttached to the barrier film Next a piece of transfer layer material to be tested was cut to a size approximately 200 mm long by t least the width of the absorbent core and pressure sensitive hot melt adhesive such as HL-1471xzp commercially availabl from HB Fuller Corporation St Paul MN 55110 was applied to the side of the transfer layer material oriented

adjacent to the exposed surface of the absorbent core Adhesive was applied to the material to be tested by transfer from releas paper which was coated with approximately 1 55 grams per square meter The transfer layer material to be tested was oriented with adhesive side toward the absorbent core and placed on top of the absorbent core To complete the test assembly the cover layer was placed over the transfer laye material to be tested

Another structure according to the invention (Example 4) was lso tested using the Fluid Penetration Te t This tructure compri ed a nonwoven layer with a plurality of di connected macrofeatures Thi structure was made as follows Both the body-contacting laye and the second layer comprised nonwovens The body contacting layer comprised a point bonded nonwoven compri ing a blend of 40% 3 denier and 60% 6 denier polypropylene staple fibers with a basi weight of 34 grams per square meter (gsm) The second layer in this exampl was made from a 30 gsm starting nonwoven comprising a blend of 50% polyester fibers and 50% bicomponent fibers having a sheath of co-polyester around polyester core and availabl from Libeltex n v in Meulebeke Belgium

Discrete macrofeatures were formed on the appropri te nonwoven layer by heat shaping the starting nonwoven with metal plate having a regular repeating pattern of truncated cones The heat shaping of the starting nonwoven was accomplished by placing the tarting nonwoven between the metal plate and 6 35 mm thick rubber back up surface and pressing at pressure of 30 1 kg force per square centimeter and temperature of 107 C for 15 seconds The metal plate had repeating pattern of truncated cones in

staggered rows on 6 36 mm centers Each cone was approximately 3 5 mm in diameter at it base and 1 2 mm in diameter at its top and 2 8 mm high The heat shaping cre ted discrete macrofeatures on the surface of the nonwoven

When the body-contacting layer wa placed over the second layer with the macrofeature projecting in the direction of the body-facing layer the two layers contacted each other substantially only through the macrofeatures in the second layer

Thi two-layer tructure was placed over an absorbent core material compri ing wood pulp and superabsorbent polymer such as that described in US 5 916 670 to Tan et al which is incorporated herei by reference The two layer tructure was placed against the absorbent core material with the second layer facing the absorbent core material A fluid impermeable barrier layer was placed on the opposite surface of the absorbent core material to form an absorbent article for use in absorbing body fluids such as for example menstrual fluid

As comparison two layer structure comprising the same nonwoven layers but neither layer comprising macrof tures (Example 4 Control) wa also subjected to the Fluid Penetration Test

Table 1 des ribes commercial products te ted and the absorbent test assemblies made using examples of the present invention and examples representing prior art

Assembly	Cover Layer	Transfer Layer	Absorbent	Barrier
Commercial Sample 1	Stayfree Ultra Thin Long with Wing, a commercial product sold in the U.S.A. by Personal Products Company, Inc.			
Commercial Sample 2	Always Ultra Long with Flexi-Wing, a commercial product sold in the U.S.A. by Procter & Gamble, Inc.			
Prior Art 1	Cover Layer[1]	Material of Fig. 24	Absorbent Core[2]	Barrier[3]
Prior Art 2	Cover Layer[1]	Material of Fig. 25	Absorbent Core[2]	Barrier[3]
Example 1	Cover Layer[1]	Material of Fig. 26	Absorbent Core[2]	Barrier[3]
Example 2	Cover Layer[1]	Material of Fig. 2	Absorbent Core[2]	Barrier[3]
Example 3	Cover Layer	Material of Fig. 1	Absorbent Core[2]	Barrier[3]
Example 4[5]	Cover Layer[1]	30 gsm Libeltex w Macrofeatures	Absorbent Core[4]	NA
Ex. 4 Control[5]	Cover Layer[1]	30 gsm Libeltex	Absorbent Core[4]	NA

Note 1: Cover Layer is the Cover Layer of Commercial Sample 1
Note 2: Absorbent Core is the absorbent core of Commercial Sample 1
Note 3: Barrier is the Barrier Layer of Commercial Sample 1
Note 4: Absorbent Core is the absorbent core of of Example 4
Note 5: Barrier Layer eliminated; all layers cut to 5.1 cm by 10.2 cm.

It has been found that structure of the present invention compri ing three dimensional apertured films or nonwovens with plurality of disconnected macrofeatures have improved fluid handling properties In particular the structures had low Fluid Penetration Time when used component layer in disposable absorbent products Additionally the structures comprising three-dimensional apertured films exhibited Repeat Insult Rate that increases les than about 40% over six insults

Fluid Penetration Time and Repeat Insult Time are measured according to the following test methods respectively Testing was performed in a location conditioned to 21 degrees centigrade and 65% relative humidity Prior to performing the tests the commercial

samples and test assemblies were conditioned t for at least 8 hours

Fluid Penetration Time (FPT) i measured by placing sample to be tested under Fluid Penetration Test orifice pl te The orifice plate consists of 7 6 cm X 25 4 cm plate of 1 3 cm thick polycarbonate with an lliptical orifice in its center The elliptical orifice measures 3 8 cm along it major axi and 1 9 cm along it minor axis The orifice plate is centered on the sampl to be te ted A graduated 10 cc syringe containing 7 ml of test fluid i held over the orifice pl te such that the exit of the syringe i approximately 3 inches above the orifice The syringe i held horizontally parallel to the surface of the test pl te the fluid i then expelled from the syringe at a rate that allows the fluid to flow in stream vertical to the test plate into the orifice and a top watch is started when the fluid first touches the sample to be tested The stop watch i topped when the surface of the sampl first becomes visibl within the orifice The lapsed time on the stop watch i the Fluid Penetration Time The average Fluid Penetration Time (FPT) is calculated from the result of testing five samples

PRIOR ART 1	82.6
EXAMPLE 1	89.3
PRIOR ART 2	88.3
EXAMPLE 2	43.2
EXAMPLE 4	13.8
EXAMPLE 4 CONTROL	108.8

The Repeat Insult Time is measured by placing sample to be tested on Resilient Cushion covering the sample

with Repeat Insult Orifice Plate then applying te t fluid according to the chedule described

The Resilient Cushion i made follows a nonwoven fabric of low density (0 02 0 0 g/cm3 measured t 0 24 kPa or 0 035 psi) is used as a resilient material The nonwoven fabric i cut into rectangular sheets (32x14cm) which are placed one on top of another until tack with a free height of about 5 cm is reached The nonwoven fabric tack is then wrapped with one layer of 0 01 mm thick polyurethane elastomeri film such as TUFTANE film (manufactured by Lord Corp UK) which i sealed on the back with double face clear tape

The Repeat Insult orifice plat consists of a 7 6 cm X 25 4 cm plate of 1 3 cm thick polycarbonat with circular orifice in its center The diameter of the ircular orifice i 2 0 cm The orifice plate i centered on the sampl to be tested A graduated 10 cc syringe containing 2 ml of te t fluid is held over the orifice plate such that the exit of the syringe i approximately 1 inch above the orifice The syringe i held horizontally parallel to the surface of the test pl te the fluid is then expelled from the syringe t a rat that allows the fluid to flow in tream vertical to the test pl te into the orifice and a stop watch i started when the test fluid first touches the sample to be tested The stop watch is stopped when the urface of the sample first becomes visibl within the orifice The lapsed time on the top watch is the first fluid penetration time After an interval of 5 minutes lapsed time a second 2 ml of test fluid i expelled from the syringe into the ircular orifice of the Repeat Insult Orifice Plate and timed as previously described to obtain second fluid penetration time Thi sequence is repeated

until a total of ix fluid insults each separated by 5 minut have been timed The Percent Increase in Fluid Penetration Time fter Six Insult i calculated as 100 time the difference between the first and ixth insult times divided by the first insult time The Average Percent Increase in Fluid Penetration Time i calculated from the result of testing five ampl s

TABLE 3

SAMPLE	REPEAT INSULT TIME: INSULT # (time in seconds)						DIFFERENCE In seconds between insults 6 & 1	% INCREASE
	1	2	3	4	5	6		
COMMERCIAL SAMPLE 1	6.3	7.3	12.1	12.4	14.4	18.8	12.5	194.5
COMMERCIAL SAMPLE 2	4.9	6.2	8.8	10.2	10.7	11.8	6.8	134.7
PRIOR ART 2	13.7	16.8	21.1	22.3	24.2	23.9	10.2	74.8
EXAMPLE 2	10.1	8.8	8.8	10.4	11.8	11.3	1.2	11.9
EXAMPLE 3	6.7	6.1	6.4	6.8	7.0	7.0	0.3	4.5

We laim

1 A two layer tructure for use in an absorbent articl compri ing a fluid permeabl first layer in fluid communication with fluid permeable second layer said layers contacting one another substantially only through plurality of di connected macrofeatures projecting from either aid first layer or said second layer

2 The tructure of claim 1 wherein said macrofeature each have a maximum dimension of at least about 0 15 mm

3 The tructure of claim 1 wherein said macrofeatures each have a maximum dimension of at least about 0 305 mm

4 The structure of claim 1 wherein said macrofeatures each have maximum dimension of at least about 0 50 mm

5 The tructure f claim 1 wherein said macrofeatures project from the first layer in the direction of the second layer

6 The tructure f claim 1 wherein said macrofeatures proj t from the second layer in the direction of the first layer

7 The structure of claim 1 wherein said fi t layer and said second layer are independently a nonwoven fabri or an apertured film

8 The tructure of claim 1 wherein said econd layer is an apertured film with macrofeatures

9 The tructure of claim 1 wherein said econd layer is a nonwoven web with macrofeatures

10 The tructure of claim 1 wherein said second layer i an apertured film comprising a first surface second surface and a calipar defined by a first plane and a second plane said film compri ing plurality of di connected macrofeatures and a plurality of apertures said apertures defined by sidewall originating in the first surface and extending generally in the direction of the second surface and terminating in the second plane wherein the fir t surface is coincident with the first plane at said macrofeatures and the relative positions of said apertures and macrofeatures is regular

11 The tructure of claim 10 wherein at least a portion of said sidewall have a first portion thereof originating in said first plane

12 The structure of claim 10 wherein at least 50% of said idewall have fir t portion thereof originating in aid first plane

13 The tructure of l im 10 wherein t least a portion f said idewall comprise a second portion originating between the first plane and the second plane

14 The tructure of claim 10 wherein the ratio of apertures to macrofeatures is at least one

15 An absorbent arti l comprising two layer tructure overlying an absorbent layer said tructure compri ing a fluid permeabl first layer in fluid communication with a fluid permeable second layer said layers contacting one another substantially only through a plurality of disconnected macrofeatures projecting from ither said first layer or said second layer

16 A two layer tructure for use in absorbent articles comprising a fluid permeable first layer comprising three dimensional apertured film in fluid communication with a fluid permeable second layer said first layer compri ing a plurality of apertures and plurality of apertured macrofeatures projecting in the direction of said second layer each apertured macrofeature being disconnected from other apertured macrofeatures wherein said layers contact one another substantially only through said apertured macrofeatures

17 The tructure of claim 16 wherein aid macrofeatures each have maximum dimension of at least about 0 15 mm

18 The structure of claim 16 wherein said macrofeatures each have a maximum dimension of at least about 0 305 mm

19 The structure of claim 16 wherein said macrofeatures each have a maximum dimension of t l ast about 0 50 mm

20 The structure of claim 16 wherein said second layer i nonwoven

21 The structure of claim 16 wherein said second layer is second apertured film

22 The tructure of claim 21 wherein said second apertured film comprises a first surface a second surface caliper defined by a first plane and a second plane and a plurality of apertures said apertures defined by sidewall originating in the first surface and extending generally in the direction of the second surface and terminating in the second plane at least portion of aid idewall compri ing a first portion originating in the first plane

23 The structure of claim 22 wherein at least portion of said sidewall comprise econd portion originating between the first and second planes

24 An absorbent article compri ing a two layer structure overlying an absorbent layer said tructure comprising a fluid permeable first layer compri ing

three dimensional apertured film in fluid communication with a fluid permeable s cond layer said first layer compri ing plurality of apertures and a plurality of apertured macrofeatures projecting in the direction of said second layer each apertured macrofeature being disconnected from other apertured macrofeatures wherein id layers contact one another substantially only through said apertured macrofeatures

25 A two layer structure for use in absorbent articles comprising a fluid permeable body contacting layer in fluid communication with fluid permeable s cond layer said second layer compri ing a plurality of macrofeatures projecting in the direction of said body contacting layer aid macrofeatures being disconnected from one another and said layers contacting one another substantially only through said macrofeatures

26 The structure of claim 25 wherein said body contacting layer is a nonwoven

27 The structure of claim 25 wherein said body contacting layer i an apertured film

28 The tructure of claim 25 wherein said macrofeatures each have maximum dimension of t least about 0 15 mm

29 The structure of claim 25 wherein said macrofeatures each have a maximum dimension of at least about 0 305 mm

30 The structure of claim 25 wherein aid macrofeatures each have a maximum dimension of at least about 0 50 mm

31 The tructure of claim 25 wherein said second layer comprises nonwoven

32 The structure of claim 25 wherein said econd layer comprises second apertured film

33 The structure of claim 32 wherein said econd apertured film comprises a first surface a second surface caliper defined by first plane and econd plane and a plurality of apertures said apertures defined by sidewalls originating in the first surface and extending generally in the direction of the second surface and terminating in the second plane at least portion of said sidewalls comprising a first portion originating in the first plane

34 The structure of laim 33 wherein at least portion of said sidewall comprises a second portion originating between the first and second planes

35 An absorbent arti le comprising a two layer structure overlying an absorbent layer said structure compri ing a fluid permeable body contacting layer in fluid communication with fluid permeabl second

layer said second layer comprising a plurality of macrof atures projecting in the direction of aid body contacting layer said macrofeatures being disconnected from one another and said layers contacting one another substantially only through said macrofeature

36 A two layer structure for use in absorbent arti les comprising a fluid permeable first layer in fluid communication with a fluid permeable second layer said layer contacting one another substantially only through plurality of disconnected macrofeatures projecting from either said first layer or aid second layer said macrofeatures being visibl to a normal unaided eye at a perpendicular distance of about 300 mm between the eye and said macrofeatures

1/31

FIG 1

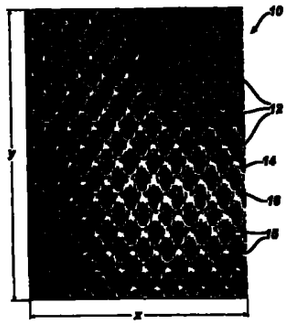


FIG 1A

FIG 2

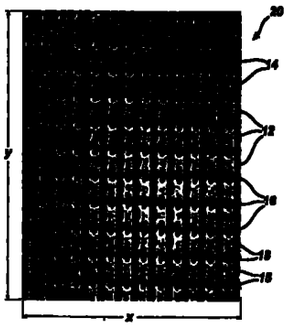


FIG 2A

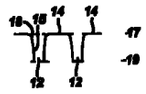


FIG 2B

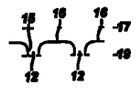


FIG 3

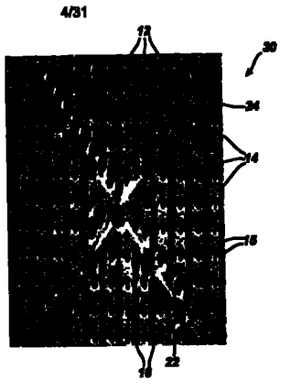


FIG 3A

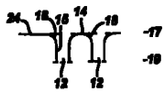


FIG 4

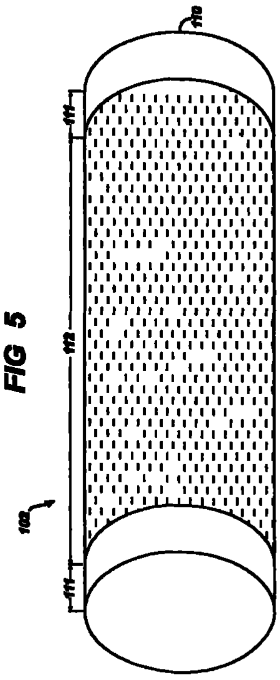


FIG 5

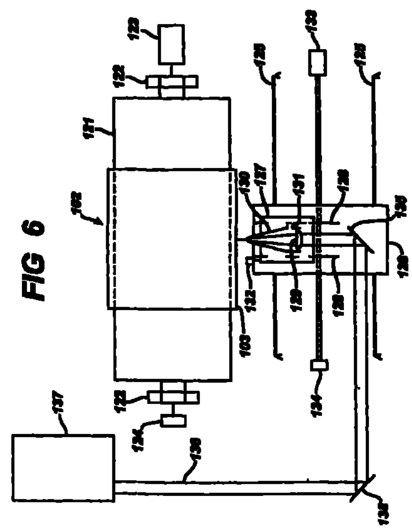


FIG 6

FIG 7

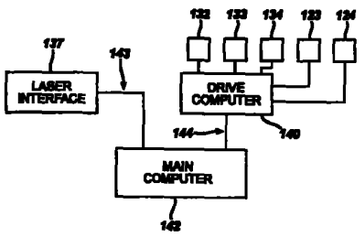

137
143
LASER INTERFACE
132
133
134
135
136
DRIVE COMPUTER
144
149
MAIN COMPUTER
142

FIG 8

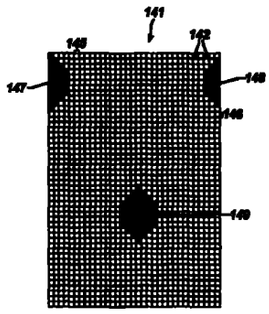

141
145
142
147
148
146
149

FIG 9

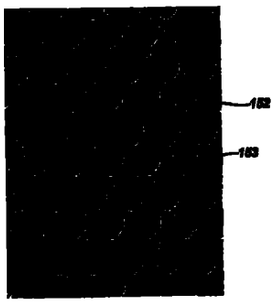


FIG 10

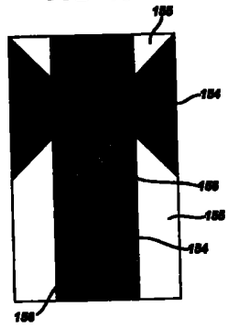


FIG 11

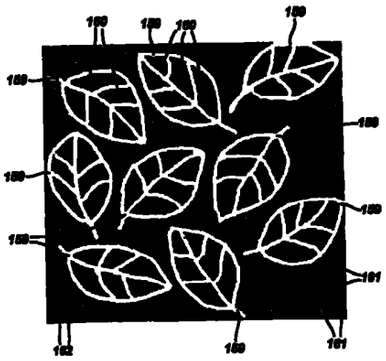

100
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FIG 12

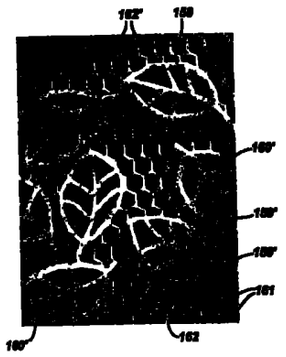
102'
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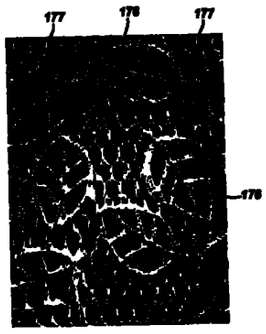
FIG 12A

FIG 13



Sub 2

FIG 13A

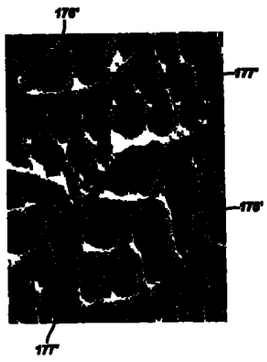


FIG 14

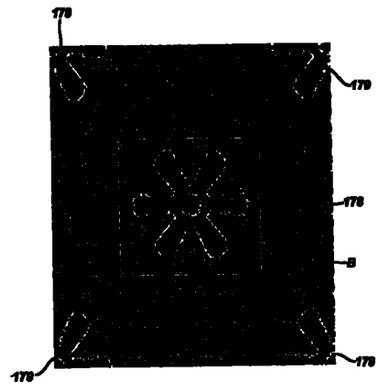


FIG 14A

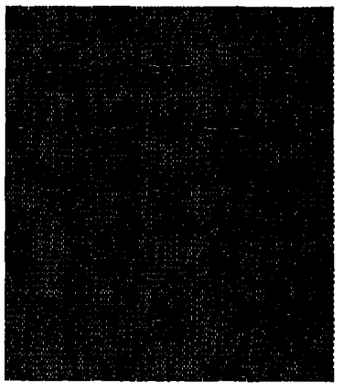


FIG 15

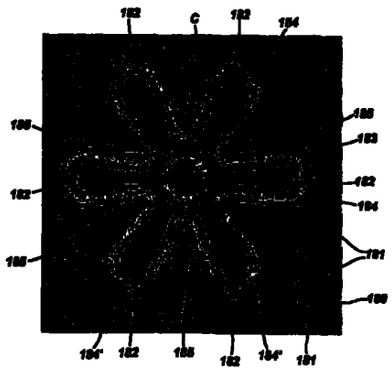


FIG 16

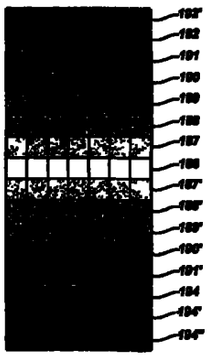

193'
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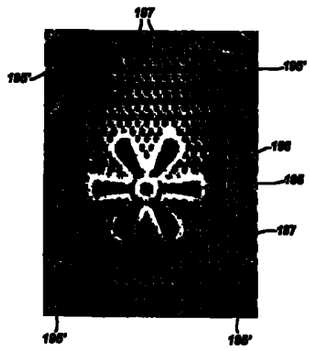
FIG 17


197
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195'

FIG 18

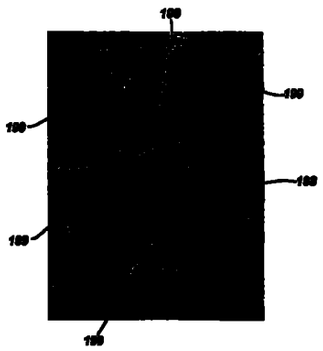

FIG 19

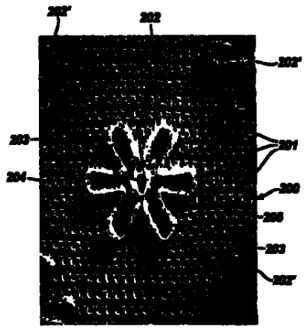

FIG 20

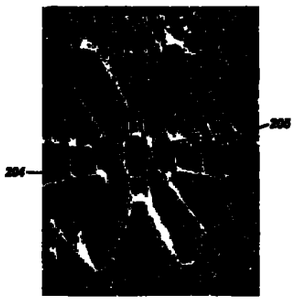

FIG 21

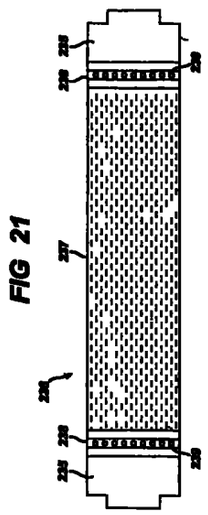

FIG 22

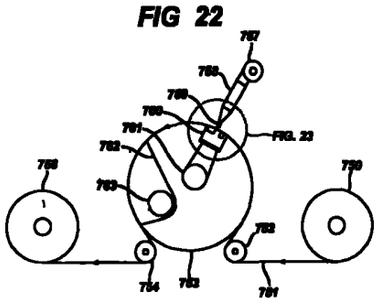
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FIG. 23
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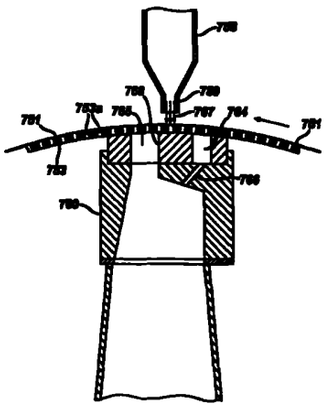
FIG 23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762a
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FIG 24 PRIOR ART

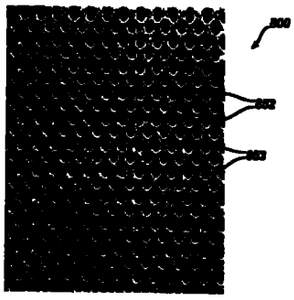
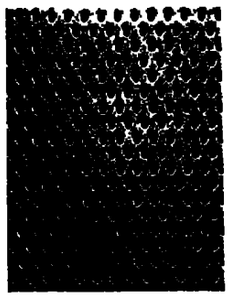


FIG 25 PRIOR ART



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Graff (43) Pub. Date: Jun. 26, 2003

(54) SHEET OF CREPED AND EMBOSSED ABSORBENT PAPER, AN EMBOSSING ROLL FOR ONE SUCH SHEET AND AN EMBOSSING METHOD

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Publication Classification

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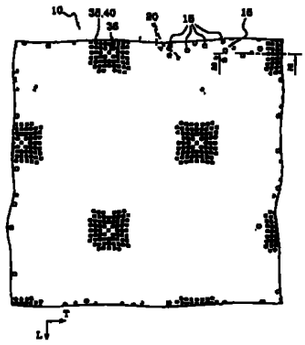
(52) U.S. Cl. 428/172

(57) ABSTRACT

The invention relates to an embossed sheet (1) made up of at least first and second ply (12, 14) of creped cellulose cotton of the type in which the first ply (12) has an embossed design (16) involving first series of first projections (18) that form in particular first alignments and in which the spaces (22) are connected to the interval (here 24) of the facing second ply (14) characterized in that these two plies (12, 14) each have second embossed design (36) involving second series of second projections (38, 40), and by the fact that the spaces (42, 44) of the second projections (38, 40) of ply (12, 14) extended outward and are facing and enter spaces (44, 42) of the second projections (40, 38) of the other ply (14, 12).



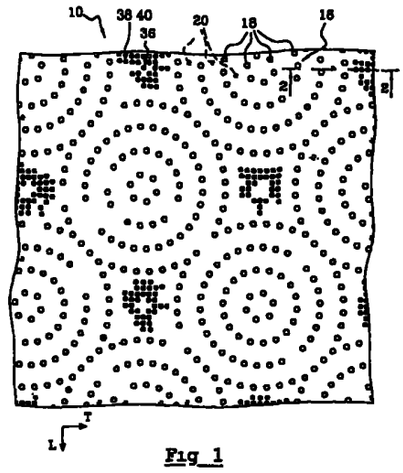


Fig 1

FIG 26

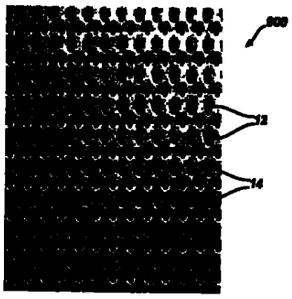


FIG 27

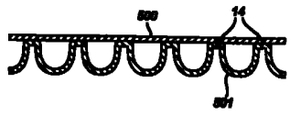
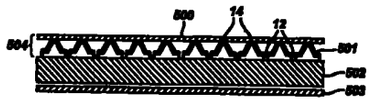


FIG 28



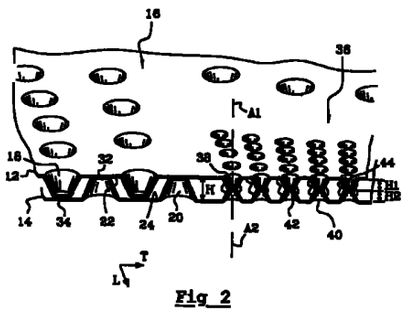


Fig 2

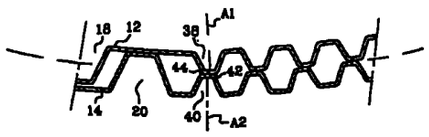


Fig 3

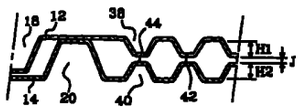


Fig 4

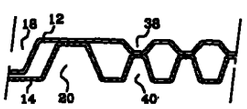


Fig 5

[0023] the aligned projections of the first series form figures of shape of closed loop;

[0024] each of the two plies have first series of first projections and an associated series of first projections, and the associated series of the first projections of the one and of the other ply are nested between the associated series of projections of the other of the two plies;

[0025] the second projections have dotted spaces;

[0026] the second projection have linear spaces.

[0027] The invention also provides pair of engraved cylinders for embossing an embossed sheet as specified in any one of the preceding claims in which first one of the cylinders comprises first series of first plates generally tapered in shape and forming the first alignments characterized by the fact that the two engraved cylinders each have second series of second plates in relief, dotted, and/or linear in which each second plate of cylinder corresponds substantially with second plate of the other cylinder and in which the sum of the heights of the corresponding second plates is substantially equal to the height of the first plates.

[0028] Lastly, the invention provides process for manufacturing an embossed sheet by means of pair of cylinders according to preceding claims, characterized by the fact that it involves embossing the two plies in such way as to form the first and the second embossed design pattern, thus assembling the two plies so that the spaces of the first projections are linked to the internal face of the facing ply and so that the spaces of the second projections of ply entered outward and are facing and near the spaces of the second projections of the other ply.

[0029] Further features and advantages of the invention will become apparent in reading the following detailed description, the understanding of which will be facilitated by the attached drawings, wherein

[0030] FIG. 1 illustrates as viewed from above an embodiment example of sheet of paper embossed in accordance with the teaching of the invention and more particularly kitchen towel sheet;

[0031] FIG. 2 is diagrammatic cross-section and perspective view of sheet of embossed paper made in accordance with the teaching of the invention;

[0032] FIG. 3 is diagrammatic sectional view of sheet of embossed paper which is made in accordance with the teaching of the invention and which is slightly embossed;

[0033] FIGS. 4 and 5 are diagrammatic sectional views of sheet of embossed paper made in accordance with variants of the embodiment of the invention;

[0034] FIG. 6 is perspective diagrammatic view illustrating the convex cylindrical surface of an embossing cylinder of ply of sheet according to FIG. 1.

[0035] FIG. 7 is enlarged view of detail D7 of FIG. 6.

[0036] An example of the embodiment of sheet 10 of embossed paper is shown in FIGS. 1 and 2, particularly sheet comprised of first paper ply 12 and of second lower ply 14 of absorbent paper, of creped tissue, intended for all types of hygienic or household products.

[0037] The tissue paper, with surface resistance ranging from 12 to 30 g/in^2 is of the type obtained by Conventional Wet Pressing (CWP) or of the type obtained by Transverse Air Drying (TAD).

[0038] More particularly, the sheet of paper 10 shown in FIGS. 1 and 2 is, for example, intended for incorporation into roll of kitchen towel paper.

[0039] The sheet 10 is extended along two longitudinal and transverse directions, shown in FIG. 2 by arrows L and T, which correspond to the direction of progression of the sheet 10 during its manufacture, also called the direction of "advance" and to the perpendicular direction respectively, also called the "transverse" direction.

[0040] After embossing, first design pattern 16 is apparent and is visually detached from the first ply 12 and from the second ply 14 of the sheet 10.

[0041] The first embossed design pattern 16 of each ply 12 and 14, of generally known design, is composed of first series of first projections 18 and 20, generally tapered in shape and extending above the lateral face 22, 24 of the corresponding ply 12, 14 while also extending over the interior of the sheet 10.

[0042] The first projections 18 and 20 form in particular the first alignments according to the drawings, in particular as closed loops which are seen here as circles.

[0043] Here, in accordance with FIG. 1, the associated series of the first projections 18, 20, of the one and of the other ply 12, 14 are nested, concentrically, between the associated series of the projections 20, 18 of the other 14, 12 of the two plies.

[0044] The first series of first projections 18 and 20 are aligned according to two principal directions in such way as to define ruled spaces quad. The two principal directions here are perpendicular between them and are inclined 45 degrees relative to the longitudinal L and transverse T directions of the sheet 10.

[0045] The spaces 23, 24 of the first projections 18, 20 are connected to the internal face 24, 22 of the facing ply 14, 12 (see FIG. 2).

[0046] According to known technique, the first projections 18, 20 comprising the elements of the first design pattern 16 are obtained by embossing the first ply 12 and the second ply 14 of the sheet 10 by means of pair of cylinders, one of which shown in FIGS. 6 and 7 as cylinder 26.

[0047] The homologous "projections" of these sought to be obtained on the first ply 12 and the second ply 14 of the sheet 10 are formed in relief on the convex cylindrical external face 28 of the associated cylinder 26.

[0048] For making the series of first projections 18 on the first ply 12 of the sheet 10, the embossing cylinder 26 has on its convex cylindrical face 28 first homologous series of plates in relief 30 generally tapered in relief, which are arranged in concentric circles along the first alignments of the first projections 18, in such way as to make the corresponding part of the first design pattern 16 of the first ply 12.

[0049] Similarly, the series of first projections 20 on the second ply 14 of the sheet 10 is made by another analogous embossing cylinder in which the plates is relief are arranged as concentric circles along the first alignments of first projections 20, in such way as to make the corresponding part of the first design pattern 16 of the second ply 14.

[0050] When the first ply 12 and the second ply 14 are embossed, they are nested among themselves by gluing the spaces 23 or 24 of the first projections 18 or 20 on the lateral face 24 or 22 of the second ply 14 or the facing first ply 12.

[0051] I accordance with the teaching of the invention, and in order to improve the appearance of the sheet 10 without diminishing its mechanical characteristics and its absorption capacity, the two plies 12, 14 have second embossed design pattern 36 involving second series of second projections 38, 40 which are, for example, generally tapered, i.e., with dotted spaces, extending out above the corresponding lateral face 22, 24 of ply 12, 14, while thus extending over the interior of the sheet 10.

[0052] The sums A1 and A2 of the second projections 38 and 40 of the first ply 12 and of the second ply 14 are more or less aligned.

[0053] The second projections 38 and 40 are made similar to the first projections 18 and 20, in particular by second series of second plates 46 tapered in shape which extend to the convex surface 28 of the embossing cylinder 26.

[0054] Each second plate of cylinder corresponds preferably with corresponding second plate of the other cylinder, and the sum of the heights of the corresponding second plates is substantially equal to the height of the first plates.

[0055] The second projections 38, 40 form in particular the second alignments according to the figures, in particular as closed loops, which are arranged between the first series of first projections 18 and 20.

[0056] Here the closed loops have the general form of square whose sides are curved inward and concave in manner substantially parallel to the circles defined by the first projections 18 and 20.

[0057] However, the second alignments may be of other forms, geometric or not, such as those of diamonds or flowers.

[0058] It is also possible that the second alignments of the second projections 38 and 40 have circles that are concentrically arranged in the circles of the first series of the first projections 18 and 20.

[0059] As variant not shown in the drawings the second projections are not necessarily tapered projections with dotted spaces, but they can also be of linear spot type defining more or less inclined linear design patterns.

[0060] The second projections can also be combinations of dotted spaces and linear spaces on the same ply, on the two plies or respectively on the one and on the other of the two plies.

[0061] When the second projections are tapered, they are preferably micro-projections in comparison with the first tapered projections with density of micro-projections of between 30 and 80 projections per cm^2

[0062] The diameter of the spaces of the plates in order to engrave the micro-projections is, for example, on the order of 0.4 mm while the former of the first (macro) projections is on the order of 1.0 mm.

[0063] By way of example, if the corresponding heights of the first plates 30 and of the second plates 46 formed by relief on the cylinder 26, intended for the embossing of first ply 12 of sheet of paper are considered for use as kitchen towel, the height of the first plates 30 is equal to .3 millimeter whereas the height of the second plates 46 is equal to 0.7 mm. With cylinder thus defined, associated with cylinder with appropriate rubber coating, ply of cellulose cotton of 22 g/m^2 is embossed and an average thickness 14 of the first ply 12 on the order of 0.8 mm is obtained.

[0064] The first spaces 23 and the second plates 46 are tapered with circular, oval, polygonal, or other shape section and preferably at steep incline of between 60° and 70°

[0065] The spaces 42, 44 of the second projections 38, 40 of the first ply 12 and second ply 14 are extended out facing and near the opposite and more or less axially aligned spaces 44, 42 of the second projections 40, 38 of the other ply 14, 12.

[0066] Such an embossed sheet 10 presents suppleness greater than that of an embossed sheet made in accordance with known techniques while not having the mechanical characteristics and absorptivity diminished.

[0067] The suppleness of the sheet 10 is improved because during the embossing of the sheet 10, the spaces 42 and 44 of the second projections 38 and 40 can be slightly displaced one by the other, i.e., by being inclined and displaced as shown in FIG. 2.

[0068] The mutual support of the spaces 42 and 44 of the second projections 38 and 40 inhibit the formation of folding line bonded to the suppleness of the sheet and favors the embossing of the sheet 10.

[0069] The mutual support of spaces 42 and 44 of the second projections 38 and 40 also permits the crushing of the sheet 10 to be minimized, which permits sheet 10 to conserve its bulk, i.e., its absorptivity.

[0070] In accordance with FIG. 3, the spaces 42 and 44 of the second projections 38 and 40 can be in contact. They are not connected among themselves.

[0071] According to variant shown here in FIG. 4, the spaces 42 and 44 of the second projections 38 and 40 are separated entirely by slight gap indicated by the letter J

[0072] FIGS. 3 and 4 show the second projections 38 and 40 which are symmetrical relative to the median plane of the sheet 10, i.e., their heights H1 H2 are all as equal as the heights H1 H2

[0073] However, according to variant shown in FIG. 5, the second projections 38 and 40 can be dissymmetrical.

[0074] Without departing from the scope of the invention, it is not necessary that the spaces of the facing second projections be perfectly aligned.

[0075] Nor is it required that there be an integral correspondence of the two projections of ply with the second projections of the other ply.

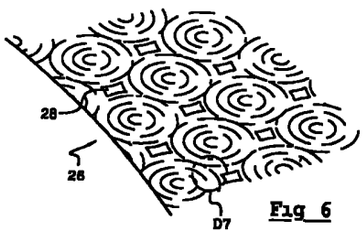


Fig 6

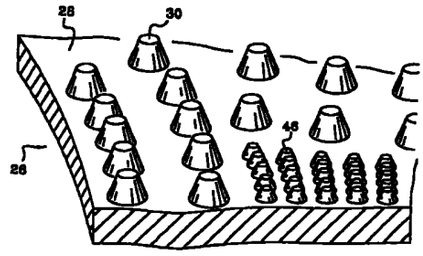


Fig 7

SHEET OF CREPED AND EMBOSSED ABSORBENT PAPER, AN EMBOSSING ROLL FOR ONE SUCH SHEET AND AN EMBOSSING METHOD

[0001] The invention relates to sheet of paper, in particular sheet of absorbent paper of creped tissue having an embossed design pattern.

[0002] The invention relates particularly to sheet of paper made up in particular of at least first ply and second ply of creped absorbent tissue paper intended for the uses of application of wiping in household, domestic, and industrial use, that is, can be utilized as an all-purpose wipe, rag, etc.

[0003] In the case of application of paper for sanitary or domestic use, such as toilet paper or all-purpose wipes, the production of sheets of paper made up of several plies of absorbent paper, such as of tissue paper, with square meter surface economic weight ranging from 12 to 30 g/m² provided with projections which are obtained by embossing, is known technique.

[0004] Embossing in fact imparts bulk to the sheet and leads to improvement in absorption of liquids, feel, and softness. An attempt has been made to increase the absorptivity further by creating multilayer sheets obtained by combining two layers, also called plies, each made up of at least one of such embossed sheets.

[0005] Thus, multilayer sheet is obtained that has mechanical characteristics such as specific resistance to traction as well as specific absorptivity.

[0006] Two methods of embossing and assembly of such plies are currently applied, depending on the characteristics desired for the final product.

[0007] The first is known in this particular field under the designation of the "nested" design method. It consists first of embossing each of the plies separately so as to form on the surface projections which are generally substantially tapered in shape or are shaped as truncated pyramids. Adhesive is then applied to the top or apex of the projections of one of the plies, and the plies are arranged so that the surfaces pressed facing the projections, with the projections of one surface being opposite the projections of the other surface. Lastly, the plies are assembled so that the projections which have been glued rest within the projections of the other ply. Thus the two plies are connected by adhesive points between the tops of the projections of one ply and the non-embossed zones between the projections of the other ply. A structure is then created, the voids of which made as this manner are suitable to ensure improved absorption for the sheet. In addition, the outer surfaces have smooth and soft feel due to the hollow zones formed by the back of the projections. This technique is shown in U.S. Pat. No. 3,867,225

[0008] The second assembly method is known in this field as "tip-to-tip" assembly. It differs from the preceding method in the relative arrangement of the two plies. After the latter have been separately embossed, they are placed one on top of the other so that the spaces of the projections coincide or so that at least portion of the spaces coincide. The plies are connected to each other by the tops of the projections, tip to tip. This technique is shown in U.S. Pat No. 3,414,459.

[0009] When the practical embodiments of these structures, whether of the nested or tip-to-tip type, are examined, it is found that the projections obtained during embossing are most often produced in such way as to be distributed according to pattern in which the projections are generally aligned uniformly according to one or several directions. One such design permits homogeneous sheet relative to its mechanical characteristics to be obtained.

[0010] However, in order to improve user satisfaction, it is important to increase the suppleness of the sheet.

[0011] The suppleness of the sheet can be defined as being its capacity to be deformed regularly when it is placed in the hand of user, his fingers being stimulated out in an extension of his palm and when the user then pulls back his fingers.

[0012] A sheet of paper which presents high degree of suppleness is thus going to be deformed and be curved or cambered in such way as to remain more or less parallel to the form determined by the interior of the palm of the hand of the user.

[0013] A sheet of paper which presents low degree of suppleness will be folded along one or several lines, each part of the sheet that extends itself between two folding lines remaining more or less flat.

[0014] A sheet of paper which has high degree of suppleness is more convenient to use.

[0015] Generally speaking, an increase in suppleness of the sheet causes in particular decrease in its mechanical characteristics.

[0016] An object of the invention is to propose new design of an embossed sheet that will allow the suppleness of the sheet to be increased without diminishing its mechanical characteristics.

[0017] To accomplish this object, the invention provides an embossed sheet composed of at least one first and one second ply of creped tissue with square meter surface economic weight ranging from 12 to 30 g/m² of the type in which least first ply has first embossed design pattern comprised of first series of first projections, generally tapered in shape and extending above the internal face of the first ply, which form in particular first alignments and in which the spaces are connected to the internal face of the second ply, characterized by the fact that these two plies each have second design pattern comprising second series of second projections extending above the internal face of corresponding ply and by the fact that the spaces of the second projections of the ply extend outward and are facing and over the spaces of the second projections of the other ply.

[0018] Other features of the invention are that:

- [0019] the spaces of the second projections of ply are in contact with the spaces of the second projections facing the other ply
- [0020] the spaces in contact with the second projections are not connected;
- [0021] the heights of the second projections of the two plies are substantially equal;
- [0022] each of the second plies has first series of the first projections, generally tapered in shape and extending over the internal face of the ply, which form the first alignments;

[0076] As regards the performances of sheet claimed for the invention, they are analogous to those of corresponding product as known in the art with solely the first projections, with the exception of the suppleness of the sheet which is greatly improved.

[0077] In fact, tests have shown that the stiffness of the sheet according to the invention, i.e., the opposite of suppleness (measured according to the Clearmetric Minus Stiffness method), is reduced by more than 20% relative to the stiffness of the sheet made in accordance with known techniques.

1 An embossed sheet 10 made up of at least of first and second ply 12, 14 of creped tissue with surface amounts ranging from 12 to 30. g/m^2 of the type in which at least first ply 12 has first embossed design pattern 16 comprising first series of first projections 18, generally tapered in shape extending above the internal face 22 of the first ply 12, which faces in particular the first alignments and in which the aperex 22 are connected to the internal face 24 of the second ply 14, characterized by the fact that these two plies 12, 14 each have second embossed design pattern 36 comprising second series of second projections 38,40 extending above the internal face 22, 24 of the corresponding ply, and by the fact that the aperex 42, 44 of the second projections 38, 40 of one ply 12, 14 extend over and are facing and near the aperex 44, 42 of the second projections 40, 38 of the other ply 14, 12.

2. An embossed sheet 10 as specified in the preceding claim wherein the aperex 42, 44 of the second projections 38, 40 of ply 12, 14 are in contact with the aperex 44, 42 of the second projections 40, 38 facing the other ply 14,12.

3. An embossed sheet 10 as specified in the preceding claim, wherein the aperex 42, 44 in contact with the second projections 38, 40 are not connected.

4. An embossed sheet 10 as specified in any of the preceding claims, wherein the heights H1 H2 of the second projections 38, 40 of the two plies 12, 14 are substantially equal.

5. An embossed sheet 10 as specified in any of the preceding claims, wherein each of the two plies 12, 14 have first series of first projections 18, 20, generally tapered in shape extending over the internal face 22, 24 of the ply 12, 14, which form the first alignments.

6. An embossed sheet 10 as specified in any of the preceding claims, wherein the projections 18, 20 aligned with the first series form the figures of the closed loop type.

7 An embossed sheet 10 as specified in the preceding claim, wherein each of the two plies 12, 14 has first series of first projections 18, 20 and wherein the associated series of first projections 18, 20, of the one and of the other ply 12, 14 are nested between the series associated with the projections 20, 18 of the other 14, 12 of the two plies.

8. An embossed sheet 10 as specified in any one of the preceding claims, wherein the second projections have distal aperex.

9. An embossed sheet 10 as specified in any of the preceding claims, wherein the second projections have linear aperex.

10. A pair of engraved cylinders 26 for the embossing of an embossed sheet 10 as specified in any of the preceding claims in which at least one of the cylinders 26 has first series of first plots 30 generally tapered in shape and forming the first alignments, wherein the two engraved cylinders 26 each comprise second series of second plots in relief, with linear and/or dotted aperex 46 in which each second plot 46 of cylinder corresponds substantially with second plot 46 of the other cylinder and in which the sum of the heights of the corresponding second plots 46 is substantially equal to the height of the first plots 30.

11 A process for manufacturing an embossed sheet 10 by means of pair of cylinders 26 as specified in the preceding claim, wherein it consists of embossing the two plies 12, 14 in such way as to form the first embossing design pattern 16 and the second embossing design pattern 36, then to assemble the two plies 12, 14 so that the aperex 22, 24 of the first projections 18, 20 are connected to the internal face 24, 22 of the facing ply 14, 12 and so that the aperex 42, 44 of the second projections 38, 40 of ply 12, 14 extend outward and are facing and near the aperex 44, 42 of the second projections 40, 38 of the other ply 14, 12.

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(12) **United States Patent**
McNeil

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(45) Date of Patent: May 28, 2002

(54) **PROCESS FOR PRODUCING EMBOSSED MULTIPLY CELLULOSIC FIBROUS STRUCTURE HAVING SELECTIVE BOND SITES**

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( ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: 09/544,838

(22) Filed: Apr. 11, 2000

Related U.S. Application Data

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(51) Int. Cl. D21H 27/00

(52) U.S. Cl. 162/132; 162/117; 162/133; 156/209; 156/324; 156/253

(58) Field of Search 162/109, 111, 162/112, 113, 116, 117, 132–133; 156/209, 252, 324, 253, 225, 282; 428/178, 153, 154, 166, 182, 172

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Primary Examiner—Jose Fortuna
(74) *Attorney, Agent, or Firm*—Jay A. Krebs; Vladimir Vitenberg; David M. Weirich

(57) ABSTRACT

An embossed multiple ply paper product and process for producing such product displaying aesthetically pleasing decorative attributes and exhibiting functional characteristics of softness, absorbency, and drape. The decorative attributes comprise embossed patterns of bubble displaying high quality cloth-like appearance for softer, more quilted look. The plies are joined in face-to-face arrangement by selective bonds which are limited to the bubbles, in order to produce more permanent decorative figures that inhibit dislocation caused by compressive forces, humidity, absorption, etc.

8 Claims, 8 Drawing Sheets

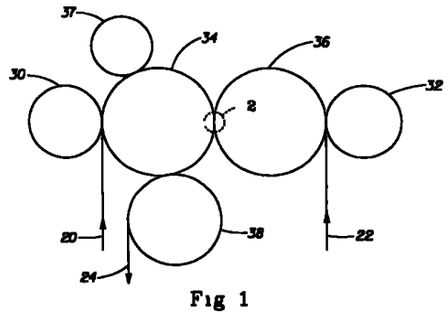

Fig 1

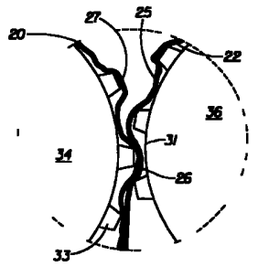

Fig 2

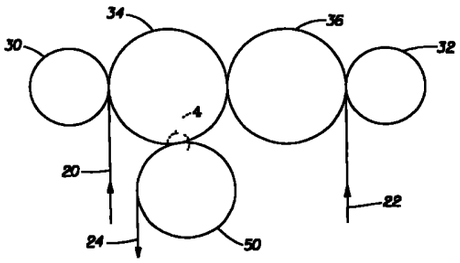

Fig 3

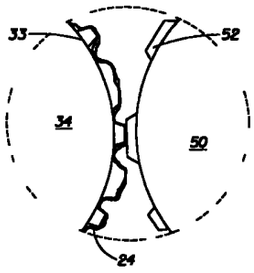

Fig 4

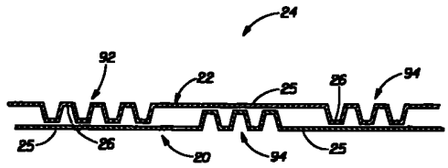

Fig 5

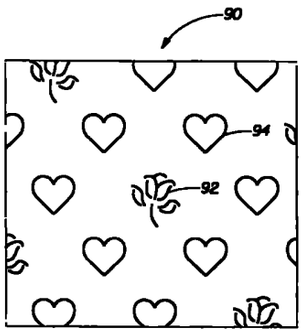

Fig 6a

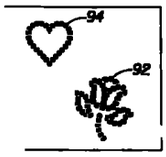

Fig 6b

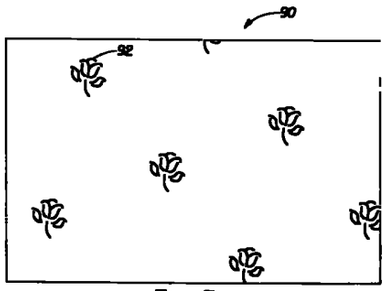

Fig 7a

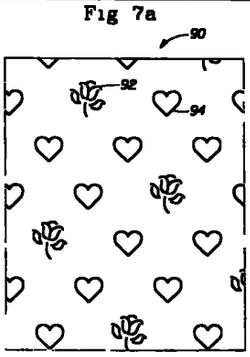

Fig 7b

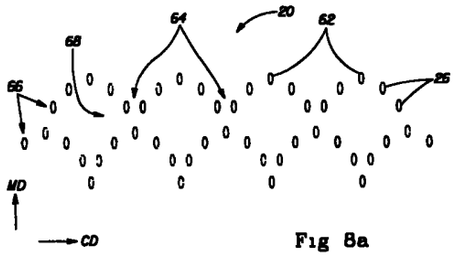

Fig 8a

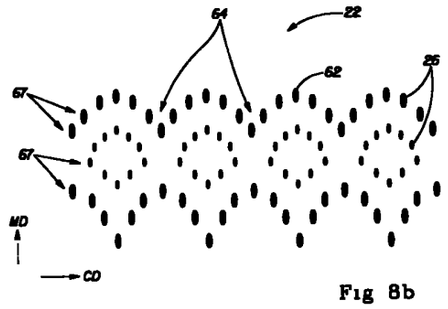

Fig 8b

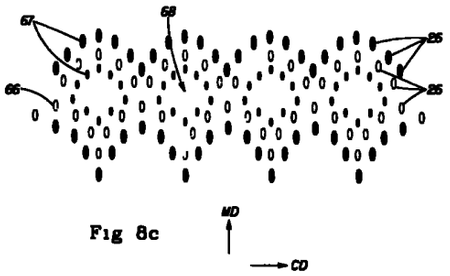

Fig 8c

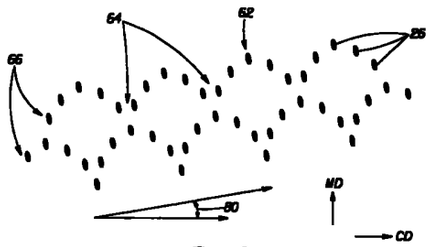

Fig 9

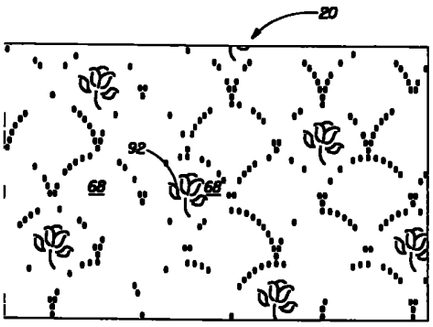

Fig 10

PROCESS FOR PRODUCING EMBOSSED MULTIPLY CELLULOSIC FIBROUS STRUCTURE HAVING SELECTIVE BOND SITES

This application is divisional of U.S. Ser. No. 09/198, 679, filed Nov. 23, 1998 now U.S. Pat. No. 6,086,715.

FIELD OF THE INVENTION

The present invention relates to multiple ply cellulosic fibrous structures, particularly embossed multiple ply cellulosic fibrous structures and the process for producing such structures.

BACKGROUND OF THE INVENTION

Cellulosic fibrous structures are staple of everyday life. Cellulosic fibrous structures are used as consumer products for paper towels, toilet tissue, facial tissue, napkins and the like. The large demand for such paper products has created demand for improved versions of the products and the methods of their manufacture.

Multiple ply cellulosic fibrous structures are very well known in the art of consumer products. Such products are cellulosic fibrous structures having more than one, typically two, plies superimposed in face-to-face relationship to form laminate. It is known in the art to emboss sheets comprising multiple plies of tissue for aesthetic purposes and to maintain the plies in face-to-face relation during use. In addition embossing can increase the surface area of the plies thereby enhancing their bulk and water holding capacity.

During the embossing process, the plies are fed through nip formed between juxtaposed axially parallel rolls. Embossment knobs on these rolls compress like regions of each ply into engagement and contracting relationship with the opposing ply. The compressed regions of the plies produce an aesthetic pattern and provide means for joining and maintaining the plies in face-to-face contacting relationship.

Embossing is typically performed by one of two processes, knob-to-knob embossing or nested embossing. Knob-to-knob embossing consists of axially parallel rolls juxtaposed to form nip between the knobs on opposing rolls. Nested embossing consists of embossment knobs of one roll nested between the embossment knobs of the other roll. Examples of knob-to-knob embossing and nested embossing are illustrated in the prior art by U.S. Pat. No. 3,414,459 issued Dec. 3, 1968 to Wells and commonly assigned; U.S. Pat. No. 3,547 723 issued Dec. 15, 1970 to Gresham; U.S. Pat. No. 3,556,907 issued Jan. 19, 971 to Nystrand; U.S. Pat. No. 3,708,366 issued Jan. 2, 1973 to Donnelly; U.S. Pat. No. 3,738,905 issued Jun. 12, 1973 to Thomas; U.S. Pat. No. 3,867,225 issued Feb. 18, 1975 to Nystrand and U.S. Pat. No. 4,483,728 issued Nov. 20, 1984 to Rosenfeld

Knob to knob embossing produces cellulosic fibrous structure composed of pillowed regions which enhance the thickness of the product. However, the pillows have tendency to collapse under pressure due to lack of support. Consequently, the thickness benefit is typically lost during the balance of the converting operation and subsequent packaging, diminishing the quilted appearance sought by embossing.

Nested embossing has proven to be the preferred process for producing products exhibiting softer more quilted appearance that is maintained throughout the balance of the converting process including packaging. With nested embossing, one ply has male pattern, while the other ply has female pattern. As the two plies travel through the nip of the embossment rolls, the patterns are meshed together. Nested embossing aligns the knob crests on the male embossment roll with the low areas on the female embossment roll. As result, the embossed sites produced on one ply provide support for the embossed sites on the other ply.

The interstitial point at the nip between nested embossment rolls is typically eliminated, since the knobs on the nested embossment rolls do not touch. This necessitates the addition of nonrying roll to apply pressure for lamination. Typical nonrying rolls are solid consisting on the lamination of many potential bonding point as shown in U.S. Pat. No. 3,867,225 issued Feb. 18, 975 to Nystrand.

The nested embossment rolls may be designed such that the knobs on one roll contact the periphery of the other embossing roll providing lamination point, thereby eliminating the need for nonrying roll. Such nested embossing arrangement is shown in U.S. Pat. No. 5,468,323 issued Nov. 21 1995 to McNeil. This arrangement also provides means for improving the bond strength between the plies by enabling glue applicator roll to be used in conjunction with each of the embossment rolls providing an adhesive joint at each of the embossed sites.

Consumer testing of products having embossed cellulosic fibrous structures have determined that softer more quilted appearance is desired. Consumers desire products having relatively high caliper with aesthetically pleasing decorative patterns exhibiting high quality cloth-like appearance. Such attributes must be provided without sacrificing the products other desired qualities of softness, absorbency, drape (limpness) and bond strength between the plies.

Different attempts have been made in the art to produce paper products exhibiting superior functional properties as well as aesthetically pleasing decorative qualities. The present invention provides an embossed multiple ply tissue where the embossment pattern includes plurality of knobs comprising aesthetically pleasing decorative images. The bonds between the plies are limited to the embossed knobs.

For the present invention, the multiple plies are selectively bonded all or less than all of the knobs by adhesive or high pressure embossing. High pressure embossing selective bonds prevents separation of the multiply product during use and balances pleasing appearance that improves the decorative nature of the product.

SUMMARY OF THE INVENTION

The present invention comprises an embossed multiple ply tissue product wherein the embossment pattern includes plurality of knobs. The knobs comprise one or more decorative images that are aesthetically pleasing. The multiple plies of tissue are selectively bonded in face to face relationship to prevent separation during use and provide soft product having improved drape. In one embodiment the plies are selectively bonded by high pressure embossing selective knobs providing glossier look which enhances the decorative nature of the product. In another embodiment, the plurality of knobs are disposed within interstices of web comprised of rows of embossed elements.

The invention further comprises process for producing such multiple ply cellulosic structure. The process comprises the steps of providing first ply embosser and second ply embosser, wherein each roll first and second ply embossers comprises pressure roll juxtaposed axially parallel to pattern roll to form nip therebetween. Each of

the pattern rolls comprises plurality of radially oriented embossment knobs projecting from periphery. The embossment knobs on at least one of the pattern rolls form plurality of indicia comprising decorative images. Plies and second plies of sheets are interposed between the nips of the first and second ply embossers such that the embossment patterns are compressed therein. Subsequently, the first and second plies are joined in face to face relationship and selectively bonded.

In one embodiment. The process includes means for selectively bonding the two plies by providing steel novel roll juxtaposed mildly parallel to one of the two pattern rolls for selectively bonding the plies via high pressure embossing.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other features, aspects and advantages of the present invention will become better understood with regard to the following description, appended claims, and accompanying drawings wherein:

FIG. 1 is schematic side elevational view of an apparatus used to perform nested embossing and adhesive bonding of two plies according to the present invention.

FIG. 2 is side view of nip formed between the two pattern rolls displayed in FIG. 1

FIG. 3 side elevational view of an apparatus used to perform nested embossing and bonding of two plies utilizing high pressure embossing according to the present invention.

FIG. 4 is side view of high pressure embossing nip formed between pattern roll and the steel novel roll displayed in FIG. 3.

FIG. 5 is fragmentary vertical sectional view of an embossed multiple ply paper product according to the present invention.

FIG. 6a is plan view of linear flower shaped cuticle and heart shaped indicia.

FIG. 6b is plan view of the indicia shown in FIG. 6a comprising consistent pattern.

FIG. 7a is plan view of first ply showing flower shaped indicia arranged in diagonal pattern.

FIG. 7b plan view of first ply showing flower shaped and heart shaped indicia arranged in diagonal pattern.

FIG. 8a is fragmentary plan view of the multiple ply paper product displaying buttonwork embossment pattern on the first ply.

FIG. 8b is fragmentary plan view of the multiple ply paper product displaying buttonwork embossment pattern on the second ply.

FIG. 9a is fragmentary plan view of the multiple ply paper product displaying the first ply embossment pattern illustrated in FIG. 8a nested within the second ply embossment pattern illustrated in FIG. 8b.

FIG. 9 is fragmentary plan view of buttonwork embossment pattern showing spines and vertices skewed relative to CD and MD.

FIG. 10 is plan view of the first ply showing the embossed buttonwork of cells having flower shaped indicia disposed therein.

DETAILED DESCRIPTION OF THE INVENTION

Definitions

As used herein the following terms have the following meanings:

"Machine direction" designated MD, is the direction parallel to the flow of paper through the papermaking equipment.

"Cross machine direction" designated CD, is the direction perpendicular to the machine direction in the X-Y plane.

"Fiberboning" refers to the process of deflecting relatively small portion of cellulosic fibrous structure normal to its plane and impacting the projected portion of the fibrous structure against relatively hard surface to permanently disrupt the fiber to fiber bonds.

A "nip" is bonding plane connecting the centers of two parallel rolls.

"Nonwovens, refers to porous/cloth disposables and may occur as result of known and predetermined features of the manufacturing process.

"Repeating" means the pattern is formed more than once. However, means the adjacent embossed sites are not contiguous.

"Resiliently continuous" refers to region extending substantially throughout the fibrous structure in one or both of its principal directions.

"Consolidated embossments elements are embossments formed into crowns and nowhere such that the side of the embossment element would resemble the top of castle wall having upward projections which are nowhere and depressions therebetween which are crenels.

An "indicia" is distinctive resulting, exhibiting decorative aspect.

A "buttonwork" is pattern of small interesting diagonal or zigzag segments or angles.

A "cell" is unit of two-dimensional array comprising group of individual embossments.

The specification contains detailed descriptions of (1) the embossing/bonding aparatus of the present invention and (2) the finished paper product of the present invention.

(1) The Embossing/Laminating Equipment

Illustrated in FIG. 1 is an embossing and bonding system used to manufacture embossed fibrous structures for consumer paper products. The system depicted performs process referred to in the prior art as nested embossing. In nested embossing two plies 20 and 22 are embossed between mated pressure rolls 34 and 32 and likewise mated pattern rolls 34 and 36. The pressure rolls 30 and 32 and pattern rolls 34 and 36 are juxtaposed with parallel axes to form three nips, first nip between the first pressure roll 30 and the first pattern roll 34, second nip between the second pressure roll 32 and the second pattern roll 36, and third nip between the first and second pattern rolls 34 and 36. Although the present invention is equally applicable to all types of consumer paper products such as paper towels, toilet tissue, facial tissue, napkins, and the like, the embossing process used to produce the multiple ply tissue 24 as well as the multiple ply tissue 24 produced thereby are representative of toilet tissue.

Pattern rolls 34 and 36 have knobs 33, as shown in FIG. 2, which extend radially outwardly and contact the periphery of the respective pressure rolls 30 or 32 at the respective nips. Each ply 20 or 22 is to be joined into the resulting multiple ply cellulosic fibrous structure 24 is fed through one of the nips between the pattern rolls 34 or 36 and the respective pressure roll 30 or 32. Each ply 20 or 22 is embossed in the nip by the knobs 33 of the respective pattern roll 34 or 36.

For the present invention, the embossment pattern disposed on one or both of the pattern rolls 34, 36 includes plurality of indicia comprising decorative images such as flowers and heart shapes. In an alternate embodiment the embossment pattern includes buttonwork of cells having

indicia disposed therein on one or both of the pattern rolls 34, 36. In still another embodiment, the embossment patterns on the first pattern roll includes buttonwork of cells comprising rows of embossment elements forming cells with indicia disposed therein, while the second pattern roll 36 includes buttonwork of cells comprising n+1 annular rows of embossment elements.

After embossing one of the plies 20 or 22 may have adhesive applied to the resulting crests 27 of the embossments 26 by an adhesive applicator roll 37 The adhesive applicator roll 37 may be utilized in conjunction with either ply 20 or 22. In this process, adhesive is applied to only the crests 27 of the embossed sites 26 of ply 20 or 22 since the crests 27 of the embossed sites 26 are the only portions of the ply 20 or 22 contacting the adhesive applicator roll 37 For the present invention, the adhesive applicator roll 37 is synchronized with one of the two pattern rolls 34, 36 to apply adhesive to the selective embossed sites comprising indicia in order to limit the bonds between the two plies to the indicia.

The plies 20 and 22 are then fed through the nip between the first and second pattern rolls 34 and 36. The patterns on each of the two rolls 34, 36 are arranged such that each embossed indicia on one or both rolls mesh with corresponding region on the opposing ply at the nip formed between the two rolls 34, 36. For pattern rolls comprising n and n+1 rows of embossment elements disposed thereon, the rows of embossment elements on the first pattern roll 34 mesh within the n+1 rows of embossment elements on the second pattern roll 36 at the nip.

As shown in FIG. 2. The knobs 33 on each respective pattern roll 34, 36 approach the periphery 31 of the neighboring pattern roll without making contact therewith. In this nip the plies 20 and 22 are juxtaposed in face-to-face relationship with the crests 27 of the embossed sites 26 on one ply 20, 22 registered with concealment regions 28 on the other ply 20, 22.

The two plies 20 and 22 are then fed through nip between the pattern roll 34 associated with the adhesive applicator roll 37 and mangling roll 38, to insure the crests of the first ply 20 embossed sites 26 having the adhesive applied from the adhesive applicator roll 37 are bonded in the concealment regions 28 of the second ply 22. Contact between the pattern roll 34 and the mangling roll 38 is limited to the embossed sites 26 of the first ply 20.

In an alternate embodiment (not shown), the pattern rolls 34, 36 can be designed such that the knobs 33 on each of the rolls contact the periphery of the opposing roll bonding the plies 20, 22 at the nip which is formed therebetween, thus eliminating the need for the mangling roll 38. Such arrangement is disclosed in commonly assigned U.S. Pat. No. 5,468,323 issued Nov. 21, 1995 to Mellott and is incorporated herein by reference. For such an arrangement an adhesive applicator roll 37 may be used in conjunction with each of the pattern rolls so that bonding points may be formed between the plies at each of the knobs 33 on the two pattern rolls 34, 36.

In another embodiment, the two plies 20, 22 are bonded by high pressure embossing. As shown in FIG. 3. The adhesive applicator roll 37 is eliminated and the first pattern roll 34 is joined with steel novel roll 39 in place of the mangling roll 38. Once the two plies pass through the nip between the first and second pattern rolls 34, 36 and are thereby juxtaposed in face to face relationship, the plies 20, 22 are made to pass through the nip between the first pattern roll 34 and the steel novel roll 39. As shown in FIG. 4, the knobs 33 on the first pattern roll 34 act in conjunction with land areas 35 on the steel novel roll 39 to apply high unit pressures to the surfaces of the two plies 20, 22 disposed therebetween. The land areas 35 on the steel novel roll have sites which correspond to and slightly exceed the dimensions associated with the bonding land portions of the mating pattern roll 34 where the bonds are to occur.

For the present invention, multiply products joined by high pressure embossing are selectively bonded at the indicia. For tissues having more than one type indicia, the adhesive bonds may be limited to one indicia type such that the glassine look further distinguishes the bonded indicia from the embonded indicia, thus further enhancing the decorative quality of the tissue.

High pressure embossing bonds the two plies by bonnelocking the fibers and reducing them to glassine. The resulting bonds exhibit glassine appearance which is aesthetically pleasing. Bonding via high pressure embossing is disclosed in U.S. Pat. No. 3,323,983 issued Sep. 6, 1964 to Palmer and is incorporated herein by reference.

(2) The Embossed Paper Product

The present invention provides tissue paper product having functional characteristics of softness, absorbency, and drape as well as exhibiting aesthetically pleasing decorative attributes. Such aesthetically pleasing features include patterns of indicia displaying high quality cloth-like appearance and pastelority, softer more quilted look.

For the present invention, the embossment patterns on the multiply tissue include indicia comprising decorative images. The plies are joined in face-to-face arrangement with the bond locations being limited to the indicia. Nesting the plies at the indicia produces more pronounced decorative figure that inhibits elongation caused by compressive forces, humidity, and absorption. In addition, by limiting the bond sites to the indicia softer tissue with improved drape is produced.

Referring to FIG. 5, the cellulosic fibrous structure 20 according to the present invention comprises two plies 20 and 22 joined in face-to-face relation. Each of the plies 20 and 22 has two distinct zones, an essentially continuous consolidated region 28, and discrete embossed sites 26 projecting generally outward therefrom and preferably orthogonal thereto. It is to be understood that each ply 20 or 22 may be directly joined to the opposite ply 22 or 20, or, may be connected through an intermediate layer (not shown) interposed between the plies 20 and 22.

For the present invention, the embossment pattern comprises plurality of one or more types of indicia distributed throughout one or both plies in nonrandom manner. Although the indicia may comprise any decorative image, for the present invention, the indicia include flowers 92 and heart shapes 94.

The indicia 90 may comprise linear pattern as shown in FIG. 6a, or consistent pattern as shown in FIG. 6b. The linear pattern comprises an essentially continuous embossed design while the consistent pattern comprises consistent embossments. The consistent embossments add bulk to the paper substrate and enhance the definition and saturation of the embossed pattern. Consistent decorative images are disclosed in U.S. Pat. No. 5,620,776 issued Apr. 15, 1997 to Schulz.

In one embodiment shown in FIG. 7a, the first ply 20 comprises indicia 90 disposed in nonrandom pattern aligning diagonal to both MD and CD. The pattern alternates between diagonal concatenated row to diagonal row comprising concatenated regions and regions having embossed flower shaped indicia disposed therein.

In an alternate embodiment shown in FIG. 7b, the embossed pattern comprises two indicia 90 comprising

flower 92 and heart 94 disposed in suspension pattern running diagonal to both MD and CD. For this embodiment, every other diagonal row in the pattern shifts from having 11 heart shaped indicia to alternating heart and flower shaped indicia.

The distal end of each embossed elm 26 on each of the two plies 20, 22 projects towards and contacts the unembossed region 25 of the opposite ply. Bonding the plies at the embossed elms 26 improves the appearance of the tissue by providing more prominent structure that exhibits subsequent distortion caused by compressive forces, humidity, and absorption. The two plies 20, 22 may be bonded at every embossed elm 26 or at selective elements elms depending on the process.

The number of bond elms connecting between the two plies not only affects the bond strength but also the product stiffness and drape. Whether the plies 20, 22 are joined selectively or via high pressure embossing, the greater the bond area the stiffer the tissue. Stiffness has direct impact on product softness and drape. Therefore, it is preferred to minimize the bond area by limiting the region bonded between the two plies 20, 22 to selective elements elms.

The two plies 20, 22 may be joined at selective elms by adhesive bonds or high pressure embossments using the processes previously described. For selective adhesive bonds, the adhesive applicator roll is synchronized with selective discrete embossment locations on the mating pattern roll. Alternatively, for selective high pressure bonds, land areas are formed on the steel anvil roll mimicking the selective discrete embossment locations on the neighboring pattern roll. The elms of the land areas correspond to and slightly exceed the dimensions of the embossments on the pattern roll where the selective bonds are desired.

As previously described, high pressure embossing produces plentiful bond elms that enhances the decorative quality of the tissue. Therefore, for the present invention, it is preferred to form the selective bond elms via high pressure embossing. Particularly, it is preferred to bond the two plies by high pressure embossing such that the area bonded between the two plies 20, 22 comprises about 0.2% to about 3% of the interfacing surface area between the two plies 20, 22.

Although any pattern of embossment elements 26 may be selected for the selective bond elms, it is preferred to choose embossment patterns of embossment elements providing adequate bond strength using minimal surface area. For the present invention, the first ply 20 represents the outside ply of multiple ply tissue which is typically exposed to consumer during use. In order to further enhance the decorative quality of the product, it is preferred to limit the selective bond elms to the indicia 90 embossed on the first ply 20. For embodiments employing more than one type of indicia, such as flower 92 and heart shape 94, it is preferred to limit the selective bond elms to one type of indicia 90 embossed on the first ply 20.

The embossment pattern for the present invention may include latticework of cells. FIG. 8a depicts plan view of the latticework of cells embossed on the first ply 20 and FIG. 8b depicts plan view of the latticework of cells embossed on the second ply 22. Although the latticework of cells on each of the two plies are composed of separate rows of discrete embossment elements 26 forming spikes 62 and vertices 64, the latticework of cells may comprise other configurations having continuous or separation rows of embossment elements.

As shown in FIGS. 8a and 8b, the latticework of cells on the first ply 20 are defined by single serrate rows 65 of embossment elements 26 while the cells on the second ply 22 are defined by two rows 67 of embossment elements 26. Once the two plies 20, 22 are joined together in face to face relationship, the single serrate rows 65 on the first ply become nested within the two rows 67 on the second ply. This nested arrangement, illustrated in FIG. 8c, provides softer, more quilted look.

Although the latticework of cells for the two plies 20, 22 depicted in FIGS. 8a, 8b, and 8c comprises first ply 20, single row 65 latticework of cells nested within second ply 22, double row 67 latticework of cells, it is apparent that other nested latticework arrangements would provide similar or improved cloth like appearance. For the present invention, it is preferred to nest every row 65 of embossment elements 26 on the first ply 20 between two rows 67 of embossment elements 26 on the second ply. In other words, if the latticework of cells on the first ply 20 comprises n+1 rows of embossment elements 26 then it is preferred that the latticework of cells on the second ply 22 comprises n+1 rows of embossment elements 26 (where n is an integer 1,2,3 etc.).

For the nested arrangement illustrated in FIG. 8c, each of the embossment elements 26 forming the rows 65 on the first ply can be radially aligned or nonaligned with the embossment elements 26 forming the n+1 rows 67 on the second ply. In addition, for the nested arrangement, each of the rows 65 of embossment elements 26 on the first ply can be arranged equidistant or nonequidistant from the adjacent rows 67 of embossment elements on the second ply 22.

As shown in FIGS. 8a and 8b, the rows 65 making up the latticework of cells are disposed in repeating array extending transversely in the CD. The latticework is typically arranged such that the spikes 62 and the vertices 64 are aligned parallel to both the MD and the CD. In an alternate embodiment, the latticework of cells are offset in the CD. As illustrated in FIG. 8, the cells are arranged such that the vertices and spikes are skewed at an angle 98 which is offset from the CD. Such skewed angle may range from about 4° to about 10°.

As previously explained, for the present invention, the first ply 20 represents the outside ply of multiple ply tissue which is typically exposed to consumer during use. In order to further enhance the decorative quality of the product, indicia 90, illustrated in FIG. 8 may be disposed within the latticework of cells 69 on the first ply 20 in somewhere repeating manner. The space within the latticework of cells on the first ply 20 for each indicia 90 is made available by limiting the number of rows of embossment elements 26. FIG. 10 shows flower shaped indicia disposed within the latticework of cells in somewhere diagonal pattern.

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

What is claimed is:

1. A process for embossing and bonding two tissue plies comprising the steps of:

providing first ply embossor and second ply embossor each said first ply embossor and said second ply embossor comprising pressure roll juxtaposed axially parallel to pattern roll to form nip therebetween, each of said rolls having an axis with center thereof, said axes of said rolls defining loading plane contacting the centers of said axes, wherein each of said pattern rolls comprises periphery and plurality of radially extended embossment knobs projecting from said periphery;

providing one anvil roll juxtaposed axially parallel to said first ply pattern roll to form nip therebetween, said anvil roll having an axis with center thereof, said axes of said anvil roll and said first ply pattern roll defining second loading plane connecting the centers of said axes;

providing first ply of tissue paper and second ply of tissue paper, each ply of tissue paper having opposed first and second sides separated by thickness of said ply;

introducing the first ply of tissue paper into the nip of the first ply embossor;

introducing the second ply of tissue paper into the nip of the second ply embossor;

rotating in nip of said first and said second ply embossors about said axes, whereby said first and said second plies of tissue paper are transported relative to said rolls such that said embossment knobs of said pattern rolls form plurality of indicia, and embossment knobs of one of the pattern rolls compressing first plurality of indicia on said first ply and said embossment knobs of the other pattern roll compressing an embossment pattern comprising second plurality of indicia on said second ply;

nonwinding said first ply of tissue paper and said second ply of tissue paper in face to face relationship to form multiple ply tissue, such that said first plurality of indicia and said second plurality of indicia are disposed relative to one another in non-random repeating pattern;

interposing said multiple ply tissue between the nip of said anvil roll and said first ply pattern roll, and

transporting said multiple ply tissue relative to said anvil roll and said first ply pattern roll whereby bond is formed between said first ply and said second ply of said multiple ply tissue, wherein said first ply and said second ply are bonded in face-to-face relationship at said first plurality of indicia and not bonded said second plurality of indicia.

2. The process of claim 1 wherein said embossment knobs on at least one said pattern roll form lattice work of cells, said embossment knobs comprises an embossment pattern comprising lattice work of cells on said first or said second ply of tissue interposed between the nip of at least one said first or said second ply embossors.

3. The process of claim 2, wherein said plurality of indicia is disposed within said lattice work of cells.

4. The process of claim 1, wherein said plurality of indicia comprises two or more decorative patterns.

5. The process of claim 1 wherein said anvil roll comprises periphery having land areas disposed thereon, the land areas interface with the embossment knobs on the first pattern roll whose bonds are to occur between the two plies.

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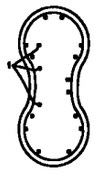
(54) Title: EMBOSSED LINER FOR ABSORBENT ARTICLE



(57) Abstract: There is provided liner for personal care products having at least two layers in face-to-face relation to one another and having at least one exposure embossed feature, and preferably an array of such features. These exposure features may have different cell geometries such as squares, diamonds, circles or ovinoid designs. In order to obtain the minimum benefit, however, they should have the necessary depth and distance between each other to allow fluid absorption and at the same time create physical barrier for the fluid to reduce its spreading. The liner may be made of combination of a top sheet material, surge layer, and absorbent core embossed together.

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EMBOSSED LINER FOR ABSORBENT ARTICLES

FIELD OF THE INVENTION

The invention is related to absorbent personal care products. More particularly it concerns an absorbent system for disposable articles such as feminine care napkins, diapers and training pants wound care dressings and bandages, and adult incontinence products having a liner with modified surface characteristics to improve performance

BACKGROUND OF THE INVENTION

Disposable products generally have a structure including a top sheet material (also referred to as a cover sheet) an absorbent core and a fluid repellent backing sheet. Some may also have a surge layer or other specialized layers between the top sheet and absorbent core. The structure referred to herein as a "liner" is a combination of at least a first layer (top sheet) and a second layer (surge layer) which are in face-to-face relation.

The function of the top sheet material, since it is the layer in contact with the user's body is to provide the necessary softness for the user's comfort while wearing the product but, more importantly it should have the structural characteristics to allow rapid absorbency of the fluids from the user's body Fast absorbency is important to reduce the possibility of fluid spreading outside the absorbent material periphery and into the wearer's garments, causing undesirable leakage or staining The absorbent material has the function of absorbing the fluid from the top sheet, preferably distributing it through the absorbent material's length, width and thickness, and retaining it. Top sheet materials are often made from nonwoven fabrics or apertured films. Apertured films can be made by

mechanically aperturing a film top sheet with the use of a pattern roll and an anvil roll as described in US Patent 5,536,555 to Zelazoski et al. and US Patent 5 704,101 to Majors, et al. Another material used in this kind of application can be found in US Patent 4,342,314 assigned to the Procter & Gamble Company in which a vacuum apertured film is described

A surge layer is most typically interposed between and in intimate liquid communicating contact with the top sheet and another layer such as a distribution or retention layer The surge layer is usually adjacent the inner (away from a wearer) surface of the top sheet. It is usually desirable to attach the upper and/or lower surfaces of the surge layer to the top sheet and next layer respectively in order to further enhance liquid transfer

The absorbent cores used in hygienic personal care products are generally made from pulp fibers or pulp fibers mixed with superabsorbent particles. These structures may include binder fibers for integrity as well.

The difficult challenge in the design of products to absorb the typical fluids insulted to hygienic products such as feminine care products and infant care products is well known in the industry In the case of infant care products, the concern is to absorb urine and fecal (BM) discharges, while feminine care products are mainly concerned with menstrual fluids to be absorbed. Due to the differences in viscosity density and composition of each fluid, each type of personal care product presents a different and complex challenge for the product designer in optimizing the absorption characteristics of each material used in the final product.

One common thread in all of the product designs is that each of them should have the ability to absorb fluid fast, without allowing it to spread outside the absorbent periphery while at the same time keeping the fluid far away from the top sheet and the user's body

to reduce the wet sensation and possible skin irritations that a wet top sheet can produce. For these reasons the structure of any product should to be developed in such a way that each component works well with the others to optimize their use This means that the absorbent core should have the ability to absorb the top sheet material at a fast rate while having the capability of distributing and retaining the fluid

A number of patents exist which attempt to address the needed balance between softness and fluid absorption. US Patent 4,323,068 to Ashe, for example, which describes a top sheet material with elevated bosses to isolate the surfaces from the user's body thereby improving dryness US Patent 4,041 951 to Sanford discloses a top sheet material that contains a multiplicity of depressed areas to isolate the wearer's skin from the moisture of the absorbent. As taught in US Patent 4,323,068, however the '951 invention has the disadvantage of not having the necessary structural integrity to maintain the material bosses after pressure is applied U.S Patent 3 634,588 to Masek describes a nonwoven top sheet made of long and short fibers that provide thinned areas to act as preferential passageways for the fluid absorption. U S Patent 5,695,585 to Van Heut et al teaches a process of forming a material with a plurality of thinned regions made in the shape of protrusions that permit the permeation of steam and water vapors. US Patent 4,741,941 to Englebert et al describes a nonwoven web with hollow projections that can be designed to provide the proper structure characteristics to allow fast intake time All of the references described above show the necessity of modifying the top sheet structure to provide separation of the user's body and the disposable article while providing the necessary absorption for fast fluid transfer to the absorbent core.

There remains a need however for a liner for personal care products that will absorb fluid in designated regions and will be capable of retaining its integrity during pressure loads while also keeping its absorbency characteristics It is an object of this

invention to provide a novel structure that enhances the fluid absorption characteristics of highly viscoelastic fluids such as menses or feces (BM) and that also retains its integrity under pressure conditions

SUMMARY OF THE INVENTION

The objects of the invention are achieved by a liner that will enhance the absorption characteristics of a porous material by modifying its surface. The ideal personal care product would be one that could absorb fluid as fast as it was delivered to the product, without allowing it to spread outside the absorbent periphery Due to differences in the fluid characteristics observed between insults, however the election and design of the materials used in a personal care product are quite complicated. The invention described herein, therefore addresses the fluid absorption characteristics of an absorbent system capable of retaining the fluid and reducing likelihood of leakage while also improving its absorbency characteristics using surface modifications.

The surface modification to absorb viscous fluids, as, for example, menses, urine and BM, is at least one concave feature that is embossed onto a composite structure, although an array of such features is preferred The composite structure, referred to herein as a liner is a composite of at least a first layer (top sheet) and a second layer (surge layer) which are in face-to-face relation A third layer an absorbent layer may optionally be present. Any of these elements may have more than one layer The embossing of concave features on structures made of a top sheet and surge layer alone has shown the best results and is therefore preferred

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows an example of the array of concave features of the liner of the invention

Figure 2 shows another example of the array of concave features of the liner of the invention

Figure 3 shows cross sectional view of a two layer composite with the concave features

Figures 4- 10 show examples of a feminine hygiene product with concave features located in various configurations on the product.

Figure 11 shows a three-layer embodiment having concave features.

Figure 12 is a schematic diagram of a rate block apparatus suitable for use in determining fluid intake time of a material or material system.

DEFINITIONS

"Disposable" includes being disposed of after a single use and not intended to be washed and reused.

As used herein and in the claims, the term "comprising" is inclusive or open-ended and does not exclude additional unrecited elements, compositional components, or method steps.

As used herein the term "nonwoven fabric or web" means a web having a structure of individual fibers or threads which are interlaid but not in an identifiable manner as in a knitted fabric. Nonwoven fabrics or webs have been formed from many processes such as for example meltblowing processes, spunbonding processes, and bonded carded web

processes The basis weight of nonwoven fabrics is usually expressed in ounces of material per square yard (osy) or grams per square meter (gsm) and the fiber diameters useful are usually expressed in microns. (Note that to convert from osy to gsm, multiply osy by 33.91)

"Spunbonded fibers" refers to small diameter fibers that are formed by extruding molten thermoplastic material as filaments from a plurality of fine capillaries of a spinneret. Such a process is disclosed in, for example, US Patent 4,340,563 to Appel et al. and US Patent 3,692,618 to Dorschner et al., US Patent 3,802,817 to Matsuki et al. US Patents 3,338,992 and 3,341,394 to Kinney US Patent 3,502,763 to Hartman, and US Patent 3,542,615 to Dobo et al. The fibers may also have shapes such as those described in US Patents 5,277 976 to Hogle et al. US Patent 5,466,410 to Hills and 5,069,970 and 5,057,368 to Largman et al. which describe fibers with unconventional shapes.

"Conjugate fibers" refers to fibers which have been formed from at least two polymers arranged in substantially constantly positioned distinct zones across the cross-section of the fibers and which extend continuously along the length of the fibers. Conjugate fibers are taught in US Patent 5,108,820 to Kaneko et al., US Patent 5,336,552 to Strack et al., and US Patent 5,382,400 to Pike et al.

"Bonded carded web" refers to webs that are made from staple fibers which are sent through a combing or carding unit, which separates or breaks apart and aligns the staple fibers in the machine direction to form a generally machine direction-oriented fibrous nonwoven web. Such fibers are usually purchased in bales, which are placed in an opener/blender or picker which separates the fibers prior to the carding unit. Once the web is formed, it then is bonded by one or more of several known bonding methods. One such bonding method is powder bonding wherein a powdered adhesive is distributed through the web and then activated, usually by heating the web and adhesive with hot air

Another suitable bonding method is pattern bonding wherein heated calender rolls or ultrasonic bonding equipment are used to bond the fibers together usually in a localized bond pattern, though the web can be bonded across its entire surface if so desired One example of a pattern is the Hansen Pennings or "HP" pattern with about a 30% bond area with about 200 bonds/square inch as taught in U.S. Patent 3,855,046 to Hansen and Pennings. The HP pattern has square point or pin bonding areas wherein each pin has a side dimension of 0.038 inches (0.965 mm), a spacing of 0.070 inches (1 778 mm) between pins, and a depth of bonding of 0.023 inches (0.584 mm). The resulting pattern has a bonded area of about 29.5%. Another typical point bonding pattern is the expanded Hansen Pennings or "EHP" bond pattern, which produces a 15% bond area Numerous other bonding patterns exist. Another suitable and well-known bonding method particularly when using conjugate staple fibers, is through-air bonding wherein hot air is passed through the web, at least partially melting a component of the web to create bonds.

Airlaying" is a well-known process by which a fibrous nonwoven layer can be formed. In the airlaying process, bundles of small fibers having typical lengths ranging from about 3 to about 19 millimeters (mm) are separated and entrained in an air supply and then deposited onto a forming screen, usually with the assistance of a vacuum supply The randomly deposited fibers then are bonded to one another using for example hot air or a spray adhesive.

"Coapertured" refers to a composite wherein (at least two) materials are apertured together to create holes which extend through the layers. An interface is created between the materials which is represented by light contact and/or entanglement and/or interpenetration and/or bonding The degree or extent of this depends on specific materials composition and process conditions. The apertures which extend through the

layers are represented by a fibrous/film-like structure created through melting and some flow of the fiber

"Personal care product" means diapers, training pants absorbent underpants adult incontinence products, feminine hygiene products, wound care items like bandages, and other articles.

"Feminine hygiene products" means sanitary napkins or pads, tampons and panty-liners.

"Target area" refers to the area or position on a personal care product where an insult is normally delivered by a wearer

TEST METHODS

Rate Block Intake Test: This test is used to determine the intake time of a known quantity of fluid into a material and/or material system The test apparatus consists of a clear preferably acrylic, rate block 10 as shown in Figure 12 and a timer or stopwatch. A 4 inch by 4 inch (102 mm by 102 mm) piece of liner material 13 to be tested is die cut. (The specific liners to be tested are described in the specific examples.) The absorbent 14 used for these studies is described under "Test Materials" below

The rate block 10 is 3 inches (76.2 mm) wide and 2 87 inches (72.9 mm) deep (into the page) and has an overall height of 1 125 inches (28.6 mm) which includes a center area 19 on the bottom of the rate block 10 that projects farther from the main body of the rate block 10 and has a height of 0.125 inches (3.2 mm) and a width of 0.886 inches (22.5 mm). The rate block 10 has a capillary 12 with an inside diameter of 0.186 inches (4 7 mm) that extends diagonally downward from one side 15 to the center line 18 at an angle of 21.8 degrees from the horizontal. The capillary 12 may be made by drilling

the appropriately sized hole from the side 15 of the rate block 10 at the proper angle beginning at a point 0.725 inches (18.4 mm) above the bottom of the rate block 10; provided, however that the starting point of the drill hole in the side 15 must be subsequently plugged so that test fluid will not escape there The top hole 17 has a diameter of 0.312 inches (7.9 mm), and a depth of 0.625 inches (16.9 mm) so that it intersects the capillary 12. The top hole 17 is perpendicular to the top of the rate block 10 and is centered 0.28 inches (7 1 mm) from the side 15 The top hole 17 is the aperture into which the funnel 11 is placed. The center hole 18 is for the purpose of viewing the progression of the test fluid and is actually of an oval shape into the plane of Figure 12. The center hole 18 is centered width-wise on the rate block 10 and has a bottom hole width of 0.315 inches (8 mm) and length of 1.50 inches (38.1 mm) from center to center of 0.315 inch (8 mm) diameter semi-circles making up the ends of the oval The oval enlarges in size above 0.44 inches (11.2 mm) from the bottom of the rate block 10, for ease of viewing to a width of 0.395 inches (10 mm) and a length of 1 930 inches (49 mm). The top hole 17 and center hole 18 may also be made by drilling

The sample to be tested is placed over the absorbent 14 and the rate block 10 is placed on top of the two materials. Two ml of an artificial menses fluid as prepared below is delivered into the test apparatus funnel 11 and a timer started. The fluid moves from the funnel 11 into a capillary 12 where it is delivered to the material 13 or material system in the center of the center hole 18. Fluid typically spreads towards the ends of the center hole 18 oval. The timer is stopped when all the fluid is absorbed into the material or material system as observed through the center hole 18 and the capillary 12 in the rate block 10. The intake time for a known quantity of test fluid is recorded for a given material or material system This value is a measure of a material or materials system's absorbency Lower intake time represents more absorbent systems. Each type of sample

is subjected to five repetitions of testing and the results are averaged to produce a single value

Rewet Test: This test is used to determine the amount of fluid that will come back to the surface of a top sheet when a load is applied The amount of fluid that comes back through the surface is called the rewet value The more fluid that comes to the surface the larger the rewet value while if a smaller amount of fluid comes back to the surface the rewet value is lower Lower rewet values are associated with a dryer material and hence a dryer product.

After performing the intake test described above the material system (top sheet and absorbent or top sheet surge and absorbent) is placed onto a closed bag which is partially filled with saline solution in order to better distribute the forces on the system The fluid bag is positioned on top of a lab jack. Two pieces of blotter paper are pre-weighed and placed on top of the material system. The bag material system and paper are raised against a fixed acrylic plate using the lab jack until a total of 1 psi is applied. The pressure is held fixed for 3 minutes, after which the pressure is removed and the blotter paper is again weighed. The difference in weight between the initial blotter weight and its weight after the test is recorded as the rewet value. Each type of sample is subjected to five repetitions of testing and the results are averaged to produce a single value

Run-off test: The 4 inch by 4 inch (102 mm by 102 mm) material system piece is placed on an acrylic stage that has an inclination angle of 20° One ml of artificial menses is insulted to the center of the material system with the use of a pipette from a distance of 5 mm. Any fluid that runs off the material sample is collected in a pre-weighed plastic container and the residue left on the acrylic stage is removed with pre-weighed absorbent gauze The run-off value is obtained by summing the fluid absorbed by the gauze and

that retained in the plastic container A lower run-off value implies better fluid absorption. Each type of sample is subjected to five repetitions of testing and the results are averaged to produce a single value.

Material caliper (thickness): The caliper or thickness of a material, in inches, is measured at three different pressures; 0.05, 0.20 and 0.50 Psi, using a Frazier spring model compressometer 6326 bulk tester with a 2 inch (50.8 mm) foot (Frazier Precision Instrument Corporation 825 Sweaney Drive Hagerstown Maryland 21740). Each type of sample is subjected to five repetitions of testing and the results are averaged to produce a single value.

Artificial Menses Preparation: The artificial menses fluid used in the testing was made according to US Patent 5,883,231 from blood and egg white by separating the blood into plasma and red cells and separating the white into thick and thin portions, where "thick" means it has a viscosity after homogenization above about 20 centipoise at 150 sec^{-1} combining the thick egg white with the plasma and thoroughly mixing, and finally adding the red cells and again thoroughly mixing A more detailed procedure follows:

Blood in this example defibrinated swine blood is separated by centrifuging at 3000 rpm for 30 minutes, though other methods or speeds and times may be used if effective The plasma is separated and stored separately the buffy coat removed and discarded and the packed red blood cells stored separately as well. It should be noted that the blood must be treated in some manner so that it may be processed without coagulating Various methods are known to those skilled in the art, such as defibrinating the blood to remove the clotting fibrous materials, the addition of anti-coagulant chemicals and others. The blood *must* be non-coagulating in order to be useful and any method which accomplishes this without damaging the plasma and red cells is acceptable.

Jumbo chicken eggs are separated, the yolk and chalazae discarded and the egg white retained. The egg white is separated into thick and thin portions by straining the white through a 1000 micron nylon mesh for about 3 minutes, and the thinner portion discarded. The thick portion of egg white which is retained on the mesh, is collected and drawn into a 60 cc syringe, which is then placed on a programmable syringe pump and homogenized by expelling and refilling the contents five times. The amount of homogenization is controlled by the syringe pump rate of about 100 ml/min, and the tubing inside diameter of about 0.12 inches. After homogenizing the thick egg white has a viscosity of about 20 centipoise at 150 sec^{-1} and is then placed in the centrifuge and spun to remove debris and air bubbles at about 3000 rpm for about 10 minutes

After centrifuging, the thick, homogenized egg white, which contains ovamucin is added to a 300 cc FENWAL® Transfer pack container using a syringe. Then 60 cc of the swine plasma is added to the FENWAL® Transfer pack container The FENWAL® Transfer pack container is clamped all air bubbles removed, and placed in a Stomacher lab blender where it is blended at normal (or medium) speed for about 2 minutes. The FENWAL® transfer pack container is then removed from the blender 60 cc of swine red blood cells are added, and the contents mixed by hand kneading for about 2 minutes or until the contents appeared homogenous. A hematocrit of the final mixture should show a red blood cell content of about 30 weight percent and generally should be at least within a range of 28-32 weight percent for artificial menses made according to this example. The amount of egg white is about 40 weight percent.

The ingredients and equipment used in the preparation of artificial menses are readily available. Below is a listing of sources for the items used though of course other sources may be used providing they are approximately equivalent.

Blood (swine). Cocalico Biologicals Inc. 449 Stevens Rd. Reamstown, PA 17567 (717) 336-1990.

Fenwal® Transfer pack container 300 ml, with coupler code 4R2014 Baxter Healthcare Corporation, Fenwal Division, Deerfield, IL 60015.

Harvard Apparatus Programmable Syringe Pump model no. 55-4143 Harvard Apparatus, South Natick, MA 01760

Stomacher 400 laboratory blender model no. BA 7021 serial no. 31968: Seward Medical London, England UK.

1000 micron mesh, item no. CMN-1000-B Small Parts Inc. PO Box 4650, Miami Lakes FL 33014-0650, 1-800-220-4242.

Hemata Stat-II device to measure hemocrits, serial no. 1194203127 Separation Technology Inc., 1099 Reiner Drive Altamont Springs, FL 32714.

DETAILED DESCRIPTION

In a personal care product, the top sheet material is the layer against the wearer's skin and so the first layer in contact with liquid or other exudate from the wearer The top sheet further serves to isolate the wearer's skin from the liquids held in an absorbent structure and should be compliant, soft feeling and non-irritating

Various materials can be used in forming the bodyside top sheet of the present invention including apertured plastic films, woven fabrics, nonwoven webs, foams and the like Nonwoven materials have been found particularly suitable for use in forming the top sheet, including spunbond or meltblown webs of polyolefin, polyester polyamide (or other like fiber forming polymer) filaments, or bonded carded webs of natural polymers (for example, rayon or cotton fibers) and/or synthetic polymers (for example, polypropylene or

polyester) fibers For example, the top sheet can be a nonwoven spunbond web of synthetic polypropylene filaments. The nonwoven web can have a basis weight ranging from about 10.0 grams per square meter (gsm) to about 68.0 gsm and more particularly from about 14.0 gsm to about 42.0 gsm, a bulk or thickness ranging from about 0.13 millimeter (mm) to about 1.0 mm, and more particularly from about 0.18 mm to about 0.85 mm, and a density between about 0.025 grams per cubic centimeter (g/cc) and about 0 12 g/cc, and more particularly between about 0.058 g/cc and about 0.083 g/cc. Additionally the permeability of such nonwoven web can be from about 150 Darcy to about 5000 Darcy The nonwoven web can be surface treated with a selected amount of surfactant, such as about 0.28% TRITON® X-102 surfactant, or otherwise processed to impart the desired level of wettability and hydrophilicity If a surfactant is used, it can be applied to the web by any conventional means, such as spraying, printing brush coating and the like. Nonwoven top sheets are usually made from staple fibers, by for example, carding or from long fibers by for example, meltspinning processes. These nonwoven webs are often made from polyolefins or polyesters, and may be conjugate fibers of polypropylene and polyester or polyethylene, for example, set up in different arrangements such as sheath/core, side-by-side, etc. Mixtures of various fibers may also be used. These materials can be bonded with different technique to provide the necessary mechanical integrity Such means can include thermal bonding or through-air bonding, ultrasonic bonding or adhesive bonding with latex or other adhesives, entangling with water or by needling etc. Usually the top sheet layer is joined to the subsequent layers and the backing sheet with hot melt or latex adhesives, or ultrasonic or mechanical bonding

The surge layer is most typically interposed between and in intimate liquid communicating contact with the top sheet and another layer such as a distribution or retention layer The surge layer is usually subjacent the inner (unexposed) surface of the

top sheet. To further enhance liquid transfer it can be desirable to attach the upper and/or lower surfaces of the surge layer to the top sheet and next layer respectively Suitable conventional attachment techniques may be utilized, including without limitation, adhesive bonding (using water-based, solvent-based and thermally activated adhesives) thermal bonding ultrasonic bonding, needling and pin aperturing as well as combinations of the foregoing or other appropriate attachment methods. If for example the surge layer is adhesively bonded to the top sheet, the amount of adhesive add-on should be sufficient to provide the desired level(s) of bonding without excessively restricting the flow of liquid from the top sheet into the surge layer

Various foams and woven and nonwoven webs can be used to construct a surge layer For example, the surge layer may be a nonwoven fabric layer composed of a meltblown or spunbond web of polyolefin filaments. Such nonwoven fabric layers may include conjugate, biconstituent and homopolymer fibers of staple or other lengths and mixtures of such fibers with other types of fibers. The surge layer also can be a bonded carded web or an airlaid web composed of natural and/or synthetic fibers The bonded carded web may for example be a powder bonded carded web, an infrared bonded carded web, or a through-air bonded carded web. The bonded carded webs can optionally include mixture or blend of different fibers, and the fiber lengths within a selected web may range from about 3 mm to about 60 mm. Exemplary surge layers can have a basis weight of at least about 0.50 ounce per square yard (about 17 grams per square meter), a density of at least about 0.010 gram per cubic centimeter at a pressure of 68.9 Pascals, a bulk of at least about 1 0 mm at a pressure of 68.9 Pascals, a bulk recovery of at least about 75 percent, a permeability of about 500 to about 5000 Darcy and a surface area per void volume of at least about 20 square centimeters per cubic centimeter The surge layer may be composed of a substantially hydrophobic material,

and the hydrophobic material may optionally be treated with a surfactant or otherwise processed to impart a desired level of wettability and hydrophilicity The surge layer can have a generally uniform thickness and cross-sectional area Exemplary surge materials may be found in US Patent numbers 5,570,343 and 5,820,573 to Dodge et al.

It is preferred that an array of concave features be present in the practice of the invention. These concave features may have different configurations such as squares, diamonds, circles or artistic designs. In order to obtain the maximum benefit, however the preferred array of concave features should have the necessary depth and distance between concavities to allow fluid absorption and at the same time create a physical barrier to contain the fluid and reduce its spreading. These concave structures are designed in such a way as to provide a temporary reservoir for the fluid, allowing the top sheet to accept the fluid at its own rate without allowing the fluid to spread. Currently available products do not have this feature and usually allow the fluid to spread in an erratic path when using materials that have slow intake times.

Although a description of a process that produces these results is disclosed here one skilled in the art may proposed alternative way to achieve similar results. One process that achieves this type of structure is made using a calander unit having an embossing roll and a matching female roll The materials to be modified are fed through the nip of the calender system at the same time. Heat and pressure (or ultrasonics) permanently emboss the concave features to the materials. This kind of process may be in an off-line operation or can be incorporated into a production line.

In another aspect of the invention, material savings may be achieved by using a narrow surge layer placed particularly in the product target area. This means that the surge (second) layer should be at least a third narrower than the top sheet (first) layer

It is preferred that there be the melting compatibility of the materials used in the creation of the structures of the invention. By "melting compatibility" it is meant that materials may be joined together by heat alone or by heat and pressure Materials which are not melt compatible may be joined together by other means, such as by entanglement or by the use of adhesives.

When using materials that are melt compatible, after embossing the composite obtains high mechanical strength that is desired to maintain the material's integrity during use In a less optimal embodiment wherein the materials are not melt compatible a hot melt or latex adhesive could be used as an alternative to achieve bonding between layers.

In addition to surfactants, other chemical treatments may be added to the material of the invention. One area of increasing consumer interest is in the area of "skin wellness" treatments like, for example, aloe, which is believed by many to positively effect skin health. Other skin wellness chemicals are known in the art.

The preferred embodiment of the invention has an intake value less than 40 seconds, a re-wet value of less than 0.35 grams, a run-off value of less than 0.50 grams, and a caliper loss under pressure less than 50 percent.

TEST MATERIALS AND PREPARATION

The materials used to demonstrate the invention were the following

A top sheet layer of nonwoven fabric was made by the spunbonding process of 3.5 dpf (denier), 0.8 osy (20.3 gsm) polypropylene fibers containing 8 weight percent of titanium dioxide (product code 41438 Ampacet Corp., 660 White Plains Rd. Tarrytown, NY) treated with 0.3 weight percent of AHCOVEL® Base N-62 wettable surfactant (ICI

Surfactants of Wilmington, Delaware USA). This fabric had an HP type bonding pattern though the bonding pattern chosen is not critical to the functioning of the invention.

A surge layer was made from a through-air bonded carded web of 100 weight percent polypropylene/polyethylene (PP/PE) sheath-core conjugate fibers having 6 dpf 0.7 osy (23.7 gsm) with a HR6 finish from the Chisso Corporation (Fiber Division) of Osaka, Japan.

An absorbent was made according to the airlaying process using 280 gsm 90 weight percent Coosa 0054 pulp and 10 weight percent Kosa (formerly Trevira Inc. and more formerly Hoechst-Celanese) T-255 fiber binder with a density of 0.14 g/cc (unless otherwise specified).

The concave features were applied to the materials with the use of a hot press model OK380 from the Precix MFG Company located at 3416 Centrell, Precix RD AC, Worth, GA, 30101 The temperature used on the hot plate was 177° C (350° F) with a dwell time of 15 seconds and 50 Psi of pressure.

Two sets of plates having a male/female arrangement with a different hole size but equivalent depth were made for the purpose of this testing

Plate 1 had an array of projections and holes, each projection having a diameter of 4.5 mm and being separated from each hole by 1mm Each hole had a volume of 0.05 cc and a depth of 3 mm. This plate 1 produced a material having what will be referred to as "Feature 1

Plate 2 had an array of projections and holes, each projection having a diameter of 6.5 mm and separated from each hole by 1mm. Each hole had a volume of 0.18 cc and a depth of 3 mm. This plate 2 produced a material having what will be referred to as Feature 2"

EXAMPLES

The following testing matrix has been evaluated to demonstrate the fluid absorption characteristics of each material using the Intake re-wet and run off- test described in the prior section.

1 – Top sheet of spunbond fabric only no embossing.

2 – Top sheet of spunbond fabric only embossing of Feature 1

3 Top sheet of spunbond fabric only embossing of Feature 2.

4 – Top sheet of spunbond fabric over surge, no embossing

5 – Top sheet of spunbond fabric over surge, the combination embossed using Feature 1

6 – Top sheet of spunbond fabric over surge the combination embossed using Feature 2.

7 – Top sheet of spunbond fabric over absorbent core, the combination embossed using Feature 1

8 – Top sheet of spunbond fabric over absorbent core, the combination embossed using Feature 2.

9 – Top sheet of spunbond fabric over surge and absorbent core, the combination embossed using Feature 1

10 Top sheet of spunbond fabric over surge and absorbent core, the combination embossed using Feature 2.

11 – Top sheet of spunbond fabric over surge and absorbent core, the combination embossed using Feature 2. Absorbent core density 0.08 g/cc.

Structures with the modified surface were created by bonding together via the embossed concave features (where applicable). All the materials were tested using the absorbent core described previously

Results obtained from testing the materials are shown in Table 1

TABLE 1

Material	Intake (seconds)	Re-wet (grams)	Run-off (grams)
1	55	0.226	0.63
2	47	0.274	0.57
3	47	0.268	0.68
4	49	0.108	0.60
5	28	0.310	0.24
6	14	0.164	0.02

As seen in Table 1 the absorption of fluid was enhanced by modifying the composite surface. The addition of a surge layer beneath the top sheet material impacted the fluid absorption by greatly reducing its re-wet, this is a result of the additional volume that the surge material provided giving a separation between the absorbent core and the top sheet material. Materials satisfying the needs of this invention have a re-wet of less than 0.40 gms and preferably less than 0.35 gms.

When the concave features are added to the composite liner structure (top sheet/surge), the fluid absorption characteristics are enhanced as seen by the significant intake time reduction obtained in the test. Materials satisfying the needs of this invention have an intake time of less than 50 seconds and preferably less than 40 seconds.

As seen in the results, the void volume of the concavity has a direct relationship with the material performance Although Feature #1 showed improvement compared to

the single layer spunbond and to the un-embossed composite, it did not offer the performance advantages of that of Feature #2

Another feature that has been improved with this invention is the reduction of the fluid run-off The addition of a surge layer in addition to the concave features was able to reduce significantly the movement of the fluid in the absorbent material, keeping a higher amount of it within the periphery of the absorbent structure. This effect can not be obtained by the un-embossed combination of the top sheet and surge materials alone due to the lack of a physical barrier Materials satisfying the needs of this invention have a run-off amount of less than 0.60 gms and preferably less than 0.50 gms.

The following examples describe the effect of adding the concave features to an absorbent system comprised of top sheet and absorbent material compared to a system comprised of top sheet, surge and absorbent material embossed together

Table 2

Material	Intake (seconds)	Re-wet (grams)	Run-off (grams)
1	55	0.226	0.63
7	57	0.290	0.63
8	27	0.30	0.53
9	75	0.15	0.60
10	70	0.188	0.56
11	31	0.378	0.38

As seen in Table 2, the results show that airlaid absorbent cores with high density (0.14 g/cc) had slower intake times than the single layer system This is believed to be a result of the increased densification of the absorbent layer which may slow down the absorption of fluid into the absorbent layer This effect is also believed to be apparent in the increased intake times of the spunbond/surge/absorbent Examples 9 and 10 versus

the similar Examples, 5 and 9 which have no absorbent. Nevertheless in all the examples, samples with concave features presented lower run-off values compared to the flat systems. One way to improve the slow intake time seen is by using a lower density absorbent core before embossing, as seen in the example using 0.08 g/cc absorbent in which faster intake times and the lowest run-off values were obtained.

As seen from this data, the election of the top sheet, surge and absorbent material has an important role in the functionality of the modified top sheet structure. Adding the concave feature to the three layers described above provides a more stable structure but may compromise the absorption functionality of the system depending on the material elected. The absorbent system may be optimized for a particular application by regulating the degree of compaction and the surfactant type and concentration.

A common requirement for this kind of material structure is its capacity to retain its integrity after use, or after the product has been produced and packaged. Usually to optimize the space occupied by the products on the shelf manufacturers have chosen to either bi-fold or tri-fold the products exerting a high-pressure load on the product. For that reason, an evaluation on the thickness lost at different pressures was performed on the different samples.

The results of that evaluation are located in Table 3.

TABLE 3

Material	Material caliper (inches) at 0.05 Psi	Material caliper (inches) at 0.35 Psi	Material caliper (inches) at 0.50 Psi	Caliper difference between 0.05 and 0.5 Psi in percentage
1	0.055	0.049	0.040	-27
2	0.080	0.0354	0.011	-81
3	0.042	0.018	0.014	-66
4	0.075	0.063	0.055	-27
5	0.068	0.050	0.050	-26
6	0.052	0.040	0.028	-60
10	0.086	0.097	0.091	17

Table 3 shows that adding the concave feature to the single spunbond top sheet produces a reduction in the material thickness with a load application. This effect is the result of having a hollow embossed feature that loses its integrity easily when load is applied, reducing the capacity to manage the fluid absorption. Contrary to that, having a top sheet and surge system reduces the amount of thickness lost with the load application.

As seen in Table 3, the structure made of top sheet, surge and absorbent core together showed the lowest value of thickness lost of all the samples. This is a result of the structure modification achieved with the process in which the airlaid fiber binders, top sheet and surge are modified together creating a stable structure. Materials satisfying the needs of this invention have a caliper loss of less than 60 percent and preferably less than 50 percent between 0.05 and 0.5 psi.

Turning now to the drawings, it can be seen that many possible configurations of concavities may be present in a product and yet be within the spirit and intent of the invention. Figures 1 and 2 show a view of a material, in this case a two layer material, having concavities 1 of differing sizes. Figure 3 shows a cross-sectional view of a

material comprised of two layers and having concavities1 Figures 4-10 show various configurations for feminine hygiene products encompassed by the instant invention.

In Figure 4, the concavities 1 are arranged around the periphery of the inner portion 2 of the product. Figure 5 shows the concavities 1 arranged only in the target area 3 of the product. Figure 6 shows concavities 1 having artistic or "whimsical" designs in a slightly expanded target area 3. Figure 7 shows the concavities 1 arranged in an unimaginative row-by-row arrangement. Figure 8 shows a feminine pad having concavities 1 arranged in a random pattern. Figure 9 shows a pattern of large and small concavities 1 arranged in a single product. Figure 10 shows a row arrangement of concavities wherein each concavity is quite small. Figure 11 shows a three layer material, which has been embossed with concavities 1 according to the invention.

The concave feature of this invention may vary in size depth, shape and separation between concavities. The diameter of the features may be up to 10 cm, preferably in a range from 3 to 20 mm in diameter and still more preferably about 8 mm. The depth may be up to 20 mm, preferably between 1 and 10 mm and still more preferably about 3 mm The separation between concavities will depend on the effect desired. Concavities that are more closely packed will provide a more effective fluid barrier by reducing the movement of liquid beyond the liner The features may also touch such that they are in liquid communication with each other and so facilitate fluid movement within the liner It is preferred, however that the features, depending on their shape, be arranged to have a separation between feature edges of between about 0.5 and 10 mm.

Embodiments of the invention may be prepared with concavities of different shapes and/or sizes. This may be done for purely aesthetic reasons or may be done to produce different absorbent characteristics in various areas of the personal care product.

In the case of a diaper for example, which is exposed to urine and BM, a pattern of smaller concavities may be incorporated into the product in the area most likely to be exposed to urine and a pattern of larger concavities may be incorporated into the product in the area most likely to be exposed to BM, which may at times be runny Alternatively the concavities may be applied in only the target area or central region of a product with the likely result being a reduction in spreading In yet another alternative location, the concavities may be located only on the periphery of a product with the likely result that fluid will be prevented from moving outside of the product. A combination of such features may be designed to improve overall product performance and protection. The exact size location, etc. depends on the fluid to be handled and the benefit desired Yet another alternative embodiment may include a liner in which the layers e.g top sheet and surge are coapertured. Such coaperturing may be done in a pattern such that the apertures occur at the bottom of each concavity The placement of various treatments like surfactants or skin wellness chemicals may also be varied, placing them, for example, only at the bottom of each concavity or only on the underside of the liner Yet another method of encouraging fluid flow into the concavities is by placing fibers in each concavity perpendicular to the plane of the material. The fibers are capable of directing fluid into the concavity and so reduce the possibility of liquid run-off from the product.

As will be appreciated by those skilled in the art, changes and variations to the invention are considered to be within the ability of those skilled in the art. Such changes and variations are intended by the inventors to be within the scope of the invention.

What is claimed is.

1 A liner for personal care products comprising a first layer and a second layer said layers being in face-to-face relation to one another and having at least one concave embossed feature

2. The liner of claim 1 having an array of discrete concave features.

3 The liner of claim 2 wherein said array of discrete concave features has fibers in at least one concavity in a direction perpendicular to said layers.

4 The liner of claim 2 wherein said first and second layers are bonded together by a method selected from the group consisting of adhesive, mechanical entanglement, thermal and ultrasonic means

5 The liner of claim 2 wherein said first and second layers are melt compatible

6. The liner of claim 2 wherein said first layer has been treated with a wettable surfactant.

7 The liner of claim 6 wherein said concavities each have a bottom and said first layer has been treated with a wettable surfactant at the bottom of each of said concavities.

8. The liner of claim 2 wherein said first layer has been treated with a skin wellness chemical

9. The liner of claim 2 wherein said first layer comprises a nonwoven web made of polyolefin fibers.

10. The liner of claim 9 wherein said polyolefin is polypropylene.

11 The liner of claim 2 further comprising apertures in said first layer

12. The liner of claim 2 wherein said first and second layers have been coapertured

13. The liner of claim 2 wherein said first layer is made of a film apertured by a method chosen from the group consisting of vacuum aperturing and mechanical aperturing.

14. The liner of claim 2 wherein said second layer comprises a bonded carded web of polyolefin fibers, bonded by a method selected from the group consisting of through-air bonding, thermal bonding and adhesive bonding

15 The liner of claim 13 further comprising conjugated fibers.

16 The liner of claim 2 wherein said second layer is more wettable than said first layer

17 The liner of claim 2 wherein said second layer comprises a foam.

18. The liner of claim 2 wherein said concave features are located in a target area.

19. The liner of claim 2 having an intake value less than 60 seconds.

20. The liner of claim 2 having a re-wet value of less than 0.40 grams.

21 The liner of claim 2 having a run-off value of less than 0.60 grams.

22 The liner of claim 2 having a caliper loss under pressure less than 60 percent.

23. The liner of claim 2 wherein said concave features have a diameter of less than 10 cm

24. The liner of claim 2 wherein said concave features have a depth of less than 20 mm.

25. A feminine hygiene pad comprising the fabric of claim 2

26. A diaper comprising the fabric of claim 2.

27 An adult incontinence product comprising the fabric of claim 2.

28. A liner for personal care products comprising a first layer and a second layer said layers being in face-to-face relation to one another and having an array of discrete concave embossed features wherein said liner has an intake value less than 40 seconds, a re-wet value of less than 0.35 grams, a run-off value of less than 0.50 grams and a caliper loss under pressure less than 50 percent.

29. The personal care product of claim 27 wherein said second layer is at least a third narrower than said first layer

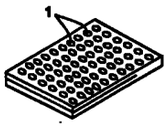

FIG. 1

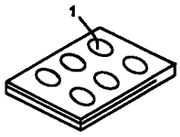

FIG. 2

FIG. 3

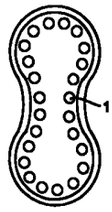

FIG. 4

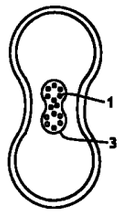

FIG. 5

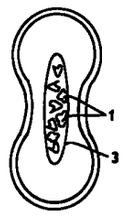

FIG. 6

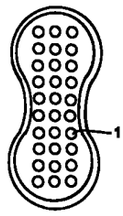

FIG. 7

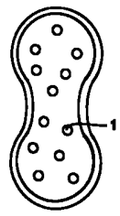

FIG. 8

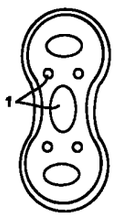

FIG. 9

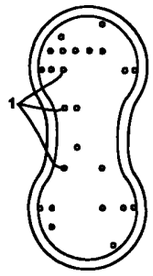

FIG 10

FIG 11

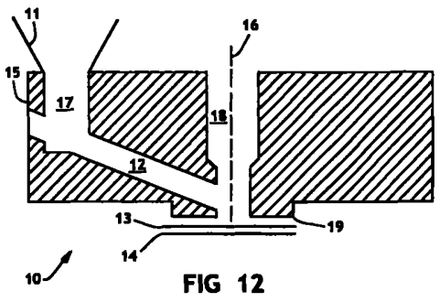

FIG 12