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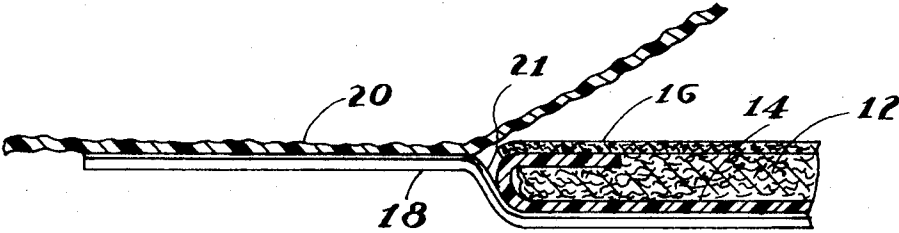
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Primary Examiner—Charles F. Rosenbaum
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[54] **FASTENING ARRANGEMENT FOR DISPOSABLE DIAPERS**
8 Claims, 5 Drawing Figs.
[52] **U.S. Cl.**..... **128/287,**
117/122 P
[51] **Int. Cl.**..... **A61f 13/16**
[50] **Field of Search**..... **128/155-156,**
153, 169, 284, 287, 296; 117/122 P

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ABSTRACT: A disposable diaper of the type having an impervious thin film backing is provided with integral fasteners comprising narrow strips of pressure-sensitive tape characterized by particularly advantageous properties. The tape has an adhesive mass strength of over 400 gms. per ¼ inch width, a tensile strength in the long direction of the strip of at least 10 lbs. per inch of width, and an Elmendorf tear of at least 150 grams in the cross direction of the strip. One end of the strip is attached to the thin film backing of the diaper and adheres thereto so firmly that it will tear a 1 mil thick film rather than release. The other end of the strip extends beyond the diaper edges and is covered with a protective release sheet which adheres to the adhesive with an attachment force of from about 50 to about 300 gms. per ¼ inch of width. This latter force is sufficient to retain the protective sheet on the strip during processing and handling but will permit stripping the sheet off the adhesive without damaging the adhesive, the film backing, or the strip itself when the diaper is ready for use.



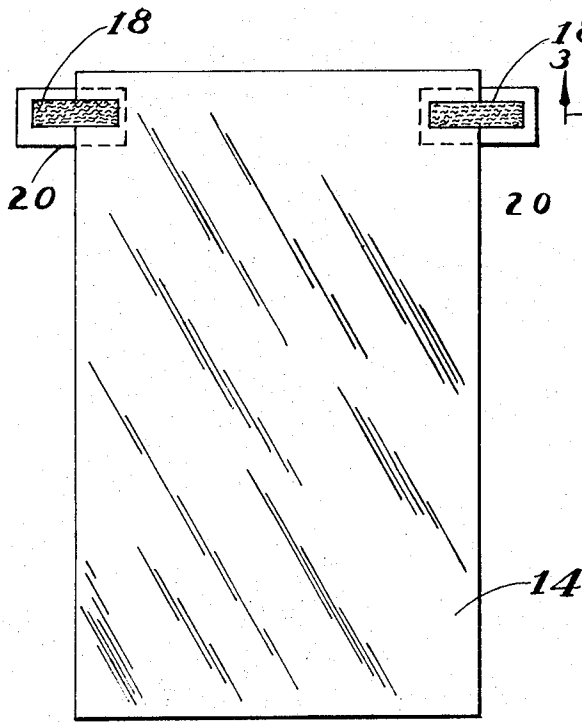


Fig. 1

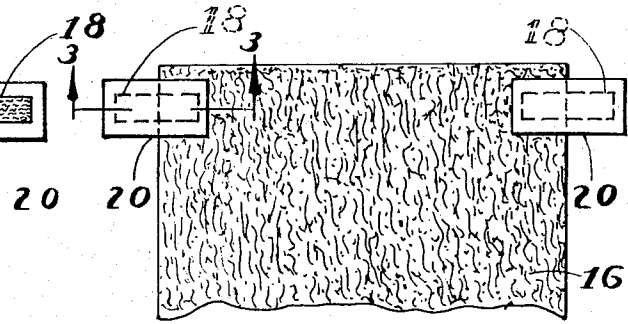


Fig. 2

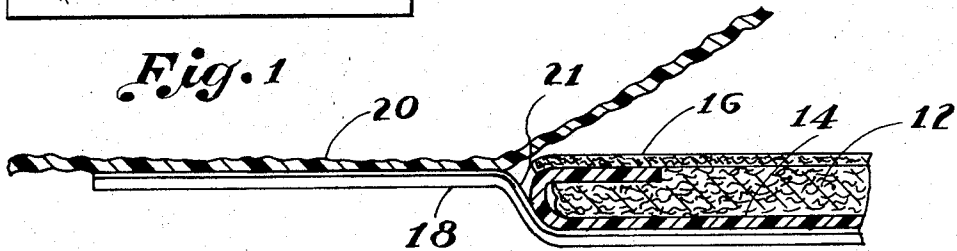


Fig. 3

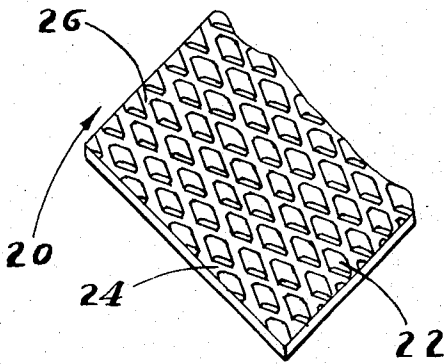


Fig. 4

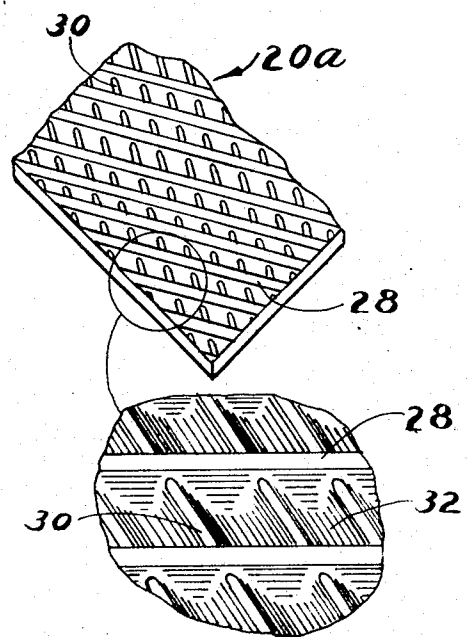


Fig. 5

FASTENING ARRANGEMENT FOR DISPOSABLE DIAPERS

BACKGROUND OF THE INVENTION

In the manufacture of disposable diapers having an impervious thin film backing such as polyethylene, it is highly desirable to provide a positive fastening means other than the old-fashioned safety pin commonly used for that purpose. There is a need for improved fastening, both from a safety and from a convenience standpoint. In addition, it is desirable that such fastener be an integral part of the garment and that an economical method of attachment during manufacture be devised.

It has been suggested that strips of ordinary pressure-sensitive tape would serve this purpose. However, most conventional tapes of this type do not have a sufficiently aggressive adhesive to remain adhered to the surface of polyolefin film such as polyethylene during normal handling. The problem is further aggravated when an embossed film is used to provide more attractive feel and appearance attributes. Consequently, when ordinary tapes are used for such attachment strips, the strips frequently become detached prematurely and are lost before the diaper is ready for use. In addition, once the diaper is in place on the baby, if the adhesive does not adhere firmly, the fastening strip may come loose and therefore be ineffective. When tack is increased to overcome these premature detachment problems, another problem arises in trying to provide a suitable protective release sheet for temporarily covering the adhesive on the unattached half of the fastening strip.

Conventional release sheets for covering pressure sensitive adhesives are designed for easy release. As a result, these sheets tend to become displaced prematurely during handling of the diaper, uncovering the pressure-sensitive mass and causing it to stick inadvertently to a wrong portion of the diaper or to an adjacent diaper in a package, whereupon these diapers may be rendered useless. If the release sheet is designed with sufficient adherent power to stay in place prior to using the diaper, it is difficult to remove the sheet without tearing the other end of the strip from the diaper backing, or causing transfer of adhesive to the protective strip, or rupturing the tape itself. If the protective sheet has a release agent applied on its contact surface to alleviate this problem, the sheet may release too easily, causing the same problems mentioned above, or the release agent may destroy the pressure-sensitive nature of the adhesive upon aging. It is highly desirable, therefore, to provide a strip of tape for diaper fastening purposes in which one end adheres firmly to the film backing of the diaper, and the free end lends itself to easy release from a protective cover strip without destroying the adhesive power of the pressure-sensitive mass.

With this invention there is disclosed a pressure-sensitive tape fastener strip for film-backed diapers which does adhere to the film backing with sufficient firmness to insure against displacement in normal handling and which is provided with a protective cover sheet that can be removed from the portion of the tape it covers without damaging the tape strip, the adhesive mass, or the diaper.

SUMMARY OF THE INVENTION

Pressure-sensitive tape strips normally found suitable for use with diapers usually have a width of from about $\frac{1}{2}$ inch to $\frac{3}{4}$ inch and a length of about $2\frac{1}{2}$ inches to 3 inches. These tapes are ordinarily supplied in the narrow width rolls and cut to the required length for application to the diaper. In such cases the highest tensile strength of the tape runs in the lengthwise or machine direction of the tape roll, and the highest tear strength runs in the crosswise or machine direction of the tape roll. Accordingly, many common tape specifications will meet the required minimum strengths in tear and tensile as specified herein if used in the normal manner. However, if tapes with widths set forth above are used in the machine production of diapers it means that the tape must be applied transversely to the movement of the

diaper through the machine, requiring complicated indexing mechanisms and intermittent stop motions in the machine operation. The use of such complicated machinery would call for an increase in capital expenditure, and the intermittent operation would result in increased cost of operations, neither of which is desirable.

In accordance with this invention, it has been found that by utilizing a tape stock whose width is equal to the length of the strip required, i.e., $2\frac{1}{2}$ inches to 3 inches, and by cutting narrow strips from this wider tape stock, i.e., $\frac{1}{2}$ inch to $\frac{3}{4}$ inch, the tape can be applied from rolls of tape arranged to turn in the same direction the diaper is moving through the machine. Application to the diaper, therefore, is greatly facilitated, the machine may be operated continuously without stop motion, and the capital expenditures are minimized. However, when tape is applied in this fashion, tear strength across the narrow dimension of the resulting strip is normally poor and tensile in the long dimension of the resulting strip is also poor, as might be expected. Ordinary tape, therefore, cannot be used, and special attention must be given to providing higher tear and tensile properties. In this regard, it has been found that wide tape stocks with a machine direction tear of at least 150 gms. (this is the cross direction of the tape strip) and a tensile strength of at least 10 lbs. per inch of width in the cross direction (this is the long direction of the tape strip) is suitable.

In addition to having the above requirements with respect to tensile and tear, the tape must have sufficient adhering power to the surface of polyethylene or similar film used for the diaper backing so that it does not release prematurely. An adhesive mass strength of at least 400 grams per $\frac{3}{4}$ inch width has been found suitable. This characteristic is determined by applying the tape to a smooth polyethylene surface with pressure from a steel roll $1\frac{3}{4}$ inches wide, 4.0 inches in diameter, and weighing $4\frac{1}{2}$ pounds, and then measuring the stripping force required.

A tape having such tack or adhering strength will tear a polyethylene film of 1 mil thickness rather than release therefrom. Film used for diapers usually is 1 mil thick or less, although some thicker specifications have been used.

Pressure sensitive adhesive masses, including natural rubbers and/or synthetics, can be formulated by known means by persons skilled in the art, to achieve a tack of the required degree. Tack can also be improved by making the polyethylene surface itself more acceptable of adhesives applied thereto, by treating the surface with corona discharge or by chemical or physical modification, also well known in the art.

Still another requirement is to provide a protective release sheet for the unattached portion of the tape strip which will stick to the adhesive during normal handling but will readily release therefrom when ready to apply the diaper. Conventional planar surface sheets having a release surface, or treated with a release agent, were generally found to pull away too easily, and such sheets tended to fall off prematurely during processing or handling. Planar sheets of polyethylene used as protective covers were found to adhere tightly to the tape strip having the higher adhesive mass strength as set forth above, but could not be removed without damage to the strip or diaper. However, if the polyethylene protection sheet is provided with raised embossments of limited area and applied to the adhesive in a manner such that only the raised embossed portions contact the adhesive, the effective peeling width and concomitant adherence is reduced to an extent that the embossed strip will remain attached during processing, yet may be removed when necessary. By peeling width is meant the width of the contact area of the embossed polyethylene to the pressure sensitive adhesive transverse to the direction of peeling.

When the raised embossments comprise $33\frac{1}{3}$ percent of the surface area in contact with the pressure sensitive adhesive mass, and the individual contact points have a peeling width of about 1.5 mm., attachment force of a tape normally having

about 400 gm. per $\frac{1}{4}$ inch of width attachment force to smooth polyethylene is reduced to about 300 gm. per $\frac{1}{4}$ inch of width. When the raised area of the embossments still comprise 33 $\frac{1}{3}$ percent of the surface area of the embossed strips, but contact of the individual embossments is reduced to about 0.2 mm. peeling width, attachment force is reduced to about 50 g. per $\frac{1}{4}$ inch of width. When the raised area embossments with the 0.2 mm. peeling width are placed closer together so that they comprise 50 percent of the surface area, the attachment force is in the neighborhood of 150 g. per $\frac{1}{4}$ inch width.

In summary, the invention comprises a film-backed disposable diaper with improved integral fasteners comprising strips of pressure-sensitive tape attached to the film backing at opposite edges of one end of the diaper. One end of each strip is attached to the film backing by means of the pressure sensitive adhesive which is formulated to have an adhesive mass strength of over 400 g. per $\frac{1}{4}$ inch of width. The other end of the strip extends beyond its respective edge of the diaper and is covered with a protective release sheet which adheres to the pressure sensitive adhesive with an attachment force of from about 50 g. to about 300 g. per $\frac{1}{4}$ inch of width. The reduced attachment force of the protective release strip may be obtained by providing a polyethylene sheet with raised embossments of limited area to contact the adhesive. The tape strip has a tensile strength in its long direction of at least 10 lbs. per inch of width, and an Elmendorf tear of at least 150 grams in the cross direction of the strip.

Accordingly the primary object of the invention is to provide an improved integral fastening device for film-backed disposable diapers.

Another object is to provide a fastening tape for diapers with a release sheet of improved function.

Still another object is to provide a fastening tape for diapers which may be more economically applied during manufacture.

These and other objects will become apparent by reference to the following specification and drawings wherein there are described various selected embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of the back side of a disposable diaper showing a pair of pressure-sensitive tape strips affixed to the film backing near the side edges of the diaper at one end thereof.

FIG. 2 is a partial plan view of the front side of the top portion of the diaper of FIG. 1.

FIG. 3 is a section taken along lines 3—3 of FIG. 2.

FIG. 4 is a perspective view of a suitable protective cover sheet showing a typical embossing pattern for contact with the pressure sensitive adhesive.

FIG. 5 is a perspective view showing another typical embossing pattern for a protective cover sheet with a selected portion thereof greatly enlarged.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The disposable diaper having the improved fastening devices of this invention applied thereon may be of conventional construction comprising a main absorbent pad 12 consisting of wood pulp fluff, layers of cellulose wadding, absorbent cotton fibers, and the like. Pad 12 has a thin impervious film backing 14, which typically may be pigmented and embossed 1 mil polyethylene. The outer surface of the film backing 14 may also be treated by corona discharge or the like to provide a surface more receptive to adhesive. Film backing 14 is usually at least coextensive with the pad but preferably extends around the edges of the pad and partially overlaps the top of the pad. The top surface of pad 12 is covered with a fluid pervious sheet 16 which is usually of nonwoven construction and may be hydrophilic or hydrophobic. Cover sheet 16 may be attached to film backing 12 either on top of the overlapping edge as shown in FIG. 3 or underneath the over-

lapping edge as shown in FIG. 3 or underneath the overlapping edge. In other constructions cover sheet 16 may extend around the sides of pad 12 and be attached on the bottom side of the diaper either over or under film backing 12, or cover sheet 16 and film backing 12 may extend beyond the diaper edges and be heat sealed together.

Near one end of the diaper and at opposite edges thereof are attached narrow strips 18 of pressure-sensitive tape with one end extending beyond the respective edges of the diaper with the pressure sensitive adhesive coating 21 on the surface of these extensions covered by a protective cover sheet 20 which preferably is embossed polyethylene as further described below. The cover sheet is usually wider and longer than the tape to provide a convenient handle for removal. The inwardly disposed end of the cover sheet preferably extends over the face of the diaper.

Typical embossing patterns for the protective sheets are shown in FIG. 4 and FIG. 5. In FIG. 4 the face of cover sheet 20, which is about 6 mils thick, comprises a plurality of raised diamond shaped embossments or land areas 22 separated by intersecting sets of parallel channels or grooves 24 and 26. It is this face of the cover sheet 20, and consequently only raised embossments 22 which contact adhesive 21 when sheet 20 is in place, and which provide the effective peeling width. Typical dimensions of the diamonds in the pattern shown in the drawing are about 1.5 mm. from point to point of the narrow dimension and 2.5 mm. from point to point of the wide dimension.

In FIG. 5, the face of the cover sheet 20a comprises a plurality of parallel raised lines 28, intersected by a plurality of parallel lines 30, which lines 30 are in a lower plane than lines 28, and still deeper diamond-shaped embossments 32 which the intersecting lines 28 and 30 define. Typical width dimensions of the raised lines 28 is about 0.2 mm. When the face of this cover sheet is placed in contact with adhesive 21 only the raised lines 28 adhere thereto, and the effective peeling width of the individual lines is 0.2 mm.

The pressure sensitive adhesive mass 21 is compounded from natural or synthetic rubber or the like, by methods known to persons skilled in the art, to have an adhesive force of at least 400 g. per $\frac{1}{4}$ inch of width; i.e., 400 g. of force are needed to strip a 182 inch wide tape having such an adhesive coating from a smooth polyethylene surface when applied as previously defined. When tape with such a coating is applied to 1 mil thick polyethylene film, it will normally tear the film rather than release therefrom.

The preferred base sheet material for the tape strip is a latex-impregnated paper having a high delamination resistance and high internal or edge tear. Base sheets of this type are generally defined in assignee's U.S. Pat. Nos. 3,026,241; 3,026,217; and 3,066,043. Such tapes generally comprise a sheet of cellulose fibers impregnated with an elastomeric polymer such as polymers and copolymers of conjugated dienes, natural rubber, and the like. Other suitable base sheets for the tape including nonfibrous films such as vinyl plastics, cellophane, cellulose esters, polyethylene terephthalate or similar polyesters, and the like, may be employed as long as they have the tensile and edge tear characteristics mentioned above. Also usable are woven and impregnated fabrics such as cotton fabric, synthetic fiber fabrics, glass fabrics and the like, and nonwoven and impregnated fibrous webs such as carded webs of natural fibers, self-bonded synthetic fiber felts and the like. However, the invention is particularly useful in connection with the more economical-type tapes in which the base sheet is made from paper stock which has been treated with a saturant to unify the fibers and which imparts internal strength and resistance to delamination.

If such latter tapes are used in the 2 $\frac{1}{2}$ inches to 3 inch widths mentioned earlier and cut into $\frac{1}{2}$ inch to $\frac{3}{4}$ inch strips for application to the diaper, the fibers in the tape are generally aligned transverse to the cut strips and the major tensile strength is in the cross direction of the cut strips, accordingly care should be taken to select a tape which meets

the minimum strengths previously mentioned, i.e., an Elmendorf tear of at least 150 g. in the width or cross direction of the strip and a tensile strength of at least 10 lbs. per inch of width in the long direction of the strip.

A suitable protective cover sheet for the pressure sensitive mass polypropylene: the ends of the strip which extend beyond the edge of the diaper is embossed polyethylene film of from about 3 to 6 mils thick. Other embossments besides the diamond pattern configurations shown in the drawings may also be used. However an important consideration is that the transverse width of of the raised portions of the embossments does not exceed about 2.5 mm. and that the area of the raised embossments does not exceed 50 percent of the total surface area of the sheets, so that the peel force required will not exceed about 300 grams per $\frac{1}{4}$ inch of width. Other fairly rigid films such as polypropylene, polyesters, and polyvinyl chloride may also be used as the protective cover sheet.

Extensive tests under actual use conditions were made of diapers with tape strips having an adhesive mass with an attachment strength to smooth polyethylene of 400 grams per $\frac{1}{4}$ inch width, an Elmendorf tear of 150 grams in the narrow direction, and a tensile in excess of 10 lbs. per inch of width. Results indicated a failure rate of less than 2 percent. However upon further analysis these failures were attributed to the inadvertent coating by the mother of the pressure-sensitive mass with powder or lotion rather than to inadequate attachment strength.

Additional tests also indicate that the Elmendorf tear strength of 150 grams is necessary in the narrow direction of the strip to prevent larger babies from tearing the tape strips themselves.

What is claimed is:

1. In a disposable diaper of the type combining an absorbent pad with a fluid pervious cover and a fluid impervious thin film backing to which are attached a pair of integral fasteners comprised of narrow strips of pressure-sensitive tape, the improvement in which said tape comprises a cellulose fiber paper sheet impregnated with a unifying and strength imparting saturant with the fibers in said sheet aligned transverse to the

length of said strips; in which said tape has a tensile strength in the long direction of the strip of at least 10 lbs. per inch of width and an Elmendorf tear in the cross direction of the strip of at least 150 grams; and in which the pressure sensitive adhesive of said tape has an adhesive mass strength of more than about 400 grams per $\frac{1}{4}$ inch of width; one end of each of said strips being disposed in contact with and attached to said film backing by said adhesive near opposing edges of one end of said diaper and the adhesive surface of the other end of each of said strips being covered by a protective cover sheet having an attachment force to the adhesive of between about 50 and 300 grams per $\frac{1}{4}$ inch of width.

2. The diaper fastening arrangement of claim 1 in which said film backing is about 1 mil thick and the adhesive attachment of said strip thereto is such that it will tear said film backing without releasing therefrom when sufficient force is applied thereto.

3. The diaper fastening arrangement of claim 1 in which the free ends of the tape strip extend beyond the respective edges of the diaper.

4. The diaper fastening arrangement of claim 3 in which a portion of the protective sheet covering the free ends of the diaper extends inwardly over the face of the diaper.

5. The diaper fastening arrangement of claim 1 in which said cover sheet has raised embossments on the surface and said embossments are in contact with said adhesive.

6. The diaper fastening arrangement of claim 5 in which the raised area of said embossments comprise from about one third to about one half of the surface area of said film and the peeling width of said embossments range between about 0.2 and 2.5 mm.

7. The diaper fastening arrangement of claim 5 wherein said protective cover sheet comprises a plastic film of from about 3 to 6 mils in thickness.

8. The diaper fastening arrangement of claim 7 in which said plastic film is selected from the group consisting of polyethylene, polypropylene, polyester, and polyvinyl chloride.

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