This is a continuation-in-part of copending patent application Ser. No. 286,294, filed June 7, 1963 now abandoned.

This invention relates to improvements in light-weight, laminated webs of a non-woven type particularly adapted for use as cover material for absorbent sanitary products such as sanitary napkins, absorbent pads, diapers and the like.

A primary object of the invention is to provide an improved light-weight fabric of high flexibility and strength, characterized by a very soft hand and feel, having low resistance to fluid passage therethrough while presenting substantial resistance to scuffing, wet rub, and deforming tensions in normal use.

Another object is to provide an improved laminated web which combines the advantages of a smooth body-contacting surface of substantially aligned very low denier synthetic fibers with the permeability of an underlying creped wadding element associated therewith.

A further object is to provide a method for the economical, high-speed manufacture of a web of the character indicated.

Other objects and advantages will become apparent to persons skilled in the art upon examination of the drawings and specification, the scope of the invention being defined in the appended claims.

The drawings, in which like parts are identified by the same reference numerals:

FIG. 1 illustrates in elevation one form of production apparatus suitable for fabrication of the improved product herein taught.

FIG. 2 shows fragmentarily, in plan, the surface of an in-line printing roll employed in applying adhesive to a web of creped wadding which becomes an integral part of the laminated web.

FIG. 2A is similar to FIG. 2 but shows another variation of an intaglio pattern for a printing roll.

FIG. 3 is a greatly enlarged sectional view of a fabric product incorporating the invention, illustrating the assembled relationship of the laminated components.

FIG. 4 is a micro-photograph showing a plan view of a product fabricated in accordance with the principles herein taught.

Since the introduction of synthetic monofilaments and staple fibers formed therefrom, many attempts have been made economically to employ very thin and light-weight layers of either monofilaments or fibers of very low denier in a manner to render a resulting product suitable for use as sanitary napkin wrappers or the like. It is known that when staple length fibers such as cotton, and synthetic fibers in the denier range of 0.5 to 3 obtained from such materials as viscose or acetate rayon, nylon, polyesters, acrylonitriles, and the like, are formed in substantial alignment and contiguously disposed, as from the output of a drawframe, they provide an assembly of consistently increased tensile strength, when bonded, over ordinary carded webs.

Means for drawing cotton fibers to their maximum length by lengthwise tensioning and alignment into a striated web of uniform density for use in structural materials are described in United States Patent 2,407,548 of Sept. 10, 1946. A method and apparatus substantially as described therein, which includes carding, silver forming, lapping, and repeated drafting operations, is utilized in this invention to form a suitable starting web from synthetic fibers for subsequent lamination as defined herein. The drafting process is merely preliminary to the invention herein disclosed. The invention is directed primarily to the further processing of a highly drafted web, as obtained from the above operations, in a manner to make it especially useful for employment as a sanitary napkin wrapper or the like.

The use of highly drafted fibers as light-weight webs for sanitary napkin and bandage wrappers has here-to-fore been deemed impractical because of the difficulties involved in suitably binding the fibers together while retaining permeability, soft hand and drapery. This is particularly true when the fibers are of a very low denier, for example, of a denier range of 0.5 to 3. Non-bonded webs formed solely of highly drafted fibers within the above denier range are extremely delicate, and it is difficult to maintain such webs in a tensioned unitary assembly while applying a suitable adhesive. Also, because of their light-weight nature, a substantial amount of adhesive is needed to strengthen the webs sufficiently to serve a useful purpose. The amount of adhesive required to insure acceptable form-sustaining properties not only results in web stiffening and resultant loss of desirable hand and feel, but also substantially increases resistance to fluid penetration therethrough.

Attempts were made to print the flimsy webs resulting from the drafting operation directly with thermoplastic adhesives in order to avoid the stiffness which results from the use of the easier applied thermostetting materials. These attempts failed principally because the stickiness of the adhesive on the printing roll tended to pull out fibers, destroy their substantial alignment and disrupt the desired uniform formation. Temporarily bonding the drawn web with adhesives which subsequently could be washed out aided the situation somewhat, but the resulting web had little cross-direction strength and required the use of inordinate amounts of adhesive which penetrated to both sides of the web and left an undesirable uneven finish and poor permeability, in addition to detracting from softness and drape.

The present invention overcomes the above disadvantages by employing a novel method of incorporating the adhesive into the finished web. The method utilizes a carrier web on which thermoplastic adhesive in the desired open pattern is first applied. The highly drafted fiber web is then positioned on the adhesive without disturbing the aligned fiber arrangement. The carrier web subsequently becomes an integral part of the finished fabric and provides desirable cross-direction strength and fluid permeability without detracting from flexibility and softness.

The invention, therefore, is directed to an improved non-woven multi-ply web assembly, one ply of which consists of substantially aligned synthetic monofilaments or highly drafted and aligned staple fibers of very low denier and of very light weight, while another ply comprises a light-weight web of cellulose wadding. The web assembly is such that the monofilaments or long staple fibers are retained in form-sustaining alignment to insure the maintenance of high tensile strength without destroying surface smoothness or softness. This is accomplished by permanently embedding the fibers, while held under tension, into a soft, flexible, substantially cured, thermoplastic adhesive which has been suitably applied to the underlying creped wadding web.

The concepts herein taught result in an improved non-woven material wherein the advantages attendant the employment of a highly drafted web of very low denier synthetic fiber are retained to a high degree. Such advantages include a silk-like appearance and soft feel, high
The improved product includes a light-weight creped wadding layer, having applied to one side thereof a soft and flexible adhesive confined in a patterned configuration to a minor portion of the base layer. Selected portions of substantially aligned synthetic fibers, applied in the form of a tensioned thin layer, are bonded to the base layer by embedment in said adhesive. It is very important to provide a uniform adhesive bonding of the surface fiber layer to the base layer of creped wadding to be effected in a manner to retain the synthetic fibers in tensioned alignment while keeping the top surface of the fiber layer substantially free of adhesive. The process as herein defined permits lamination and bonding to be carried out at high speeds without disturbing the delicate fiber arrangement.

As shown in FIG. 1, a creped wadding sheet 11, which has been stretched and ironed to facial tissue softness by known means, is drawn from a supply roll 10 into a nip formed between a printing roll 12 and preferably a back-up roll 14 maintained in very light pressure engagement with sheet 11. Printing roll 12 is provided with an intaglio printing pattern, such as the diamond pattern shown in FIG. 2. Grooves 16 of roll 12 are continuously supplied with a low viscosity thermoplastic adhesive 18 from dip pan 19, part of the adhesive thus applied being arrested by doctor roll 20 prior to transfer of a metered amount of adhesive to the wadding in the patterned configuration provided by grooves 16. Other suitable adhesive patterns may be employed, it being important, however, that the pattern of applied adhesive be substantially open, and that the total area occupied by the adhesive comprise not more than 25% of the total area of the final product, and preferably only about 15% or less of that area. For maximum transverse strength, the pattern chosen may be interconnected, as for example the diamond pattern of FIG. 2, in which the lines of adhesive cross each other. Alternatively, a grid-like pattern, wherein the lines extend transversely of the web in spaced parallel arrangement and the adhesive in each line is substantially continuous, may be used. However, for improved flexibility, better drape, and softer hand, the adhesive may be applied in the form of spaced, discontinuous areas or broken lines, in which the discontinuous portions provide a staggered pattern of fiber attachment. When a pattern of spaced discontinuous lines of adhesive is provided, those lines are preferably parallel and disposed substantially perpendicularly to the direction of the aligned fibers. A fragmentary showing of a roll surface having such an arrangement, with a portion of the pattern shown in FIG. 2A wherein the grooves 16a provide a brick-like pattern of adhesive. Other angular dispositions of adhesive patterns with respect to the direction of fiber lay are also useful. Further variations in shape, size and arrangement of the adhesive pattern may be employed. An important factor, however, is that, no matter what pattern is chosen for the desired open configuration, the spacing between the areas of adhesive measured between adjoining adhesive patterns in the longitudinal direction of the web preferably should be less than the average fiber length in order that the cross-directional integrity of the web is maintained.

The applied adhesive penetrates part way into the wadding with a substantial portion remaining on the surface. Some lateral migration of adhesive also occurs, but it is important that the amount applied be controlled so that the total area of fiber surface having adhesive does not exceed, as above mentioned more than about 25% and preferably not more than about 15% of the total area of the wadding, in order to preserve the openness as well as the flexibility of the final product. The wadding thus printed is drawn from the output nip between the printing and back-up rolls, and passed closely adjacent to a drawframe or the like 26. A web 28a of substantially aligned synthetic fibers of a density in the range of 0.5 to 3 has been formed and drafted as previously described by passing multiple slivers 28 of staple length synthetic fibers through drawframe 26, is applied, while under continuous tension, onto that side of the base sheet 11 to which the adhesive pattern has previously been printed. A sufficient number of fibers are provided in the multiple slivers 28 to result in the formation of a substantially aligned highly drafted web 28a, at the output of drawframe 26, having a weight between about 3 and 20 grams per square yard. The unsupported material thus formed is drawn from guide roll 24 over guide roll 30 and around heated drum 32 where curing of the adhesive is substantially completed to a non-tacky condition while web 28a is in firm contact therewith. As shown in the drawings, the curing operation is carried out prior to or over the forming of the upper ply of the laminate in contact with the heated surface of drum 32. Alternatively, the creped wadding side may be positioned against the heated surface. To provide effective heat curing of the adhesive, travel thereof around a substantial portion of drum 32 is desirable. For this purpose, the calender roll 34, which adresses the fiber layer into adhesive at pressure nip 35 while the curing is being completed, is positioned downstream of the top of the drum, somewhat as shown, to utilize a substantial arc of the peripheral drum surface for the earlier stages of curing. Auxiliary heating means, including recalendering rolls and radiant lamps or radiant heaters, may be positioned either before or after the calendering step to speed up the curing and insure that such curing is complete.

It will be noted that creped wadding base sheet is continuously subjected to tension during its travel from the supply roll 10 to finished roll 13, the tension being provided by driven rolls 12, 34, and 40. The web output 28a from drawframe 26 is maintained under a like degree of tension as the laminate is pulled around heated drum 32, so that substantially all of the fibers remain in their aligned condition while curing takes place. The fully cured product is drawn around guide rolls 36 and 38 by a driven roll 40 for windup on a spindel 42 carried by a bracket 44 pivoted at 46.

FIG. 4 is a micro-photograph in plan view of the finished laminate, illustrating how substantially all of the fibers 48 are line oriented in a substantially continuous manner. The relatively small amount of fibers whose ends elude complete embedment in the adhesive are free to move to a relaxed state and form a somewhat fuzzy surface, as shown in the micro-photograph, which adds to the desirable soft cosmetic feel in the finished product.

FIG. 3 illustrates how the pattern shown in FIG. 2A, wherein the grooves 16a provide a brick-like pattern of adhesive. Other angular dispositions of adhesive patterns with respect to the direction of fiber lay are also useful. Further variations in shape, size and arrangement of the adhesive pattern may be employed. An important factor, however, is that, no matter what pattern is chosen for the desired open configuration, the spacing between the areas of adhesive measured between adjoining adhesive patterns in the longitudinal direction of the web preferably should be less than the average fiber length in order that the cross-directional integrity of the web is maintained.

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volatility. Such adhesives remain soft and flexible after curing, and insure that the resultant laminate product retains the desired stiffness and proper hand and feel.

The base sheet of creped cellulose wadding preferably has a basis weight before creping of between about 4 and 12 pounds per 2880 square foot ream. The sheet may have a crepe ratio of between about 1.1 and 2.5 when creped off the drier on the paper machine, and preferably contains wet strength resins, although such latter treatment is not essential. Any conventional method of imparting wet strength may be employed as those described in TAPPI Monograph No. 13, "Wet Strength in Paper and Paperboard." The methods usually employed comprise incorporating a melamine formaldehyde, urea formaldehyde, polyalkylene polyamine, or similar resin in the pulp furnish. Conventional wetting agents may also be employed to prevent loss of water absorbency which the wet-strength treatment may engender.

It is preferred also that the creped wadding sheet be formed in such a manner as to produce an open or perforated formation in order to enhance rapid fluid penetration in the final laminated product. A patterned or specially woven screen in the forming area of the paper machine may be utilized for such purpose, or the formed sheet may be subsequently perforated by a suitable needling operation. While a sheet with open formation is preferred, a regularly formed wadding sheet may also be used.

It is also preferred that the creped web be stretched and ironed after creping to reduce the crepe ratio to about 1.1 to 1.5 and to produce a soft sheet such as is customarily used in the manufacture of facial tissues. Generally, the base sheet should possess good bulk, softness, absorbency, permeability, and strength.

The synthetic monofilaments or staple length fibers employed should preferably be of a denier in the range of 0.5 to 3. When fibers are used, as in the preferred embodiment, they should be of staple length, or in the range of 1/2 to about 3 inches or longer, with the majority of fibers being at least one inch in length. The drafted web should be of light weight as possible commensurate with handleability on the drawing frame. Suitable webs in the weight range of 3 to 20 grams per square yard have been successfully drafted and laminated at speeds of from 20 feet per minute to well over 500 feet per minute.

As is known to those skilled in the art, highly drafted webs of staple length fibers have approximately 80% to 95% of their fibers oriented substantially in the machine direction. This high degree of alignment is important to the invention and should be distinguished from conventional carded webs wherein only about 50% to 70% of the fibers are substantially longitudinally aligned. Whenever the term highly drafted webs is used in the specification and claims, it means webs in which about 80% to 95% of the fibers are aligned substantially in the machine direction.

Having now described the invention in general terms, the following specific example is given to provide a more detailed account of the process and product involved.

A creped wadding sheet having a basis weight before creping of 6.5 pounds per 2880 square feet and a crepe ratio of 2.2, was stretched and ironed to a finished crepe ratio of about 1.2. This sheet was printed in a diamond pattern with a plastisol adhesive, in the manner above described, to cover approximately 21% of the surface area. The adhesive was applied in the amount of about 6.1 grams per square yard and consisted of 100 parts of polyvinyl chloride resin dispersed in 60 parts by weight of dioctyl phthalate and thinned with mineral spirits. A web of highly drafted fibers and having a weight of 7.1 grams per square yard, comprised substantially of 2.5 inch long fibers of 1.5 denier viscose rayon, in which about 90% of the fibers were parallelly aligned in the machine direction, was fed into contact with the adhesive printed on the creped wadding web. The combined web was drawn under tension over a heated drum operated at a temperature of about 325° F. where the adhesive was substantially cured while the fibers were pressed therethrough calendaring as shown.

The finished web was tested for tensile strength on an Instron tester and found to have a breaking strength of 2.93 lbs./inch in the machine direction and 0.21 lb./inch in the cross direction.

A similar laminate was prepared using as the top element, in place of the highly drafted web, a conventional carded web in which approximately 60% of the fibers were longitudinally aligned. The carded web weighed 7.25 grams per square yard. This laminate tested out at a breaking strength of 1.04 lbs./inch in the machine direction and 0.28 lb./inch in the cross direction.

While only one specific embodiment of the inventive concept has been set forth herein, it is understood that the invention is not to be construed as limited thereby, and that any suitable changes, modifications, and variations may be made without departing from the spirit and scope of the invention as defined in the appended claims.

What is claimed is:

1. A laminated fabric comprising a base web of lightweight creped cellulose wadding, a thin overlying web of synthetic fibers in which 80 to 95 percent of the fibers are parallelly aligned in fully extended and straight condition, and an intermediate binding layer comprising an elastomeric adhesive disposed in the form of a regularly spaced pattern of an open configuration between said webs, said webs being bonded together by said adhesive only in the areas defined by said adhesive pattern, and the fibers of said overlying web being bonded and held in alignment by imboden in said adhesive.

2. A laminated fabric as set forth in claim 1, in which said adhesive at least partially penetrates said wadding and the top surface of said overlying web is substantially free of adhesive.

3. A laminated fabric as set forth in claim 1, in which the cellulose wadding has an open formation.

4. A laminated fabric as set forth in claim 1, in which the cellulose wadding contains wet strength resin.

5. A laminated fabric as set forth in claim 1, in which the fiber web is in the weight range of about 3 to 20 grams per square yard.

6. A laminated fabric as set forth in claim 1, in which the adhesive is a plastisol adhesive.

7. A laminated fabric as set forth in claim 1, in which the adhesive pattern covers an area comprising about 15 to 25 percent of the total area of said webs.

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