Aug. 8, 1961 N. L. SELTZER 2,995,154

ELASTIC DIAPER

Filed Jan. 7, 1959

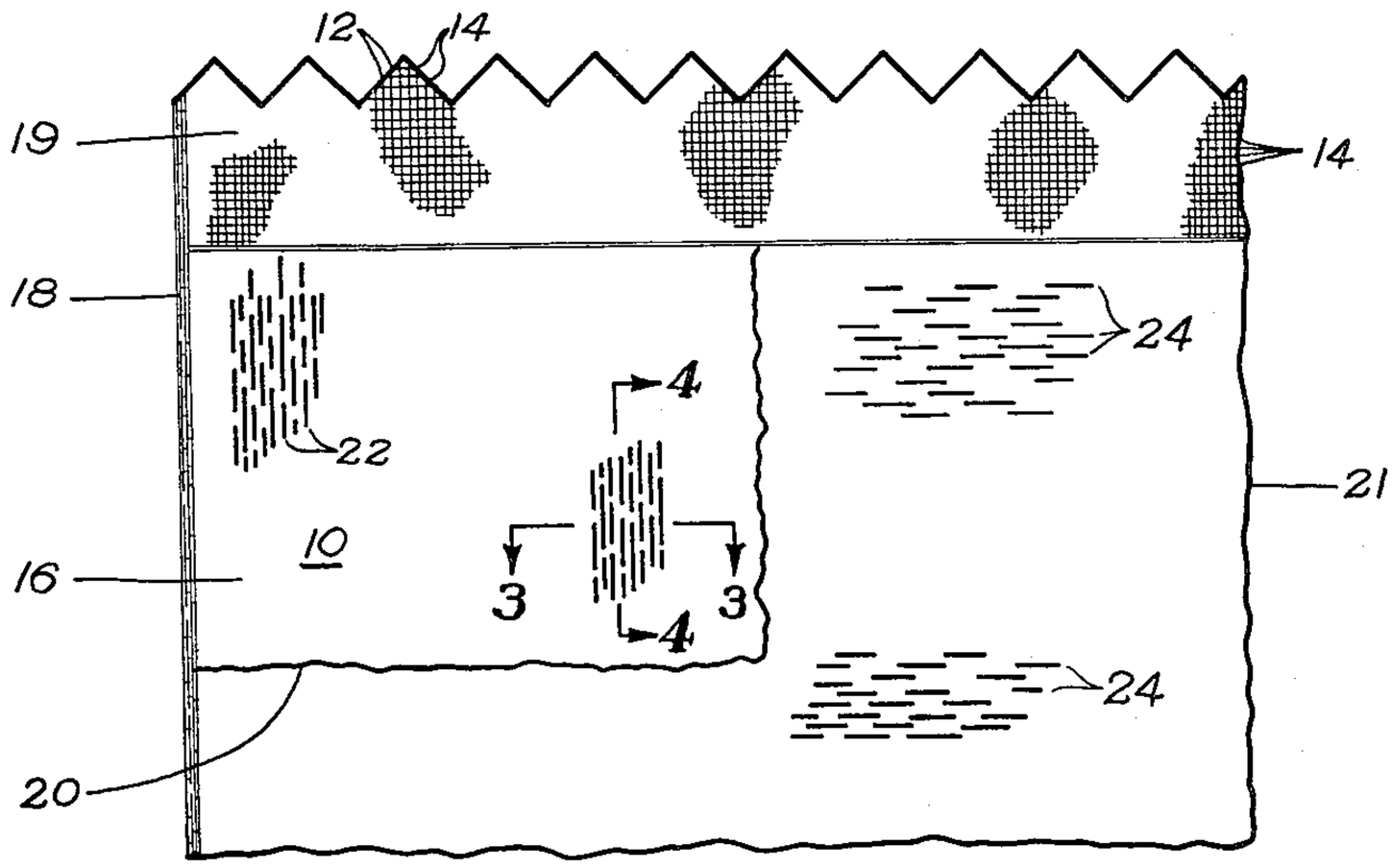

Fig. 1.

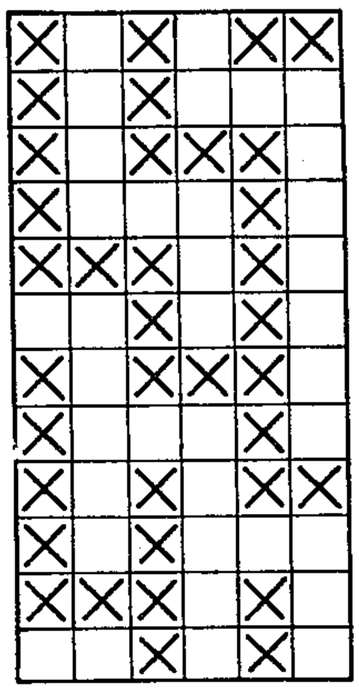

Fig. 2.

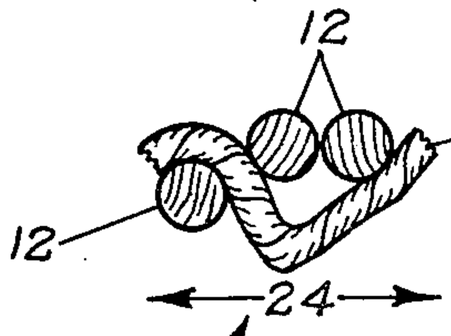

Fig. 3.

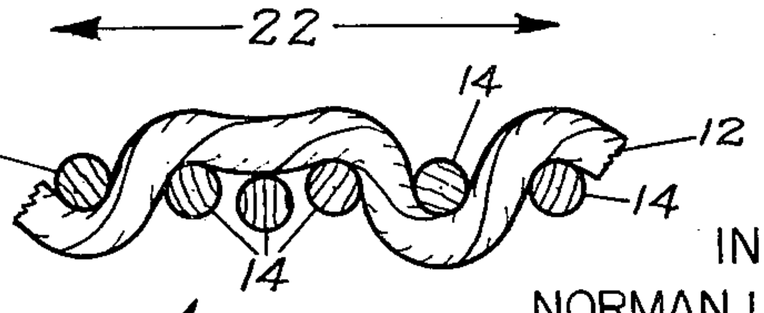

Fig. 4

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ELASTIC DIAPER

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This invention relates to an improvement in the art of producing soft, absorbent fabrics intended for repeated laundering and re-use, such as diapers. More specifically, it relates to a woven diaper which is elastic, comfortable, and conformable, but which is comprised entirely of absorbent yarns, without the utilization of rubber or other nonabsorbent elastomeric material.

In its preferred embodiment, the diaper of the invention conserves the recognized advantages of the popular porous, quick-drying two-layered gauze diaper of commerce, as it is woven of absorbent yarns on conventional gauze diaper looms. In its unstressed condition it may be undistinguishable from an ordinary gauze diaper, yet it possesses certain specific advantages over ordinary gauze diapers, as will be hereinafter set forth. To the best of my knowledge, these specific advantages have never before been realized in the diaper art without the introduction of definite disadvantages which I have discovered how to avoid.

By "gauze diaper of commerce" I mean a type of diaper woven of two layers of open-meshed porous fabric, connected at the edges by the interweave of the selvage, and usually produced by periodically causing the loom to interweave the two layers of gauze as a single layer which can be cut by a pinking apparatus or other device to provide unitary diapers from a loom roll of cloth. Such diapers have certain recognized advantages over single layer diapers of flannelette or birdseye: They are soft, very absorbent per unit weight, easy to wash free of stains, and faster drying. However, in common with single-layered material of heavier unit area weight, prior art gauze diapers have a basic disadvantage in that they are relatively inextensible under stress.

This inextensibility or lack of elasticity or stretch is a particularly series defect in an article of apparel intended for use on an infant. It is well-known that a bady's skin is very sensitive to chafing, and readily susceptible to irritation from tight-fitting garments. The waist line of an infant varies markedly with the feeding and evacuation intervals, so that the snugness and comfort of fit varies periodically during a day, and is best satisfied by a yielding, elastic garment.

Furthermore, prior-art non-extensible woven diapers are subject to shrinkage when wet, so that a comfortably snug fit may be transposed into an uncomfortably tight constriction merely by the absorption of moisture which is the primary function of a diaper.

Finally, the anatomy of a baby is not conducive to the unsupported application of a pinned-on non-extensible fabric diaper. An infant has no projecting hip structure, and its waist line is characteristically the thickest dimension of an infant's body. Therefore, it is almost universal practice to anchor a diaper to a shirt, harness, or similar device, particularly when the infant reaches the toddling stage and the normal downward-slipping tendency of the diaper is aggravated by attempts to walk. The provision of such a suspension device for a diaper is frequently an unecomonic, insanitary, and otherwise undesirable expedient, dictated by the inherent lack of extensibility of prior art diapers. In addition, since infants' shirts are almost universally made of knitted material which is readily subject to ravelling when yarns

are broken or punctured by pins, the constant practice of pinning diapers to shirts rapidly causes the appearance of spreading holes which render such shirts unusuable long before the potentially realizable life of the garment has been reached.

The degree to which this lack of elasticity has been recognized as a disadvantage is witnessed by various prior art expedients to overcome it. Most of these expedients resort either to the use of knitted extensible structures, the use of rubber or other non-absorbent yarns in a woven structure, or a combination of both. None of these expedients has provided a satisfactory solution to the problem of providing an all-absorbent form-fitting conformable diaper which retains the advantages of gauze diapers as set forth above. The use of rubber or rubber-like yarns or bands is undesirable for several reasons: It is uneconomical, inconvenient to weave, and non-durable. While such yarns may provide temporary elasticity, they are liable to deteriorate rapidly by laundering, becoming brittle and nonelastic and tending to fragment. The use of knitted structures is open to the objection that knit goods are notoriously liable to ravelling and rapid propagation of holes caused by the puncturing or breakage of a single yarn in the structure.

The advantages of my elastic conformable gauze diaper are particularly apparent when embodied in a so-called "pre-fold" diaper. In this popular form, a diaper of, for example, 21 x 40 inches in the grey state is folded into the shape and dimensions it would have when applied to an infant, and then is sewn into that configuration permanently. Such diapers are meeting increasing demand and favor among users and on the part of diaper laundries, because of the time saving and convenience that such a design provides. If the diaper is thus fixed into pre-folded shape, there is no likelihood that the lively body movements of the infant will disarrange the fold, either during the pinning-on operation or afterwards.

Such diapers have the disadvantage, however, that they are no longer adjustable in width to accommodate the expanding waist-line of an infant as it grows from month to month. Such adjustment is readily made in a foldable diaper by varying the width of the panel section, but a prefold diaper is of fixed dimensions.

For this reason it has been proposed to make prior-art pre-fold diapers in different sizes to fit an infant at different stages of growth. It is obviously uneconomical to use a different set of diapers for the different stages of an infant's development. Therefore, my provision of a comfortably-fitting elastic diaper that can be made into a pre-fold diaper that fits an infant at different stages of growth is an appreciable advantage over all prior-art woven pre-fold diapers.

The diaper of my invention, furthermore, shows substantially no tendency to wrinkle or corrugate even after many repeated launderings, despite the fact that I preferably employ normal twist yarns in one direction and high twist yarns in the opposite direction, and despite the fact that both sets of yarns have the same direction of twist.

The primary object of the invention is to provide a quick-drying elastic woven diaper, readily extensible in at least one direction, without the use of rubber yarns or knitted sections.

It is a further object of the invention to provide an elastic diaper that adjusts itself to the body contours of an infant under the widely varying demands of conformation that accompany the changes that normally occur during the diaper-wearing stage.

It is another object of the invention to provide a com-

fortably fitting elastic diaper that can be made into a prefold diaper that fits an infant at different stages of growth.

It is a further object of the invention to provide an elastic diaper, the extensibility of which is maintained or even improved with repeated laundering, so that the diaper remains elastic until it is worn out.

It is also an object of the invention to provide a method for the economical production of an elastic gauze diaper on a common gauze diaper loom without additional weaving, sewing, fashioning, etc.

It is a further object of the invention to provide a diaper that can be more easily pinned onto an infant without danger of puncturing the skin.

It is a further object of the invention to provide an elastic woven diaper of all-absorbent yarns that will maintain its position around the body of the infant and resist the tendency to slip downward, even in the absence of any fastening to a supporting garment.

The invention will be better understood by referring to the drawing showing a preferred embodiment of the invention, and to the detailed description of the invention in connection with the drawing.

Referring to the drawing:

FIG. 1 is a plan view of a corner portion of one preferred embodiment of a diaper constructed in accordance with the invention, parts of it broken away,

FIG. 2 shows one repeat of the weave design of the diaper body in draft form,

FIG. 3 is a section, on a much enlarged scale, taken on line 3—3 of FIG. 1 showing a filling float from under two adjacent transverse warp yarns, and

FIG. 4 is a section, also on a much enlarged scale, taken on line 4—4 of FIG. 1 showing a warp float going over three adjacent transverse filling yarns.

Referring to the drawing, the reference numeral **10** designates a two-layer gauze diaper woven of warp yarns **12** and filling yarns **14**. All of these warp and filling yarns are spun of absorbent fibers, either natural or synthetic. The diaper **10** is woven with a body portion **16** composed of two layers, an upper layer **20** and a lower layer **21**, bounded by the common selvages **18**. The two layers are also connected by pinking bar portions **19**, where the layers **20** and **21** are interwoven into a single layer. It is in these bar portions **19**, running across the warp, that individual diapers are made by cutting or pinking in substantially in the center of these portions by any convenient device. The pinking bar portions **19** are preferably woven in a plain weave to give added durability in laundering to the cut edges of the diaper. The upper layer **20** and lower layer **21** of the body portion are woven in a design employing warp floats **22** and filling floats **24**. By "float" is meant that portion of a yarn that passes over or under at least two adjacent transverse yarns. These floats may be arranged in an orderly manner to produce a simple repeating pattern. For best results, however, a randomized float pattern is preferred. This randomized weave pattern has the advantage of breaking up any continuous diagonal or transverse strips or striations that would otherwise result from the employment of floats in an ordinary fashion. Of course, the teaching of my invention as herein disclosed is not limited to weave patterns employing floats, whether randomized or not. That is, the elastic extensibility in my diaper may be achieved by the utilization of a variety of weave patterns, even where the weave repeat incorporates only two warp threads and two filling threads.

I prefer to employ cotton yarns in both the warp and the filling, with yarn counts for both being between 20/1 and 40/1. My preferred diaper is woven with 45 sley and 36 picks per inch per layer. The size of the diaper in the grey woven state is about 21 x 40 inches, which means about 21 inches in the warp direction and about 40 inches across the diaper in the filling direction. After finishing by usual standard diaper techniques, the diaper

measures about 21 x 32 inches. For the warp yarns, normal twist multiples between 3.80 and 4.75 are used, with a twist multiple of 3.80 being preferred. In the filling, I employ a high twist yarn with a twist multiple between about 4.75 and 6.75, with a twist multiple of 6.25 being preferred. (The twist multiple equals the twist turns per inch of yarn divided by the square root of the yarn number of the cotton system.) The high twist multiple filling yarns, or as more commonly referred to and known as crepe yarns, may be made, among others, as described in Dworsky et al., U.S. Patent No. 1,823,034 granted September 15, 1931, or Lawton, U.S. Patent No. 1,823,053 granted September 15, 1931. However, in utilizing the methods set forth in said patents, the twist multiple of my elastic yarns should be limited, as mentioned above, to not greater than about 6.75. Of course, one may interchange the normal and the high twist yarns by weaving the high twist yarns in the warp and the normal twist yarns in the filling. Furthermore, one may employ high twist multiple yarns in both the warp and the fill. The twist multiples in both the warp and the fill may be the same or there may exist a twist differential between the two sets of yarns. For instance, for the warp, one may use high twist yarns with twist multiples between about 4.75 and 5.25, and, in the fill, yarns with twist multiples between about 5.25 and 6.75. This latter construction will produce a diaper that will have elastic extensibility in both the warp and the filling direction with the extensibility being greater in the filling direction. This elastic extensibility in the filling direction encompasses a range from about at least 15 percent to about 60 percent.

The highly twisted yarns, while capable of imparting the desired elasticity to a diaper constructed as I have indicated above, are inherently not as soft and non-chafing as yarns of lower twist. Therefore, if they appear on the face of the diaper that comes in contact with the infant's skin, they are liable to present an irritating and uncomfortable surface, instead of the soft cushion-like effect afforded by the lower twist yarns.

I have found that I can practically eliminate the potentially abrasive effect of these high-twist filling yarns by the use of a weave in which I so dispose the high twist yarns that, although numerically they constitute half or almost half of the total yarns of the fabric, they cover one-third or less of the outside diaper faces which come in contact with the baby's body. Furthermore, due to the high twist I impart to them, where these high-twist yarns do appear on the surface of the diaper, in use they rapidly become imbedded down in and among the softer yarns, thereby still further minimizing their contribution to the coverage of the surface. This may be best explained by reference to FIGS. 3 and 4. These figures represent sections of the upper layer of the body of the diaper along the respective lines indicated in FIG. 1, showing the disposition of the warp and filling yarns relative to each other on a much enlarged scale. Sections of the lower layer **21** would be similar, except turned upside down.

In FIG. 3, it is particularly noticeable that the high-twist elastic filling yarn **14**, by its inherent elasticity arising from its tendency to bend and crimp, crowds the softer warp yarns **12** into tighter relationship relative to each other so that they edge out of the plane of the fabric. These softer warp yarns **12** are the ones that do impart the soft feeling to the touch so desirable in a diaper. By disposing them in accordance with this invention, these softer yarns are brought into a position where they dominate the body-contacting faces of the diaper. In this way, the desirable surface softness is enhanced to an extent that is not obvious or predictable from a consideration of the geometry of the basic weave. At the same time, the functional filling yarns which impart elasticity to the fabric are protected by the imbedding action from abrasion to which they would otherwise be exposed in laundering, thereby prolonging their durability and maintain-

ing their elasticity for the normal life of the diaper. This dual benefit is an unexpected and unanticipated result of the practice of this invention.

In FIG. 4 is shown a warp float **22** going over of at least three filling yarns **14**. By the combined effect of the warp floats, on the one hand, and of the protuberance and close alignment of the warp yarns in the outer surface of the diaper, on the other hand, I succeeded in designing a diaper that maintains all of the desirable characteristics of a woven gauze diaper. At the same time, my diaper also incorporates the added advantage of elastic extensibility and high degree of conformability, characteristics previously found only in diapers employing rubber or other elastomeric yarns or knitted sections.

Referring to the weave structure of the upper layer **20** of the two-layer body portion **16** of the diaper as shown in FIG. 1, the drawing shows the predominance of the warp floats **22** at the outer surface of the upper layer **20**, which likewise is the outer surface of the diaper **10**. This predominance of the warp floats **22** results in having at least about two-thirds of the warp yarns **12** on the outer surface with only about one-third of the filling yarns being on the same surface. The reverse side of the same upper layer has about two-thirds of the filling yarns **14** in the form of filling floats **24** with only about one-third of the warp yarns being present in this reverse side. This same weave construction applies likewise to the lower layer **21**, where we see the filling floats **24** facing the filling floats of the upper layer **20** representing the inner faces of the diaper. The lower, outer surface of the lower layer **21** is likewise covered predominantly with the warp yarns **12** in the form of warp floats **22**.

By this method of burying about two-thirds of the length of the harsh filling yarns **14** on the inside faces of the diaper, its surface softness and comfort in wearing are much enhanced, while the desired elasticity is maintained throughout repeated launderings. It is, of course, possible to float the softer warp yarns **12** over a greater number of filling yarns **14** than is shown in FIG. 4. I find, however, that, with the use of longer floats, the durability and wear-resistance of the diaper fabric are materially decreased.

It is also possible to arrange the warp floats in an orderly fashion so that a simple repeating pattern is established. For maximum softness, however, I prefer to break up the pattern in as random a manner as is consistent with economy in manufacture. By this randomization, the possibility of the filling yarns coacting in definite arrangements to set up diagonal or transverse strips or striations in which the harsh yarns appear at regularly repeated intervals is prevented, or, at least minimized. The diapers of the invention, furthermore, evidence substantially no tendency to corrugate on their body surfaces, despite the employment of these high-twist yarns.

It is my theory that the diaper constructed in accordance with my invention remains in substantially flat condition on its outside surfaces due to the fact that the high-twist yarns are largely buried on the inside of the diaper. There, when the diaper is untensioned, i.e. when it is in a relaxed state, these high-twist yarns bend and crimp on the inside faces of the diaper. This, however, does not in any way affect the appearance of the outside surfaces of my diaper—that is, these outside surfaces remain substantially flat and devoid of wrinkles or corrugations—presenting a smooth and pleasing appearance, as well as a comfortable feeling to the skin of the user. The bends and crimps of the high-twist yarns formed on the inside faces of the diaper function like a series of little springs imparting a springly elasticity to my diaper. When the diaper is put under tension, i.e. when it is stretched, these bends and crimps will straighten out and the diaper gives, i.e. extends, in the direction of the stretch. When the forces of stretch are released, these high-twist yarns progressively resume their former bends and crimps, and the diaper, as a result, contracts.

The high-twist yarns may, if desired, be buried only on one of the outside surfaces, preferably that which is to be in contact with the baby's skin. Alternatively, these yarns may be buried over only a portion of one or both outside surfaces.

A structure as set forth in my preferred examples has an unexpected softness and surface dominance of warp yarns that are not obvious from the geometry of the fabric. The reason seems to be that the tightly twisted filling yarns on repeated laundering tend to distort the softer yarns and bring these softer yarns more effectively to the surface, as shown in FIG. 3 and as set forth in detail above. Whatever the mechanics of the effect may be, it is apparent that the greater stresses set up in the tightly twisted filling yarns result in a gradual increase in the percentage of surface area occupied by the softer warp yarns. The net result is that, unlike prior art elastic diapers, my diaper becomes softer and more absorbent with repeated laundering.

Another important advantage of the invention over prior art elastic diapers is that all yarns are absorbent and remain so throughout the life of the garment. Since moisture absorbency is the basic function of a diaper, the provision of elasticity through absorbent yarns is a significant economic advantage, as well as it represents a marked advance in the diaper art.

Still a further and unexpected advantage of the diaper of this invention is that its elasticity is not only maintained but enhanced as the diaper is subjected to repeated laundering. When the diaper is first used, it may have a dimension of about 21 x 32 inches with an elastic extensibility of about 8 inches in the filling direction, amounting to about 25 percent extensibility. After about 50 home launderings, the same diaper will have dimensions of about 19 x 25 inches with an elastic extensibility of about 14 inches in the filling direction, amounting to about 56 percent extensibility.

The elastic diaper of this invention may be applied to an infant with a degree of convenience and safety hitherto unattainable in an all-gauze diaper. First, there is less need to secure the diaper to an upper shirt or suspending device, which is a cumbersome annoyance. In addition, the two overlapped edges of the diaper can be readily pulled away from the baby's body, so that the pin can be inserted and fastened without danger to the baby's skin or to the applier. On release, the diaper will reconform to the body of the baby and will stay snugly in place.

Having thus described my invention and the advantages thereof, I do not wish to be limited to the details herein disclosed, except as set forth in the appended claims.

I claim:

1. An elastic multi-layer gauze diaper comprising a body portion stretchable in at least one direction and woven of absorbent warp and filling yarns, said warp yarns having a twist multiple not exceeding 4.75 and said filling yarns having a twist multiple in excess of 4.75 but not greater than 6.75, said filling yarns possessing elastic extensibility and being interwoven with the warp yarns in the diaper body portion to incorporate in the diaper body portion an elastic extensibility in the filling direction of from about at least 15 percent to about 60 percent after repeated laundering, said filling yarns being disposed between the two exterior faces of the diaper body portion so that not more than about one-third of said exterior faces are covered by said high twist filling yarns.

2. An elastic multi-layer gauze diaper comprising a body portion stretchable in at least one direction and woven of sets of absorbent warp and filling yarns, one of said set of yarns having a twist multiple not exceeding 4.75 and the other set of yarns having a twist multiple in excess of 4.75 but not greater than 6.75, said other set

of yarns possessing elastic extensibility and being interwoven with said one set of yarns in the diaper body portion to incorporate in the diaper body portion an elastic extensibility in the lengthwise direction of said other set of yarns of from about at least 15 percent to about 60 percent after repeated laundering, said other set of yarns being disposed between the two exterior faces of the diaper body portion so that not more than about one-third of said exterior faces are covered by said other set of yarns.

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