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THROWAWAY DIAPER

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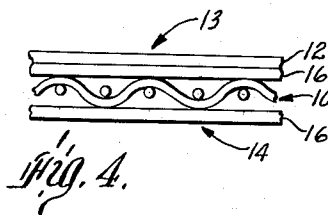
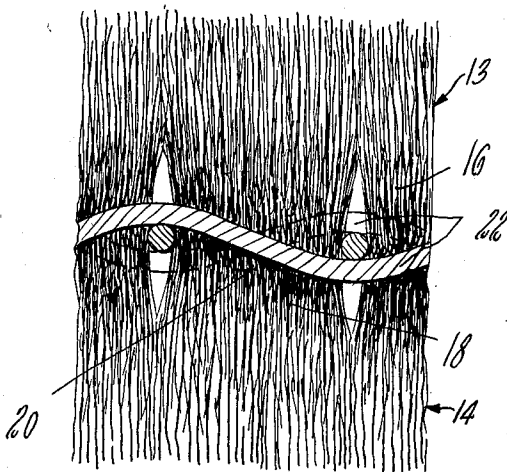
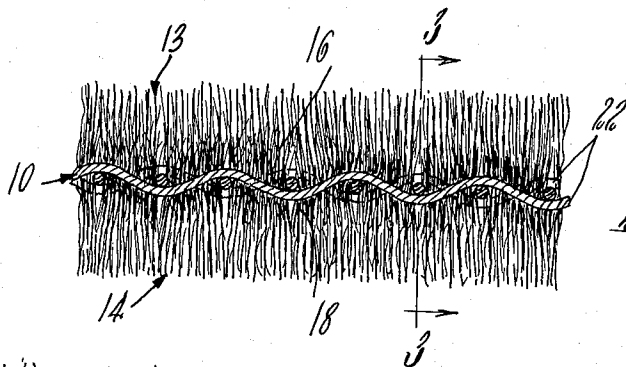
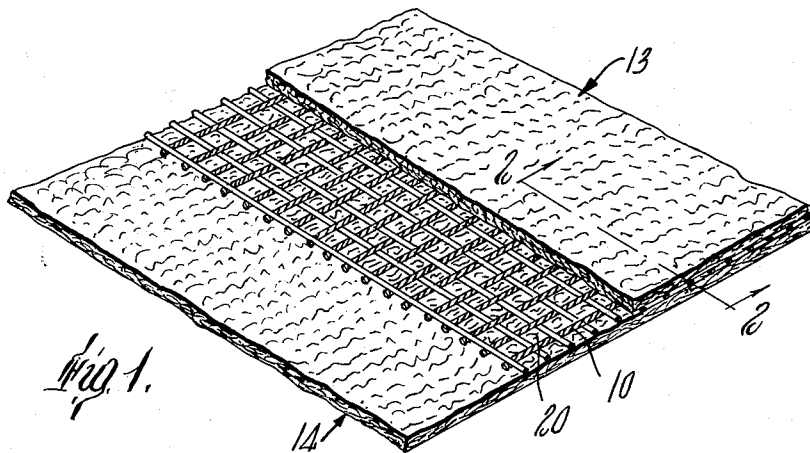
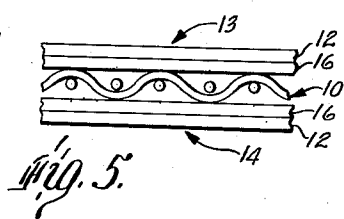


Fig. 3.



1

3,085,309

THROWAWAY DIAPER

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This invention relates to a throwaway diaper, and more particularly to a throwaway diaper composed of textile-length fibers integrally bonded to an open-meshed fabric without the use of binding agents.

In the manufacture of conventional throwaway diapers, also called "one-use" or "disposable" diapers, recourse is commonly had to the use of a filler composed of cellulose wadding, or cellulose flock, or a similar inexpensive wood-pulp derivative to provide the absorbent element. Such materials, as is well known, are almost completely lacking in wet strength, and are intended to disintegrate into a shapeless mass when wet. When they are used in a throwaway diaper, therefore, they cannot be used alone. Since the diaper must be fastened around the baby, provision must be made for incorporating the absorbent element into a structure composed at least of a pair of sheets of high wet-strength material serving as a sheath or bag which contains the absorbent material. It is common to use as the facing element which is used next to the body, a sheet of wet-strength tissue, frequently reinforced with threads, yarns, or low-count fabric. It is also common practice to employ for a backing element, a sheet of water-repellent material such as paper laminated to a plastic film. This combination of facing and backing elements are sealed or otherwise fixed together at least along their long edges. They serve not only as a container for the absorbent filler, but they constitute the only elements which are strong enough to allow the diaper to be pinned or fastened to the baby. But even these elements in some types of conventional throwaway diapers are recognized as having inadequate pin strength, so it is frequent practice to reinforce the zone where safety pins are to be inserted with added strips of plastic, paper, fabric, or other reinforcing material.

Conventional throwaway diapers are necessarily expensive and wasteful devices compared with the function which they are intended to perform. The use of a cellulose wadding or cellulose flock filler, which is practically universal practice, supplies the requisite absorbency, but the choice of such material necessitates the use of facing, backing, and reinforcing elements which add unduly to the cost of the finished product, complicate its assembly, and necessitate its manufacture on a complicated machine which must be devised to feed and combine several different elements, as well as to perform a sealing or fastening operation.

Weight for weight, fabric diapers are not as absorbent as cellulose wadding. The fibers of which the fabric is formed, if tested in bulk and not spun into yarns, have many times the water-holding capacity of the fabric into which they are made. The U.S. Pharmacopoeia specifies that bleached absorbent cotton, in bulk, shall retain 24 times its own weight in water in a dip-and-drain test. A gauze diaper made of bleached cotton yarns will retain about four and one-half times its weight in water in a similar test, or less than one-fifth of the absorbent potential of its composite fibers. This decreased absorbency is the penalty that accompanies the transformation of bulk absorbent into durable, washable, reusable fabric.

The use of bulk absorbent, in the form of cellulose wadding and the like, also imposes a penalty, inasmuch as the non-absorbent but functionally essential containing elements may cost more than the absorbent filler.

2

It is apparent, then, that neither conventional fabric diapers nor prior-art throwaway diapers have succeeded in meeting the basic requirement of a diaper material, which is to provide maximum absorbency at minimum expense.

It is an object of this invention to provide a throwaway diaper of enhanced absorbency and capillarity.

It is a further object of this invention to provide a throwaway diaper containing textile-length fibers not associated into yarns, and completely free of binding agent.

A further object is to provide a throwaway diaper of textile-length fibers in which the natural absorbency of the fibers when tested in bulk form is maintained to an exceptional degree.

It is a further object of this invention to provide a throwaway diaper which has a tensile strength and pinning strength at least double that of conventional throwaway diapers.

A further object is to provide a throwaway diaper in which the tensile strength and pinning strength are greater when the diaper is wet than when it is dry.

A further object is to provide a throwaway diaper in which the "toughness index" is at least double that of conventional throwaway diapers.

It is a further object of this invention to provide a throwaway diaper that can be produced simply and economically, and which needs no reinforcing elements or elements of special design to render it functionally usable.

I accomplish these and other aspects of my invention, as will appear to those skilled in the art, from the following specification and claims, by preparing a diaper structure of bulk absorbent textile-length fibers and an open-meshed relatively low-count inexpensive gauze.

Although absorbent textile-length fibers in bulk do not disintegrate into a slurry or pulp when wet, as does cellulose wadding, nevertheless, a batt of such textile fibers is not satisfactory for diaper use without further treatment, since it has neither the wet nor the dry strength to be handled, applied, pinned, or removed without being ruptured. Attempts have been made to utilize textile-length fibers in throwaway diapers, but the bonding agent necessary to furnish the required pin strength and tensile strength invariably decreases the potential absorbency of the fibrous array to the point where the performance of the array is unsatisfactory for diaper usage. The use of adhesive binders, whether in the form of powders, emulsions, latices, solutions, or binder fibers, has the effect of decreasing the capillarity of the fiber mass, and thereby the ability of the fibers to retain all the water they are capable of holding is decreased. Moreover, in order to insure adequate tensile strength, such an amount of binder must be used that the product becomes undesirably firm, hard, and generally possesses an undesirable texture. Finally, many binders are unsuitable for use in a product of this type because of irritative or sensitizing effects on the skin.

I have found that I can maintain the desirable softness and high absorbent capacity of textile fibers, when made into a throwaway diaper, by sandwiching a layer of relatively open-meshed fabric, such as surgical gauze, between the two layers of absorbent fibers. The fibers of the layers are then reoriented and forced into a closer proximity to each other. In addition, a substantial number of said fibers are aligned into mutual parallelism at substantially right angles to the plane of the gauze. Since the product is composed essentially of integrated textile fibers, mechanically engaged, it has a softness and conformability that is especially appealing, and is free from the objectionable folding, buckling, creasing, and channeling which is characteristic of conventional wadding-type throwaway diapers encased in a paper envelope of some sort.

Going into more detail, I refer to the accompanying

3

drawings, which illustrate a preferred embodiment of my invention and in which:

FIGURE 1 is a plan view of the diaper of my invention shown partially in cut-away section to reveal the gauze contained therein;

FIGURE 2 is a cut-away section along 2—2 of FIGURE 1;

FIGURE 3 is an exploded perspective view of a small area of the fabric taken along line 3—3 of FIGURE 2;

FIGURE 4 is a schematic representation of two fibrous batts, 13 and 14, assembled on either face of a layer of open-meshed fabric 10, the upper batt 13 consisting of a layer of absorbent fibers 16 disposed next to the fabric and another layer of non-absorbent fibers 12 disposed away from the fabric, the lower batt 14 consisting substantially entirely of absorbent fibers; and

FIGURE 5 is a schematic representation of two fibrous batts, 13 and 14, assembled on either face of a layer of open-meshed fabric 10, each batt comprising a layer of absorbent fibers 16 disposed next to the fabric and a layer of non-absorbent fibers 12 disposed away from the fabric.

In the drawings, an open-meshed gauze 10 is positioned substantially centrally of fibrous batts 13 and 14. As is shown in FIGURE 3, the fibers 16 of batt 13 and the fibers 18 of batt 14 are forced into the apertures 20, which are formed by the yarn 22 of the gauze 10. The fibers 16 and 18 are at least partially drafted and straightened by their passage through the apertures 20. Within the confines of the aperture 20 the fibers are in substantial parallelism.

The alignment of fibers within the apertures 20 results in the accommodation of a larger number of fibers per unit area within the apertures than an area of similar size would accommodate externally of the apertures. The yarns 22 of the apertures 20 engage, compress, and lock the fibers mechanically within the apertures. Within the apertures, therefore, the fibrous density is greater than is the density of fibers in the principal part of the fibrous batts. In this manner, I create numerous wick-like areas of enhanced capillarity.

The interengagement of the fibers in batts 13 and 14 is accomplished by fluid jets, by a blunt punching device, or by a device such as a needle loom. As the jets or punch-points or needles pass through the gauze and fibers, the fibers are drafted and are packed together into areas of higher density. Some of the fibers mechanically engage the yarns of the gauze, whereby the fiber masses and gauze are mechanically united and locked together.

By preparing my throwaway diaper structure by the mechanical engagement of fibers and gauze as by needle-punching or needle-felting bulk textile-length fibers and a low-cost, open-meshed fabric, I avoid the need of adhesive binders and the like, and thereby I take advantage of the enhanced capillarity which is brought about by aligning and densifying the fiber mass.

In making the product of my invention, I prefer to carry out the fiber densification and alignment process just to the point at which the fibrous aggregation has retained the maximum absorbency consistent with the development of adequate strength. When rayon fibers are used, this point will be reached when the "apparent density" of the batt is between 0.01 and 0.10, where the thickness of the batt is measured by an Ames gauge with a foot one and one-half inches in diameter exerting a force of 42 grams on the batt. While it is possible to prepare a diaper structure of greater density, I prefer not to do so since increasing the density of the batt above this amount usually involves decreasing its absorbency, which is undesirable since my object is to maintain maximum loft and volume consistent with adequate tensile strength and pin strength.

For my absorbent fibers, I prefer to use viscose rayon, in the 1.5 to 3.0 denier range, although obviously other fibers, or other deniers, can be used alone or in blends. Additionally, to enhance the performance of my diaper,

4

I find it advantageous to combine highly absorbent fibers on one face with an outside layer of fibers which are either less absorbent by nature, or which have been treated to render them water-repellent. By uniting the fibrous layers in accordance with this invention, I find that I impart to the diaper a resistance to water-penetration which slows down the transfer of moisture, thereby allowing the intra-fiber capillary forces to spread the fluid more completely throughout the length and width of the diaper. In this way I utilize the potential absorbent capacity of my fibrous assembly more completely than would be possible if all absorbent fibers were used. At the same time, my diaper remains porous and comfortable to wear.

It is also possible in my invention to combine outer plies of long-fibered material with inside plies of short-fibered absorbent stock, such as cellulose wadding or thin sheets of soft paper pulp, which are unsuitable for use alone in a product of this sort, as has been set forth above.

I have found that the presence of the layer of gauze between the layers of absorbent and non-absorbent fibers has the unexpected effect of decreasing the intermingling of the two types of fiber. If a layer of absorbent and a layer of non-absorbent fibers are punched together repeatedly, the displacement of the fibers in one layer into the other layer will, if prolonged, lead to a nearly uniform dispersion that shows a semi-absorbent property throughout the assembly. Obviously, this is undesirable if the object is to maintain an absorbent face on one side of the diaper and a water-repellent face on the other. I have found that, for any given degree of inter-engagement, the presence of a layer of open-meshed gauze between the layers of absorbent and non-absorbent fibers will allow the development of the tensile and pin strength necessary in a diaper, but will minimize the intermingling of the fibers, thereby maintaining a differential absorbency on the two faces of the product.

This effect may be due to the fact that in the presence of an inner layer of gauze, the fibers in the absorbent layer are forced into the gauze mesh, where they are retained and interlocked by the gauze threads, rather than being translated into the layer of non-absorbent fibers and co-mingled therewith. At any rate, I have found that in the preparation of the product of my invention, the maintaining of a differential or two-faced effect is significantly facilitated by the presence of the gauze layer.

The uniting of the two inside layers with capillary tubes of parallelized fibers of absorbent and non-absorbent fibers, has an unusual effect. Fluid applied to the non-absorbent face is rapidly swept away into the inside absorbent layer of fibers, so that the non-absorbent layer is capable of transmitting and disposing of fluid, without itself becoming wet and soggy. Apparently, this is due to the creation of a multiplicity of small holes or channels, lined with or stuffed with absorbent fibers, where the absorbent fibers connect with and are an extended part of the absorbent fibrous layer, but where the absorbent fibers do not constitute a sufficient portion of the non-absorbent fibrous surface to alter its normally dry condition. In this way, I have found that I can produce a throwaway diaper that has the decided advantage of presenting, during use, a dry, non-soggy, fibrous surface to the infant's skin, thus minimizing skin irritation and diaper rash.

The degree to which the fibrous assemblage is integrated into a poriferous unit will obviously depend on the particular fibers chosen, the degree of strength desired, and other structural considerations. If an outside layer of non-absorbent fibers is used, in order to impart a certain degree of water repellancy, such non-absorbent fibers need be needed to the supporting gauze only in a sufficient number of places to insure that the non-absorbent fibers cannot be readily brushed off or peeled off. In certain diaper constructions, however, I prefer to inter-engage a light layer of non-absorbent and a heavier

5

layer of absorbent fibers together with a prolonged needling action, after which this combination is plied with a layer of gauze and an outside layer of non-absorbent fibers in the usual way.

Example I

Two batts of air-laid, three-denier viscose rayon fibers, each weighing 55 grams per square yard, were prepared on a fiber-randomizing machine and were then plied together with a layer of 32 x 28 bleached cotton gauze between the plies. This assembly was passed through a Hunter laboratory model needle loom equipped with No. 18-25-32 x 2½" regular barb ball-point needles adjusted so that the bottom barb of the needles penetrated ¼ inch below the bed plate. The needles were spaced in 20 rows of ½" apart and the needle board was of the Hunter modified herringbone pattern. The advance of the loom was set at ¼" per stroke. Two passes of the fiber-gauze assembly were made through the machine with settings as above and then the fiber gauze assembly was turned over so that the needle penetration occurred in the reverse direction with respect to the fibrous layer for two more passes with the machine settings exactly as described above. The integrated product weighed 153 grams per square yard, or 22 grams per 17 inch by 12¼ inch cut diaper.

Example II

One batt of raw cotton 20 grams per square yard, 1 batt viscose rayon 1.5 denier 20 grams per square yard, 1 layer of 20 x 12 bleached gauze, 1 batt of 5.5 denier viscose 20 grams per square yard, 1 batt viscose rayon 1.5 denier 20 grams per square yard were plied up in that order. This assemblage was passed through a Hunter laboratory model needle loom equipped with No. 18-25-32 x 3½ inch barb needles adjusted so that the bottom barb of the needles penetrated ¼ inch below the bed plate. A Hunter modified herringbone pattern needle board was used. The advance of the loom was set at ¼ inch per stroke. Three passes of the fiber-gauze assembly were made through the machine with settings as above and then the assembly was turned so that the needle penetration was in the reverse direction for one more pass with the machine settings described above. The integrated product weighed 94 grams per square yard, or 15 grams per 17 inch x 12¼ inch cut diaper.

The functional strength of the above two examples was measured by testing the wet pin-strength, in comparison with a conventional commercial throwaway diaper composed of a layer of non-woven fabric, ten layers of cellulose wadding, and a backing of plastic film. This conventional diaper weighed 22 grams in a 17 inch x 12¼ inch size.

Two-inch wide strips of test material seven inches long were fastened together in a one-inch overlap area by means of a two-inch safety pin passed through both strips in four evenly-spaced holes. By pulling on the unsecured ends of the two strips in an Instron Tensile Tester, the resistance to tearing of the pinned diaper was measured.

The conventional diaper had in this test a wet strength of 3.15 pounds in the long or machine direction and 3.10 pounds in the cross direction. The product of Example I had a wet strength of 10.5 pounds in the machine direc-

6

tion and 6.0 pounds in the cross direction. Example II had a strength of 12.1 pounds in the machine direction and 5.7 pounds in the cross direction.

Thus the diaper of my invention has a toughness and functional strength far in excess of conventional throwaway diapers, yet retains a soft, absorbent quality that makes it eminently suitable for diaper use.

Although my invention has been described for the most part in terms of a throwaway diaper, it can of course be put to a number of allied uses due to its softness, integrity, and high absorbency and capillarity. It can be used as a pad, a towel, a bib, and for other general utility absorbent purposes. Moreover, since it has exceptional wet-strength due to its long fibers and my method of uniting them, my product will withstand several launderings, with no sacrifice in properties, thus combining economy in use with its other desirable features.

It will also be apparent to those skilled in the art that my invention can also be used for the production of unified fibrous diaper-like articles intended for use in connection with a binder or holder, such as baby pants, where the reusable holder provides durability and wet-strength. In such applications, the gauze reinforcement may be omitted, and the fibrous layers are united only sufficiently to provide the desired high capillary transfer, while retaining maximum absorbency and softness.

Having thus described my invention, I claim:

1. An absorbent throwaway diaper structure which comprises an open-mesh, low-count gauze of cellulosic yarns held in spaced-apart relationship to each other and defining apertures therebetween, a batt of textile fibers disposed on each side of the gauze, said batts being made up of multiple layers of fibers, the layers next adjacent the gauze being absorbent fibers and the layers furthest away from the gauze being non-absorbent fibers, the fibers of said batts extending through the apertures in substantial parallelism with respect to each other, said fibers being in greater number density within the apertures than externally thereof, the fibers of the batts and the yarns being mechanically interlocked with each other.

2. An absorbent throwaway diaper structure which comprises an open-mesh, low-count gauze of cellulosic yarns held in spaced-apart relationship to each other and defining apertures therebetween, a batt of textile-length fibers disposed on each side of said gauze, said batts being made up of multiple layers of textile-length fibers, at least one of said batts having a layer of non-absorbent fibers and a layer of absorbent fibers, the non-absorbent fibers layer being disposed outwardly of the gauze, the fibers of said batts extending through the apertures in substantial parallelism with respect to each other and said fibers being in greater number and density within the apertures than externally thereof, the fibers of the batts and the yarns being mechanically interlocked with each other.

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