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45. 46

SUPERINDUSTRIA Y COMERCIO
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Fecha (RAD): 2001-08-20 16:30:23
Trámite: 002 PATENTES D 1 REGISTRO/ 538 PETICION
Dependencia: 2020 DIVISION DE NUEVAS CREACIONES
Folios: 2

SEÑORES
SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO
DIVISIÓN DE NUEVAS CREACIONES
MINISTERIO DE DESARROLLO ECONOMICO

REF EXPEDIENTE 00067200 ✓
SOLICITANTE GRUPO P I MABE, S.A DE C V
FECHA DE LA SOLICITUD SEPTIEMBRE 6 DE 2000
TITULO NUCLEO ABSORBENTE MEJORADO

DILIA RODRÍGUEZ D'ALEMAN, en mi condición de apoderada de la Sociedad solicitante, por el presente escrito atentamente solicito a Usted que habiéndose surtido la publicación de la presente solicitud, en la Gaceta de la Propiedad Industrial N° 502 de fecha Marzo 27 de 2001, se proceda con el estudio de Fond

Para tal fin me permito anexar la tasa correspondiente

Agradezco continuar con el presente trámite

Señor Jefe,


DILIA RODRÍGUEZ D ALEMAN

CCR.zmc

P-363

Industria y Comercio
Indicacion: 00057598 00000001
Fecha (MM/AA): 2001-08-30 16:30:29
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Dependencia: 0020 DIVISION DE NUEVAS CREACIONES

Folios: 2

MIT 800176089-2

RECIBO OFICIAL DE CAJA 01 - 54,596
FECHA AGOSTO 29 DE 2001

***** CONSIGNACION *****

DEPOSITANTE	TIPO PAGO	BANCO	CUENTA	No PAGO	FECHA PAGO	Vr PAGO	
CLARKE MODET Y CO	COLOMBIA	CONSIGNACION	BANCO POPULAR	050-00110-6	8207769	29/08/2001	600 000 00

***** CONCEPTO *****

CANT	RENTISTICO	CONCEPTO	TOTAL CONCEPTO
1	50005-01-01	SOLICITUDES	
		05 EXAMEN DE PATENTABILIDAD DE INVEN	300 000 00
		TOTAL	\$ 300 000 00

SOM TRESIENTOS MIL PESOS

RESPONSABLE _____

RECIBO DE CAJA APLICADO AL EXPEDIENTE No _____

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**SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO
DIVISIÓN DE NUEVAS CREACIONES**

2020
Bogotá, D. C., 23 de Junio de 2005

Doctora
DILIA RODRIGUEZ D'ALEMAN
Representante **GRUPO P I MABE, S.A. DE C.V.**

363

ASUNTO	Radicación No	00-067200
	Trámite	002
	Evento	001
	Actuación	430
	Oficio	10119
	Folios	037

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 4 a 13 de la solicitud en estudio
- b) Para el presente estudio se tendrán en cuenta los dibujos comprendidos en los folios 49 a 51 de la solicitud en estudio
- c) Para el presente estudio se tendrá en cuenta el capítulo reivindicatorio que comprende 20 reivindicaciones en los folios 14 a 17 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 6 de septiembre de 2000, y en el momento de la radicación SI se reclama prioridad de la primera solicitud presentada en México MX998328

2) Objeto de la invención

- a) Las reivindicaciones 1 a 20 de la solicitud en estudio se refieren a un núcleo absorbente para ser usado en artículos absorbentes desechables **CARACTERIZADO** porque tiene al menos tres zonas con diferentes pesos específicos y densidades, una zona de distribución-almacenamiento, una zona anti-escurrimientos y una o más zonas de transición que unen la zona de distribución almacenamiento con la zona antiescurrimientos
- b) El anterior producto busca mejorar las propiedades de los 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 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 emplea términos como "aproximadamente" o "alrededor de" que son ambiguos. Deben eliminarse dichos términos.

El título tampoco es claro pues la expresión "mejorado" no permite establecer elementos técnicos relacionados con lo que se quiere proteger. Se sugiere que el título sea "núcleos absorbentes con al menos tres zonas con diferentes pesos específicos y densidades".

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. **Debe anexarse nuevo capítulo completo.**

4) 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 10 de septiembre de 1999 (fecha para determinar el estado de la técnica) habían sido publicados los documentos que se enumeran en la siguiente tabla los cuales se relacionan con núcleos absorbentes con zonas de varias densidades

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

N°	Documento	Título	Fecha de Publicación
D1	US 5849002	Disposable diaper with reception, distribution storage and anti-leakage zones within the absorbent core	15 12 1998
D2	US 4834735	High density absorbent members having lower density and lower basis weight acquisition zones	30 05 1989
D3	US 4449979	Absorbent structure having gradient densities	22 05 1984

5) Evaluación de los requisitos de patentabilidad

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

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

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

a) Evaluación de la novedad y el del Nivel Inventivo

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

"Una invención se considerará nueva cuando no está comprendida en el estado de la técnica " "El estado de la técnica comprenderá todo lo que haya sido accesible al público por una descripción escrita u oral, utilización comercialización o cualquier otro medio antes de la fecha de presentación de la solicitud de patente o, en su caso, de la prioridad reconocida "

"Sólo para el efecto de la determinación de la novedad, también se considerará dentro del estado de la técnica, el contenido de una solicitud de patente en trámite ante la oficina nacional competente, cuya fecha de presentación o de prioridad fuese anterior a la fecha de presentación o prioridad de la solicitud de patente que se estuviese examinando, siempre que dicho contenido esté incluido en la solicitud de fechas de prioridad cuando ella se publique o hubiese transcurrido el plazo previsto en el artículo 40 "

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

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

El documento (D1) US 5849002 revela, en esencia, la misma materia que le solicitante para Colombia pretende proteger. Nótese como el núcleo contempla tres zonas, que son las mismas de la presente solicitud. Las áreas son prácticamente las mismas. Por tanto, D1 afecta directamente la presente solicitud. Si bien es cierto que el solicitante describe los documentos (D2) US4834735 y (D3) US 4449979, para un técnico puede resultar evidente obtener lo que se quiere proteger, conociendo que la falla de dichos documentos radica en que no tienen una zona de transición entre las dos zonas de densidades diferentes. Si el problema es ese, como se describe en la presente solicitud, pues la solución obvia es colocarle dicha zona. Por tanto, resulta evidente el encontrar la solución partiendo del estado de la técnica y más aun, apoyándose en el documento D1.

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	US 5849002	1 - 20	Novedad
			Nivel inventivo
D2	US 4834735	1 - 20	Nivel inventivo
D3	US 4449979	1 - 20	Nivel inventivo

6) Notificación

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

Notifíquese el presente oficio conforme a lo dispuesto por el numeral 5.2, literal e) del capítulo quinto del título primero de la Circular Única N° 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

30 JUN 2005

Concepto Técnico N°	EXAMINADOR TÉCNICO Código No	EXAMINADOR JURÍDICO Código No
923	202003	



US005849002A

United States Patent [19]
Carlos et al

[11] **Patent Number** **5,849,002**
[45] **Date of Patent** **Dec. 15, 1998**

[54] **DISPOSABLE DIAPER WITH RECEPTION DISTRIBUTION-STORAGE AND ANTI LEAKAGE ZONES WITHIN THE ABSORBENT CORE**

5,192,606 3/1993 Proxmire et al
5,246,431 9/1993 Muelola et al
5,514,104 5/1996 Cole et al
5,582,603 12/1996 DiIppantonio et al

FOREIGN PATENT DOCUMENTS

0254476 1/1988 European Pat. Off
171485 10/1993 Mexico

Primary Examiner—Robert A. Clarke
Attorney Agent, or Firm—Fish & Richardson PC

[75] **Inventors** Alberto Corona Carlos, Carlos Canales Espinosa de los Monteros, Lucia Sanchez Fernandez, all of Puebla, Mexico

[73] **Assignee** Productos Internacionales Mahe, S.A., Puebla, Mexico

[21] **Appl No** 497,058

[22] **Filed** Jun 30, 1995

[30] **Foreign Application Priority Data**

Jun 30, 1994 [MX] Mexico - - - - - 945015

[51] **Int. Cl. ⁶** - - - - - A61F 13/15

[52] **U.S. CL.** - - - - - 604/378 604/368 604/385 1

[58] **Field of Search** - - - - - 604/358 368 604/372, 378, 379 380 384, 385 1

[56] **References Cited**

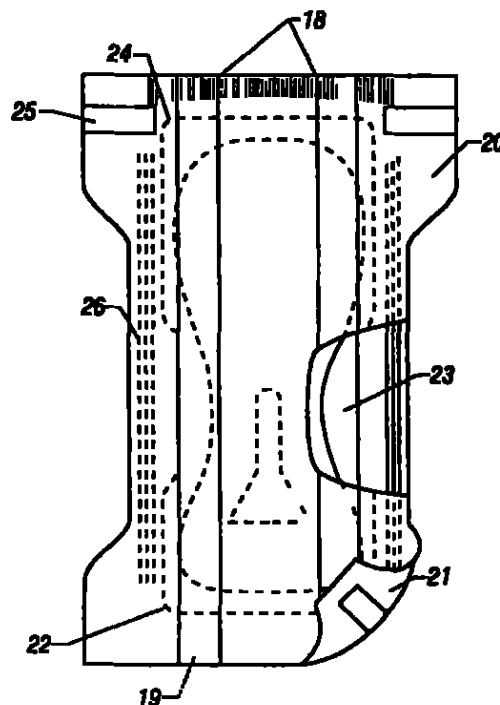
U.S. PATENT DOCUMENTS

3,017,304 1/1962 Hugen
4,027,672 6/1977 Karami
4,213,459 7/1980 Sagl et al
4,333,463 6/1982 Holtman
4,685,909 8/1987 Berg et al
4,685,915 8/1987 Hase et al
5,087,506 2/1992 Palumbo

[57] **ABSTRACT**

A disposable diaper is described in which the absorbent core material is distributed in such a way that three zones are made inside of it: one of liquid reception, a zone of distribution-storage, and finally an anti leakage zone. The reception zone is placed where generally the user discharges urine while using the diaper. This zone is less dense and has a lower specific gravity than the distribution-storage zone that fully surrounds it, in such way that when liquid flows in the reception zone it is immediately absorbed and flows towards the distribution-storage zone, which will distribute the liquid to every zone of the diaper and there it will remain until the diaper is disposed since when liquid reaches the anti-leakage zone fluid flow is drastically stopped because this zone has lower density than the distribution-storage zone and the liquid will not flow towards it due to the increased size of the capillary radius. This anti leakage zone surrounds all the distribution-storage zone shaping all the periphery of the absorbent core, so that as is does not permit liquid flow towards it it will remain dry and it will completely avoid leakage in any of the zones of the diaper.

18 Claims, 2 Drawing Sheets



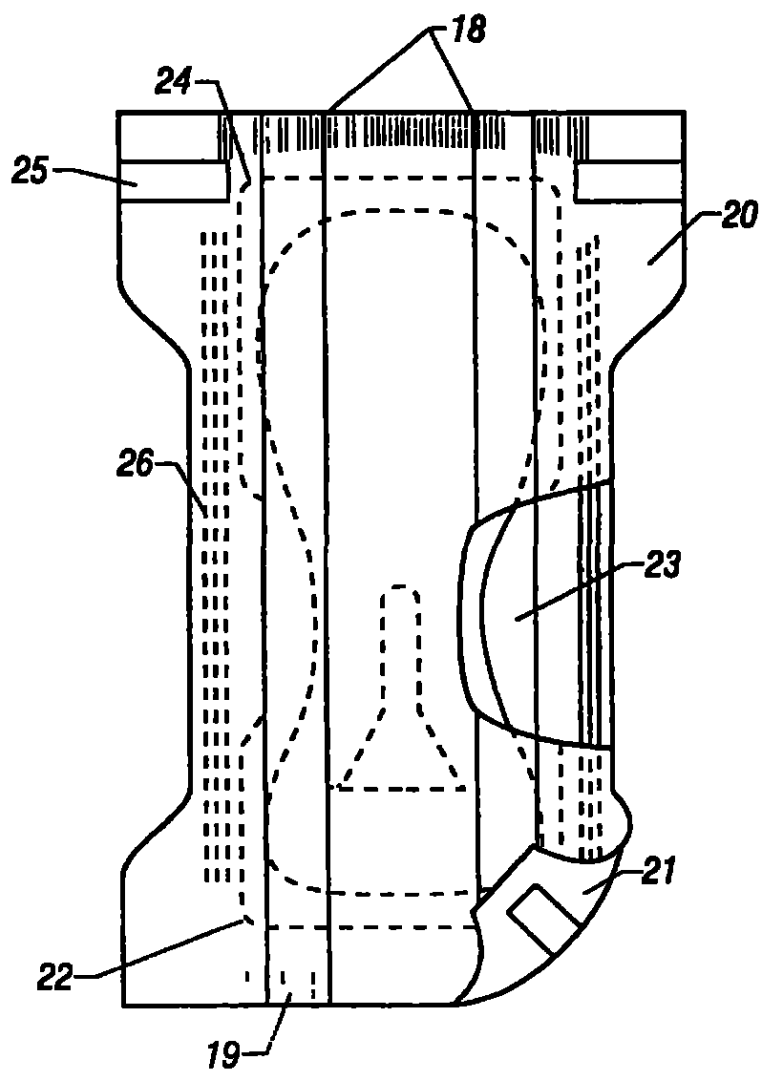
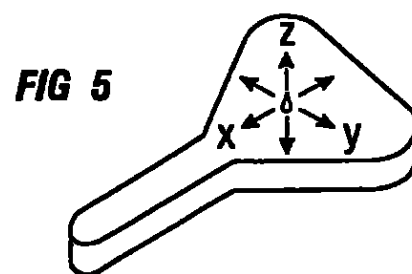


FIG 1

**FIG 5**

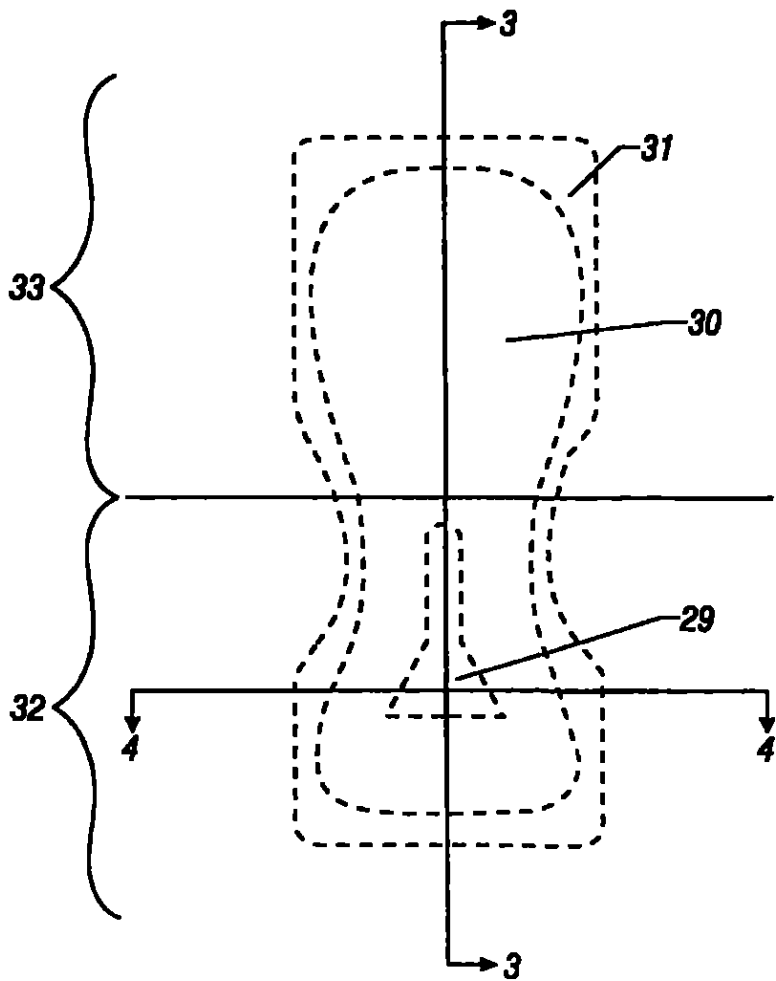


FIG 2



FIG 3

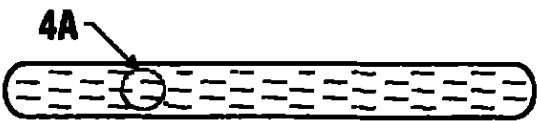


FIG 4



FIG 4A

DISPOSABLE DIAPER WITH RECEPTION, DISTRIBUTION-STORAGE AND ANTI LEAKAGE ZONES WITHIN THE ABSORBENT CORE

BACKGROUND OF THE INVENTION

Improvements to disposable diapers are constantly looked for so to make them more comfortable for the user as well as safer, avoiding leakage as much as possible.

At laboratory level as well as in surveys directed to the user's mothers, it has been noticed that the absorbent core in diapers is not used fully that is, liquid remains only in one part of the core (generally in front) and is not distributed to the other zones of it (the back almost always remains dry). If the user urinates again on the same diaper the already wet zone will receive urine without distributing it causing diverse inconvenient phenomena: the user feels uncomfortable being wet, the absorbent core breaks because of the excess weight, and probably there will be leakage because of lack of absorbent capacity.

To employ advantageously the capacity of the absorbent core and to make it work more efficiently many attempts have been made: for example in U.S. Pat. No. 4,027,672 to Hamzel et al., and assigned to Colgate Palmolive, it is suggested to put more dense channels joined to less dense channels so that the more dense channels distribute liquid rapidly to all the core and the less dense channels serve as storage sites. However this arrangement presents two problems: first, the fluid flow from a high density zone to a low density zone is hindered or nullified, and second, that in case this flow happens, the low density zone has less capacity to retain the liquids.

In U.S. Pat. No. 4,213,459 to Wayne C. Sigl et al., and assigned to Kimberly-Clark Corporation, it is suggested to place in the back of the diaper which generally is not used, the high density zone so that when liquid reaches it it is distributed internally in this zone. This design has the disadvantage that being the low density zone too big (all of the front part of the diaper), the fluid will distribute slowly and not being trapped quickly the return of liquids to the surface is favored, producing humidity in the user's skin.

The European Pat. No. 0,254,476 to Alemany et al. and assigned to The Procter & Gamble Company, considers a reception zone located where generally urine is deposited when the user uses the diaper surrounded by a storage zone, however in this patent the different anatomy of boys and girls is not considered in the reception zone. On the other hand, only reception and storage zones are mentioned and an anti leakage zone in the whole periphery of the core is not contemplated.

The Mexican Pat. No. 171,485 granted to the assignee hereof, describes a diaper with three different zones in the absorbent core: one of reception, one of distribution and another of storage: the first being of lower density than the distribution zone, surrounding it wholly and the storage zone of lower density than the distribution zone which also surrounds it. Although different functions for each of the mentioned zones are considered in the present invention it is proposed to improve the state of the art particularly identified by the above-mentioned Mexican patent giving more efficiency to the use of the absorbent core and permitting to take advantage of a larger area of the diaper.

Another approach to solve the problem of leakage has been to use adjustment members placed over the topsheet of the diaper although the acceptance that these adjustment members have had in the market and the fact that they have

helped to reduce the lateral leakage: the more known designs of them seem to have reached the peak of their efficiency which makes necessary to approach the problem of leakage by way of improvement of the diaper's other structures as it is in this invention by means of an anti leakage zone among other elements, in the absorbent core.

The present invention proposes the use of an absorbent core with a reception zone located where the user deposits the urine when he uses the diaper. This reception zone has the shape of a flask with a long neck so that it includes the zone used by boys (the body of the flask) and the zone used by girls (part of the body of the flask and the neck of it). This reception zone, when the liquid is received by it, absorbs it rapidly and starts distributing in all directions. Surrounding all the reception zone, the distribution-storage zone is located which distributes the urine toward all the areas of this zone where it will remain strongly bonded. This zone comprises both the front and the back parts of the diaper. Surrounding all the distribution-storage zone is the anti leakage zone which since it has lower density than the distribution-storage zone makes difficult or stops the liquid flow towards it, preventing it from reaching the edge of the core.

On the other hand the superabsorbent material inside the absorbent core must be fully mixed with the absorbent material to avoid the blocking and increase the distribution.

What is looked for with this invention is that the absorbent core works more efficiently that the liquid be properly distributed and that it does not reach the edge of the core to avoid leakage.

To achieve this objective, the weights and the densities of the absorbent material of the core are varied. As an aid to accomplish this main objective, the absorbent material of the core is mixed with the superabsorbent material in a very particular way which will be explained later.

Thus, the objectives of the present invention are the following:

- A) That the absorbent core of a diaper works at its maximum efficiency
- B) That the user is comfortable, feeling dry at any time
- C) To prevent leakage
- D) To lower costs using the necessary amount of superabsorbent material so that it works without blocking the distribution of liquids.

All the foregoing will be explained in detail and because of this it will be understood much better with reference to the following description of a presently preferred embodiment of the invention referred particularly to the drawings, which form an integral part hereof.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a diaper with all its components, having a part cut so the details of construction are shown, in the absorbent core the reception, distribution-storage, and anti leakage zones can be seen.

FIG. 2 is a plan view of the absorbent core, where the three zones can be clearly appreciated.

FIG. 3 is a view along line A-A of FIG. 2, where the variations in density along the core are perfectly shown.

FIG. 4 shows a view along the line B-B of FIG. 2, where the differences in density of the three zones as well as how the superabsorbent material is uniformly distributed in these zones can be observed.

DETAILED DESCRIPTION OF THE INVENTION

FIG. 1 shows a diaper with all its components. It is formed by a topsheet (20), a backsheet (21) and an absorbent core

(22) that is placed between the topsheet and the backsheet, a fastening system (25), crotch elastic (26), two open adjustment members (18), and a waist elastic (19). The diaper may or may not have a distribution material layer (23) that may wrap wholly the absorbent core be placed all along in the central part of it by both sides of the core or cover only the central part of it by the upper or the lower part.

The topsheet and the backsheet have the same dimensions and are longer and wider than the absorbent core. The part that projects out of the absorbent core (24) forms the outline of the diaper and the cut that is made upon this outline will be the final shape of the diaper. In the figure an "I" shape is shown but it can have any other proper or desired shape.

The topsheet (20) is pervious to fluids, must be soft and must not irritate the user's skin. Generally non woven polyester rayon polypropylene, polyethylene fabric or mixtures of these is used.

The backsheet (21) is impervious to fluids, must be soft and must resist the user's movements. Generally low density polyethylene is used, although any material of the described characteristics may be used.

The fastening system (25) may be constituted by three bands, two adhesive bands and a front band which are one protective and one or two adhesive or by any other fixing means for the diaper.

The crotch elastic elements (26) may be constituted by one or many threads or filaments, that are joined to the inner part of the diaper or backsheet by means of an adhesive. These filaments, when fixed to the backsheet are stressed so that when stress is removed they retract and provide the function of an elastic. To achieve the adjustment in the user's waist in a preferred embodiment of the invention a poly urethane foam band is used that is fixed by means of an adhesive to the topsheet and the backsheet of the diaper. Upon fixing, the band is stressed, so that when stress disappears it provides the function of an elastic and the adjustment in the waist is achieved upon placing the diaper.

The open adjustment members (18) are two parallel bands that are placed along the whole diaper and have elastic in one of its terminals so that they adjust to the user and form a first retaining barrier of the liquid and solid exudates discharged from the body of the user. The material for these adjustment members is liquid impervious non woven fabric as it is well known in the art.

The absorbent core (22) is formed by fibers of an absorbent material (27) generally cellulose mixed with particles of superabsorbent material (28). As absorbent material, fiber-depleted cellulose may be used either in its natural state or mixed with various components, and as superabsorbent material water insoluble polymers with acidic terminations may be used.

The technical principles upon which the present invention is based are:

- A) The pulp fibers, of which the absorbent material is constituted work by means of capillarity: thus is, the liquid does not introduce through them but these being in contact with the liquid they cause it to distribute flowing through them and remaining stored in them.
- B) The superabsorbent material, on the other hand captures the liquid, introducing inside each of the particles of it until every one of them is saturated. These particles, once saturated, are resistant to explosion when put under pressure, thus is, the liquid will stay trapped inside them.
- C) While density increases inside the absorbent core, the liquid distribution will be faster in one plane only

because of the reduction of space between the fibers of pulp, that is, the increase in the capillarity forces. Simultaneously by the same reason the liquids are trapped slowly.

- D) While density decreases there is a quicker absorption, because there is more space for the capture of liquids.
- E) At lower densities in the absorbent core the liquid distribution will be slower because of the reasons exposed in C; however a distribution in all dimensions will be achieved because the liquid will be able to flow more freely.
- F) Once the liquid is distributed in the high density zones, it remains completely trapped between the fibers and in this way it avoids returning to the surface of the core: this is why the high density zone is better for storing the fluids.
- G) The liquids always flow from the low density zones to the high density zones, and never in the opposite way. This means that the fluid flow is eased from zones with higher capillary radius to zones with lower capillary radius and it is hindered or stopped in the opposite way.
- H) The superabsorbent material if not distributed correctly, may cause blocking and diminish the liquid distribution because of it it must be placed in the zone where it is most needed and mixed with the absorbent material to avoid the blocking.

All the foregoing is supported mathematically by the Lucas and Laplace equations, that establish:

$$v = \frac{2\gamma \cos \theta}{4\eta h} \quad \text{Lucas equation}$$

$$p = 2\gamma \cos \theta / r \quad \text{Laplace equation}$$

where

r = capillary radius

γ = liquid surface tension

θ = contact angle

η = liquid viscosity

h = liquid height in the capillary

p = pressure or force with which the liquid is sustained in the capillaries.

From the Lucas equation it is deduced that the velocity in the fluid movement through the capillaries is determined by the size of these, which indicates that in big empty spaces, obtained in low densities (reception zone) the liquid absorption is fast, it has little fluid retention and allows the transfer of these to high density zones.

From the Laplace equation it is established that the force with which the fluids are "tied" in the capillaries is higher as the radius of the capillary is smaller. It has been proved that high density cores have lower liquid returns (distribution storage zone).

Considering the foregoing, the reception zone must have a much lower density than the distribution-storage zone to receive the liquid and distribute it in all directions to that zone. And the anti leakage zone must have lower density than the distribution-storage zone to avoid the liquid flowing to it and in that way it may remain dry.

The density considered right for the reception zone is of about 0.015 to 0.09 g/cm³, for the distribution-storage zone is of about 0.1 to 0.3 g/cm³ and for the anti leakage zone is of about 0.04 to 0.1 g/cm³.

FIG. 2 shows a drawing of the absorbent core in which the three zones formed by distributing the absorbent core material in such way that it works more efficiently can be seen: the reception zone (29), the distribution-storage zone (30), and the anti leakage zone (31).

The absorbent core is divided in FIG. 2 in two sections by means of line 3-4: the front section (32), that includes around 50% of the absorbent core, and the back section (33), that includes the remaining 50% of the absorbent core.

The reception zone (29) has the shape of a long, neck flask and includes an area that is from 5 to 20% of the core's front section. Its density, considering the absorbent material already mixed with the superabsorbent material, is of about 0.015 to 0.09 g/cm³ and preferably is of about 0.05 to 0.07 g/cm³.

The correct shape of the reception zone was determined after several tests with boys and girls of different weights and ages. It was waited until the user wetted the diaper for the first time and at that time it was determined the exact area in which the urine dropped. The conclusion was that both, boys and girls, wet first the diaper's front section but in different zones. The boys use the zone that has the triangle shape in FIG. 2 and girls use the flask's neck and the upper apex of the triangle. With the obtained results in this experiment it was determined also the right area for the reception zone.

The distribution-storage zone (30) surrounds wholly the reception zone and includes an area that is around 45% to 75% of the absorbent core's total area.

Its density varies in the range of about 0.1 to 0.3 g/cm³, preferably between about 0.14 to 0.18 g/cm³.

The anti-leakage zone (31) includes an area that is of about 20 to 50% of the absorbent core's total area and shapes the whole outline of it, has a density lower than the distribution-storage zone so that it creates a change in the capillary size making them bigger so that the flow stops or becomes difficult from the distribution-storage zone to the anti-leakage zone and therefore prevent the liquid from going out of the absorbent core. The density of this zone is of about 0.04 to 0.1 g/cm³ and preferably of about 0.065 to 0.075 g/cm³.

According to the technical principles exposed, liquid will fall in the reception zone and immediately be absorbed and distributed in all directions (X, Y, Z) to the distribution-storage zone, which may be seen clearly in FIG. 5. The density difference between both zones will help the liquid flow to be fast from the reception zone to the distribution-storage zone because the fluids move easily from capillaries with big radius to the ones with smaller radius. Having the distribution-storage zone a high density the capillary forces will rise and the liquid will flow rapidly in only one plane towards every place in this zone. Being this zone more dense than the reception zone, besides producing speed in the fluid flow it will retain or tie fluid, so that a low return of liquids to the surface is assured.

The superabsorbent material (28) which can be clearly observed in FIGS. 3 and 4, is distributed preferably homogeneously along the whole core. In this way it helps supporting the structure of the core when the diaper is wet and keep the baby dry at any moment.

One may think that according to the little specific gravity of the reception zone it may be convenient that there are no particles of superabsorbent material to avoid blocking, but it is important that there is a minimum amount because when the liquid falls these particles will inflate avoiding that the absorbent material fibers (cellulose) compress and make an empty space in this zone. On the other hand by inflating the superabsorbent material particles spaces will be made so that if the user urinates again on the same diaper the reception zone will continue developing its function. This will occur also in the distribution-storage zone and instead of causing blocking, the superabsorbent material will help

the liquid distribute better. It is also very important the presence of superabsorbent material in this zone, because it will help absorption and liquid retention. The fiber/superabsorbent material relation varies in a ratio of about 60/40 to 95/5.

The absorbent core may be made in many shapes and sizes. In the figures, a hourglass shape is shown but this may vary according to the manufacturing method.

In FIG. 3 the differences in thickness and density along the whole diaper and in the different zones may be seen clearly. The distribution-storage zone is the one with greater density followed by the anti-leakage zone and at last the reception zone.

We claim:

1. A disposable diaper comprising:

a fluid pervious topsheet

a fluid impervious backsheet and

an absorbent core placed between the topsheet and the backsheet, that includes three zones, each consisting of an absorbent material mixed with particles of superabsorbent material including

a fluid reception zone positioned to receive fluid discharged by a wearer

a primary storage zone encircling the fluid reception zone to store the fluid received by the fluid reception zone, and

an anti-leakage zone encircling the primary storage zone and having a lower density than the primary storage zone to deter the fluid from leaving the primary storage zone.

2. The disposable diaper of claim 1, wherein the fluid reception zone, the primary storage zone, and the anti-leakage zone each have different densities.

3. The disposable diaper of claim 1 wherein the absorbent core has a front half and a rear half and the fluid reception zone comprises from about 5% to about 20% of the surface area of the front half.

4. The disposable diaper of claim 1 wherein the fluid reception zone has a long-neck flask shape.

5. The disposable diaper of claim 1 wherein the fluid reception zone has a density in a range of about 0.015 g/cm³ to about 0.09 g/cm³.

6. The disposable diaper of claim 1 wherein the fluid reception zone has a density in a range of about 0.05 g/cm³ to about 0.07 g/cm³.

7. The disposable diaper of claim 1 wherein the primary storage zone entirely encircles the fluid reception zone in a given cross-section.

8. The disposable diaper of claim 1 wherein the primary storage zone comprises about 45% to about 75% of the surface area of the absorbent core.

9. The disposable diaper of claim 1 wherein the primary storage zone has a density in a range of about 0.1 g/cm³ to about 0.3 g/cm³.

10. The disposable diaper of claim 1 wherein the primary storage zone has a density in a range of about 0.14 g/cm³ to about 0.18 g/cm³.

11. The disposable diaper of claim 1 wherein the anti-leakage zone entirely encircles the primary storage zone in a given cross-section.

12. The disposable diaper of the claim 1 wherein the anti-leakage zone comprises about 30% to about 50% of the surface area of the absorbent core.

13. The disposable diaper of claim 1, wherein the anti-leakage zone has a density in a range of about 0.04 g/cm³ to about 0.10 g/cm³.

14. The disposable diaper of claim 1 wherein the anti-leakage zone has a density in a range of about 0.065 g/cm³ to about 0.075 g/cm³.

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15 The disposable diaper of claim 1 wherein the ratio of absorbent material to superabsorbent material in the absorbent core is in a range of about 95/5 to about 60/40

16 The disposable diaper of claim 1 wherein the superabsorbent material is mixed homogeneously with the absorbent material in each of the three zones of the absorbent core

17 A disposable diaper comprising:

a fluid pervious topsheet,

a fluid impervious backsheet and

an absorbent core, placed between the topsheet and the backsheet that includes three zones, each consisting of an absorbent material mixed with particles of a superabsorbent material including:

a fluid reception zone positioned primarily in a front half of the absorbent core to receive fluid discharged by a wearer and having a density in a range of about 0.015 g/cm³ to about 0.09 g/cm³.

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a primary storage zone encircling the fluid reception zone comprising about 50% to about 80% of the surface area of a rear half of the absorbent core, and having a density in a range of about 0.1 g/cm³ to about 0.3 g/cm³ to store the fluid received by the fluid reception zone and

an anti leakage zone encircling the primary storage zone and having a density in a range from about 0.04 g/cm³ to about 0.1 g/cm³ to deter the fluid from leaving the primary storage zone

18 The disposable diaper of claim 17 wherein about 60% to 90% of the superabsorbent material is located in the primary storage zone of the absorbent core and the rest of the superabsorbent material is mixed homogeneously throughout the absorbent core

* * * * *

68 75

United States Patent [19]
Alemany et al.

[11] **Patent Number** 4,834,735
[45] **Date of Patent** May 30, 1989

[34] **HIGH DENSITY ABSORBENT MEMBERS HAVING LOWER DENSITY AND LOWER BASIS WEIGHT ACQUISITION ZONES**
[75] **Inventors:** Miguel Alemany; Charles J. Berg, both of Cincinnati, Ohio
[73] **Assignee:** The Procter & Gamble Company, Cincinnati, Ohio
[21] **Appl. No.** 887,584
[22] **Filed.** Jul. 18, 1986
[51] **Int. Cl.** A61F 13/16
[52] **U.S. Cl.** 604/368; 428/213, 428/218; 428/283; 428/284; 428/913
[58] **Field of Search** 428/213, 284, 213, 218, 428/913 604/368

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Primary Examiner—James J. Bell
Attorney, Agent, or Firm—Steven W. Miller; John M. Pollaro; Fredrick H. Braun

[57] **ABSTRACT**

An absorbent article wherein the deposition region of its absorbent member comprises a storage zone and an acquisition zone having a lower average density and a lower average basis weight per unit area than the storage zone. The acquisition zone is positioned toward the front of either the absorbent member or the absorbent article so that the acquisition zone may most effectively and efficiently rapidly acquire discharged liquids. The absorbent member also comprises a mixture of hydrophilic fibrous material and discrete particles of absorbent gelling material to enhance the absorbent capacity of the absorbent member.

78 Claims, 3 Drawing Sheets

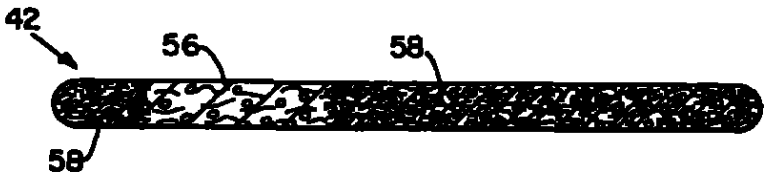


Fig. 1

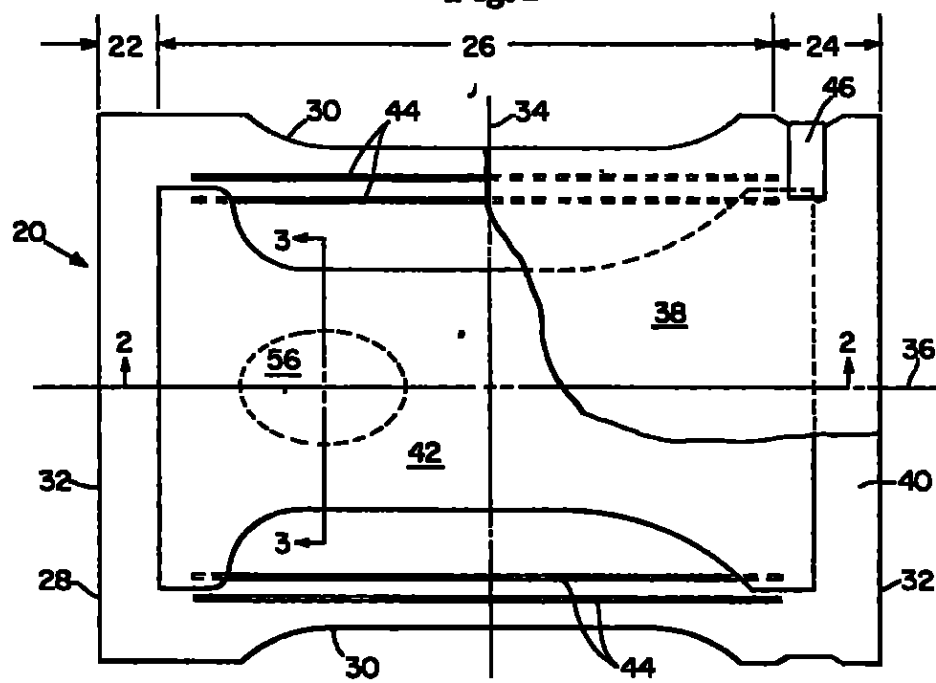


Fig.2

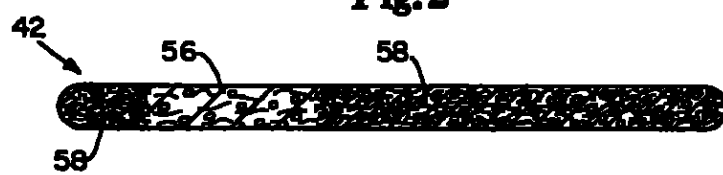
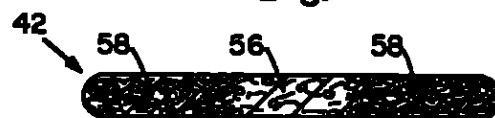


Fig.3



20 25

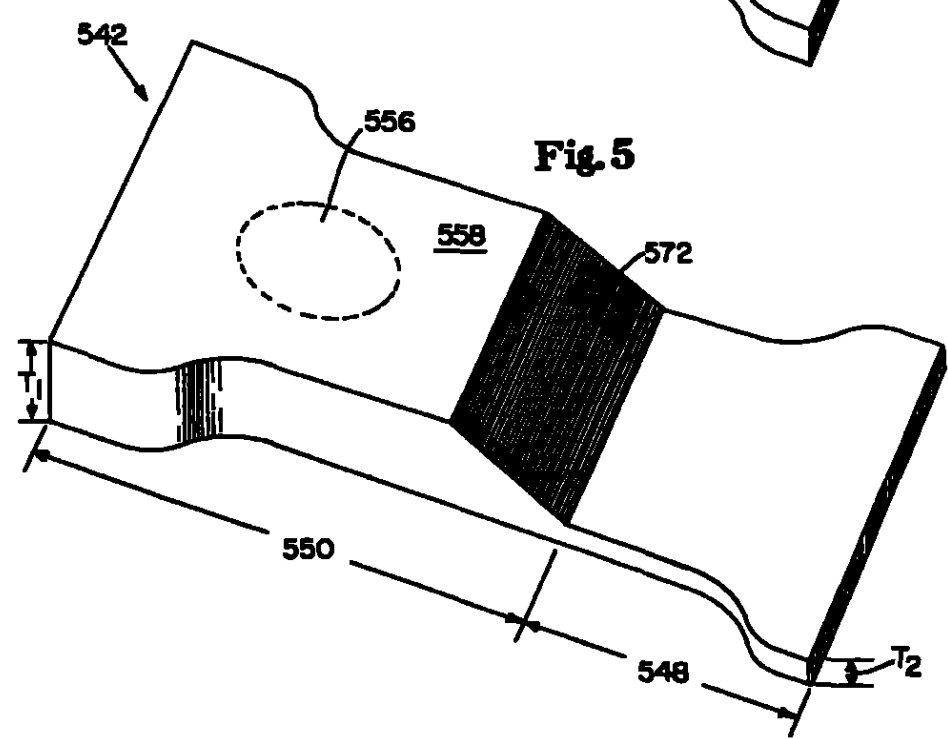
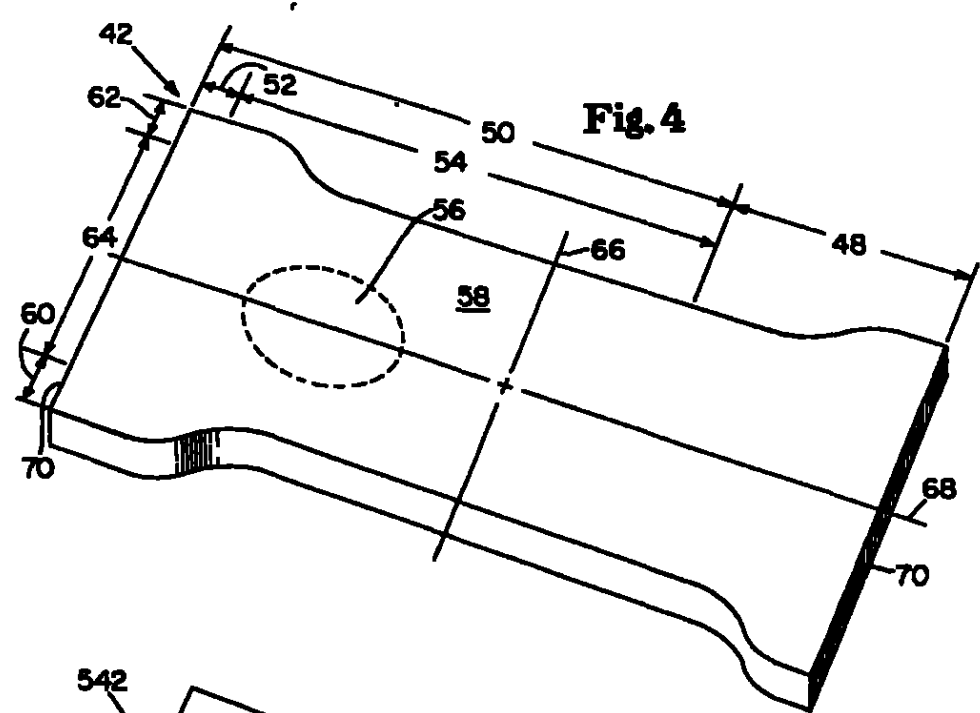


Fig. 6

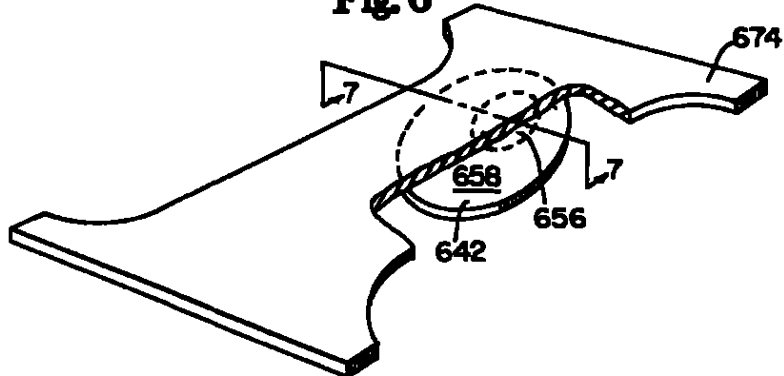


Fig. 7

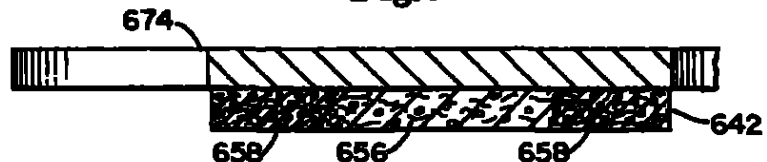
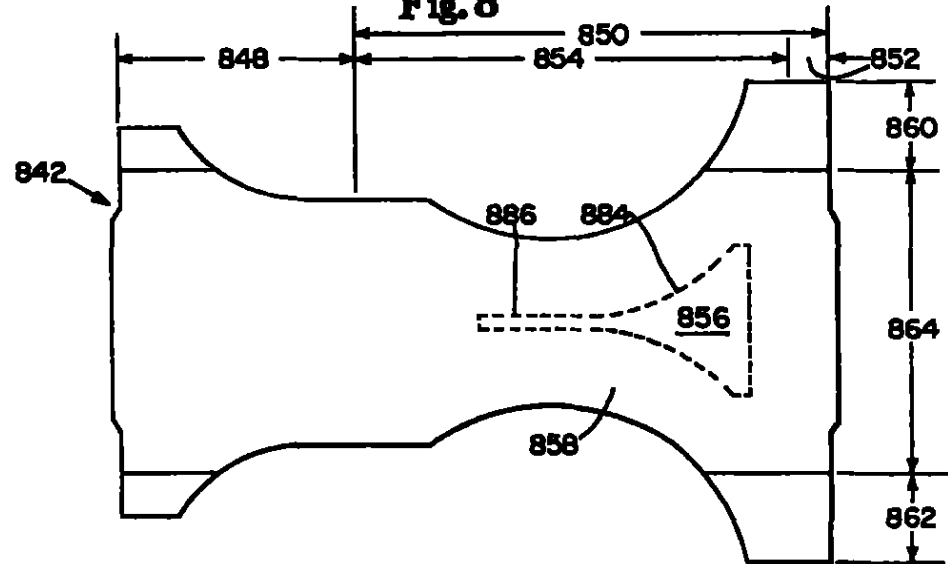


Fig. 8



HIGH DENSITY ABSORBENT MEMBERS HAVING LOWER DENSITY AND LOWER BASIS WEIGHT ACQUISITION ZONES

FIELD OF THE INVENTION

The invention relates to absorbent members having a mixture of hydrophilic fibrous material and discrete particles of an absorbent gelling material. More particularly the invention relates to a relatively high density absorbent member having a relatively lower average density and lower average basis weight acquisition zone positioned in the area of typical liquid deposition to more quickly acquire and distribute liquids within the absorbent member.

BACKGROUND OF THE INVENTION

Absorbent articles such as disposable diapers, adult incontinent pads, sanitary napkins and the like are generally provided with absorbent members to receive and retain body liquids. In order for such absorbent articles to function efficiently, the absorbent members must quickly acquire body liquids into the structure from the point of application and subsequently distribute the body liquids within and throughout the absorbent member to provide maximum leakage containment. In addition, the absorbent members should be capable of retaining liquids when placed under loads. Prior art attempts to improve the effectiveness of such absorbent members have included distributing particles of absorbent gelling material throughout or in portions of the absorbent member. For example, Procter & Gamble, European Patent Application EP-A-122,042, published Oct. 17, 1984 discloses absorbent members wherein particles of absorbent gelling material (hydrogel) are dispersed in an air-laid web of hydrophilic fibrous material and compressed to a particular density. In addition, United States patent application Ser. No. 734,426, filed May 15, 1985, by Paul T. Weisman, Dawn I. Houghton and Dale A. Gellert discloses a dual-layer absorbent core wherein an absorbent acquisition layer overlays a lower fluid storage layer that consists essentially of a uniform combination of hydrophilic fibrous material and discrete particles of absorbent gelling material.

Absorbent gelling materials are polymeric materials which are capable of absorbing large quantities of liquids relative to their weight such as water and body wastes, and which are further capable of retaining such absorbed liquids under moderate pressures. These absorption characteristics of absorbent gelling materials make them especially useful for incorporation into absorbent articles such as disposable diapers, adult incontinent pads, sanitary napkins and the like. However in spite of the extremely high absorption capacities of such absorbent gelling materials, their performance when used in disposable absorbent articles has still not been optimized.

The effectiveness of absorbent gelling materials in disposable absorbent articles is quite dependent upon the form, position, and/or manner in which the particles of absorbent gelling material are incorporated into the absorbent member. In some cases, for example, the effectiveness of absorbent members containing particles of absorbent gelling material can be adversely affected by a phenomenon called gel blocking. The term gel blocking describes a situation that occurs when a particle of absorbent gelling material is wetted, the surface of the particles swelling so as to inhibit liquid trans-

mission into the interior of the absorbent member. Wetting of the interior of the absorbent member, therefore, takes place via a very slow diffusion process. In practical terms, this means that acquisition of liquids by the absorbent member is much slower than the discharge of the liquid to be absorbed, and leakage from the absorbent article may take place well before the particles of absorbent gelling material in the absorbent member are fully saturated or before the liquid can diffuse or wick past the "blocking" particles into the rest of the absorbent member. The slow acquisition rate also fails to take advantage of the rapid wicking of liquids to other parts of the absorbent member provided by a densified absorbent member containing particles of absorbent gelling material.

Thus, it would be advantageous to provide an absorbent member that more quickly acquires and distributes liquids within itself while minimizing gel blocking during the liquid acquisition phase. It is therefore a primary objective of the present invention to provide absorbent members which are especially effective and efficient in their use of absorbent gelling materials.

SUMMARY OF THE INVENTION

The present invention provides an absorbent article such as disposable diapers, incontinent pads, sanitary napkins or the like that has an absorbent member that is suitable for acquiring and containing liquids in an especially effective and efficient manner. Such an absorbent article comprises a liquid pervious topsheet, a liquid impervious backsheet, and an absorbent member positioned between the topsheet and the backsheet.

The absorbent member has a deposition region which comprises a storage zone of a relatively high density and high basis weight to absorb and retain liquids acquired by the absorbent member and an acquisition zone of a relatively lower average density and lower average basis weight than the storage zone to quickly acquire and temporarily hold discharged liquids. The absorbent member also comprises a mixture of hydrophilic fibrous material and discrete particles of absorbent gelling material.

In accordance with one aspect of the present invention, the acquisition zone is positioned toward the front of the absorbent member so that the acquisition zone may be positioned in the area of typical liquid deposition. The acquisition zone is also sized so that the top surface area of the acquisition zone comprises less than about 50% of the top surface area of the front section of the absorbent member.

In accordance with another aspect of the present invention, the ratio of the average density of the storage zone to the average density of the acquisition zone is preferably about equal to or greater than 1.25:1 and most preferably about equal to or greater than 2:1. The acquisition zone preferably has a density of from about 0.05 to about 0.15 g/cm³; the acquisition zone also preferably having a uniform density and uniform basis weight throughout.

In a preferred embodiment of the present invention, a relatively high gel strength absorbent gelling material is mixed with hydrophilic fibrous material to not only minimize gel blocking but also to help maintain an open capillary structure within the absorbent member to enhance planar transport of liquids away from the area of typical liquid deposition to the rest of the absorbent member. The mixture of hydrophilic fibrous material

and discrete particles of absorbent gelling material preferably have a fiber-to-particulate weight ratio of from about 40:60 to about 98:2, more preferably about 50:50 to about 91:9.

The present invention also relates to dual-layer absorbent cores of the type having an absorbent acquisition core which consists essentially of hydrophobic fibrous material and an absorbent member which consists of a mixture of hydrophilic fibrous material and discrete particles of absorbent gelling material. The absorbent member has a top surface area which is from about 0.25 to about 1.0 times the top surface area of the absorbent acquisition core. The absorbent member is further positioned relative to the backsheet of the absorbent article in which its position is such that at least about 75% of the absorbent gelling material is found within the front two-thirds portion of the absorbent article. The acquisition zone of the absorbent member is also positioned relative to the backsheet such that it is completely positioned within the front two-thirds portion of the absorbent article.

DETAILED DESCRIPTION OF THE DRAWINGS

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

FIG. 1 is a plan view of a disposable diaper embodiment of the present invention wherein most of the topsheet has been cut-away to more clearly show the underlying absorbent member of the diaper;

FIG. 2 is a longitudinal sectional view of only the absorbent member of the disposable diaper taken along sectional line 2-2 of FIG. 1;

FIG. 3 is a transverse sectional view of only the absorbent member of the disposable diaper taken along sectional line 3-3 of FIG. 1;

FIG. 4 is a perspective view of the absorbent member of the disposable diaper shown in FIG. 1;

FIG. 5 is a perspective view of an alternative embodiment of the absorbent member of the present invention;

FIG. 6 is a perspective view of a dual-layer absorbent core having a further alternative embodiment of the absorbent member of the present invention;

FIG. 7 is a sectional view of the dual-layer absorbent core of FIG. 6 taken along sectional line 7-7 of FIG. 6; and

FIG. 8 is a plan view of a still further alternative embodiment of the absorbent member of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The absorbent members of the present invention will be described herein in relationship to their use in disposable absorbent articles; however, it should be understood that the potential application of the absorbent members of the present invention should not be limited to disposable absorbent articles. As used herein, the term "disposable absorbent article" refers to articles which absorb and contain body exudates and more specifically refers to articles which are placed against or in proximity to the body of the wearer to absorb and contain the various exudates discharged from the body and which are intended to be discarded after a single use

(i.e., they are not intended to be laundered or otherwise restored or reused). A preferred embodiment of a disposable absorbent article, diaper 20, is shown in FIG. 1. As used herein, the term "diaper" refers to a garment generally worn by infants and incontinent persons that is worn about the lower torso of the wearer. It should be understood, however, that the present invention is also applicable to other disposable absorbent articles such as incontinent briefs, sanitary napkins, and the like.

FIG. 1 is a plan view of the diaper 20 of the present invention in its flat-out, uncontracted state (i.e., with all elastic induced contraction removed) with portions of the structure being cut-away to more clearly show the construction of the diaper 20 and with the portion of the diaper 20 which contacts the wearer facing the viewer. The diaper 20 is shown in FIG. 1 to have a front waistband region 22, a back waistband region 24, a crotch region 26 and a periphery 28 which is defined by the outer edges of the diaper in which the longitudinal edges are designated 30 and the end edges are designated 32. The diaper additionally has a transverse centerline which is designated 34 and a longitudinal centerline which is designated 36.

The diaper 20 comprises a liquid pervious topsheet 38; a liquid impervious backsheet 40; an absorbent member 42; and elastic members 44. While the topsheet 38, the backsheet 40, the absorbent member 42, and the elastic members 44 may be assembled in a variety of well known configurations, a preferred diaper configuration is described generally in U.S. Pat. No. 3,860,003 entitled "Contractible Side Portions for Disposable Diaper", which issued to K. B. Buell on Jan. 14, 1973, and which patent is incorporated herein by reference.

FIG. 1 shows a preferred embodiment of the diaper 20 in which the topsheet 38 and the backsheet 40 are co-extensive and have length and width dimensions generally larger than those of the absorbent member 42. The topsheet 38 is associated with and superimposed on the backsheet 40 thereby forming the periphery 28 of the diaper 20. The periphery 28 defines the outer perimeter or the edges of the diaper 20. The periphery 28 comprises the end edges 32 and longitudinal edges 30.

The diaper 20 has front and back waistband regions 22 and 24 respectively, extending from the end edges 32 of the diaper periphery 28 toward the transverse centerline 34 of the diaper a distance from about 2% to about 10%, preferably about 5%, of the length of the diaper 20. The waistband regions comprise those upper portions of the diaper 20, which when worn, encircle the waist of the wearer. The crotch region 26 is that portion of the diaper 20 between the waistband regions 22 and 24, and comprises that portion of the diaper 20 which, when worn, is positioned between the legs of the wearer and covers the lower torso of the wearer. Thus, the crotch region 26 defines the area of typical liquid deposition for a diaper 20 or other disposable absorbent article.

The topsheet 38 is compliant, soft feeling, and non-irritating to the wearer's skin. Further, the topsheet 38 is liquid pervious permitting liquids to readily penetrate through its thickness. A suitable topsheet 38 may be manufactured from a wide range of materials, such as porous foams, reticulated foams, apertured plastic films, natural fibers (e.g., wood or cotton fibers), synthetic fibers (e.g., polyester or polypropylene fibers) or from a combination of natural and synthetic fibers. Preferably, the topsheet 38 is made of a hydrophobic material to

isolate the wearer's skin from liquids in the absorbent member 42.

A particularly preferred topsheet 38 comprises staple length polypropylene fibers having a denier of about 1.5, such as Hercules type 151 polypropylene marketed by Hercules, Inc. of Wilmington, Del. As used herein, the term "staple length fibers" refers to those fibers having a length of at least about 15.9 mm (0.62 inches).

There are a number of manufacturing techniques which may be used to manufacture the topsheet 38. For example, the topsheet 38 may be woven, non-woven, spunbonded, carded, or the like. A preferred topsheet is carded, and thermally bonded by means well known to those skilled in the fabrics art. Preferably, the topsheet 38 has a weight from about 18 to about 25 grams per square meter, a minimum dry tensile strength of at least about 400 grams per centimeter in the machine direction and a wet tensile strength of at least about 55 grams per centimeter in the cross machine direction.

The backsheet 40 is impervious to liquids and is preferably manufactured from a thin plastic film, although other flexible liquid impervious materials may also be used. The backsheet 40 prevents the exudates absorbed and contained in the absorbent member 42 from wetting articles which contact the diaper 20 such as bed sheets and undergarments. Preferably, the backsheet 40 is polyethylene film having a thickness of from about 0.012 mm (0.5 mil) to about 0.051 centimeters (2.0 mils), although other flexible, liquid impervious materials may be used. As used herein, the term "flexible" refers to materials which are compliant and which will readily conform to the general shape and contours of the wearer's body.

A suitable polyethylene film is manufactured by Monsanto Chemical Corporation and marketed in the trade as Film No. 8020. The backsheet 40 is preferably embossed and/or matte finished to provide a more clothlike appearance. Further, the backsheet 40 may permit vapors to escape from the absorbent member 42 while still preventing exudates from passing through the backsheet 40.

The size of the backsheet 40 is dictated by the size of the absorbent member 42 and the exact diaper design selected. In a preferred embodiment, the backsheet 40 has a modified hourglass-shape extending beyond the absorbent member 42 a minimum distance of at least about 1.3 centimeters to about 2.5 centimeters (about 0.5 to about 1.0 inch) around the entire diaper periphery 28.

The topsheet 38 and the backsheet 40 are associated together in any suitable manner. As used herein, the term "associated" encompasses configurations whereby the topsheet 38 is directly joined to the backsheet 40 by affixing the topsheet 38 directly to the backsheet 40, and configurations whereby the topsheet 38 is indirectly joined to the backsheet 40 by affixing the topsheet 38 to intermediate members which in turn are affixed to the backsheet 40. In a preferred embodiment, the topsheet 38 and the backsheet 40 are affixed directly to each other in the diaper periphery 28 by attachment means (not shown) such as an adhesive or any other attachment means as known in the art. For example, a uniform continuous layer of adhesive, a patterned layer of adhesive, or an array of separate lines or spots of adhesive may be used to affix the topsheet 38 to the backsheet 40.

Tape tab fasteners 46 are typically applied to the back waistband region 24 of the diaper 20 to provide a fastening means for holding the diaper on the wearer. Only one of the tape tab fasteners is shown in FIG. 1. The

tape tab fasteners 46 can be any of those well known in the art, such as the fastening tape disclosed in U.S. Pat. No. 3,848,594 issued to K. B. Buell on Nov. 19, 1974, which patent is incorporated herein by reference. These tape tab fasteners 46 or other diaper fastening means, such as pins, are typically applied near the corners of the diaper 20.

The elastic members 44 are disposed adjacent the periphery 28 of the diaper 20, preferably along each longitudinal edge 30 so that the elastic members 44 tend to draw and hold the diaper 20 against the legs of the wearer. Alternatively, the elastic members 44 may be disposed adjacent either or both of the end edges 32 of the diaper 20 to provide a waistband as well as or rather than leg cuffs. For example, a suitable waistband is disclosed in U.S. Pat. No. 4,515,595 issued to David J. Klevit and Thomas F. Osterhage on May 7, 1985, which patent is herein incorporated by reference. In addition, a method and apparatus suitable for manufacturing a disposable diaper having elastically contractible elastic members is described in U.S. Pat. No. 4,081,301 entitled "Method and Apparatus for Continuously Attaching Discrete, Stretched Elastic Strands to Predetermined Isolated Portions of Disposable Absorbent Products" which issued to K. B. Buell on Mar. 28, 1978 and which patent is incorporated herein by reference.

The elastic members 44 are secured to the diaper 20 in an elastically contractible condition so that in a normally unrestrained configuration, the elastic members 44 effectively contract or gather the diaper 20. The elastic members 44 can be secured in an elastically contractible condition in at least two ways. For example, the elastic members 44 may be stretched and secured while the diaper 20 is in an uncontracted condition. Alternatively, the diaper 20 may be contracted, for example, by pleating, and the elastic members 44 secured and connected to the diaper 20 while the elastic members 44 are in their unrelaxed or unstretched condition.

In the embodiment illustrated in FIG. 1, the elastic members 44 extend essentially the entire length of the diaper 20 in the crotch region 26. Alternatively the elastic members 44 may extend the entire length of the diaper 20, or any other length suitable to provide an elastically contractible line. The length of the elastic members 44 is dictated by the diaper's design.

The elastic members 44 may take a multitude of configurations. For example, the width of the elastic members 44 may be varied from about 0.25 millimeters (0.01 inches) to about 25 millimeters (1.0 inch) or more; the elastic members 44 may comprise a single strand of elastic material or may comprise several parallel or non-parallel strands of elastic material; or the elastic members 44 may be rectangular or curvilinear. Still further, the elastic members 44 may be affixed to the diaper in any of several ways which are known in the art. For example, the elastic members 44 may be ultrasonically bonded, heat and pressure sealed into the diaper 20 using a variety of bonding patterns or the elastic members 44 may simply be glued to the diaper 20.

The absorbent member 42 is positioned between the topsheet 38 and the backsheet 40 to form the diaper 20. The absorbent member 42 is generally compressible, conformable, non-irritating to the wearer's skin, and capable of absorbing and retaining liquids and certain body exudates. It should be understood that for purposes of this invention that an absorbent member is not necessarily limited to a single layer or sheet of material.

Thus, the absorbent member 42 may actually comprise laminates or combinations of several sheets or webs of the requisite types of materials as hereinafter described. Thus as used herein, the term "member" includes the term "members" or "layers" or "layered."

FIG 4 is a perspective view of a preferred embodiment of the absorbent member 42 of the present invention. The absorbent member 42 is shown in FIG 4 to comprise a back section 48 and a front section 50. The front section 50 is shown to have an end region 52 and a deposition region 54. The deposition region 54 comprises an acquisition zone 56 (shown by the dotted lines) and a storage zone 58. Further the front section 50 is transversely divided into three regions comprising two transversely spaced ear regions 60 and 62 respectively, and a central region 64. The absorbent member 42 additionally has a transverse centerline which is designated 66 and a longitudinal centerline which is designated 68.

The absorbent member 42 has a back section 48 and a front section 50 that is contiguous with the back section 48. The back section 48 and the front section 50 of the absorbent member 42 extend respectively from the end edges 70 of the absorbent member 42 toward the transverse centerline 66, the front portion 50 extending a distance from about one half to about three-fourths, preferably about two-thirds, of the length of the absorbent member 42. The front section 50 is preferably greater than one half of the total length of the absorbent member 42 so that it will encompass all of the area of typical liquid deposition of an absorbent member 42 when it is placed in a diaper or other absorbent article.

The front portion 50 has an end region 52 and a deposition region 54. The end region 52 comprises that portion of the front section 50 extending from the respective end edge 70 of the absorbent member 42 toward the transverse centerline 66 a distance from about 2% to about 10%, preferably about 5% of the length of the absorbent member 42. The deposition region 54 comprises that portion of the front portion 50 that is contiguous with and positioned between the end region 52 and the back section 48 and encompasses the area of typical liquid deposition of the absorbent member 42.

The front portion 50 further has two transversely spaced ear regions 60 and 62 respectively and a central region 64 disposed intermediate said ear regions 60 and 62. The ear regions 60 and 62 comprise those portions which generally extend from the longitudinal edges 30 of the periphery 28 toward the longitudinal centerline a distance from about one-tenth to about one-third of the width of the absorbent member 42. Thus, the ear regions 60 and 62 are those portions that engage the side marginal portions of the wearer's waist and torso, whereas the central region 64 engages the medial portion of the wearer's waist and torso. The central region thus defines the transverse area of typical liquid deposition.

The absorbent member 42 may be manufactured in a wide variety of sizes and shapes (e.g., rectangular, hourglass, asymmetrical, etc.) and from a wide variety of materials. The total absorbent capacity of the absorbent member 42 should, however, be compatible with the design liquid loading for the intended use of the absorbent article or diaper. Further, the size and absorbent capacity of the absorbent member 42 may be varied to accommodate wearers ranging from infants through adults. The absorbent member 42 preferably comprises a mixture of hydrophilic fibrous material and particular

amounts of discrete particles of absorbent gelling material.

Various types of hydrophilic fibrous material can be used in the absorbent member 42. Any type of hydrophilic fibrous material which is suitable for use in conventional absorbent products are suitable for use in the absorbent member 42 of the present invention. Specific examples of such hydrophilic fibrous material include cellulose fibers, rayon, and polyester fibers. Other examples of suitable hydrophilic fibrous materials include hydrophilized hydrophobic fibers, such as surfactant treated or silica-treated thermoplastic fibers. For reasons of availability and cost, cellulose fibers, in particular wood pulp fibers which are also referred to as airlaid, are preferred.

As used herein, the term "hydrophilic" describes fibers or the surfaces of fibers which are wetted by the liquids deposited onto the fibers. The state of the art respecting wetting of materials allows definition of hydrophilicity (and wetting) in terms of contact angles and the surface tension of the liquids and solids involved. This is discussed in detail in The American Chemical Society publication entitled *Contact Angle, Wettability, and Adhesion* edited by Robert F. Gould and copyrighted in 1964. A fiber or surface of a fiber is said to be wetted by a liquid either when the contact angle between the liquid and the fiber or surface is less than 90° or when the liquid will tend to spread spontaneously across the surface; both conditions normally coexist.

In addition to hydrophilic fibrous material, the absorbent member 42 also contains particular amounts of discrete particles of absorbent gelling material. Such absorbent gelling material may be inorganic or organic compounds capable of absorbing liquids and retaining them under moderate pressures.

Suitable absorbent gelling materials can be inorganic materials such as silica gels or organic compounds such as cross-linked polymers. Cross-linking may be by covalent, ionic, van der Waals, or hydrogen bonding. Examples of absorbent gelling material polymers include polyacrylamides, polyvinyl alcohol, ethylene maleic anhydride copolymers, polyvinyl ethers, hydroxypropyl cellulose, carboxymethyl cellulose, polyvinylmorpholine, polymers and copolymers of vinyl sulfonic acid, polyacrylates, polyacrylamides, polyvinyl pyridine and the like. Other suitable hydrogels are disclosed in Assarson et al., U.S. Pat. No. 3,901,236 issued Aug. 26, 1975, which patent is incorporated herein by reference. Particularly preferred polymers for use in the absorbent member are hydrolized, acrylonitrile grafted starch, acrylic acid grafted starch, polyacrylates and isobutylene maleic anhydride copolymers, or mixtures thereof.

Processes for preparing hydrogels are disclosed in Masuda et al., U.S. Pat. No. 4,076,663, issued Feb. 28, 1978; Tsubakimoto et al. U.S. Pat. No. 4,286,082, issued Aug. 25, 1981 and further in U.S. Pat. Nos. 3,734,876, 3,661,815, 3,670,731, 3,664,343, 3,783,871 and Belgium Pat. No. 785,850, which patents are all incorporated herein by reference.

Absorbent gelling material used in the absorbent member 42 is in the form of discrete "particles." Particles of absorbent gelling material can be of any desired shape, e.g., spiral or semi-spiral, cubic, rod-like, polyhedral, etc. Shapes having a large greatest dimension/smallest dimension ratio, like needles, flakes, and fibers, are also contemplated for use herein. Conglomerates of

particles of absorbent gelling material may also be used in the absorbent member 42.

Although the absorbent gelling material-containing absorbent member is expected to perform well with particles having a size varying over a wide range, other considerations may preclude the use of very small or very large particles. For reasons of industrial hygiene, average particle sizes smaller than about 30 microns are less desirable. Particles having a smallest dimension larger than about 2 millimeters may also cause a feeling of grittiness in the absorbent member, which is undesirable from a consumer aesthetics standpoint. Furthermore, the rate of fluid absorption is affected by particle size. Larger particles have very much reduced rates of absorption. Preferred for use herein are particles having an average size of from about 50 microns to about 1 millimeter. "Particle size" as used herein means the weighted average of the smallest dimension of the individual particles.

Although most absorbent gelling materials will perform well in the absorbent member 42 of the present invention, absorbent gelling materials having high gel strength are particularly useful. Gel strength must be such that the particles of absorbent gelling material do not deform and fill to an unacceptable degree the capillary void space in the absorbent member 42, thereby inhibiting both absorbent capacity of the structure and fluid distribution throughout the structure.

Gel strength refers to the tendency of the particles of absorbent gelling material to deform or spread under stress once the particles absorb liquids. For a given type of absorbent gelling material, gel strength will generally decrease as the gel volume increases. It has been found that it is desirable to utilize an absorbent member 42 whose polymer materials have as high a gel strength as possible consistent with the realization of absorbent gelling materials of acceptably high gel volume.

It has been found that gel strength, i.e. gel deformation tendency, (in the context of absorbent gelling materials incorporated into absorbent members and absorbent articles) correlates directly with the shear modulus of the absorbent gelling material. Accordingly, polymer materials of absorbent gelling material having sufficient gel strength can be appropriately characterized by specifying gel strength in terms of the shear modulus of the particles of absorbent gelling material.

Shear modulus can be conventionally measured, for example, by a procedure which involves the use of a stress rheometer to determine the ratio of (a) stress applied to a given sample versus (b) the resulting strain exhibited by the sample. The absorbent gelling material sample tested in this manner is swollen to its gel volume with synthetic urine. Using a procedure described in greater detail hereinafter the stress/strain ratio is determined. The shear modulus of the resulting sample in dynes/cm² is then subsequently calculated from this ratio. Absorbent gelling materials which have been found to be particularly useful in the present invention exhibit a shear modulus of at least about 2,000 dynes/cm². More preferably, the absorbent gelling materials have a shear modulus within the range of about 2500 to about 92,000 dynes/cm² and most preferably of from about 5,000 to about 35,000 dynes/cm².

Without wishing to be bound by any particular theory, it is believed that absorbent gelling materials having high gel strength as reflected in their shear modulus values will resist deformation upon fluid absorption and will have a reduced tendency to flow into the void

spaces between fibers. Thus, high gel strength absorbent gelling materials may actually serve to maintain separation of the individual fibers of the hydrophilic fibrous material. Such fiber separation improves both the wicking and the absorbent capacity of such absorbent members. Low gel strength materials, on the other hand, merely flow into the void spaces between the fibers upon fluid absorption and can thereby actually reduce the acquisition rate and the absorbent capacity of the absorbent members and absorbent articles into which they are incorporated.

Gel strength of absorbent gelling materials is quantified by means of determining the shear modulus of a sample of the swollen particles. Shear modulus is determined using a stress rheometer which comprises a circular lower plate onto which the swollen particle sample is placed. A truncated conical upper element having the same projected surface area as the area of the lower circular plate is positioned above the circular lower plate. This upper element is lowered into the mass of swollen particle material on the circular lower plate and is positioned at the proper gap relative to the circular lower plate. This gap corresponds to the point at which an untruncated cone would contact the lower plate.

An oscillating torque (stress) is applied torsionally to the conical element, and the resulting angular displacement of the cone is determined as a function of the applied torque.

The sample being tested is swollen to its gel volume in synthetic urine. Synthetic Urine is typically 15.0 parts of 1% Triton X 100, 60.0 parts of NaCl, 1.8 parts of CaCl₂ · 2H₂O, and 3.6 parts of MgCl₂ · 6H₂O, diluted to 6000 parts with distilled H₂O. The resulting solution has an absorbance of about 0.25 at its absorbance maximum of 617 nm.

Excess free synthetic urine is removed from the sample by blotting, and approximately 1.5 cc of the swollen material is placed in the gap between the lower circular plate and the upper conical element of the rheometer. This mass is usually formed from an agglomeration of swollen particles which have unswollen particle dimensions less than 710 microns. Spherical particles should be ground to form irregular shaped particles before testing.

Stress and strain measurements are taken under the following conditions:

Parameter	Value
Type of Rheometer	Sungene Visco-elasto Analyzer
Configuration	Oscillating Cone and Plate
Plate Radius	2.5 cm
Cone Radius	2.5 cm
(Edge to vertex)	
Cone Angle ^a	43.6 milliradians
Oscillation Frequency	1.0 Hertz
Strain Amplitude	1.5%
Sample Temperature	21.4 C.

^a Angle between surface of the lower plate and the surface of the cone i.e. (R/r) and-vertex angle.

Under these conditions, an oscillatory torque (stress) is applied via the upper conical element to the swollen particles. This results in an oscillatory response (strain) of the sample which is reflected by the magnitude of the angle through which the conical element rotates in response to the applied torque. The shear modulus of the particles is calculated from the ratio of (I) the applied stress to (II) the amplitude of the in-phase component of the resultant strain.

For the particular cone/plate geometry employed in this testing, the ratio of stress (g-cm) to strain (milliradians) is converted to shear modulus (dynes/cm²) using the following formula.

Shear modulus =

$$\frac{1 \times 981 \times \cos \text{Angle} \times \cos \text{Phase Angle} \times \text{Torque}}{2 \times \pi \times \text{Plate Radius}^2 \times \text{Strain}}$$

wherein the cone angle and strain are expressed in units of milliradians, the plate radius in units of cm and torque in units of g-cm. For absorbent gelling materials, the phase angle is close to zero and so the cosine of the phase angle is taken as unity. The factor 981 is that which converts g-cm to dyne-cm. Thus

$$\text{Shear Modulus (dynes/cm}^2\text{)} = 1308 \times \frac{\text{Torque (g-cm)}}{\text{Strain (milliradians)}}$$

for the particular equipment used in this test method.

The relative amount of hydrophilic fibrous material and particles of absorbent gelling material used in the absorbent member 42 of the present invention can be most conveniently expressed in terms of a weight percentage of the absorbent member 42. The absorbent member 42 preferably contains from about 2% to about 60% more preferably from about 10% to about 25% by weight, of the absorbent member 42 of absorbent gelling material. This concentration of absorbent gelling material can also be expressed in terms of a weight ratio of fiber to particulate. These ratios may range from about 40:60 to about 98:2. For most commercially available absorbent gelling materials, the optimum fiber-to-particulate weight ratio is in the range of from about 50:50 to about 91:9. Based on a cost/performance analysis, ratios of from about 75:25 to about 90:10 are most preferred for use in the absorbent member 42.

In addition, the particles of absorbent gelling material may be dispersed in various weight ratios throughout different regions and thicknesses of the absorbent member 42.

For example, the mixture of hydrophilic fibrous material and particles of absorbent gelling material may be disposed only in the deposition region 54 of the absorbent member 42 and not in the back section 48 or the end region 52. In addition, the acquisition zone 56 need not comprise the fiber/particulate mixture. While an acquisition zone 56 containing only hydrophilic fibrous material may work satisfactorily in rapidly acquiring liquids, such an embodiment is not preferred. When particles of an absorbent gelling material are maintained in the acquisition zone 56, especially high gel strength absorbent gelling materials, the particles help maintain an open capillary structure when the acquisition zone 56 is wetted so as to enhance planar transport of liquids away from the acquisition zone 56 to the rest of the absorbent member 42. Thus, the acquisition zone 56 preferably contains a uniformly distributed mixture of hydrophilic fibrous material and discrete particles of absorbent gelling material. It is most preferred that the particles are substantially uniformly dispersed throughout the entire absorbent member 42.

The deposition region 54 comprises an acquisition zone 56 and a storage zone 58 in liquid communication with at least a portion of the acquisition zone 56. The acquisition zone 56 comprises portions of the deposition region 54 designated by the dotted lines in FIG. 4. The storage zone 58 generally comprises the remainder of

the deposition region 54 and more preferably the remainder of the absorbent member 42.

It has been found that a relative capillarity difference between the acquisition zone 56 and the storage zone 58 is of importance in the overall efficiency and effectiveness of the absorbent member 42. While liquid capillarity can be defined in several ways (e.g. pore size, density, basis weight, etc.), the density and basis weight of the structure are the preferred parameters to define liquid capillarity in the absorbent member 42 of the present invention. Thus, the acquisition zone 56 must have both a relatively lower average density and lower average basis weight per unit area than the storage zone 48 to establish the preferred capillary force gradient between them. Thus, the ratio of the average density of the storage zone 58 to the average density of the acquisition zone 56 should preferably be about equal to or greater than about 1.25, more preferably about 1.5, and most preferably about 2.1.

Without wishing to be bound by theory, it is believed that the differential lower capillarity, the lower average density and lower average basis weight, of the acquisition zone 56 in comparison to the storage zone 58 is significant in achieving both a more optimized liquid acquisition rate into the absorbent member 42 and a relatively high liquid planar wicking rate throughout the absorbent member 42. When an absorbent member 42 having a mixture of hydrophilic fibrous material and particles of absorbent gelling material is densified to the densities approximating those of the storage zone 58, the liquid planar wicking rate becomes much faster. It is believed that densifying the absorbent member 42 results in better planar wicking of liquid throughout the absorbent member 42 (the x-y direction) because of the higher capillary force due to the smaller pore size of the densified fibers. Densifying the absorbent member 42 further results in a reduction in the bulk of the structure (which is desirable from a consumer standpoint for aesthetic reasons).

However, the densification of the absorbent member 42 also results in a reduction in the rate of liquid acquisition into the absorbent member 42 in the direction normal to planar wicking (i.e. the z-direction). It is believed that as higher concentrations of absorbent gelling material are located in the area of typical liquid deposition, a maximum gel blocking effect is achieved, thereby reducing the liquid acquisition rate. Thus, it is important to provide a means for delivering the liquid into the absorbent member 42 at a high rate. The acquisition zone 56 of lower average density and lower average basis weight per unit area than the densified absorbent member 42 or storage zone 58 provides such a means. The acquisition zone 56 has a smaller concentration of particles of absorbent gelling material in the area of typical liquid deposition, thereby reducing the incidence of gel blocking in this area during the liquid acquisition phase and thus improving the liquid acquisition rate.

The capillary force gradient created at the interface between the acquisition zone 56 and the storage area 58 also improves the containment characteristics of the absorbent member 42. Liquids deposited on the acquisition zone 56 tend to be acquired quickly into the structure by the action of the acquisition zone 56. Because the storage zone 58 has a higher capillarity than the acquisition zone 56, the acquired liquids tend to be drawn into the storage zone 58 and are then delivered to

the other portions of the storage zone 58 by the enhanced planar wicking rate achieved in the storage zone 58; the liquids being retained even under moderate pressure by the particles of absorbent gelling material in the storage zone 58. Thus, it has been found that an absorbent member 42 having an acquisition zone 56 having a lower average density and lower average basis weight per unit area than the storage zone 58 improves leakage containment by more quickly acquiring and distributing liquids into and throughout the absorbent member 42.

In addition, it is believed that the acquisition zone 56 provides an additional mechanism whereby an absorbent member 42 that has already been wetted may contain and more readily acquire further discharged liquids. A property of the particles of absorbent gelling material is that they expand when wetted. Thus when the absorbent member 42 is wetted, the particles of absorbent gelling material in both the acquisition zone 56 and the storage zone 58 expand. However, because there is a greater concentration of particles of absorbent gelling material in the higher average density and higher average basis weight storage zone 58, the storage zone 58 tends to expand to a greater thickness than the acquisition zone 56. Thus, if the acquisition zone 56 is laterally surrounded by the storage zone 58, a well or hole effect is created. This "well" is advantageous for second depositions of liquids because the liquids will tend to be drawn into the well because it is in effect a zero density acquisition area. This is especially helpful in the case of diapers for overnight use wherein the wearer sleeps on the stomach because gravity additionally tends to pull the later discharged liquids into the well whereupon they distribute into the acquisition zone 56 and are wicked into the storage zone 58. Thus, the acquisition zone 56 provides an additional advantage for wetted absorbent members.

The storage zone 58 is thus the relatively high capillarity (high density and high basis weight) portion of at least the deposition region 54. The primary functions of the storage zone 58 are to absorb discharged liquids that are either deposited directly onto the storage zone 58 or transferred to the storage zone 58 via the capillary force gradients established between the acquisition zone 56 and the storage zone 58, and to retain such liquids under the pressures encountered as a result of the wearer's movements. Preferably the storage zone 58 consists essentially of the structure disclosed in European Patent Application EP-A-122,042 or the lower fluid storage layer disclosed in United States patent application Ser. No. 734,426, both of which are incorporated herein by reference, although other high capillarity structures may also be used.

The storage zone 58 preferably has a relatively high density and a high basis weight in relation to the acquisition zone 56. The density and basis weight values of the storage zone 58 include the weight of the particles of absorbent gelling material, such that the density and basis weight values will vary depending upon the amount of particles dispersed throughout the absorbent member 42. Thus, the storage zone 58 will generally have a density of from about 0.06 to about 0.4 g/cm³, and more preferably within the range of from about 0.09 to about 0.20 g/cm³ for an absorbent member 42 containing about 15% by weight of particles of absorbent gelling material. The basis weight of such a storage zone 58 can range from about 0.02 to about 0.186 g/cm² preferably from about 0.038 to about 0.12 g/cm² For an absorbent member 42 containing about

50% by weight of particles of absorbent gelling material, the density will typically range from about 0.1 to about 0.68 g/cm³ with a basis weight from about 0.034 to about 0.31 g/cm². The density of the storage zone 58 is calculated from its basis weight and caliper measured on newly unpacked, unfolded and dissected diapers. The caliper is measured using a standard gauge with the sample under a "gentle" load of 10 g/cm². The basis weight is measured by die-cutting a certain size sample and weighing the sample on a standard scale, the weight and area of the sample determining the basis weight. (It should be noted that the density and basis weight values include the weight of the particles of absorbent gelling material.)

While the storage zone 58 may take on a number of sizes and shapes, it is preferred that the storage zone 58 comprises the portion of at least the deposition region 54 wherein there is no acquisition zone 56. (i.e. The entire deposition region 54 comprises a storage zone 58 except for the acquisition zone 56.) While the back section 48 and the end region 52 need not comprise storage zones, in the particularly preferred embodiments of the absorbent member 42 as shown in FIGS. 2, 3 and 4, the entire absorbent member 42 except for the acquisition zone 56 consists of one or more storage zones 58. In addition, while the storage zone 58 need not completely laterally surround the acquisition zone 56 (i.e. it is in liquid communication with at least a portion of the lateral area of the acquisition zone 56), in preferred embodiments of the present invention, the storage zone 58 laterally surrounds the acquisition zone 56 so as to take full advantage of the capillary differences between them.

The acquisition zone 56 has a relatively lower capillarity and thus preferably a lower average density and a lower average basis weight per unit area than the storage zone 58. The acquisition zone 56 serves to quickly collect and temporarily hold discharged liquids. Since such liquids are generally discharged in gushes, the acquisition zone 56 must be able to quickly acquire and transport liquid by wicking from the point of liquid contact to other parts of the absorbent member 42. The acquisition zone 56 preferably has a density of from about 0.03 to about 0.24 g/cm³ more preferably from about 0.05 to about 0.15 g/cm³ for an absorbent member 42 containing about 15% by weight of particles of absorbent gelling material. The basis weight of such an acquisition zone 56 will preferably range from about 0.015 to about 0.1 g/cm² and more preferably from about 0.018 to about 0.06 g/cm². For an absorbent member 42 containing about 50% by weight of particles of absorbent gelling material, the density will typically range from about 0.05 to about 0.41 g/cm³ with a basis weight of from about 0.025 to about 0.17 g/cm². The density of the acquisition zone 56 is calculated from its basis weight and caliper measured on newly unpacked, unfolded and dissected diapers. The caliper is measured using a standard gauge with the sample under a "gentle" load of 10 g/cm². The basis weight is measured by die-cutting a certain size sample and weighing the sample on a standard scale, the weight and area of the sample determining the basis weight. (The density and basis weight values include the weight of the particles of absorbent gelling material.)

While the acquisition zone 56 may conceivably have density and basis weight values equal to zero, i.e. a hole or void space, such an embodiment is not as preferred as an acquisition zone 56 having some minimal value of

density and basis weight. The transfer of liquids through the topsheet 38 has been found to be diminished in an absorbent member 42 having an acquisition zone 56 of zero density and basis weight due to the lack of intimate contact between any fibers of the acquisition zone 56 and the topsheet 38. Thus, liquid may tend to pool or collect on the topsheet 38 thereby creating a wet feeling for the wearer. Thus, it is preferred that the acquisition zone 56 have some minimum density and basis weight.

While the density and basis weight of the acquisition zone 56 may vary throughout its area and thickness, such an embodiment is also not preferred. The acquisition zone 56 preferably has a substantially uniform density and uniform basis weight throughout its area and thickness. This uniform density and basis weight provides a uniform capillary force gradient across the interface between the acquisition zone 56 and the storage zone 58 that provides even liquid transfer.

The shape, size and positioning of the acquisition zone 56 is of importance in determining the effectiveness of the resulting absorbent member 42 in rapidly acquiring discharged liquids. In accordance with the present invention, the acquisition zone 56 should be placed in a specific positional relationship with respect to the area of typical liquid deposition of the absorbent member 42. While portions of the acquisition zone 56 may be positioned in the back section 48 of the absorbent member 42, the acquisition zone 56 is preferably positioned generally in the front section 50 of the absorbent member 42 so that the acquisition zone 56 is positioned in the area of typical liquid deposition, i.e. the deposition region 54. Thus, the acquisition zone 56 is placed in the vicinity of the point of discharge of liquids so as to be capable of quickly acquiring such liquids at their contact zone.

The generally forward positioning of the acquisition zone 56 can be defined by specifying the percentage of the top surface area of the acquisition zone 56 which is found forward of particular points along the length of the absorbent member 42. While the positioning of the acquisition zone 56 can alternatively be defined with respect to the volume of the acquisition zone positioned forward of particular points, it has been found that the top surface area of the acquisition zone 56 is a more desirable definition because the top surface area actually defines the initial area available for liquid acquisition. In addition, since the thickness of the absorbent member 42 is preferably uniform in the deposition region 54 and the acquisition zone 56 has a generally rectangular cross-sectional area, the top surface area definition is equal to a volumetric definition in a preferred embodiment. Thus, the positioning of the acquisition zone 56 will be referenced throughout the specification as related to its top surface area. (i.e. The percentage of the top surface area of the acquisition zone positioned in a given area.)

Thus, in accordance with the present invention, at least a portion of the acquisition zone 56 must be placed in the deposition region 54, even though the remaining portion may be positioned anywhere in the absorbent member 42 including the back section 48 and the end regions 52. (It being understood that if plural acquisition zones are utilized, at least a portion of one of the acquisition zones must be positioned in the deposition region 54.) However, the acquisition zone 56 is preferably positioned relative to the absorbent member 42 such that the top surface area of the acquisition zone 56 is

completely positioned within the front section 50 of the absorbent member 42. More preferably the acquisition zone 56 is positioned relative to the absorbent member 42 such that the top surface area of the acquisition zone 56 is completely positioned within the deposition region 54 of the absorbent member 42. Even more preferably, at least 30% of the top surface area of the acquisition zone 56 is positioned in the front half of the front section (approximately the front $\frac{1}{2}$ of the overall absorbent member 42) of the absorbent member 42.

The forward positioning of the acquisition zone 56 may alternatively be defined by specifying the percentage of the top surface area of the acquisition zone 56 that is found forward of particular points along the length of the diaper 20 or other absorbent article. Thus, the acquisition zone 56 is preferably positioned on the absorbent member 42 relative to the backsheet 40 such that at least a portion of the top surface area of the acquisition zone 56 is in the crotch region 26 of the diaper 20. More preferably, the acquisition zone 56 is positioned such that its top surface area is completely positioned in the front two-thirds portion of the diaper 20, most preferably in the front half portion of the diaper 20; the top surface area also most preferably being completely positioned in the crotch region 26 of the diaper 20. (As noted herein, "portions" of the diaper 20 or other absorbent article can be defined by reference to the top surface area of the unfolded diaper 20 or absorbent article found in front of a given point on the line which defines the length of the diaper 20).

For purposes of determining the positioning of such acquisition zone 56, the length of the absorbent member 42 or diaper 20 will be taken as the normal longest longitudinal dimension of the elongated structure. This normal longest dimension can be defined with respect to the structure as it is applied to the wearer. When worn, the opposing ends of the backsheet are fastened together so that the ends form a circle around the wearer's waist. The normal length of the absorbent member 42 or diaper 20 will thus be the length of the line running through the absorbent member 42 or diaper 20 from the point on the edge of it at the middle of the wearer's back waist, through the crotch, to the point on the opposite edge of the absorbent member 42 or diaper 20 at the middle of the wearer's front waist.

The top surface area of the acquisition zone 56 may be found using either of two techniques. The primary and simplest way is to place the absorbent member 42 on a standard light box, such as the transilluminator model manufactured by Aristo grid Lamp Products, Inc. The acquisition zone 56, because it has a lower average density and lower average basis weight than the surrounding storage zone 58, will appear lighter or brighter due to the fact that more light will be transmitted through the acquisition zone 56. The acquisition zone 56 can then be mapped onto paper having grids to measure the top surface area of the acquisition zone 56.

The alternative method comprises mapping the density profile of the absorbent member 42 to determine the top surface area of the acquisition zone 56. The absorbent member 42 is cut into samples having small areas. The density and basis weight of each of the samples are then calculated using the techniques discussed above. Thus, the relatively lower density and lower basis weight samples are charted against the relatively higher density and higher basis weight samples to measure the top surface area of the acquisition zone 56.

The acquisition zone 56 can be of any desired shape consistent with the absorbency requirements of the absorbent member 42 or diaper 20 including, for example, circular, rectangular, triangular, trapezoidal, oblong, hourglass-shaped, funnel-shaped, dog-bone-shaped or oval. Preferred shapes of the acquisition zone 56 are those that increase the perimeter of the interface between the acquisition zone 56 and the storage zone 58 so that the relative capillarity difference between the zones is fully utilized. In a preferred embodiment, the acquisition zone will be oval shaped having a top surface area of about 45 cm² (about 7 in²).

In order to maintain a certain minimal absorbency level in the front section 50 of the absorbent member 42, the top surface area or volume of the storage zone 58 must comprise some minimal amount of the top surface area or volume of the front section 50. Thus, it has been found that the acquisition zone 56 should preferably comprise less than the entire top surface area and/or volume of the front section 50 of the absorbent member 42. (Since in a preferred embodiment the acquisition zone 56 is of generally uniform thickness and cross-sectional area, volume can be interchanged with top surface area as a definitional point.) The top surface area of the portion of the acquisition zone 56 positioned in the front section 50 of the absorbent member 42 preferably comprises less than about 50% of the top surface area of the front section 50. More preferably the top surface area of the acquisition zone 56 comprises less than about 35% of the top surface area of the front section 50 of the absorbent member 42, with less than about 20% being especially preferred. In addition, the top surface area of the acquisition zone 56 preferably comprises less than about 50% of the top surface area of the deposition region 54, more preferably less than about 35%, and most preferably less than about 20%.

The acquisition zone 56 may also have a number of different cross-sectional areas and configurations including those wherein the area of portions of the acquisition zone 56 is less or greater than its top surface area (i.e., the acquisition zone 56 is smaller or wider below the top surface of the absorbent member 42.) For example, the acquisition zone 56 may have conical, trapezoidal, T-shaped or rectangular cross-sectional areas. As shown in FIGS. 2 and 3, the acquisition zone 56 preferably has a rectangular cross-sectional area so as to provide a uniform acquisition zone 56.

In addition, the acquisition zone 56 need not comprise the entire thickness of the absorbent member 42, but may extend through only a fraction of its total thickness. The acquisition zone 56 may also have a different thickness than the surrounding storage zone 58. However, in a preferred embodiment as shown in FIGS. 2 and 3, the acquisition zone 56 preferably extends through the entire thickness of the absorbent member 42 and has a thickness equal to the thickness of the surrounding storage zone 58 in the deposition region 54.

While the acquisition zone 56 may be transversely positioned anywhere along the absorbent member 42, it has been found that the acquisition zone 56 functions the most efficiently when it is transversely centered within the front section 50 or the deposition region 54 of the absorbent member 42. Thus, the acquisition zone 56 is preferably centered about the longitudinal centerline 60 of the absorbent member 42. More preferably, the acquisition zone 56 is transversely positioned only in the central region 64 of the front section 50 or deposition region 54 of the absorbent member 42 such that none of

the acquisition zone 56 is located in the ear regions 60 and 62.

Such an absorbent member 42 is preferably made by extruding a thickness profiled absorbent member-preform and then calendering the absorbent member 42 in a fixed-gap calender roll to effect densifying the absorbent member 42. The thickness profiled absorbent member 42 initially has areas of higher basis weight which define the storage zone 58 and of lower basis weight which define the acquisition zone 56. The absorbent member 42 is then calendered preferably to at least a uniform thickness in the deposition region. Thus, a lower average density and a lower average basis weight per unit area acquisition zone 56 is created relative to the higher average density and higher average basis weight storage zone 58. Additionally, discrete particles of absorbent gelling material are added to an entrained stream of fibers prior to their deposition onto the preform to affect uniform distribution of absorbent gelling material throughout the preformed absorbent member 42. Thus, the resultant absorbent member 42 contains a uniform mixture of hydrophilic fibrous material and discrete particles of absorbent gelling material.

In use, the diaper 20 is applied to a wearer by positioning the back waistband region 24 under the wearer's back, and drawing the remainder of the diaper 20 between the wearer's legs so that the front waistband region 22 is positioned across the front of the wearer. The ends of the tape-tab fasteners 46 are then secured preferably to outwardly facing areas of the diaper 20. In use, disposable diapers or other absorbent articles having such absorbent members 42 having a relatively lower average density and lower average basis weight acquisition zone 56, tends to more quickly acquire liquids into the acquisition zone 56 and to distribute these liquids to the remaining portions of the absorbent member 42 and to remain dry or dryer due to the preferential capillarity between the storage zone and the acquisition zone 56 of the absorbent member 42. Thus, such an absorbent member 42 helps to alleviate leakage around the edges of such absorbent articles.

FIG. 5 shows an alternative embodiment of an absorbent member 542 of the present invention. As shown in FIG. 5, the front section 550 of the absorbent member 542 has a thickness, T1, greater than the thickness, T2, of the back section 548. The acquisition zone 56 is preferably of the same thickness, T1, as the storage zone 58 positioned in the front section 550 of the absorbent member 542; the front section 550 having a terraced character by virtue of the thickness difference between the front section 550 and the back section 548 and by virtue of the relatively steep slope formed by a density/basis weight transition zone which is designated 572. Preferably, T1 is at least about 1.5 times as great as T2 and preferably about 2.0 times as great as T2. In this preferred embodiment, about three-fourths of the absorbent material is disposed in the front section 550 of the absorbent member 542 thereby providing an absorbent member 542 wherein the front section 552 has high absorbent capacity as well as rapid acquisition characteristics.

FIGS. 6 and 7 show a further alternative embodiment of an absorbent member 642 of the present invention. An absorbent acquisition core 674 is positioned over the absorbent member 642 of the present invention to form a dual-layer absorbent core. An example of a similar dual-layer absorbent core is discussed in more detail in United States patent application Ser. No. 734,426 filed

by Paul T. Weisman, Dawn L. Houghton, and Dale A. Gellert on May 15, 1983, which is incorporated herein by reference.

The absorbent acquisition core 674 preferably consists essentially of hydrophilic fibrous material. This absorbent acquisition core 674 thus serves to quickly collect and temporarily hold discharged liquids and to transport such liquids by wicking from the point of initial contact to other parts of the absorbent acquisition core 674. Since the primary function of the absorbent acquisition core 674 is to receive liquids passing through the topsheet 38 and to transport such liquids to other areas of the absorbent acquisition core 674 and eventually onto the absorbent member 642, the absorbent acquisition core 674 can be substantially free of absorbent gelling material. Alternatively the absorbent acquisition core 674 can contain particular amounts of absorbent gelling material. Thus, the absorbent acquisition core 674, for example, can contain up to about 50%, or preferably up to about 25% or 40%, by its weight of particles of absorbent gelling material. In the most preferred embodiments, the absorbent acquisition core contains up to about 8% by its weight of particles of absorbent gelling material. In some instances, the presence of particles of absorbent gelling material in the absorbent acquisition core 674 can actually serve to maintain its density within the optimum range to promote fluid distribution. The specific type of absorbent gelling material optionally used in the absorbent acquisition core 674 does not have to be the same as the type essentially employed in the absorbent member 642.

The shape, size and character including capillarity of the absorbent acquisition core 674, is of some importance in determining the effectiveness of the resulting diaper 20 or other absorbent article. The absorbent acquisition core 674 in the unfolded configuration can be of any desired shape, for example, rectangular, oval, oblong, asymmetric or hourglass-shaped. The shape of the absorbent acquisition core 674 will frequently define the general shape of the resulting diaper 20. In preferred embodiments of the present invention as shown in FIG. 6, the absorbent acquisition core 674 will be hourglass-shaped and will be of a substantially uniform density within the range of from about 0.07 to about 0.20 g/cm³. Preferably the core will have a basis weight ranging from about 0.007 to about 0.075 g/cm².

The absorbent acquisition core 674 may alternatively comprise a core acquisition zone (not shown) having a lower average density and a lower average basis weight than the remainder of the absorbent acquisition core 674. This core acquisition zone may have the same shape, positioning and characteristics as the acquisition zone 636 of the absorbent member 642, or it may have different shapes, positioning and/or characteristics. Preferably, the core acquisition zone of the absorbent acquisition core 674 overlays at least a portion of the acquisition zone 636 of the absorbent member 642, and more preferably the entire acquisition zone 636 of the absorbent member 642, so as to provide an overall acquisition zone extending throughout the entire thickness of the dual-layer absorbent core system.

The absorbent member 642 of the present invention need not be as large as the absorbent acquisition core 674 and can, in fact, have a top surface area which is substantially smaller than the top surface area of the absorbent acquisition core 674. Generally the absorbent member 674 will have a top surface area from about 0.25 to about 1.0 times that of the absorbent acqui-

sition core 674. Most preferably the top surface area of the absorbent member 642 will be only from about 0.25 to about 0.75, and most preferably from about 0.3 to about 0.5, times that of the absorbent acquisition core 674.

The absorbent member 642 is preferably placed in a specific positional relationship with respect to the backsheet 40 and/or the absorbent acquisition core 674 in the diaper or other absorbent article. More particularly, the absorbent member 642 is positioned generally toward the front of the diaper so that absorbent gelling material is most effectively located to acquire and hold discharged liquids from the absorbent acquisition core 674.

The forward positioning of the absorbent member 642 can be defined by specifying the percent of total absorbent gelling material which is found forward of particular points along the length of the diaper or other absorbent article. Thus, in accordance with the present invention, the absorbent member 642 is positioned relative to the backsheet and/or the absorbent acquisition core such that (1) at least about 75% of the total absorbent gelling material in the absorbent member 642 is found within the front two-thirds portion of the diaper or other absorbent article, and (2) at least about 35% of the total absorbent gelling material in the absorbent member 642 is found within the front half portion of the diaper or other absorbent article. More preferably the absorbent member 642 is positioned relative to the backsheet 38 and/or the absorbent acquisition core 674 such that at least about 90% of the total absorbent gelling material in the absorbent member 642 is found in the front two-thirds portion and at least about 60% of the total absorbent gelling material is found in the front half portion of the diaper or other absorbent article. (As noted, for purposes of the present invention, "portions" of the diaper or other absorbent article can be defined by reference to the top surface area of the unfolded diaper 20 or absorbent article found in front of a given point on the line which defines the length of the diaper 20 or absorbent article).

In the usual instance when the absorbent acquisition core 674 generally defines the shape of the diaper or other absorbent article, the normal length of the backsheet 38 will be approached by the longest longitudinal dimension of the absorbent acquisition core 674. In such instances, the positioning of the absorbent member 642 can also be defined with respect to its location toward the front portion of the absorbent acquisition core 674. However, in some applications (e.g. adult incontinence articles) wherein bulk reduction or minimum cost are important, the absorbent acquisition core would not take on the general shape of the diaper or incontinence structure. Rather it would be generally located to cover only the genital region of the wearer and could in this case have approximately the same top surface area as the absorbent member 642. In this instance, both the absorbent acquisition core 674 and the co-extensive absorbent member 642 would be located toward the front of the article as defined by only the backsheet 38 such that the requisite percentages of absorbent gelling material would be found in the front two-thirds and front half sections respectively of the diaper or other absorbent article.

The absorbent member 642 of the dual layer absorbent core can be of any desired shape consistent with comfortable fit including, for example, circular, rectangular, trapezoidal, oblong, hourglass-shaped, dog-bone-

shaped or oval. If desired, the absorbent member 642 can be wrapped in a high wet strength envelope web such as tissue paper or a synthetic fine pore, e.g., non-woven material, to minimize the potential for particles of absorbent gelling material to migrate out of the absorbent member 642. Another objective of such overwrapping is to desirably increase the in-use integrity of the dual layer absorbent core. Such a web can, in fact, be glued to the absorbent member 642. Suitable means for carrying out this gluing operation include the glue spraying procedure described in U S Pat. No. 4,573,986 issued to Mmstola and Tucker, on Mar 4, 1986, which patent is incorporated herein by reference.

In preferred embodiments, the absorbent member 642 of the dual layer absorbent core will be oblong. In especially preferred embodiments, an oblong absorbent member 642 overwrapped with spray-glued tissue will be employed.

Because the absorbent member 642 of the dual-layer absorbent core is generally smaller than the absorbent acquisition core 674 such that the absorbent member 642 may entirely be placed in the area of typical liquid deposition, and because the absorbent member 642 is preferably positioned in a specific positional relationship with respect to the backsheet 38 and/or the absorbent acquisition core 674, the acquisition zone 636 may be positioned anywhere in the absorbent member 642. The acquisition zone 636 is not necessarily limited to a portion of the deposition region, since in effect the entire absorbent member 642 of the dual-layer absorbent core is in the "deposition region". The acquisition zone 636 is, however, preferably positioned in a specific positional relationship with respect to the backsheet 38 and/or the absorbent acquisition core 674 of the diaper or other absorbent article. More particularly the acquisition zone 636 should be positioned generally toward the front of the diaper at least partially in the crotch region 26 so that the acquisition zone 636 is most effectively located to quickly acquire and distribute liquids within the absorbent member 642. Thus, the positioning of the acquisition zone 636 in the diaper or other absorbent article can be defined by specifying the percentage of the top surface area (and/or volume) which is found forward of a particular point along the length of the diaper or other absorbent article. In accordance with the present invention, the acquisition zone 636 is preferably positioned relative to the backsheet 38 and/or the absorbent acquisition core 674 such that the top surface area of the acquisition zone 636 is completely positioned within the front two-thirds portion of the diaper or absorbent article. More preferably, the acquisition zone 636 is positioned relative to the backsheet 38 and/or the absorbent acquisition core 674 such that the top surface area of the acquisition zone 636 is completely positioned within the front half portion of the diaper or absorbent article and, most preferably, such that at least about 30% of the top surface area is located in the front one-third section of the diaper or absorbent article. The acquisition zone 636 is also most preferably completely positioned within the crotch region 26 of the diaper or absorbent article.

In order to maintain a certain minimal absorbency level in the front portions of the diaper or other absorbent article, it has been found that the top surface area of the acquisition zone 636 should comprise less than the entire top surface area of the absorbent member 642 of the dual-layer absorbent core. The top surface area (and/or volume) of the acquisition zone 636 preferably

comprises less than about 50% of the top surface area (and/or volume) of the absorbent member 642. More preferably the top surface area of the acquisition zone 636 comprises less than about 35% of the top surface area of the absorbent member 642 and most preferably less than about 20% of the top surface area of the absorbent member 642. All other aspects of the acquisition zone 636 may be similar to the acquisition zone 56 discussed with respect to the absorbent member 42.

FIG 8 shows a still further alternative embodiment of an absorbent member 842 of the present invention. The absorbent member 842 has an asymmetric shape (i.e., the absorbent member 842 is not symmetrical about its transverse centerline). In addition, the ear regions 860 and 862 and the ear regions of the back section 848 preferably have a different thickness than the central region 864. Further, the density and basis weight values of the ear regions 860 and 862 and the back section 848 are different from the storage zone 858 positioned in the central region 864 by virtue of the method by which the absorbent member 842 is formed.

The ear regions 860 and 862 and the back section 848 are preferably formed with a lesser basis weight than the storage zone 858 of the central region 864 so as to hold down the cost of such absorbent members 842 because less materials are being used. The absorbent member 842 is calendered to a uniform thickness in the central region 864 and the back section 848 except for its ear regions; the storage zone 858 of the central region 864, therefore, having a greater average density than the back section 848 except for its ear regions. (It should be understood that all or portions of the back section 848 may alternatively be calendered to a lesser thickness than the central region 864 such that the back section 848 has about an equal or a greater average density than the storage zone 858.) The ear regions 860 and 862 and the ear regions of the back section 848 are preferably calendered such that they have substantially less thickness than the central region 864 and a greater average density than the storage zone 858 of the central region 864. The thickness difference between the ear regions and the central region 864 is such that the absorbent member 842 may be easily folded to a thin configuration during packaging with the ear regions overlaying the respective central region 864 and the back section 848. The ear regions are also preferably more dense than the storage zone 858 to provide an additional capillarity difference so that liquids will tend to be pulled toward the ear regions so that the total absorbent capacity of the absorbent member 842 will be utilized.

The acquisition zone 856 of the absorbent member 842 has a funnel shape. The funnel shape is defined by a generally triangular portion 884 in combination with a stem or rectangular portion 886. The triangular portion 884 is especially effective in absorbing liquids discharged by a male wearer, while the stem portion 886 is effective for a female wearer. While it is possible that the shape of the acquisition zone 856 may vary according to the type of wearer contemplated, such as only a triangular portion 884 for a male wearer and only a stem portion 886 for a female wearer, it is preferred that the acquisition zone 856 comprise both elements.

Yet another alternative to each of the embodiments of the above absorbent members of the present invention comprises varying the pore size of the fibers without necessarily varying the density of the fibers to form an acquisition zone and a storage zone. For example, fine fiber dimensions of hardwood fluff can be utilized to

advantage by substituting at least about 30% and preferably about 80% to 100%, hardwood fluff fibers of approximately the same density as lower density softwood fluff fibers for the softwood fibers in the storage zone. This can be done because the hardwood fluff has a smaller pore size than the softwood fluff material. As result, a capillary difference will still be obtained within the scope of the invention, even if the density of each zone is the same. Thus, for example, an absorbent member can be obtained from using a predominately softwood pulp with a fine pore structure to define the acquisition zone and a predominately hardwood fluff pulp to define the storage zone.

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

What is claimed is:

1. An absorbent member having a back section and a front section contiguous with said back section, said front section having an end region and a deposition region contiguous with said end region and said back section so that said deposition region is positioned between said end region and said back section, the absorbent member comprising:

a mixture of hydrophilic fibrous material and discrete particles of absorbent gelling material,
a storage zone positioned in at least said deposition region of the absorbent member; and
an acquisition zone positioned in at least said deposition region of the absorbent member said acquisition zone having a density and basis weight per unit area greater than zero, said acquisition zone having a lower average density and a lower average basis weight per unit area than said storage zone, said storage zone at least partially laterally surrounding the perimeter of said acquisition zone so as to be in liquid communication with at least a portion of the lateral area of said acquisition zone.

2. The absorbent member of claim 1 wherein said acquisition zone extends from the top surface of the absorbent member through at least a fraction of the total thickness of the absorbent member the top surface area of said acquisition zone being completely positioned within said front section.

3. The absorbent member of claim 2 wherein the top surface area of said acquisition zone comprises less than about 50% of the top surface area of said front section.

4. The absorbent member of claim 1 wherein said acquisition zone extends from the top surface of the absorbent member through at least a fraction of the total thickness of the absorbent member, the top surface area of said acquisition zone being completely positioned within said deposition region.

5. The absorbent member of claim 4 wherein the top surface area of said acquisition zone comprises less than about 30% of the top surface area of said front section.

6. The absorbent member of claim 4 wherein the top surface area of said acquisition zone comprises less than about 35% of the top surface area of said front section.

7. The absorbent member of claim 4 wherein the top surface area of said acquisition zone comprises less than about 20% of the top surface area of said front section.

8. The absorbent member of claim 7 wherein said acquisition zone is positioned so that at least 30% of the top surface area of said acquisition zone is positioned in the front half of said front portion.

9. The absorbent member of claim 5 wherein said acquisition zone has a thickness approximately equal to the thickness of said storage zone.

10. The absorbent member of claim 9 wherein said back section has a thickness approximately equal to the thickness of said deposition region.

11. The absorbent member of claim 10 wherein said end region has a thickness approximately equal to the thickness of said deposition region.

12. The absorbent member of claim 11 wherein said acquisition zone extends through the entire thickness of the absorbent member.

13. The absorbent member of claim 12 wherein the top surface area of said acquisition zone is transversely centered within said deposition region.

14. The absorbent member of claim 13 wherein the top surface area of said acquisition zone has a generally triangular shape.

15. The absorbent member of claim 9 wherein said deposition region has a thickness greater than an about 1.5 times the thickness of said back section.

16. The absorbent member of claim 9 wherein said deposition region has a thickness greater than about 2.0 times the thickness of said back section.

17. The absorbent member of claim 16 wherein the top surface area of said acquisition zone is transversely centered within said deposition region.

18. The absorbent member of claim 17 wherein the top surface area of said acquisition zone has an oval shape.

19. The absorbent member of claim 9 wherein said front section further has two transversely spaced ear regions and a central region disposed intermediate said ear regions, said acquisition zone being positioned within said central region.

20. The absorbent member of claim 19 wherein said ear regions have a thickness substantially less than the thickness of said central region of said front portion.

21. The absorbent member of claim 20 wherein said ear regions and said central regions are demarked from each other by sufficiently abrupt thickness differences that said front section has a terraced character.

22. The absorbent member of claim 20 wherein said ear regions have a greater average density than said storage zone positioned within said central region.

23. The absorbent member of claim 13 wherein the top surface area of said acquisition zone has a funnel shape.

24. The absorbent member of claim 13 wherein the absorbent member has an asymmetrical shape.

25. The absorbent member of claim 24 wherein the average density of said back section is less than the average density of said storage zone of said deposition region.

26. The absorbent member of claim 25 wherein the top surface area of said acquisition zone has a generally triangular shape.

27. The absorbent member of claim 1 wherein the ratio of the average density of said storage zone to the average density of said acquisition zone is about equal to or greater than 1.25:1.

28. The absorbent member of claim 1 wherein the ratio of the average density of said storage zone to the

average density of said acquisition zone is about equal to or greater than 2.1

29. The absorbent member of claim 28 wherein the density of said acquisition zone is from about 0.05 to about 0.15 grams/cm³

30. The absorbent member of claim 29 wherein said acquisition zone has a substantially uniform density and uniform basis weight throughout.

31. The absorbent member of claim 1 wherein only said deposition region has discrete particles of absorbent gelling material dispersed therein.

32. The absorbent member of claim 1 wherein said mixture of hydrophilic fibrous material and discrete particles of absorbent gelling material has a fiber-to-particle weight ratio of from about 40:60 to about 98:2.

33. The absorbent member of claim 1 wherein said mixture of hydrophilic fibrous material and discrete particles of absorbent gelling material has a fiber-to-particle weight ratio of from about 50:50 to about 91:9.

34. The absorbent member of claim 33 wherein said particles of absorbent gelling material have a gel strength such that said particles have a shear modulus of at least about 2000 dynes/cm².

35. The absorbent member of claim 33 wherein said hydrophilic fibrous material and said discrete particles of absorbent gelling material are uniformly dispersed with respect to each other throughout the absorbent member.

36. An absorbent article comprising:

a liquid pervious topsheet;

a liquid impervious backsheet associated with said topsheet; and

an absorbent member according to claims 1, 2, 4, 9, 12, 16, 18, or 24 positioned between said topsheet and said backsheet.

37. An absorbent member having a back section and a front section contiguous with said back section, said front section having an end region and a deposition region contiguous with said end region and said back section so that said deposition region is positioned between said end region and said back section, the absorbent member comprising:

a mixture of hydrophilic fibrous material and discrete particles of absorbent gelling material;

a storage zone positioned in at least said deposition region of the absorbent member and

an acquisition zone positioned in at least said deposition region of the absorbent member said acquisition zone having a larger average pore size of the fibers than said storage zone, said storage zone at least partially laterally surrounding the perimeter of said acquisition zone so as to be in liquid communication with at least a portion of the lateral area of said acquisition zone.

38. An absorbent article having a front waistband region, a back waistband region, and a crotch region disposed between said front waistband region and said back waistband region, said absorbent article comprising:

a liquid pervious topsheet;

a liquid impervious backsheet associated with said topsheet; and

an absorbent member positioned between said topsheet and said backsheet, said absorbent member comprising a mixture of hydrophilic fibrous material and discrete particles of absorbent gelling material; a storage zone positioned in at least said crotch region of said absorbent article; and an ac-

quisition zone positioned in at least said crotch region of said absorbent article, said acquisition zone having a density of from about 0.05 g/cm³ to about 0.41 g/cm³, said acquisition zone having a lower average density and a lower average basis weight per unit area than said storage zone, said acquisition zone extending from the top surface of the absorbent member through at least a fraction of the total thickness of the absorbent member the top surface area of said acquisition zone comprising less than about 35% of the top surface area of said absorbent member said storage zone laterally surrounding the perimeter of said acquisition zone so as to be in liquid communication with the lateral area of said acquisition zone.

39. The absorbent article of claim 38 wherein said absorbent member has a uniform thickness and said acquisition zone extends through the entire thickness of said absorbent member.

40. The absorbent article of claim 39 additionally comprising an absorbent acquisition core positioned between said topsheet and said absorbent member.

41. The absorbent article of claim 40 wherein said absorbent member is generally oblong and has a top surface area that is from about 0.25 to about 1.0 times that of said absorbent acquisition core, said absorbent member being positioned relative to said backsheet and said absorbent acquisition core in a manner such that at least 75% of the absorbent gelling material in said absorbent member is found within the front two-thirds portion of the absorbent article.

42. The absorbent article of claims 38, 40, or 41 wherein said acquisition zone is positioned relative to said backsheet such that the top surface area of said acquisition zone is completely positioned within the front two-thirds section of the absorbent article.

43. The absorbent article of claim 41 wherein said acquisition zone is positioned relative to said backsheet such that the top surface area of said acquisition zone is completely positioned within the front one-half section of the absorbent article.

44. The absorbent article of claim 43 wherein the top surface area of said acquisition zone is completely positioned within said crotch region.

45. The absorbent article of claim 41 wherein said absorbent acquisition core has a core acquisition zone having a lower average density and a lower average basis weight than the remainder of said absorbent acquisition core.

46. The absorbent article of claim 45 wherein said core acquisition zone of said absorbent acquisition core overlays at least a portion of said acquisition zone of said absorbent member.

47. The absorbent article of claim 46 wherein said absorbent acquisition core contains particles of absorbent gelling material in an amount up to about 50% by weight of said absorbent acquisition core.

48. An absorbent core comprising:

an absorbent member comprising a mixture of hydrophilic fibrous material and discrete particles of absorbent gelling material, a storage zone, and an acquisition zone having a lower average density and a lower average basis weight per unit area than said storage zone, said acquisition zone having a density of from about 0.05 to about 0.41 g/cm³, said storage zone at least partially laterally surrounding the perimeter of said acquisition zone so as to be in liquid communication with at least a

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portion of the lateral area of said acquisition zone; and
an absorbent acquisition core positioned adjacent said absorbent member, said absorbent acquisition core comprising hydrophilic fibers that are substantially free of absorbent gelling material, said absorbent acquisition core having a core acquisition zone having a lower average density and a lower average basis weight per unit area than the remainder of said absorbent acquisition core, said core acquisition zone being positioned with respect to said acquisition zone of said absorbent member so as to provide an overall acquisition zone throughout the entire thickness of the absorbent core.

48. The absorbent core of claim 48 wherein said core acquisition zone has the same shape as said acquisition zone of said absorbent member.

49. The absorbent core of claims 48 or 49 wherein said absorbent member and said absorbent acquisition core are a continuous web of fibrous material.

50. The absorbent core of claim 50 wherein said overall acquisition zone is funnel-shaped.

51. The absorbent core of claim 50 wherein said overall acquisition zone has a generally triangular shape.

52. An absorbent member having a back section and a front section contiguous with said back section, said front section having an end region and a deposition region contiguous with said end region and said back section so that said deposition region is positioned between said end region and said back section, the absorbent member comprising:
a mixture of hydrophilic fibrous material and discrete particles of absorbent gelling material,
a storage zone positioned in at least said deposition region of the absorbent member and
an acquisition zone positioned in said deposition region of the absorbent member, said acquisition zone having a density of from about 0.03 to about 0.15 g/cm³, said acquisition zone having a lower average density and a lower average basis weight per unit area than said storage zone, said acquisition zone extending from the top surface of the absorbent member through the entire thickness of the absorbent member, the top surface area of said acquisition zone being completely positioned within said deposition region and comprising less than about 35% of the top surface area of said deposition region, said storage zone laterally surrounding the perimeter of said acquisition zone so as to be in liquid communication with the lateral area of said acquisition zone.

53. The absorbent member of claim 53 wherein the absorbent member has a uniform thickness.

54. The absorbent member of claim 54 wherein the absorbent member comprises a substantially uniform mixture of hydrophilic fibrous material and discrete particles of absorbent gelling material distributed throughout the absorbent member.

55. The absorbent member of claim 55 wherein said acquisition zone has a rectangular cross-sectional area.

56. The absorbent member of claim 56 wherein the ratio of the average density of said storage zone to the average density of said acquisition zone is about equal to or greater than 1.25-1.

57. The absorbent member of claim 57 wherein said mixture of hydrophilic fibrous material and said particles of absorbent gelling material are disposed in the

absorbent member in a fiber-to-particulate weight ratio of from about 40:60 to about 98:2.

58. The absorbent member of claim 58 wherein said back section has less average basis weight per unit area than said storage zone positioned in said deposition region.

59. The absorbent member of claim 59 wherein the top surface area of said acquisition zone has a generally triangular shape.

60. The absorbent member of claim 60 wherein the absorbent member has an asymmetric shape.

61. The absorbent member of claim 61 wherein the top surface area of said acquisition zone comprises less than about 20% of the top surface area of said deposition region.

62. The absorbent member of claim 62 wherein the ratio of the average density of said storage zone to the average density of said acquisition zone is about equal to or greater than 1.5-1.

63. The absorbent member of claim 63 wherein the top surface area of said acquisition zone has an hourglass shape.

64. The absorbent member of claim 64 wherein said acquisition zone comprises plural acquisition zones.

65. An absorbent article comprising:
a liquid pervious topsheet;
a liquid impervious backsheet associated with said topsheet; and
an absorbent member according to claims 53, 54, 55, 57, 58, 60, 61, 63, 64 or 65 positioned between said topsheet and said backsheet.

66. An absorbent member having a back section and a front section contiguous with said back section, said front section having an end region and a deposition region contiguous with said end region and said back section so that said deposition region is positioned between said end region and said back section, the absorbent member comprising:
a mixture of hydrophilic fibrous material and discrete particles of absorbent gelling material,
a storage zone positioned in at least said deposition region of the absorbent member and
an acquisition zone positioned in said deposition region of the absorbent member, said acquisition zone having a density of from about 0.03 to about 0.41 g/cm³, said acquisition zone having a lower average density and a lower average basis weight per unit area than said storage zone, said acquisition zone extending from the top surface of the absorbent member through a fraction of the total thickness of the absorbent member, the top surface area of said acquisition zone being completely positioned within said deposition region and comprising less than about 35% of the top surface area of said deposition region, said storage zone laterally surrounding the perimeter of said acquisition zone so as to be in liquid communication with the lateral area of said acquisition zone.

67. The absorbent member of claim 67 wherein said storage zone and said acquisition zone have the same thickness.

68. The absorbent member of claim 68 wherein the absorbent member has a uniform thickness.

69. The absorbent member of claim 69 wherein said back section does not comprise said storage zone.

70. The absorbent member of claim 70 wherein only said storage zone comprises said mixture of hydrophilic

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fibrous material and discrete particles of absorbent gelling material.

72. The absorbent member of claim 70 wherein only said storage zone and said acquisition zone comprise said mixture of hydrophilic fibrous material and discrete particles of absorbent gelling material.

73. The absorbent member of claim 72 wherein the top surface area of said acquisition zone has a generally triangular shape.

74. The absorbent member of claim 73 wherein the absorbent member has an asymmetric shape.

75. An absorbent article comprising:
a liquid pervious topsheet;
a liquid impervious backsheet associated with said topsheet; and
an absorbent member according to claims 67, 69, 72, 73 or 74 positioned between said topsheet and said backsheet.

76. A disposable diaper comprising:
a liquid pervious topsheet;
a liquid impervious backsheet associated with said topsheet;
an absorbent member according to claims 1, 48, 53 or 67 positioned between said topsheet and said backsheet; and
an elastic member disposed along each longitudinal edge of said disposable diaper.

77. An absorbent core comprising:
an absorbent member comprising a mixture of hydrophilic fibrous material and discrete particles of absorbent gelling material, and
an absorbent acquisition core positioned adjacent said absorbent member, said absorbent acquisition core comprising a mixture of hydrophilic fibrous material and up to about 8% by weight of said absorbent acquisition core of discrete particles of absorbent gelling material, a storage zone positioned in at least a portion of said absorbent acquisition core; and a core acquisition zone positioned in said absorbent acquisition core, said core acquisition zone having a density and basis weight per unit area greater than zero, said core acquisition zone having a lower average density and a lower average basis weight per unit area than said storage zone, said

core acquisition zone extending from the top surface of the absorbent member through the entire thickness of the absorbent acquisition core, the top surface area of said core acquisition zone comprising less than about 35% of the top surface area of said absorbent acquisition core, said storage zone laterally surrounding the perimeter of said core acquisition zone so as to be in liquid communication with the lateral area of said core acquisition zone.

78. An absorbent article having a front region, a back region, and a crotch region disposed between said front region and said back region, said absorbent article comprising

a liquid pervious topsheet;
a liquid impervious backsheet associated with said topsheet,
an absorbent member comprising a mixture of hydrophilic fibrous material and discrete particles of absorbent gelling material, and
an absorbent acquisition core positioned between said topsheet and said absorbent member, said absorbent acquisition core comprising a mixture of hydrophilic fibrous material and up to about 8% by weight of said absorbent acquisition core of discrete particles of absorbent gelling material, a storage zone positioned in at least said crotch region of said absorbent article; and a core acquisition zone positioned in said crotch region of said absorbent article, said core acquisition zone having a density and basis weight per unit area greater than zero, said core acquisition zone having a lower average density and a lower average basis weight per unit area than said storage zone, said core acquisition zone extending from the top surface of the absorbent member through the entire thickness of the absorbent member the top surface area of said core acquisition zone comprising less than about 35% of the top surface area of said absorbent member said storage zone laterally surrounding the perimeter of said core acquisition zone so as to be in liquid communication with the lateral area of said core acquisition zone.

* * * * *

United States Patent [19]

Holtzman

[11] 4,449,979
[45] May 22, 1984

[54] **ABSORBENT STRUCTURE HAVING
GRADIENT DENSITIES**

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[51] **Int. Cl.** --- --- --- --- A41B 13/02

[52] **U.S. Cl.** --- --- --- --- 604/379

[58] **Field of Search** --- --- 128/284, 287, 290 R,
604/358, 367, 374, 378, 379-380, 385

[56] **References Cited**

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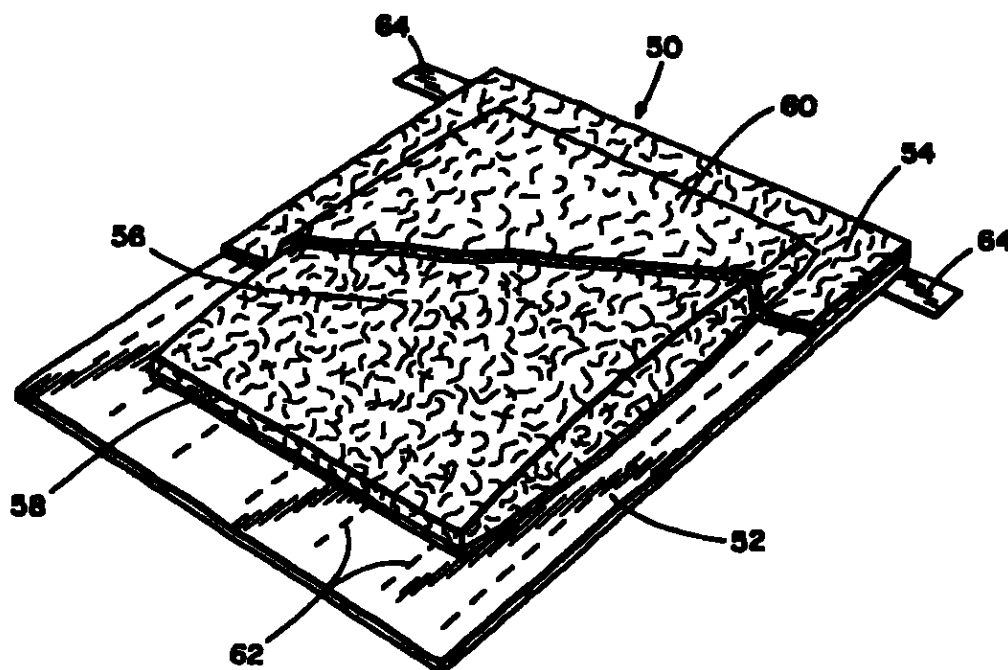
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Primary Examiner—C. Fred Rosenbaum
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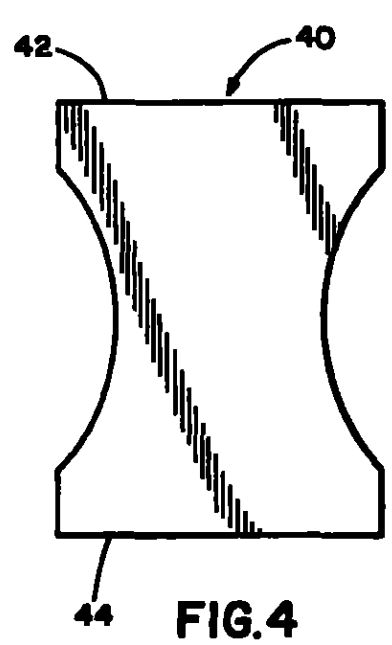
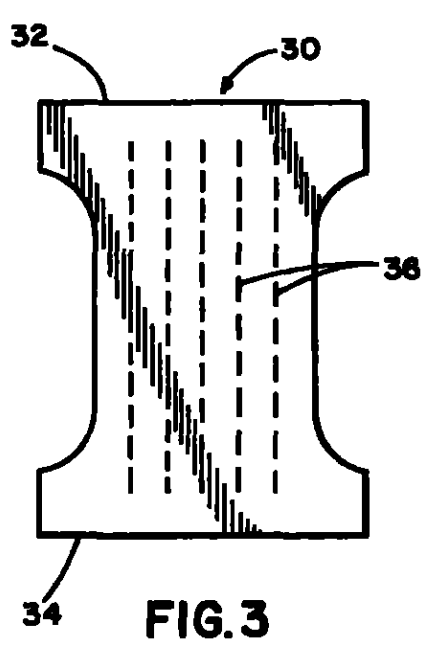
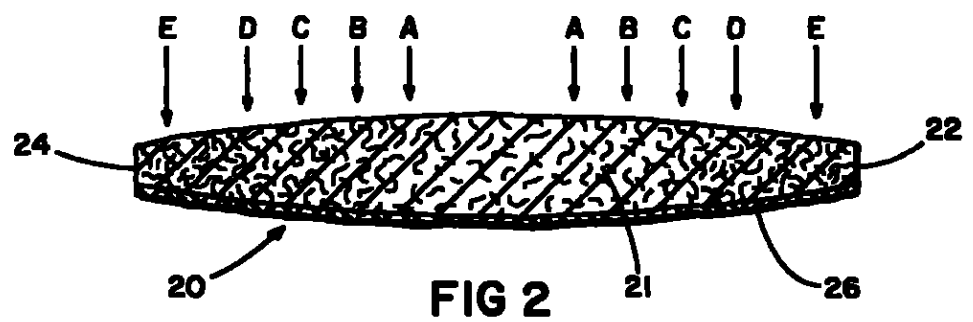
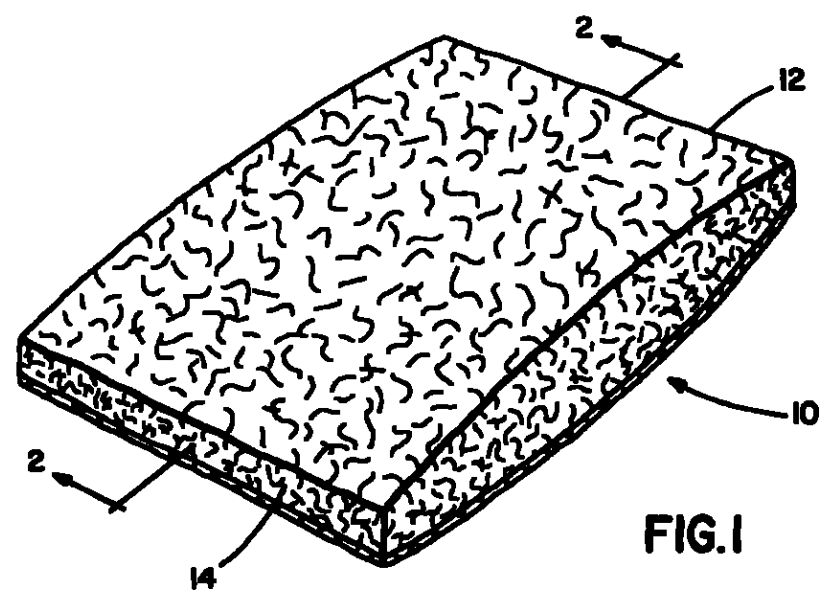
[57] **ABSTRACT**

An absorbent structure of loosely compacted cellulosic fibers substantially rectangular in shape having increasing gradient densities from the central portion to each transverse end and methods for making the structure.

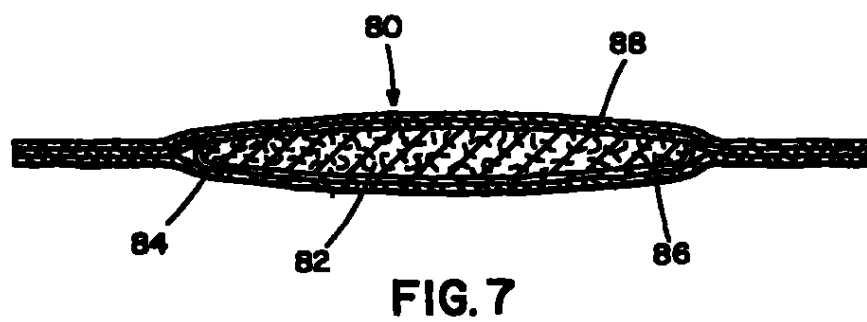
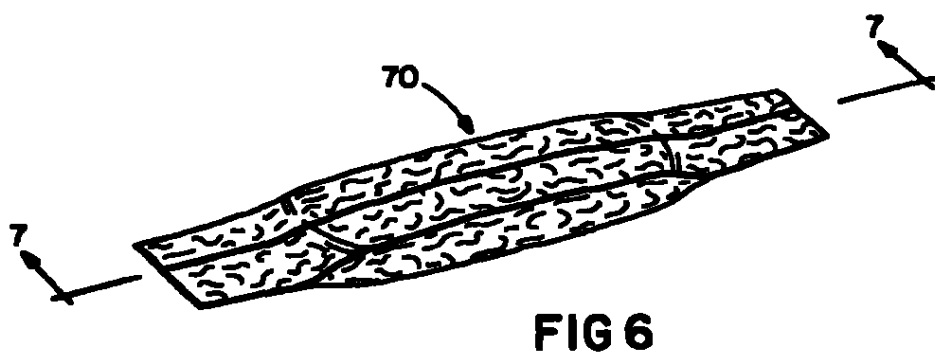
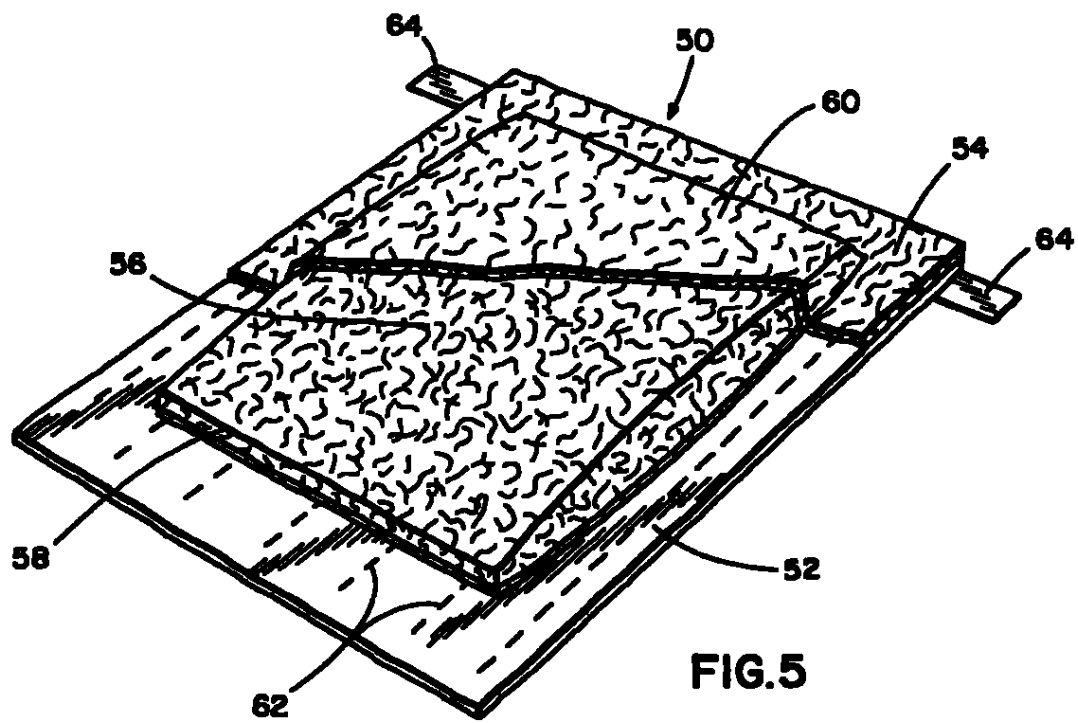
14 Claims, 7 Drawing Figures



88 13



89 24



ABSORBENT STRUCTURE HAVING GRADIENT DENSITIES

BACKGROUND OF THE INVENTION

The present invention relates to an absorbent structure containing loosely compacted cellulosic fibers, which structure is particularly suitable for use in absorbent products requiring a substantial liquid holding capacity.

Absorbent structures such as disposable diapers, sanitary napkins, incontinent pads and the like are generally structured so as to have a facing sheet which is moisture permeable, an absorbent batt which has a high liquid holding capacity and a backing sheet which is moisture impervious. For any absorbent structure to be satisfactory, it is highly desirable for the structure to (1) readily accept liquid (2) easily transport the liquid from one portion of the structure to another and (3) hold the liquid accepted. The facing sheet mentioned above must permit the liquid to penetrate the facing to reach the absorbent batt. The backing sheet keeps the liquid from leaking and therefore must be moisture impermeable. The present invention relates to an improvement in the absorbent batt used for these absorbent structures.

Conventionally, loosely compacted cellulosic fibrous batts are of substantially rectangular shape and are made by air laying wood pulp fibers, cotton linters or the like, on a foraminous support. The batt may be laid in a prescribed shape or may be shaped subsequent to the air laying of the fibers. These batts are incorporated by various techniques into products such as disposable diapers, sanitary napkins, incontinent pads and the like. Various techniques have been developed or suggested for improving the absorbent characteristics of the absorbent batts and to improve the liquid transporting characteristics, i.e., wicking characteristics. For instance, U.S. Pat. No. 3,017,304 to Burgani teaches forming a paper-like densified skin on one surface of the absorbent batt. The skin assists in transporting the liquid and lends integrity to the batt. In another instance, U.S. Pat. No. 3,938,522 to Repke suggests densifying portions of the batt to both assist in transporting of liquid and strengthening the absorbent batt. Previously, in each instance when a portion or portions of the absorbent batt have been densified, liquid holding capacity has been reduced and those densified portions are rigid and have a tendency to break when the batt is flexed. As mentioned above, for any absorbent structure to be satisfactory, it is not only necessary for the structure to hold liquid, but also to readily accept liquid and transport it. The liquid holding capacity of the absorbent structure relates to the pore size of the fibrous bed. If the pore size (i.e., the spaces surrounding the fibers) is large, then the structure will have a relatively high liquid holding capacity but generally does not accept and transport liquid readily. On the other hand, if the pore size is smaller, the structure readily accepts and wicks liquid but may have a lower liquid holding capacity.

SUMMARY OF THE PRESENT INVENTION

It has been discovered that a flexible absorbent batt can be made from loosely compacted, cellulosic fibers such as wood pulp fibers, which will readily accept and wick liquid while retaining a high liquid holding capacity.

The present invention provides an absorbent structure comprising an absorbent batt substantially rectangular in shape and having gradient densities whereby the density of the batt increases from the center to the transverse ends.

The new absorbent structure is made by air laying cellulosic fibers to form a batt and subjecting the batt to compression in a contoured press, or by calendaring at different pressures. The pressure increases from the central region to the transverse ends of the batt.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of an absorbent structure of the present invention,

FIG. 2 is a cross-sectional view of the absorbent structure of FIG. 1 taken along lines 2-2;

FIG. 3 is a top view illustrating a particular configuration of another embodiment of the present invention;

FIG. 4 is a top view illustrating still another particular configuration of an embodiment of the present invention,

FIG. 5 is a perspective view with certain portions broken away for clarity of illustration of one embodiment of a diaper of the present invention,

FIG. 6 is a perspective view of one embodiment of a sanitary napkin of the present invention;

FIG. 7 is a cross-sectional view of the sanitary napkin of FIG. 6 taken along lines 7-7.

DETAILED DESCRIPTION OF THE PRESENT INVENTION

The "wicking" of liquid is the transporting of liquid from one point to another in an absorbent structure. Wicking has heretofore been accomplished by densifying either one surface of an absorbent batt or by embossing lines in a prescribed pattern in a selected area to create a smaller capillary structure resulting in an increased capillary pressure. One method of densifying an area is disclosed in U.S. Pat. No. 3,017,304 wherein a "paper-like" skin is formed on one surface of an absorbent batt. Another method of densifying a selected area of fibers is found in U.S. Pat. No. 3,938,522 wherein densified regions are provided.

In these absorbent structures wherein a portion of the fibrous batt is densified to decrease the capillary radius between adjacent fibers resulting in an ability to wick more liquid in a given period of time, the densified area does not hold as much liquid, resulting in a reduction of the liquid holding capacity of the absorbent structure.

The present invention improves the wickability and integrity i.e., stability of the absorbent structure while retaining flexibility without a loss of liquid holding capacity.

The absorbent structure of the present invention is a fibrous batt formed of loosely compacted cellulosic fibers which are primarily held together by interfiber bonds requiring no added adhesive. In order for the absorbent structure to perform, the batt should be substantially wettable, should transport liquid from one area to another and should have a high liquid holding capacity. It has been discovered that by providing an absorbent batt of substantially rectangular shape, having longitudinal sides longer than the transverse ends, and having gradient densities whereby the density of the batt increases from the center to the transverse ends, the objectives are reached.

It has further been discovered that such an absorbent structure is provided by forming a loosely compacted

cellulosic batt having longitudinal sides longer than the transverse ends and compressing the batt in a contoured press or by calendaring at different pressures to provide gradient densities which increase from the center of the batt to the transverse ends.

Although the density of the absorbent batt increases along a longitudinal line from the central portion to each transverse end, the density in a cross direction is substantially constant on any given line.

It has been observed that the wicking of liquid from the central portion toward each transverse end is improved and even though the density in a cross direction is substantially constant on any given line, no side leakage is experienced. In other words, the structure of the present invention wicks longitudinally in preference to the cross direction, even though the structure is shorter from side to side.

In FIG. 1 an absorbent batt 10 is provided. The density of the batt 10 increases from the center of the batt toward each of the ends 12 and 14. For instance, in FIG. 2, a cross section of FIG. 1 at line 22, an absorbent batt 20 increases in density from the central portion to the transverse ends 22 and 24 in increments represented by the letters A, B, C, D, and E. The batt 20 consists of loosely compacted cellulosic fibers 21 and a paper-like densified skin 26. The skin 26 assists in providing stability to the batt and in wicking liquid from one portion of the batt 20 to another.

FIG. 3 illustrates one desirable shape of an absorbent batt 30 that is particularly suitable for use in a disposable diaper structure. The density of the fibrous structure increases from the central portion to each transverse end 32 and 34. Although cross direction wicking is not a problem, embossed lines 36 as provided may increase the speed of the wicking of liquid and additionally lend stability to the batt 30.

FIG. 4 illustrates another shaped batt 40 suitable for use in a disposable diaper structure. The density of the batt 40 is increased from the central region to the transverse ends 42 and 44.

FIG. 5 presents a typical disposable diaper structure 50 using the absorbent batt 56 of the present invention. A moisture-impermeable backing sheet 52 is laminated to a moisture-permeable facing 54 with the absorbent batt 56 held in place between the backing and the facing. The density of the batt 56 increases from the central region to each end 58 and 60. The batt 56 is held in place and the facing 54 and backing 52 laminated by glue lines 62. Tape tabs 64 are provided for securing the diaper about the waist of the infant.

FIG. 6 depicts a sanitary napkin 70 containing an absorbent batt of the present invention. FIG. 7 illustrates the sanitary napkin of FIG. 6 taken along the line 7-7. The sanitary napkin 80 contains an absorbent batt 82 wherein the density increases from the central portion toward the transverse ends 84 and 86. The napkin is covered with a covering 88.

The absorbent batts of the present invention are prepared by forming a substantially uniform batt of air laid loosely compacted cellulosic fibers. The fibers generally are wood pulp fibers which have been subjected to conventional chemical processing. Typically chemically processed wood pulp fibers appear in ribbon-like form and upon air laying become entangled to provide a degree of cohesiveness and fibrous web integrity.

Non-delignified wood pulp fibers are also suitable and may have an additive present to enhance the cohesiveness of the fibers to form a stable absorbent batt.

Preferably, whether the batt is made from chemically processed fibers or non-delignified wood pulp fibers, the batt is provided with an integral, continuous, paper-like, densified cellulosic fibrous layer increasing in density from the central region to each transverse end.

This layer is generally located on the planar surface away from the point of entry of liquid when the product is in use. U.S. Pat. No. 3,017,304, Burgenl, describes the paper-like skin and a process for preparing an absorbent batt having a densified fibrous layer.

The air laid, loosely compacted absorbent batt is subjected to different degrees of compaction so that the central portion of the batt receives little or no compaction whereas the transverse ends of the batt are compacted sufficiently to provide a density generally at least 1.5 times that of the central portion. Portions of the batt between the central portion and the transverse ends are increasingly higher in density from the central portion to the ends. It is not necessary that the progression of the density between the central portion and each end be uniform or symmetrical. However a continuing increase in density from the central portion to the ends is preferred.

The absorbent batts of the present invention are particularly useful in disposable products such as disposable diapers, sanitary napkins, incontinence pads and the like. Each of the disposable products usually contains a moisture-impermeable backing sheet, an absorbent batt in superposed position and a moisture permeable facing or cover in superposed position on the side of the batt opposite the backing sheet.

The disposable product when ideally constructed permits a void of liquid onto the facing to be rapidly drawn through the facing into the absorbent batt for storage. Leakage when the batt becomes substantially wetted is prevented by the backing sheet.

Because a void generally occurs in a relatively small area, it is necessary that the absorbent batts have the ability to transport or wick the liquid to more remote areas of the batt.

The absorbent batt is substantially more wettable than the facing and tends to draw liquid away from the facing. The individual fibers of the batt are extremely wettable, generally having liquid-fiber contact angles below about 15° and approaching zero in the optimum embodiment. The wickability of the body of the batt for liquid is limited by its low density which results in a large effective capillary radius for the capillaries between adjacent fibers.

The pressure causing a liquid to enter a cylindrical capillary is expressed by the equation

$$P = (2\gamma \cos \theta) / r$$

wherein

P is the capillary pressure

γ is the surface tension of the liquid

θ is the liquid-fiber contact angle, and

r is the capillary radius.

With a given liquid, the pressure (capillary force) increases with the cosine of the liquid-fiber contact angle (reaching a maximum where the angle is zero), and increases with narrower capillary radii so that narrower capillaries will draw liquid from wider ones.

As the density gradient increases from the central portion of the absorbent structure to the transverse ends, the capillary pressure increases.

It has been noted that as the density of a fibrous absorbent structure increases the wickability of liquid from one area to another increases, but the overall liquid holding capacity decreases.

In the absorbent structure of the present invention, the density gradient features provide improved wicking but also greater liquid holding capacity than the same structure without the density gradient feature.

The following examples illustrate specific embodiments of the present invention, and are not limiting in any way

EXAMPLE 1

Absorbent batts are formed by air laying wood pulp fibers from a hammermill onto a foraminous belt. The batts are shaped so as to resemble the shape illustrated in FIG 2. The batts weigh an average of 26 grams. Water, in the amount of 1.6 grams, is sprayed on the under-surface of the batt. The entire batt is subjected to compression in a contoured press or is calendared with increasing pressure from the central portion to the transverse ends. The pressure increases from the central region to the transverse ends of the batt.

A paper-like gradient densified skin is formed on the surface of the batt to which the water spray is applied. Portions of the batt are removed and tested for density. These portions are designated by the letters A-E in FIG 2. These densities are shown in Table 1 below. The distances indicated are measured from the center of the batt to the center of the portion removed.

Sample 1 is prepared as discussed above.

Sample 2 is prepared as before with the addition of 5 embossed lines as shown in FIG 3.

Sample 3 is prepared in the same manner as Sample 2 except that the paper-like skin is formed by substituting 12 g of latex emulsion for the water.

Sample 4 is prepared in the same manner as Sample 3 except that 0.6 g of the latex emulsion is used.

A control sample is prepared in the same manner as each of the samples above except the batt is not compressed in the contoured press, but is highly compressed by a flat press or conventional calendaring procedure.

TABLE 1

SAMPLE NO.	PORTION					CONTROL Average Density
	A 1"	B 2"	C 3"	D 4"	E 5"	
1	0.080	0.043	0.048	0.039	0.079	0.063
2	0.082	0.068	0.080	0.039	0.100	0.074
3	0.038	0.065	0.069	0.078	0.087	0.073
4	0.056	0.062	0.074	0.086	0.100	0.068

The data in Table 1 clearly show that the density in the samples made in accordance with the present invention increases with distance from the center of the batt.

EXAMPLE 2

The samples prepared in Example 1 are tested to determine the wicking properties and the liquid holding capacity

The wicking test is performed by separating the batt at the center cross section line into two equal halves. The batt section is then hung in a vertical position with Section E (FIG 2) at the top. A large Petri dish, containing 1.59% saline solution, is placed on an adjustable stand and is raised to contact the bottom surface of the

batt strip. The time necessary for the liquid to wick the distance shown is expressed in seconds.

The liquid holding capacity is expressed in grams of liquid per gram of batt measured after 8 minutes of wicking.

TABLE 2

SAMPLE NO.	WICKING IN SECONDS					LIQUID HOLDING CAPACITY g/g
	1"	2"	3"	4"	5"	
Control 1	3	9	19	36	90	5.8
Example 1	3	8	17	33	81	6.8
Control 2	3	7	16	28	106	4.6
Example 2	4	8	16	29	72	7.6
Control 3	3	9	19	32	104	5.8
Example 3	3	8	17	30	86	7.0
Control 4	3	9	20	38	99	6.1
Example 4	4	9	17	29	71	7.3

As can be seen from the data above, in each instance wherein the density gradient is present, the liquid wicks faster and the liquid holding capacity is greater.

It will be understood by those skilled in the art that variations and modifications of the specific embodiments described above may be employed without departing from the scope of the invention as defined in the appended claims.

I claim:

1. An absorbent structure comprising an absorbent batt of loosely compacted cellulose fibers substantially of rectangular shape wherein the longitudinal sides are longer than the transverse ends, said batt having gradient densities whereby the density of the batt increases along a longitudinal line starting from the central portion of the batt to each transverse end, the density in a cross direction being substantially constant on any given line.

2. The absorbent structure of claim 1 wherein the density near the transverse ends of the absorbent structure is at least 1.5 times the density in the central portion of the absorbent structure.

3. The absorbent structure of claim 1 wherein a paper-like gradient densified skin is formed on one surface of the absorbent batt.

4. The absorbent structure of claim 1 wherein densified lines extending from the central portion toward the transverse ends of the absorbent structure are provided.

5. The absorbent structure of claim 4 wherein a paper-like gradient densified skin is formed on one surface of the absorbent batt.

6. A disposable diaper comprising a moisture-permeable facing, an absorbent batt in superposed position to said facing, and a moisture-impermeable backing superimposed on the side opposite the absorbent batt from the facing, said absorbent batt being of loosely compacted cellulose fibers and having gradient densities whereby the density of the batt increases along a longitudinal line starting from the central portion of the batt to each transverse end, the density in a cross direction being substantially constant on any given line.

7. The disposable diaper of claim 6 wherein a paper-like gradient densified skin is formed on the surface of the batt in contact with the backing.

8. The disposable diaper of claim 6 wherein densified lines extend longitudinally from the central portion of the batt toward each transverse end.

9. A disposable diaper of claim 6 wherein a paper-like gradient densified skin is formed on the surface of the batt in contact with the backing and densified lines

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longitudinally extending from the central portion toward the transverse ends of the batt are provided.

10. A sanitary napkin comprising a moisture-impermeable backing, an absorbent batt superposed on said backing, and a moisture-permeable covering superposed on said batt on the side opposite the backing, said batt being of loosely compacted cellulosic fibers and having gradient densities whereby the density of the batt increases along a longitudinal line starting from the central portion of the batt longitudinally toward each transverse end, the density in a cross direction being substantially constant on any given line

11 The sanitary napkin of claim 10 wherein a paper-like gradient densified skin is formed on the surface of the batt in contact with the moisture-impermeable backing.

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12. The sanitary napkin of claim 10 wherein densified lines extending longitudinally from the central portion to each transverse end are provided on the absorbent batt.

13. The sanitary napkin of claim 10 wherein a paper-like gradient densified skin is formed on the surface of the batt in contact with the backing and densified lines longitudinally extending from the central portion toward each transverse end of the absorbent batt are provided.

14. A process for preparing an absorbent structure which comprises providing a loosely compacted cellulosic fibrous batt having longitudinal sides longer than the transverse ends and compressing the batt to provide gradient densities whereby the density of the batt increases from the central portion of the batt toward each transverse end

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