

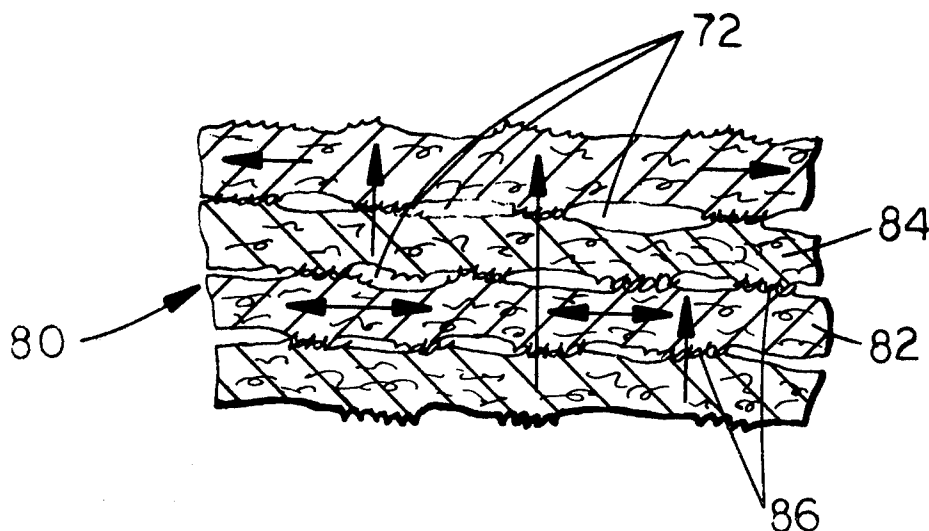
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 [21] Appl. No. **711,014**
 [22] Filed **Mar. 6, 1968**
 [45] Patented **June 28, 1971**

[56] **References Cited**
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[54] **DISPOSABLE DIAPER PRODUCTS AND METHOD OF MANUFACTURING**
7 Claims, 17 Drawing Figs.

[52] U.S. Cl. **93/1,**
 128/284, 156/164, 156/229, 156/494
 [51] Int. Cl. **B31d**
 [50] Field of Search 156/163,
 164, 229, 494, 495, 496; 93/1, 1 (C), 1.1

ABSTRACT: Disposable diapers and other products including a method of manufacture from fibrous creped cellulose material whereby multiple plies of the material are received together without abrasive action disruptive of the fibrous surface texture and under a tension interlocking the creped surfaces when relaxed to provide appreciably higher absorption and lateral dispersion rates for dissipating the aqueous solution of urea and precluding bacterial growth conducive to ammoniacal odors and skin irritations.



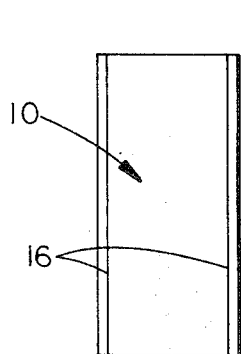


FIG. 1

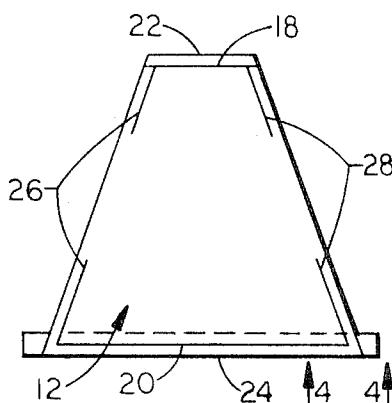


FIG. 2

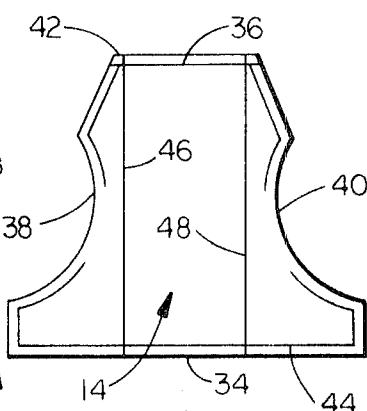


FIG. 3

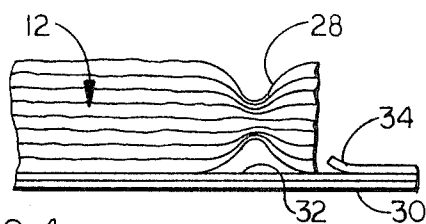


FIG. 4

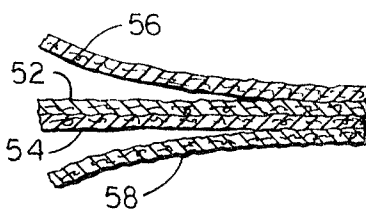


FIG. 5

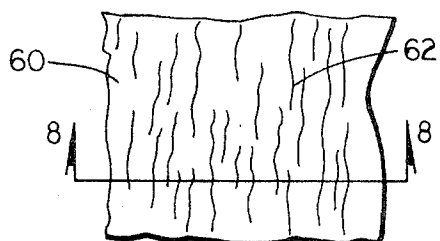


FIG. 6

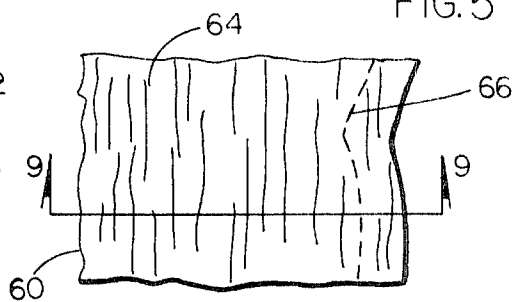


FIG. 7

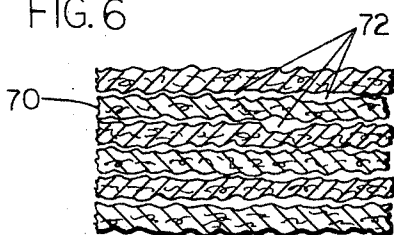


FIG. 8

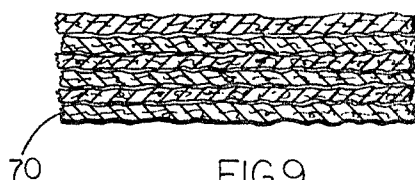


FIG. 9

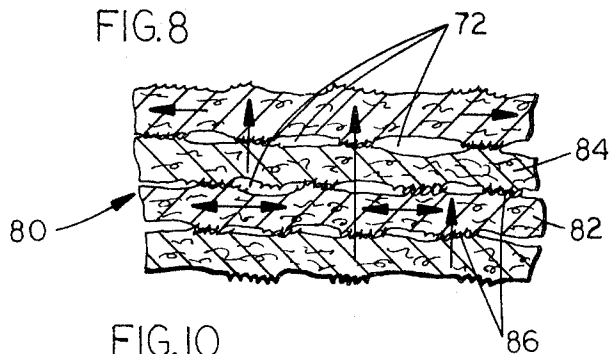


FIG. 10

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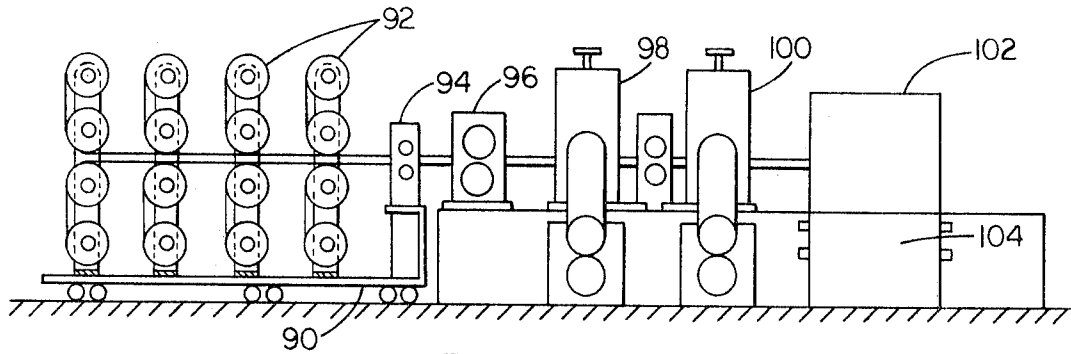


FIG 11

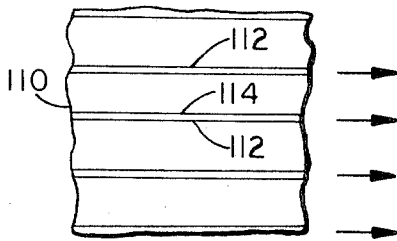


FIG 12

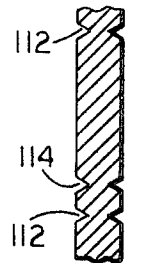


FIG 13

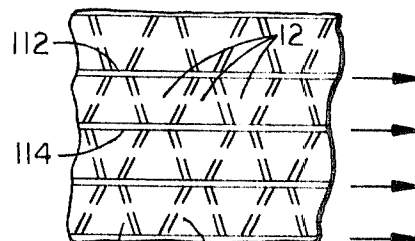


FIG 14

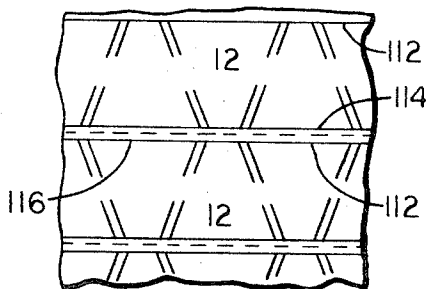


FIG 15

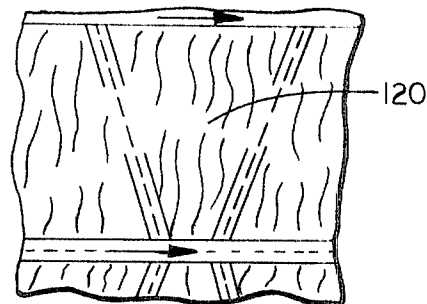


FIG 16

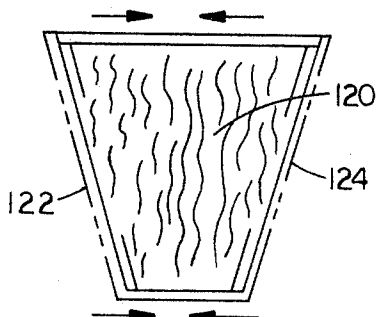


FIG 17

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DISPOSABLE DIAPER PRODUCTS AND METHOD OF MANUFACTURING

BACKGROUND OF THE INVENTION

In the use of diapers and like products to babies and incontinent patients two of the principal concerns are the elimination of ammoniacal odors and the occurrences of diaper dermatitis, which is commonly known as diaper rash. Although very little is known about diaper dermatitis, it is generally considered to be a consequence of the decomposition of urea which also causes the ammoniacal odors. Accordingly, most efforts to solve these two problems have centered about cleanliness of the person and of the diaper or like product.

Unfortunately, cloth diapers, no matter how thoroughly they are laundered invariably retain some bacteria, which is instrumental in the decomposition of urea, and they invariably supply other irritants effecting the skin from the soaps and detergents used. Consequently, hospitals and most concerned parents are turning more and more to the use of disposable diaper products which can be manufactured under sanitary conditions and are used only once and then thrown away.

In general, the disposable diaper product is made and used in much the same way and with the same considerations given cloth diapers. Accordingly, it has done very little towards helping solve the problems of odor and diaper rash, other than as mentioned in eliminating any transfer of bacteria or the introduction of other irritants. Whereas cloth diapers are used with four to six folds for an absorbency that requires 12 to 14 changes a day, disposable diapers are made with seven to eight plies of cellulose material to obtain a like absorbency if not less. Cloth diapers are seldom used or folded double because of the added bulk or thickness which produces little increased absorbency and similarly disposable diapers in greater ply thickness have not been used since they are made by folding the individual or double plies upon themselves and have relatively the same limitations.

Until the present invention, which will be hereinafter described, no one has apparently appreciated the full potential of the cellulose materials used in making disposable diapers and that when properly constructed a product may be attained which has a greater absorbency level and method of absorption, without appreciable bulk or thickness, and which will, in itself, effectively reduce and eliminate the problems of diaper odor and rash while requiring diaper changes of no more than seven or eight times a day.

SUMMARY OF THE INVENTION

This invention relates to diapers and like products for babies and incontinent patients and to the method of manufacturing such products of cellulose sheet material to obtain a disposable diaper or like product which inhibits and eliminates the problems of diaper odor and rash.

The present invention is directed to a method of processing a highly absorbent material of cellulose sheet material in multiple ply thicknesses of from 24 to 36 in a roll feeding operation providing a continuous flow operation in which individual plies are brought together with a minimum disruption of the fibrous surfaces of the cellulose material to assure good capillary action and lateral dispersion of aqueous solutions received through and between the different plies and apart from the surfaces next to the body.

The individual plies are tensioned within elastic limits as they are received together and are released only after the material has been embossed and cut so that the fibrous surfaces are interlocked, interfitted and spaced for the most proficient capillary and lateral dispersion flow.

A diaper or incontinent pad of this material will so completely dissipate the urine liquid that there is little or no occasion for skin bacteria to act on the urea of urine and the decomposition process is so effectively disrupted that there is little or no ammonia formed and the pungent odor attributed thereto is eliminated. Without the bacteria growth, occurring

in the presence of dissolved urea in a heavily saturated media, the problems of diaper dermatitis are also avoided and in the course of normal evaporation the urea will revert to its crystalline structure.

A more full and complete description of the invention follows brief reference to the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of a diaper liner made in accord with the teachings of this invention.

FIG. 2 is a plan view of a simple diaper.

FIG. 3 is a plan view of a form-fit diaper.

FIG. 4 is an enlarged cross-sectional view of the diaper of FIG. 2 as seen in the plane of line 4-4 looking in the direction of the arrows.

FIG. 5 shows the manner of building up the different number of layers of material desired.

FIG. 6 is a plan view of a piece of material in a relaxed state.

FIG. 7 is a plan view of the same material under tension or otherwise stressed.

FIG. 8 is a fragmentary cross-sectional view taken in the plane of line 8-8 in FIG. 6, and greatly magnified.

FIG. 9 is similar to FIG. 8 as seen in the plane of line 9-9 of FIG. 7.

FIG. 10 is a further enlarged magnification of a cross section of the material of this invention.

FIG. 11 is a side elevation of a continuous flow machine for making diapers in in accord with the teachings of this invention.

FIG. 12 is a top plan view of the material being processed in the machine at one stage of operation.

FIG. 13 is an enlarged cross section of the material following the first machine operation.

FIG. 14 is a top plan view of the material following a subsequent step in the machine operation.

FIG. 15 is an enlarged top plan view of a fragmentary part of the material showing a further step in the machine operation.

FIG. 16 is similar to FIG. 15, further magnified in size, showing a still further machine operation.

FIG. 17 is a plan view of the end product showing its relaxed size and shape.

DETAILED DESCRIPTION

Chemically, urine is an aqueous solution of urea, creatinine and uric acid, together with some hippuric acid, inorganic salts and particular pigments. The urea in urine is a soluble crystalline nitrogenous compound, $\text{CO}(\text{NH}_2)_2$, which unites with acids bases and salts to form crystalline compounds but in the presence of water and with the aid of bacteria undergoes hydrolysis and yields ammonium carbonate which is unstable and decomposes rapidly into carbon dioxide, water and ammonia; the latter of which causes the pungent odor generally attributed to decomposing urine.

Although urine is principally acid in character, the alkaline content under proper conditions will undergo fermentation and when this occurs in the presence of bacteria urease is formed which is an enzyme that promotes the hydrolysis of urea into ammonium carbonate. As the bacteria grow, the process of decomposition advances rapidly, the odor due to the released ammonia becomes pronounced and the conditions for diaper dermatitis are present.

With these factors in mind, the problems of eliminating diaper odor and the conditions that cause diaper rash, within a diaper or incontinent material, have been found to require a form of construction of the material itself which will so effectively dissipate the liquid content of urine that the urea will be entrapped and allowed to form its crystalline compounds without the occasion for bacterial action necessary to its decomposition by hydrolysis. The conditions for alkaline fermentation must also be reduced, particularly in the proximity of body bacteria, and this is obtained in the dispersion of the liquid content to reduce the level of wetness in the higher tem-

perature areas of the diaper near the body. What small amounts of ammonia are formed are entrapped and used to help lower the temperature condition and impede both the fermentation and the evaporation cycle of the gas itself.

In the practice of the present invention with materials that are presently available, a fibrous cellular creped material made by the Cel-Fibe Division of Johnson & Johnson in Milltown, N.J. which has a basic weight of 14—250, a bulk of 0.130 plus, high elasticity and an XOW capacity of 20—25 has been found most suitable in ply thicknesses of 24—36.

As shown in FIGS. 1—3, the diaper product may be made in different shapes as well as in different sizes. The diaper 10 is known as a liner diaper and is relatively simple in shape and design. The triangular diaper 12 is of the type more conventionally known and used and the form-fit diaper 14 is a different innovation which, as the name implies, is intended to fit the body contours more closely. Each is constructed of the material mentioned, and in the multiple ply thicknesses ascribed by the method of construction that will be covered later.

The liner diaper 10 may be used as an incontinent pad or within a regular diaper or protective pants, as the name implies. It is of a width and length dependent upon whether it is to be used with babies, small children, or adults, but basically is intended to be received in the crotch with the midsection disposed as best serves its intended purpose. Only the side edges need be pressed together, as at 16, to hold the multiple layers together and the ends may be cut open, as shown.

The triangular diaper 12 is shown to include sealing lines 18 and 20 across the short end 22 and wider end 24, respectively, and to have interrupted sealing lines 26 and 28 along the other two side edges. The latter serve to hold the corners secure and are interrupted to afford some freedom of movement for the material to avoid bunching or puckering where it is received close about the legs.

The triangular diaper 12 is shown with a different means of fastening than the conventionally known diaper pins and one which may be used with the other diapers under discussion as well. This includes a band 30 with a pressure sensitive adhesive backing 32 received near the larger end 24 of the diaper and which has stripoff tabs 34, as best shown in FIG. 4, on the ends that extend beyond the side edges of the diaper, so that the smaller end 22 of the diaper may be fastened to the larger end when it is in position. Other fastening methods might include cooperating pressure adhesive areas on the corners of the larger and smaller flap ends which interact when brought together.

The form fit diaper 14 of FIG. 3, includes one end 34 which is wider than the other end 36 and it is undercut in the midsection area as at 38 and 40 so that it may be received and fit better between the legs. It includes sealing lines at the ends, as at 42 and 44, and which also extend around the corners, and it also has sealing lines extending lengthwise of the diaper, as at 46 and 48. This leaves the undercut edges 38 and 40 open next to the thighs and easier to fold but still provides a sealing line in close proximity for protection. It will also be appreciated that the center section of the form-fit diaper is generally similar to the diaper liner 10 shown in the first drawing FIG.

Although not specifically shown, it will be appreciated that the form-fit diaper may have less than full thickness throughout its width as by having the side edges include a lesser number of multiple ply layers and with the center section only of the higher absorbency level of thickness since the side edges are principally to retain the center area in place for its intended function. This also reduces the double thickness when the end flaps are brought in towards each other and secured down in obtaining the form-fit shape.

Referring again to FIG. 4, having reference to the triangular diaper, but being essentially the same in the others, the diapers in cross section include the multiple layers of the cellulose material, identified as 50, with the sealing lines near the edges and thereby provides a large center area for absorbing purposes.

In the production method used for the diapers disclosed, the desired extent of multiple ply thickness is obtained by a continuous flow process wherein individual plies or doubles, as hereinafter explained, are pulled from feed rolls and received together in the course of their continuous flow movement, as is best shown by FIG. 5. The single ply thicknesses are identified 52, 54, 56 and 58 with the center two 52 and 54 disposed as they would be from a previous pair of feed rolls and the outer layers 56 and 58 being received next thereto from the top and bottom sides.

The particular material used has both a fibrous and creped texture.

In FIG. 6 the surface texture of a fragmentary piece of material 60 is shown to have the irregular pattern 62 running crosswise which depicts the creped surface in its relatively relaxed state whereas FIG. 7 shows the same piece to have a more uniform pattern 64 and to be of greater length, as evidenced by the phantom line 66 for the terminal edge of the relaxed piece, when it is under tension or stressed.

Since the creped surfaces of the materials used are inherently abrasive and disruptive of the fibrous texture, it is important that material handling through the different processing steps be reduced to a minimum and that the different plies not rub together or move relative to each other, as by being stretched and relaxed, in the course of attaining the ply thicknesses desired. It is also important that the different plies not be stretched or stressed in any manner which adversely affects their creped surface texture or how they provide the small pocket areas or cells between different layers. In addition, all of this must be accomplished with equipment which provides a reasonable fast rate of production to assure a cost factor acceptable for a disposable product.

FIGS. 8 and 9 show a similar comparison wherein a six-ply thickness of material 70 has a shorter relative length and greater thickness when relaxed, as in FIG. 8, than when under tension or stressed as in FIG. 9. It will also be noted that the creped surfaces in the relaxed state form more pocketed areas 72 between respective layers or plies than when the material is under tension or set in an expanded state.

Absorbency tests show that a creped material has a greater level of absorption than one which is not so formed and that the more creping which is retained by the material, in being processed to an end product, the more effective it will be both in this respect and as regards its ability to disperse fluids. When the elasticity of the material due to the creping is exceeded, in any area, the material sets in a different pattern and the absorption and flow characteristics change. This is one very good reason why materials processed by presently known methods which involve a considerable amount of winding and unwinding of the sheet stock, as well as other handling, are far less effective than those obtained by the manufacturing process hereinafter disclosed.

Referring to FIG. 10, a four ply thickness of material 80 is shown, greatly magnified, and wherein the advantages of the manufacturing method of this invention may be better understood. The different layers or plies of material, 82 and 84 for example, are shown to have their surfaces interlocked together as at 86, where the creping, which was in tension earlier, has been allowed to relax, and in so doing locks in engagement with the surfaces next adjacent. Since the fibrous texture of the creped material has not been disturbed in receiving the different layers together in the continuous flow buildup, the hairlike feelers are received within the pocket areas 72 and circuitous pathways formed between the different layers and serve as capillary members for even better absorption characteristics in the material. The close mating and interlocking of the different layers of material provides for good vertical flow or absorption, as shown by the arrows pointing upward, and the fluid received is spread laterally through and between the different layers, as shown by the other arrows, so that the greater amount of fluid that can be retained are dispersed in all directions and upwardly into the material without the saturating concentration conducive to

bacterial growth which is experienced in other absorbent materials.

FIG. 11 shows a production line machine with which the manufacturing process of this invention may best be practiced to obtain the materials and end products desired with the characteristics which have been mentioned. It includes a roll stand 90 with four double-ply rolls 92 of material, in four tiers, which feed through guide rollers 94 to embossing rolls 96, a slit 98, a cutter 100, and a waste separation device 102 arranged in series thereafter.

The roll stand 90 is mobile so that more than one such stand may be used; with the reserve stand being loaded and threaded through the guide rollers 94 while the other one is in use. The rolls 92 carry from 60-inch to 123-inch wide material and the feedoff rate is 50 or more feet per minute.

Sixteen double-ply rolls are shown to obtain a material thickness of 32 ply in the end product which, with presently available materials of the characteristics mentioned, enables maximum proficiency in manufacture and performance in the end product. Single ply rolls require more care in the feedoff rate to avoid exceeding elastic limits of the material and therefore offset the longer running time obtained by more material length in the rolls. Similarly, rolls with more than two-ply thicknesses, while they can be run off faster, have less running time because of less length of material on each roll.

It will be noted that the center rolls receive and help pull material from the outer rolls in each of the four roll tiers so that a continuous flow of material is obtained with the material from each roll being received with that of the other rolls under a like tension well within elastic limits.

The initial tension applied to the material is retained throughout the manufacturing process and until the final product is cut. There is little or no variation in tension between different work stations and consequently no relative movement between the different layers.

At the end of the line, beside the waste separator 102 is a conveyor 104 by means of which the end product is carried off to the stacking and wrapping machine.

FIG. 12 shows the material 110 in the course of movement through the processing machine and with sealing lines 112 and 114 embossed lengthwise thereof at spaced intervals according to the running width of material to be used.

The first engagement with the material in the processing machine is intentionally in this manner to provide pull lines, as indicated by the arrows, whereby the material may be kept in tension with a minimum of contact and without pressing together or otherwise disrupting the areas where maximum absorbency characteristics are desired. With the liner diapers 10 it would be along the sealing lines 16, with the triangular shape it would be lines 18 and 20, and with the form-fit diaper 14 it is along the sealing lines 46 and 48 centrally thereof.

A subsequent step includes embossing the other sealing lines in the material, as shown by FIG. 14 and wherein the shape of the end product is more apparent. The end-for-end reversal and mirrored disposition of the triangular diaper shape 12 shows that there need be very little waste in making this particular diaper product and that like nesting for the form-fit diaper will also conserve material and may eliminate much in the way of waste for disposal.

A further step is shown by FIG. 15 wherein the material is slit lengthwise and between the pull lines 112 and 114, in this instance, as per the dotted line 116. It is not until the final cutting operation, which may, however, be at substantially the same time, that the tension in the material is relaxed and it is allowed to recover its initial creped form to the full extent.

Referring to FIGS. 16 and 17, it will be seen that the diaper form 120 has a tensioned crepe pattern on its surface due to the feeding tensioning on the material and when this is relaxed the material will shrink or pucker back to its relaxed state. The phantom lines 122 and 124 show the difference in FIG. 17 and the arrows show the return of the material to its relaxed state.

In receiving the different layers of material together while in tension, it will be appreciated that they are semiexpanded,

within elastic limits. Later, when they are relaxed and returned to their initial creped form, they crimp themselves together and form what may be considered crepe welds just as two expanded springs, when received together and later relaxed, will interlock. This causes an interengagement of the material without adhesives and allows the material-to-material wicklike absorption of fluids which in combination with the fibrous intermingling of adjacent surfaces produced a highly absorbent material with significantly greater lateral dispersion of fluids than in presently known materials intended for like purposes.

From the foregoing, it will be appreciated that a new and different material for diapers and other products may be provided by a continuous flow process of manufacture whereby multiple layers or plies are brought together in a manner affording capillary spacing for maximum absorption coupled with such lateral dispersion as will greatly enhance the performance of such products in serving their intended purpose.

With materials presently known and available, multiple-ply thicknesses between 24 and 36 have been found best in making diapers and incontinent pads which are effective in dissipating the liquid content of urine and allowing the urea to crystalize without undergoing hydrolysis and breaking down into ammonium carbonate and thereby causing ammoniacal odors and conditions conducive to diaper rash. Such other materials as may provide this same absorption and lateral dispersion, although not presently known, and which will eliminate the occasion for bacterial contact and the alkaline fermentation of urea, with or without the same number of multiple layers, are considered as inclusive within this invention. However, from experimentation with other disposable diaper materials it is believed that a significant number of separate layers will most likely be necessary if the full advantages of the vertical capillary action and lateral dispersion are to be retained.

Inasmuch as urea is excreted from the skin in perspiring and is present in the debridement from wounds and cuts, it follows that the material of this invention may have other uses; as for bandages, surgical face masks, etc., where the isolation of urea from bacterial content is important. Although there may not be the same problems of saturation, as with diapers and incontinent pads, the factors of capillary flow and lateral dispersion are of like importance if the formation of ammonium carbonate etc. and ultimate breakdown are to be avoided.

These and such other innovations and uses as are not specifically excluded by the language of the hereinafter appended claims are to be considered as inclusive thereunder.

I claim:

1. The method of making absorbent material for disposable diapers and like products, comprising: receiving a plurality of sheets of fibrous creped cellulose material together, tensioning said material within elastic limits as received together in facial engagement, and relaxing said material in the course of cutting the material to desired shapes and sizes for interlocking the creped surfaces.
2. The method of claim 1, including: pulling said material from multiple rolls and receiving said material together under the tension of so doing.
3. The method of claim 2, including: maintaining the pulling tension relatively constant until the final relaxing of the material.
4. The method of making disposable diapers comprising: receiving multiple plies of fibrous creped cellulose material together in facial engagement and under tension within the elastic limits of the material, embossing the multiple plies of material together along parallel spaced lines extending lengthwise of the material and while under tension, cutting said material to diaper shapes and in the course of so doing relieving the tension and interlocking adjacent creped surfaces together.
5. The method of claim 4, including:

receiving different of said multiple plies from separate rolls of material and together under the tension of being drawn from said rolls.

6. The method of claim 5, including:

pulling said material from said rolls along the subsequently 5
formed parallel spaced embossing lines.

7. The method of claim 6, including:

embossing the desired shape of the end product in said mul-

tiple ply material while in tension and making use at least in part of the embossing lines extending lengthwise of the material,

slitting the material between adjacently disposed of said embossing lines while maintaining the tension therein, and cutting the slit material relative to the shape embossed therein.

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