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Absorbent Structure With Reservoirs And A Channel

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Background of the Invention

10 Disposable absorbent structures such as disposable
diapers, sanitary napkins and incontinence pads have met
with increased commercial acceptance in recent years
primarily because of their convenience. Many different
15 constructions have been proposed and used and some have
met with widespread commercial success in spite of certain
inadequacies in functional properties.

One of the most serious prior art problems has been the
inability to provide a suitable construction that can
20 accept a large void of body fluids. This is particularly
true of the adult incontinent whether the incontinent be
active and working or ill and bedridden. Various attempts
have been made to provide special structures to absorb a
large body fluid void. These include U.S. Patent
25 3,441,024 to H. J. Ralph, U.S. Patent 3,747,602 to
H. J. Ralph, U.S. Patent 3,968,798 to K. C. Hokanson, and
U.S. Patent 4,067,366 to R. L. Johnson. While these
various constructions were designed to assist the adult
incontinent, the problem of providing an overall
30 disposable absorbent structure which will handle a full
volume discharge of urine without leakage still remains.

Particularly when the incontinent is an adult, disposable
structures generally have not accepted and held a full
35 volume discharge of urine without leakage onto clothing.

Although advances have been made in the sanitary napkin art to handle a full discharge of menstrual fluid (see U.S. Patent 4,184,498 to P. Franco), disposable structures which will handle a complete urine void by an adult are absent. The present invention provides an absorbent structure which accepts and holds a complete urine void by an adult and which may be used as an infant diaper, an adult incontinence device, a sanitary napkin, an incontinence pad, or the like.

Summary of the Invention

The present invention provides an absorbent structure to receive and contain body fluids comprising a loosely-compacted, cellulosic fibrous batt having a moisture-impermeable backing sheet on one side and a moisture-permeable fabric cover which covers at least the side of the absorbent batt opposite the backing sheet. The cellulosic fibrous batt is substantially rectangular in shape whereby the length of the batt is at least about 1.5 times the width of the batt, the latter not exceeding 12.7 cm (5 inches). One surface of the batt contains two reservoirs spaced apart with a connecting channel. The reservoirs and the length of the channel are substantially centered on the longitudinal axis of the batt. The reservoirs and the channel are formed by compression of the cellulosic fibers. Each reservoir has a capacity of at least about 10 cc. and the channel depth is at least half the depth of the reservoirs.

The two reservoirs and the channel act in concert to provide a three-dimensional product unlike the two dimensional products of the prior art. When the structure of the present invention is worn by the user the legs of the user apply pressure to the structure against each side, the structure selectively collapses at the channel more so

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than at the points of the reservoirs. This provides a boat shape by the back and front coming up (see Figure 1) and the reservoirs staying open and available. The selective collapsing of the channel keeps the strike zone on the longitudinal centerline. By keeping the reservoirs on the longitudinal centerline, maximum use is made of this reservoir's capacity.

The absorbent structure may be incorporated in a disposable diaper such as for an infant or in an adult diaper with a larger liquid holding capacity. Furthermore, the absorbent structure may be incorporated in a sanitary napkin as well as in an incontinence pad. In each instance the opening of the reservoir or the channel is close enough to the void zone to allow immediate acceptance by the structure of the body fluid discharge. Generally, each reservoir will hold at least 75 percent of the body fluid discharged in one second.

Therefore, the present invention also provides an adult incontinence structure substantially rectangular in shape comprising a moisture-impermeable backing sheet; an absorbent loosely-compacted cellulosic fibrous batt superimposed on said backing sheet, and a moisture-permeable facing cover, covering at least the side of said absorbent batt opposite said backing sheet; said absorbent batt being provided with at least 2 reservoirs spaced apart with a connecting channel; said reservoirs and the length of the channel being centered on the longitudinal axis of the batt; each reservoir having a capacity of at least 10 cc. the channel depth being at least one-half the depth of the reservoirs.

The present invention also provides a disposable diaper comprising a moisture-impermeable backing sheet; an absorbent loosely-compacted cellulosic fibrous batt superimposed on said backing sheet and a moisture-permeable facing superimposed on the side of the fibrous batt opposite said backing sheet; said absorbent batt being provided with at least two reservoirs spaced apart with a connecting channel; said reservoirs and the length of the channel being centered on the longitudinal axis of the batt; at least one of the reservoirs having a capacity of at least 10 cc., the channel depth being at least one-half the depth of the reservoirs.

5 The present invention further provides a sanitary napkin comprising a moisture-permeable outer layer containing an absorbent loosely-compacted cellulosic fibrous batt; said absorbent batt being provided with one surface of said batt containing at least two reservoirs spaced apart with a connecting channel; said reservoirs and the length of the channel being centered on the longitudinal axis of the batt; each reservoir having a capacity of at least 10 cc. the channel depth being at least one-half the depth of the reservoirs.

10 The reservoirs and channel are created by compression of the loosely-compacted, cellulosic fibers. The compaction may be carried out by application of pressure in the shape desired for the reservoirs and channel. This may be done by a stamping-type operation or by an embossing roll or the like.

15 Brief Description of the Drawings

Fig. 1 is a perspective view of one embodiment of the present invention;

Fig. 2 is a top view of the embodiment of Figure 1 with a portion broken away for clarity;

20 Fig. 3 is a cross-sectional view taken along line 3-3 of Figure 2;

Fig. 4 is a cross-sectional view taken along line 4-4 of Figure 2;

5 Figs. 5, 6, 7 and 8 are top views of different embodiments of the present invention.

Fig. 9 is a perspective view of a diaper incorporating the absorbent structure of the present invention; and

10 Fig. 10 is a perspective view of the diaper of Figure 9 as it appears when worn.

Detailed Description of the Invention

15 While this invention is susceptible of embodiment in many different forms, there is shown in the drawings, and herein will be described in detail, preferred embodiments of the invention and modifications thereof. It is understood that the present disclosure is to be considered as an
20 exemplification of the principles of the invention and is not intended to limit the invention to the embodiments illustrated. The scope of the invention will be pointed out in the appended claims.

25 Referring to the drawings and particularly to Figure 1, an absorbent structure 10 is provided with reservoirs 12 and 14 connected by a channel 16. The view in Figure 1 is a perspective view of the absorbent structure as it would appear while being worn. Preferably, the underside of the
30 structure has at least one adhesive strip whereby the structure can be fastened to the underwear of the wearer. The narrow portion of the pad is the back portion whereas the wider portion of the pad would be worn toward the front. The pad is satisfactory for use as a urinary pad
35 or as a menstrual fluid pad. When the absorbent structure is being worn the thighs of the wearer would press at

points 18 and 18' to cause the pad to form a boat-like shape where the sides of the pad are higher than the central portion. This assists in preventing leakage by any runover of fluid over the sides.

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Figure 2 is a top view of the pad of Figure 1 showing an absorbent structure 20 having a back reservoir 22 and a front reservoir 24 connected by a channel 26. A portion of the opening is broken away to show the absorbent batt 23. A permeable facing 25 covers the upper surface. The sides and lower surface are protected by a moisture barrier such as a polyethylene backing.

Figure 3 provides a cross-sectional view 30 of the absorbent structure of Figure 2 along lines 3-3. The absorbent structure has reservoirs 32 and 34 connected by channel 36. If the pad were to be used as a urinary pad, it could be expected that the flow of the urine into the pad would follow the direction of the arrows. The absorbent structure has an absorbent batt of loosely-compacted cellulosic fibers 33 and is provided with a moisture barrier 35 which comes up around the sides and covers a portion of the top over which is placed a liquid permeable facing 31 which may be in the form of a nonwoven such as polyester or other suitable fabric. The under surface is provided with an adhesive strip 38 to which is attached a release liner 37. Upon removal of the liner the adhesive is available for fastening to the clothing of the wearer.

Figure 4 is a cross-sectional view 40 of the absorbent structure of Figure 2 along lines 4-4. This figure particularly illustrates the relationship of the depth of the channel in relation to the reservoirs. As can be seen, the reservoir 44 is deeper than the channel 46. This is a preferred embodiment, although the channel can be as deep as the reservoirs. The cellulosic batt 43 surrounded most

of the way except for an opening on top by a moisture barrier 45. The facing 41 is used as an overwrap to wrap substantially all of the product. Release liner 47 is removed to provide the adhesive 48 for fastening to the clothing.

Figures 5, 6, 7 and 8 illustrate absorbent structures 50, 60, 70 and 80 respectively having different shapes for the reservoirs. These are merely illustrative and other shapes and size relationships may be used satisfactorily. In each case, the numeral ending in 2 and 4 denotes the reservoirs whereas the numeral ending in 6 depicts the channel.

The absorbent structure of the present invention may also be used in the form of a diaper. Such a diaper 90 is illustrated in Figure 9. The cellulosic batt 93 is provided with reservoirs 92 and 94 with the connecting channel 96. - Surrounding the cellulosic batt is a moisture-impermeable backing 97 and a moisture-permeable facing 95. The facing and backing are laminated in the margins and elastic is placed in the diaper for suitable fit. When the diaper is worn, tape tabs 91 secure the diaper about the wearer. In Figure 10, the diaper 100 is illustrated as it would appear on a wearer.

The loosely-compacted cellulosic fibrous batt used in the absorbent structure of the present invention is formed from wood pulp fibers, rayon fibers, cotton linters or mixtures thereof. The batt is primarily held together by interfiber bonds requiring no added adhesive. In some instances the batt may contain synthetic fusible fibers such as polyethylene, polypropylene and the like. The batt is a bulk density coherent web of loosely-compacted cellulosic fibers preferably comminuted wood pulp fibers in the form of so-called "fluff". When the reservoirs and

channels are created in the batt, a compressing or compaction process is used. The compression should be sufficient to create reservoirs of sufficient depth to hold at least 10 cc. The base of each of the reservoirs is a
5 densified fibrous region wherein the fibers are compacted. The densified region quickly absorbs the body fluid and commences distribution of the fluid to other parts of the cellulosic batt particularly along the connecting
10 channels. The channel is at least half the depth of the reservoirs. Although the base of the channel may not have as high a density as the base of a reservoir, there is at least some densifying of the fibers at the base of the channel. This densifying assists in transporting the
15 liquid from one reservoir to another and to other parts of the cellulosic fibrous batt. The location and spacing of the reservoirs may be customized to optimize conditions for a particular use. In the instance of urinary pads, it is desirable for the reservoirs to be placed at least two inches apart but preferably not more than about six inches
20 apart. It has been found that even in the use for a menstrual pad where the reservoirs may be relatively close together, that at least one-half inch between the reservoirs should be provided for the channel and preferably at least about an inch is suitable for the length of the
25 channel. In all instances, the reservoirs and the channel should lie substantially on the longitudinal axis of the absorbent structure.

Although the absorbent structure is substantially
30 rectangular, it can assume other shapes such as those illustrated in the drawings. One primary benefit afforded by the combination of the substantially rectangular shape of the reservoirs and the connecting channel is that when the structure is worn, the thighs, whether they be those
35 of an infant or an adult, place pressure on the sides and the sides come up in the central portion to provide a

boat-like configuration. Such a configuration is highly desirable to prevent leakage of body fluids at the side edges.

5 The absorbent structure is provided with a moisture
barrier backing on the side away from the one receiving
fluids. This barrier may come up around the sides and
cover most of the top surface. However, it is necessary
10 that both of the reservoirs and the channels be exposed to
the surface for reception of fluid. The top surface or
the entire surface may be overwrapped in a fluid permeable
material such as a nonwoven fabric. For example, the
fabric may be polyester, polyethylene, polypropylene,
nylon, rayon or the like. Preferably, the fabric used for
15 the cover is a lightweight fabric in the range of 0.3 to
5 ounces per square yard and with a density less than
0.2 grams per cc. The most suitable fabrics have unusual-
ly high elongation loft softness and drape characteris-
tics. Though the cover is moisture-permeable, it is
20 preferably of the type which after permeation of the
moisture prevents strike back of the body fluid when the
absorbent structure is approaching saturation.

The body of the cellulosic fibrous batt is substantially
25 more wettable than the cover and tends to draw liquid away
from the facing layer. Thus the void occurs and the cover
is permeated and the liquid deposited in at least one
reservoir. The individual fibers of the batt are extreme-
ly wettable and thus draw the liquid into the batt and
30 along the channel to the other reservoir. The base of the
reservoir is a densified fibrous region wherein the capil-
lary radius is quite small. Thus, the capillary pressure
is increased and the liquid is rapidly distributed to
portions of the cellulosic batt. Furthermore, the base of
35 the channel is of a higher density than the immediately
surrounding areas except for the reservoir. Thus, this

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densified fibrous region at the base of the channel provides sufficient capillary pressure to transport the liquid to the other reservoir whereupon the highly densified base of the other reservoir further absorbs the liquid and distributes it. These densified fibrous regions at the base of the reservoirs and the channel provide the maximum capillary pressure because it combines the very low contact angle of the fibers of the batt with the high density of the densified fibers.

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The individual fibers of the batt are extremely wettable, generally having liquid-fiber contact angles below about 30° in the optimum embodiment. The wickability or preferential absorptivity of the body of the batt for water is limited, however, by its low density which results in 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

$$P = \frac{2 \gamma \cos \theta}{r}$$

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wherein

P is the capillary pressure,

γ is the surface tension of the liquid,

θ is the liquid-fiber contact angle, and

30 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.

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The relative wickability between the cover layer and the body of the fibrous batt is affected by both the relative densities of the layers and the relative wettability of the individual fibers in each layer. The individual
5 fibers of the batt have substantially smaller liquid-fiber contact angles than those of the cover layer overcoming the density difference and providing a substantial overall increase in capillary pressure to absorb liquid into the body of the batt.

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A densified fiber layer such as that at the base of the reservoirs and the channel provide the maximum capillary pressure because it combines the very low contact angle of the fibers of the batt with the high density (small
15 capillary radius) of the densified fibers.

Thus, when urine is voided into an area in the cover layer, it partially wets a small portion of the cover layer and is passed through the cover layer, almost
20 instantaneously, to the reservoir. It then comes into contact with the body of the batt surrounding the reservoir and the channel and is preferentially absorbed into the body of the batt because of the enhanced wettability of the reservoir and channel and particularly
25 the base of the reservoir and channel. The same is true when the body fluid is a menstrual fluid or other liquid exudate.

In addition, it may be desirable to provide a paper-like
30 densified layer on the side of the batt opposite the reservoir. The paper-like densified layer is formed by a slight moistening of the surface of the batt followed by light compaction using the application of pressure. U.S. Patent No. 3,017,304 to Burgeni provides such a densified
35 layer in a loosely-compacted cellulosic fibrous batt.

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This paper-like densified layer promotes wicking of liquid to all portions of the structure.

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.



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Claims

1. An absorbent structure comprising a loosely-compacted
cellulosic fibrous batt substantially rectangular in shape
5 and having a length at least about 1.5 times the width of
the batt, the width not exceeding 12.7 cm (5 inches), one
surface of said batt containing at least 2 reservoirs
spaced apart with a connecting channel, said reservoirs
and the length of the channel being centered on the
10 longitudinal axis of the batt, each reservoir having a
capacity of at least 10 cc., the channel depth being at
least one-half the depth of the reservoirs; a moisture-
permeable facing covering the surface of the batt
containing the reservoirs; and a moisture-impermeable
15 backing covering at least the surface opposite the surface
containing the reservoirs.
2. The absorbent structure of Claim 1 wherein the base of
the reservoirs is a densified region of the fibers of the
20 fibrous batt.
3. The absorbent structure of claim 1 or claim 2 wherein each
reservoir is located between the center and one transverse
end of the absorbent structure.
- 25 4. The absorbent structure of any one of claims 1 to 3 wherein the
capacity of each reservoir is sufficient to hold at least
75 percent of the body fluid discharged in one second.
- 30 5. The absorbent structure of any one of claims 1 to 4 wherein the
surface of the absorbent batt opposite the reservoirs is provided
with a paper-like densified skin.
6. The absorbent structure of any one of claims 1 to 5 wherein the
35 backing is provided with an adhesive strip for securement of the
structure when worn.



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7. The absorbent structure of any one of claims 1 to 6 in the form of a sanitary napkin, a disposable diaper, or an incontinence pad.

8. An adult incontinence structure substantially rectangular in shape comprising a moisture-impermeable backing sheet; an absorbent loosely-compacted cellulosic fibrous batt superimposed on said backing sheet, and a moisture-permeable facing cover, covering at least the side of said absorbent batt opposite said backing sheet; said absorbent batt being provided with at least 2 reservoirs spaced apart with a connecting channel said reservoirs and the length of the channel being centered on the longitudinal axis of the batt; each reservoir having a capacity of at least 10 cc. the channel depth being at least one-half the depth of the reservoirs.

9. The adult incontinence structure of claim 8 wherein the backing sheet is provided with an adhesive layer which functions as an adhesive strip for securement of the pad when worn.

10. A disposable diaper comprising a moisture-impermeable backing sheet; an absorbent loosely-compacted cellulosic fibrous batt superimposed on said backing sheet and a moisture-permeable facing superimposed on the side of the fibrous batt opposite said backing sheet; said absorbent batt being provided with at least two reservoirs spaced apart with a connecting channel; said reservoirs and the length of the channel being centered on the longitudinal axis of the batt; at least one of the reservoirs having a

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capacity of at least 10 cc., the channel depth being at least one-half the depth of the reservoirs.

- 5 11'. A sanitary napkin comprising a moisture-permeable outer layer containing an absorbent loosely-compacted cellulosic fibrous batt; said absorbent batt being provided with one surface of said batt containing at least two reservoirs spaced apart with a connecting channel; said reservoirs and the length of the channel being
- 10 centered on the longitudinal axis of the batt; each reservoir having a capacity of at least 10 cc. the channel depth being at least one-half the depth of the reservoirs.
- 15 12. The sanitary napkin of Claim 11 wherein the side opposite the reservoirs is provided with an adhesive layer which functions as an adhesive strip for securement of the napkin when worn.
- 20 13'. The sanitary napkin of claim 11 or claim 12 wherein the base of the reservoirs is a densified region of the fibers of the fibrous batt.
14. An absorbent structure, substantially as hereinbefore described with reference to the accompanying drawings.
15. An adult incontinence structure, a disposable diaper or a sanitary napkin, substantially as hereinbefore described with reference to the accompanying drawings.
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