

[54] **DISPOSABLE DIAPER WITH IMPROVED ADHESIVE CLOSURE SYSTEM**

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[51] Int. Cl. **A61f 13/16**

[58] Field of Search **128/284, 287**

[56] **References Cited**

UNITED STATES PATENTS

2,788,786	4/1957	Dexter	128/284
2,834,347	5/1958	Connally	128/284
3,180,335	4/1965	Duncan et al.	128/287
3,554,195	1/1971	Barnes	128/284
3,612,055	10/1971	Mesek et al.	128/287

Primary Examiner—Aldrich F. Medbery

[57] **ABSTRACT**

A disposable multi-layer diaper is provided which has

an improved closure system that enables the diaper to be secured in close conformity around the waist and thighs of an infant. The diaper is rectangular in overall configuration, and includes a porous facing layer at one side thereof, a water-impervious backing layer at the other side thereof, and an absorbent pad sandwiched between the outer layers. The closure means is provided by exposed adhesive areas on the facing layer, which have a length greater than their width, and which are positioned at one end of the diaper adjacent the corners thereof. In one embodiment the adhesive areas are provided by one of the tacky sides of double faced adhesive tape, and in a second embodiment the adhesive areas are provided by an adhesive material that soaks through the facing layer to the backing layer. With either embodiment, when the diaper is placed upon an infant with the ends of the diaper being positioned around the infant's waist, the adhesive areas on the facing layer are pressed against an adjacent portion of the backing layer at the opposite end of the diaper to provide a hidden and protected variable length closure that fits snugly around both the waist and the thighs of the infant.

16 Claims, 5 Drawing Figures

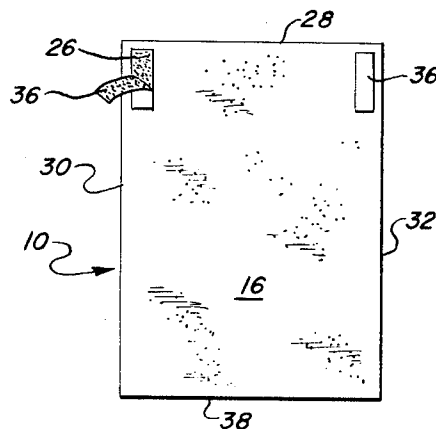


FIG. 1

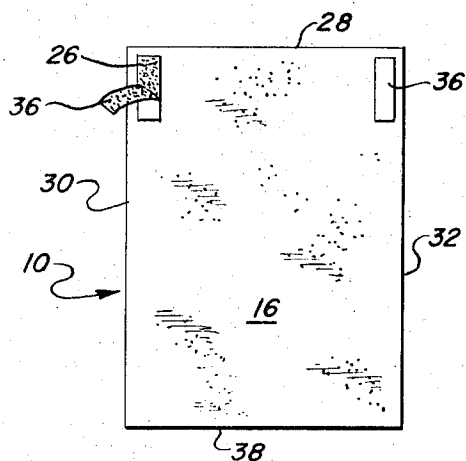


FIG. 2

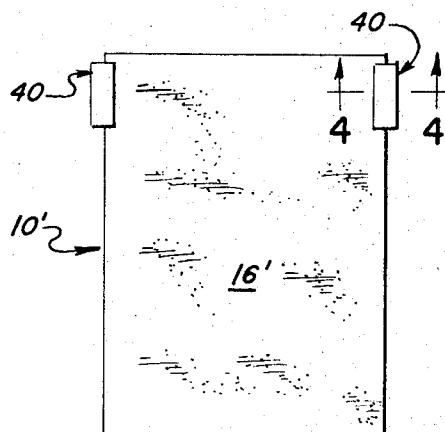


FIG. 3

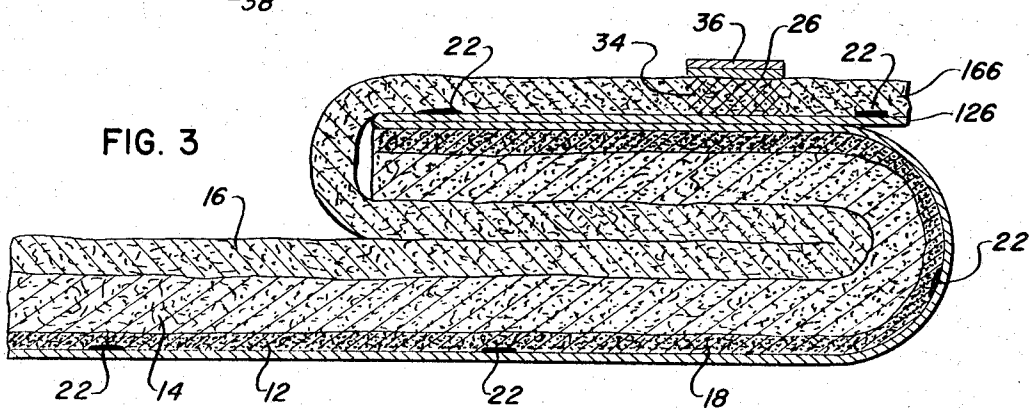


FIG. 5

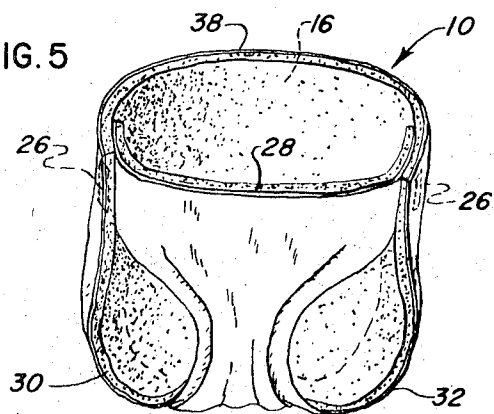
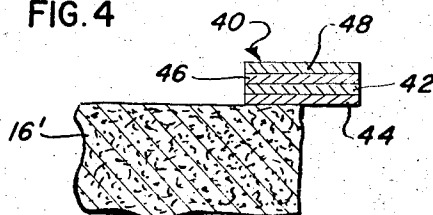


FIG. 4



DISPOSABLE DIAPER WITH IMPROVED ADHESIVE CLOSURE SYSTEM

BACKGROUND OF THE INVENTION

The diaper industry has long recognized the problems associated with the use of so-called "safety" pins to secure a diaper upon an infant. Such pins are not only unsafe for both the baby and the mother, but also are often difficult to force through the diaper material, particularly after an extended period of use when the formerly pointed end of the pin tends to become blunt. The use of pins has become even a more serious problem with the advent of disposable diapers, since the materials used in such diapers often do not have sufficient inherent strength to prevent the pins from tearing out.

Many expedients have been proposed to obviate the necessity of using pins, and those expedients requiring the use of extraneous fasteners such as snaps, zippers, etc. have met with a notable lack of commercial success because they significantly increase the cost of the diaper, and because they usually lack the capability of being able to adjust the diaper to fit snugly around the torso of an infant. To obviate the problems that are inherent in closure systems utilizing such extraneous fasteners, it has long been desired to use an adhesive closure system, and many of such systems have been proposed, as is briefly described below. However, for various reasons, to date none have proven entirely satisfactory.

One of the most successful adhesive systems that has been developed to date, is that shown in commonly assigned Mesek et al. U.S. Pat. No. 3,612,055 wherein adhesive strips that are adhered to the backing sheet extend laterally outwardly from opposite sides of the diaper at one end thereof, with the exposed areas of the adhesive strips having a release member thereon that is readily separable from the adhesive strips. It will be appreciated that when a diaper of this type is placed on an infant, so that one corner of the diaper is positioned adjacent the exposed adhesive area, the diaper can be pulled into snug engagement with the waist of the infant and the adhesive engaged with the appropriate adjacent portion of the backing sheet to thereby, in effect, provide a closure that is variable in circumference. However, while such taping systems provide for a circumferential adjustment about the waist of the infant, they do not provide a means which enable the diaper to be placed in snug engagement with the thighs of the infant. Also, the adhesive closure is positioned externally of the diaper, so as to be accessible to the infant who can pull the closure open.

Illustrative forms of other prior art adhesive systems that have been proposed are disclosed in U.S. Pat. Nos. to Miller 2,627,858, Le Bolt 2,649,858, Duncan et al. 3,180,335 (Re. 26,151), and Torr 3,638,651. The adhesive systems illustrated in the Miller and Duncan et al. patents are objectionable in that each utilizes a tape strip that is positioned externally of the diaper when it is secured in place, so as to be accessible for opening by an infant. The Le Bolt and Torr adhesive systems are superior to the Miller and Duncan et al. systems, in that both provide internal closures which are not accessible to an infant, but in each case neither closure system provides a lengthwise adjustment enabling the diaper to be positioned in close fitting engagement around the

thighs of the infant. The Le Bolt arrangement has the still further disadvantage of requiring adhesive areas to be adhered to one another, and the Torr arrangement has the still further disadvantage of not providing a release layer over the adhesive areas.

SUMMARY OF THE INVENTION

The closure system of the diaper of the present invention represents an improvement upon known types of adhesive closure systems for disposable diapers by providing a means whereby the sides of the diaper can be adjustably positioned in close conformity with the infant's thighs, with the ends of the diaper being adjustably positioned in snug engagement around the infant's waist. To achieve this, the diaper includes elongate adhesive areas that face outwardly from the corners of the facing layer of the diaper at one end thereof. When the diaper is positioned around the torso of an infant, and the ends of the diaper are brought together around the infant's waist, the end of the diaper opposite to that having the adhesive areas is positioned beneath and secured to the opposite end of the diaper by the adhesive areas. Since the adhesive areas have a significant lengthwise dimension, a variable length closure is defined which enables the sides of the diaper to closely conform to the infant's thighs. In this regard, for a small infant, the entire length of the adhesive areas would be used to secure the diaper in place, whereas with a relatively large infant, only a small portion of the adhesive areas need be used. The aforementioned arrangement also provides a means for insuring that the diaper will be positioned snugly around the infant's waist, since the ends of the diaper can be pulled tightly around the infant's waist before the adhesive areas are joined to the backing layer.

The improved adhesive closure system of the present invention can be provided by strips of double faced tape each having one of its tacky faces adhered to the facing layer, and the other of its tacky faces providing an adhesive area for bonding to the backing layer. This arrangement has particular utility with facing layers formed of polyester materials, since these materials have sufficient inherent strength to withstand stresses imparted to the diaper during use. For facing materials having less inherent strength, the present invention contemplates that the adhesive areas will be provided by an adhesive material that soaks through the facing layer and bonds to the backing layer. This arrangement takes advantage of the inherent strength of the backing layer to insure that the adhesive closure means will be secure.

In both of the above-described arrangements, when the diaper is secured in place the closure means is present within the interior of the diaper, and thus is not accessible for opening by an infant.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top plan view of a first embodiment of the invention, with the diaper being laid out flat;

FIG. 2 is a top plan view of a second embodiment of the invention, with the diaper being laid out flat;

FIG. 3 is an enlarged cross-sectional view of the diaper of FIG. 1 subsequent to its being folded for packaging;

FIG. 4 is an enlarged, fragmentary cross-sectional view taken generally along line 4—4 of FIG. 2; and

FIG. 5 is a perspective view of the diaper of FIG. 1 in the position it assumes when placed upon an infant.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

While this invention is susceptible of embodiment in many different forms, there is shown in the drawings and will herein be described in detail preferred embodiments of the invention, with the understanding that the present disclosure is to be considered as an 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.

Referring to the drawings, the diaper assembly 10, when fully opened and laid out flat, comprises a lowermost water-impervious sheet 12 which is rectangular in shape, and an overlying facing layer 16 of fibrous material, which is also rectangular in shape, equal in dimension, and coterminous with the impervious sheet. While not critical to the present invention, the diaper also preferably includes a highly water-absorbent fibrous pad, or batt 14, which is also rectangular in shape, but smaller than the facing and backing layers and centrally disposed therebetween. The batt 14 may be formed in accordance with the teachings set forth in commonly assigned Mesek et al. U.S. Pat. No. 3,612,055. As described therein, the batt 14 has a continuous paper-like densified highly compacted lowermost fibrous layer 18. Densified layer 18 is adhered to the impervious sheet by bead lines of adhesive 22 substantially throughout the interface therebetween. Marginal portions 16b and 12b of facing layer 16 and impervious sheet 12, respectively, which extend peripherally beyond the absorbent pad, are also adhered to each other by bead lines 22.

In the preferred embodiment of the invention, moisture impervious sheet 12 is formed of polyethylene having a thickness of approximately 0.001 inch. The sheet may be smooth, or may be embossed to improve its drape and feel. Other suitable flexible moisture-impervious sheets may be used in accordance with the invention, such as, for example, polyethylene terephthalate sheets having a thickness of about 0.0005 inch.

Batt 14 may be formed of loosely compacted short cellulose fibers, such as wood pulp fibers, or cotton linters, or mixtures thereof, which are primarily held together by interfiber bonds requiring no added adhesive, as is known in the art. Briefly, this batt is a low bulk density coherent web of loosely compacted cellulose fibers preferably comminuted wood pulp fibers in the form of so-called "fluff."

The term "short fibers," as used herein, refers to fibers less than about $\frac{1}{4}$ inch in length, in contrast to "long fibers," or "textile length fibers" which are longer than about $\frac{1}{4}$ inch in length, and generally are between about $\frac{1}{2}$ and $2\frac{1}{2}$ inches in length. The former are substantially less costly than the latter. The classification of fibers by length may be carried out by the Clark Classification procedure described in the test manual of The Technical Association of Pulp and Paper Industry (TAPPI-T233 SU64).

The paper-like densified layer 18 of batt 14 is formed by a slight moistening of one surface of the batt followed by the application of pressure thereto. The na-

ture of the batt and of its densified layer and the method of producing the same are described in U.S. Pat. No. 3,017,304, dated Jan. 16, 1962. The thickened densified portions 19 are formed by further compression of batt 14 while it is still moist, as will hereinafter appear.

The composite density of batt 14, including its densified layer 18, should be above about 0.07 gm./cc and preferably between about 0.10 and 0.15 gm./cc. The foregoing density values are applicable to the diaper as produced. In storage and handling, the loft or thickness of the batt is increased to some extent, resulting in lowered densities.

The present invention contemplates that several different types of facing layers may be used. For example, the facing layer 16 may be made up of a mixture of fibers consisting predominantly of inexpensive short cellulosic fibers such as wood pulp fibers or cotton linters, in amounts of about 75 percent to about 98 percent, the balance being textile length fibers such as rayon as described in Mesek et al. U.S. Pat. No. 3,612,055. In such facing layers, the short fibers are in uniform admixture with 2 to 25 percent by weight of textile length fibers, such as 1.5 denier rayon fibers uniformly cut to $1\frac{1}{2}$ inch length. The short and long fibers are randomly and substantially uniformly dispersed and bonded with a bonding agent such as a self-cross-linking acrylic emulsion. The facing web is also treated with a wetting agent to partially counteract the water repellency of the bonding agent and bring the facing layer to the desired degree of wettability. Facing layers of this character are described in greater detail in commonly assigned copending U.S. patent application Ser. No. 729,784 now U.S. Pat. No. 3,663,348, and in the above-mentioned Mesek et al. patent.

Facing layers suitable for use in this invention have fabric weights in the range of 1 to 5 oz./yd.² and densities less than 0.15 gm./cc., generally in the range between 0.05 and 0.10 gm./cc. The dry strength of the facing layer, for a fabric having a weight of about 1.5 oz./yd.², is at least 0.15 lbs./in. of width in the machine direction and at least 0.10 lbs./in. of width in the cross direction. The fabrics have unusually good elongation, loft, softness and drape characteristics in comparison to prior products incorporating any substantial amount of short fibers.

The facing layer 16 may also be an apertured nonwoven fabric formed, for example, in accordance with the teachings in commonly assigned U.S. Pat. Nos. 2,862,251; 3,081,514 and 3,081,515. Briefly, such fabrics are foraminous structures wherein groups or groupings of fibers have been rearranged from a fibrous nonwoven starting web into positions surrounding less dense fabric portions by passage of a fluid through the starting material. The fibers within the groupings are mechanically interlocked, and may be arranged into various patterns, as is well understood by those skilled in the art. A suitable binder may be utilized to help retain the fibers in their rearranged locations, as is also well understood by those skilled in the art. The fabric can be made of naturally occurring fibers, synthetic fibers or blends thereof. Typical facing layers made of a polyester material may have a weight of $\frac{3}{4}$ oz./yd.².

It should also be understood that the facing layer may be formed of nonapertured material, such as a nonwoven isotropic web, sponge, or the like. In all of the aforementioned facings, the materials should be rela-

tively hydrophobic so as to retard wicking within the facing layer.

The diaper of this invention is normally packaged and sold in a folded condition as shown in FIG. 3. Briefly, the side margins 12b and 16b of the impervious sheet 12 and the facing web 16, together with a portion of batt 14, are folded inwardly in a first fold to provide as the uppermost layer of the fold, a portion of the moisture-impervious sheet. This subassembly is then folded outwardly along each edge in a second fold to cover the first folded portion and to expose the edge portion of the facing web as the upper layer of the double fold. In the preferred embodiments, each double fold at the edge of the diaper comprises approximately $\frac{1}{3}$ of the resulting transverse dimension of the folded diaper, leaving approximately $\frac{1}{3}$ of the width of the folded diaper as a central unfolded and uncovered portion.

The diaper is held in its folded condition by two small central spots of adhesive applied between the main body of the diaper and the overlying sides 16b of the facing web, one spot on each folded side of the diaper. When the diaper is to be put on the infant, the folds are opened on one side of each of the adhesive spots, and the open portion of the diaper is put under the infant's buttocks while the folded portion is raised into the crotch region. The final form of the diaper is shown in perspective on a reduced scale in FIG. 5 and the diaper is held in this position by the improved adhesive closure system of the present invention.

The first form of the adhesive system is shown in FIGS. 1 and 3 and includes outwardly facing adhesive areas 26 at opposite corners of facing layer 16 at the upper end 28 of the diaper, as shown in FIG. 1. Adhesive areas 26 are generally rectangularly shaped, and are parallel to one another and to the side edges 30 and 32 of the diaper. The adhesive areas 26 are of equal size, and are substantially longer than they are wide. For example, each adhesive area 26 may be about 2 to 3 inches long, and about $\frac{3}{4}$ to 1 $\frac{1}{2}$ inches wide.

With facing layers of the type described above including a mixture of long and short fibers, in order to insure that the diaper will remain in place, once secured around the torso of an infant, the adhesive areas 26 are preferably provided by saturating opposite corners of the facing layer 16 with a suitable adhesive material, so that the adhesive material is bonded to the backing sheet 12. The present invention contemplates that the adhesive material (which is pressure sensitive and readily adherent to backing sheet 12) may be applied in a dispersion with a suitable solvent, with a sufficient quantity of the dispersion being applied to the facing layer that the dispersion soaks completely through to the backing layer 12. The solvent may then be driven off by heating, to leave the adhesive area 26 exposed and facing outwardly of the facing layer 16, with the adhesive area being anchored to the backing sheet 12 by a column of adhesive material that extends through the cross-sectional thickness of the facing layer 16. Release strips 36, which may be coated plastic or paper members, cover each of the adhesive areas 26 until the diaper is ready to be applied to an infant, at which time the strips 36 are readily removed from the adhesive areas.

The diaper is applied to the infant by positioning the ends 28 and 38 of the diaper around the waist of the infant with the intermediate portion of the diaper being

disposed in the infant's crotch. The ends 28 and 38 may be fanned outwardly from the folded configuration illustrated in FIG. 3, and after the release strips 36 are removed, the diaper ends 28 and 38 are pulled into tight fitting engagement with the infant's waist. The adhesive areas 26 are then pressed against the adjacent portions of the backing sheet 12, and it will be understood that for a relatively small infant pressure is applied to substantially the entire length of the adhesive areas 26 to provide a snug closure around the infant's thighs, while for a larger infant pressure is applied to only a small portion of the length of the adhesive areas 26 to provide the snug closure. In either event, the closure is disposed within the interior of the diaper, in a protected location where it is not readily accessible to the infant.

Instead of providing the adhesive areas 26 by an adhesive material that is soaked into the facing layer 16, a strip of double faced adhesive tape 40 may be used as shown in FIGS. 2 and 4. Each strip 40 includes a suitable carrier 42, with tacky adhesive material 44 and 46 being provided on opposite faces thereof. As is clear from FIG. 4, the tacky face 44 of each strip is secured to the exposed surface of facing layer 16' of diaper 10'. A release strip 48 is secured to each of the adhesive faces 46, and can be readily removed when the diaper is to be used. Tape strips 40 may be disposed in offset relationship with respect to the side edges of the diaper, as shown in FIG. 2, or the tape strips may be positioned completely within the confines of the diaper, in the position shown in FIG. 1. In either event, in use the tacky faces 46 and the tape strips 40 function in the same manner as adhesive areas 26, as described above, to provide variable length, hidden and protected closures.

What is claimed is:

1. A multi-layer diaper comprising: a lofty and foraminous fibrous facing layer at one side of the diaper adapted to be brought into engagement with an infant's skin, said layer being porous to permit liquid to pass therethrough, said layer including a minimum of about 2 percent of textile length fibers, said facing layer having a weight of from about $\frac{3}{4}$ oz./yd.² to about 5 oz./yd.² and a density of from about 0.05 to about 0.15 gm/cc., the fibers of said facing layer being arranged into fiber groups surrounding less dense portions of the facing layer; a water-impervious backing layer at the opposite side of said diaper from said facing layer; means securing said layers in assembled relationship to provide top and bottom edges adapted to be positioned around the waist of the infant and side edges adapted to encircle the thighs of the infant; means for securing said diaper in place around the infant, said means being defined solely by first and second outwardly facing adhesive areas on said fibrous facing layer, said adhesive areas each being provided by one of the tacky faces of a strip of double faced tape, the other of the tacky faces of said strips of double faced tape being adhered to said fibrous facing layer, whereby when said diaper is placed on an infant said adhesive areas may be placed in overlapping relationship with a corner of the backing layer for direct adhesion thereto to provide a closure that is within the confines of the diaper.

2. A diaper as set forth in claim 1 wherein said facing layer is formed of a polyester material.

3. A diaper as set forth in claim 1 wherein said adhesive areas have a length greater than the width thereof,

said areas being parallel with one another and with an adjacent side edge of the diaper.

4. A diaper as set forth in claim 3 wherein said adhesive areas extend outwardly beyond the adjacent side edges of the facing layer.

5. A diaper as set forth in claim 3 wherein said adhesive areas are spaced inwardly from the adjacent side edges of the facing layer.

6. A diaper as set forth in claim 3 wherein said adhesive areas are from about 2 to 3 inches long and from about $\frac{3}{4}$ to $1\frac{1}{2}$ inches wide.

7. A diaper as set forth in claim 1 wherein said facing layer is a bonded web of mixed long and short fibers.

8. A multi-layer diaper comprising: a fibrous facing layer at one side of the diaper adapted to be brought into engagement with an infant's skin, said layer being porous to permit liquid to pass therethrough; a water-impervious backing layer at the opposite side of said diaper from said facing layer; means securing said layers in assembled relationship to provide top and bottom edges adapted to be positioned around the waist of the infant and side edges adapted to encircle the thighs of the infant; means for securing said diaper in place around the infant, said means being defined solely by first and second outwardly facing adhesive areas on said facing layer, said adhesive areas being provided by an adhesive material that is present throughout the thickness of the facing layer and which is bonded to the backing layer, said adhesive areas being spaced inwardly of an adjacent side edge of the facing layer and each having a length greater than the width thereof, said adhesive areas being parallel with one another and extending in a direction parallel to the adjacent side edge of the facing layer; whereby when said diaper is placed on an infant said adhesive areas may be placed in overlapping relationship with a corner of the backing layer for direct adhesion thereto to provide a variable length closure that is within the confines of the diaper.

9. A diaper as set forth in claim 8 wherein said facing layer is a bonded web of mixed long and short fibers.

10. A multi-layer diaper comprising: a rectangularly shaped fibrous facing layer adapted to be brought into engagement with an infant's skin, said layer being a bonded web of mixed long and short fibers and said layer being porous to permit liquid to pass therethrough; an absorbent batt layer positioned in face-to-face juxtaposition with said facing layer, said batt layer being smaller than said facing layer and centered relative thereto; a backing layer positioned in face-to-face juxtaposition with said batt layer, said backing and facing layers being of equal size and coterminous with one another, said backing layer being substantially water-impervious for retaining in said batt layer liquid absorbed therewithin; means securing said layers in assembled relationship to provide top and bottom edges adapted to be positioned around the waist of the infant and side edges adapted to encircle the thighs of the infant; and means for securing said diaper in place around the infant, said means being defined solely by first and second outwardly facing adhesive areas on said facing layer, said adhesive areas being provided by an adhesive material that is present throughout the thickness of the facing layer and which is bonded to the backing layer, said adhesive areas each having a length

greater than the width thereof and extending in a direction parallel to the adjacent side edge and parallel to one another; and a release strip removably secured to each adhesive area, whereby when said release strips are removed and said diaper is placed on an infant said adhesive areas may be placed in overlapping relationship with a corner of the backing layer for direct adhesion thereto to provide a variable length closure that is within the confines of the diaper.

11. A multi-layer diaper comprising: a fibrous facing layer at one side of the diaper adapted to be brought into engagement with an infant's skin, said layer being porous to permit liquid to pass therethrough; a water-impervious backing layer at the opposite side of said diaper from said facing layer; means securing said layers in assembled relationship to provide top and bottom edges adapted to be positioned around the waist of the infant and side edges adapted to encircle the thighs of the infant; means for securing said diaper in place around the infant, said means being defined solely by first and second outwardly facing adhesive areas on said fibrous facing layer, said adhesive areas being provided by an adhesive material that is present throughout the thickness of the facing layer and which is bonded to the backing layer whereby when said diaper is placed on an infant said adhesive areas may be placed in overlapping relationship with a corner of the backing layer for direct adhesion thereto to provide a closure that is within the confines of the diaper.

12. A diaper as set forth in claim 11 wherein said adhesive areas have a length greater than the width thereof, said areas being parallel with one another and with an adjacent side edge of the diaper.

13. A diaper as set forth in claim 12 wherein said adhesive areas are from about 2 to 3 inches long and from about $\frac{3}{4}$ to $1\frac{1}{2}$ inches wide.

14. A diaper as set forth in claim 11 wherein said facing layer is formed of a polyester material.

15. A diaper as set forth in claim 11 wherein said facing layer is a bonded web of mixed long and short fibers.

16. A multi-layer diaper comprising: a rectangularly shaped facing layer adapted to be brought into engagement with an infant's skin, said layer being porous to permit liquid to pass therethrough; an absorbent batt layer positioned in face-to-face juxtaposition with said facing layer, said batt layer being smaller than said facing layer and centered relative thereto; a backing layer positioned in face-to-face juxtaposition with said batt layer, said backing and facing layers being of equal size and coterminous with one another, said backing layer being substantially water-impervious for retaining in said batt layer liquid absorbed therewithin; means securing said layers in assembled relationship to provide top and bottom edges adapted to be positioned around the waist of the infant and side edges adapted to encircle the thighs of the infant; and means for securing said diaper in place around the infant, said means being defined solely by first and second outwardly facing adhesive areas on said facing layer, said adhesive areas being located in close adjacency to a corner of said facing layer; and a release strip removably secured to each adhesive area, whereby when said release strips are removed and said diaper is placed on an infant said adhesive areas may be placed in overlapping relationship with a corner of the backing layer for direct adhesion thereto to provide a closure that is within the confines of the diaper.

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