

Nov. 12, 1963

J. C. BLETZINGER

3,110,609

CELLULOSIC PRODUCT

Filed April 30, 1959

4 Sheets-Sheet 1

Fig. 1

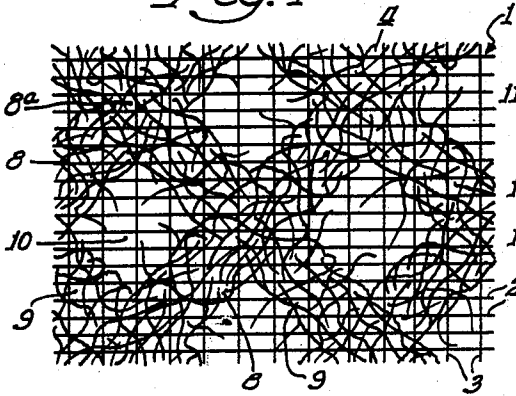


Fig. 2

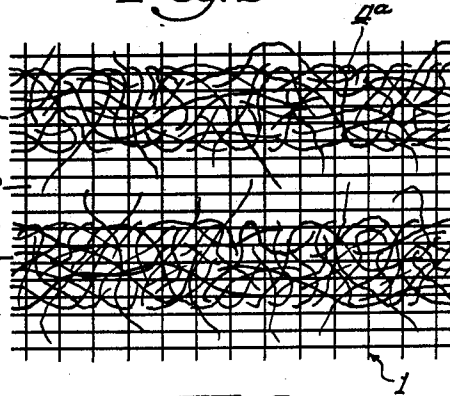


Fig. 3

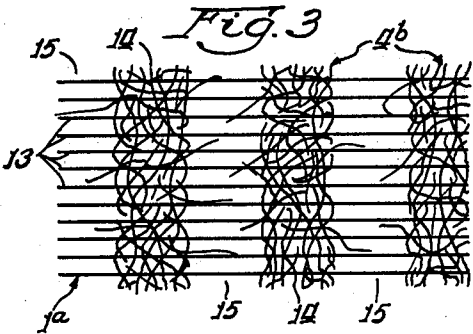


Fig. 4

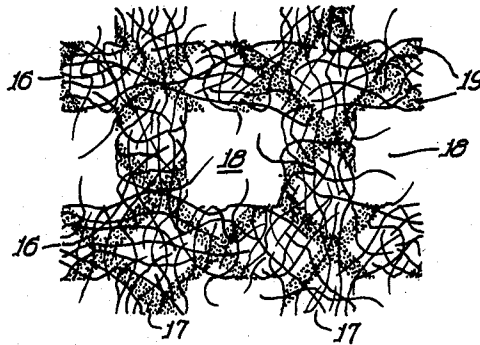


Fig. 5

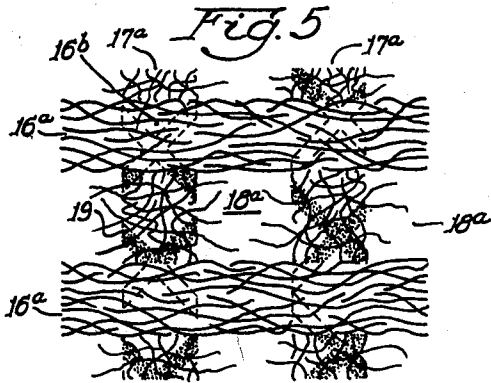


Fig. 7

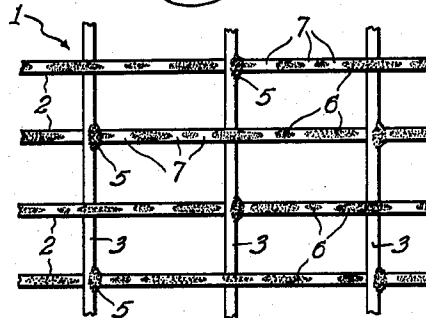
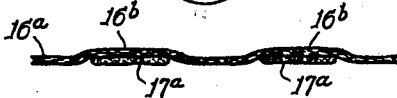


Fig. 6



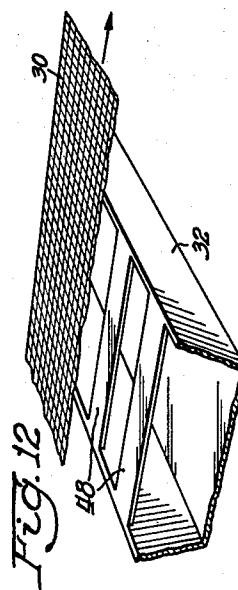
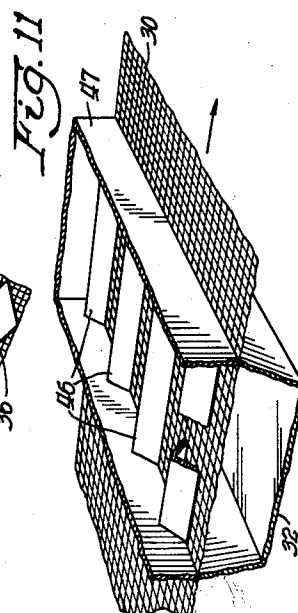
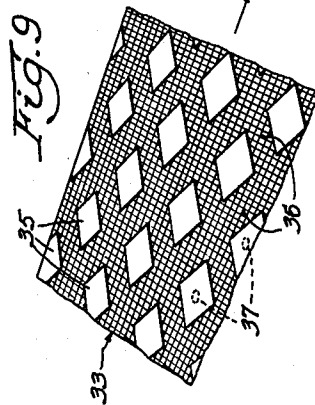
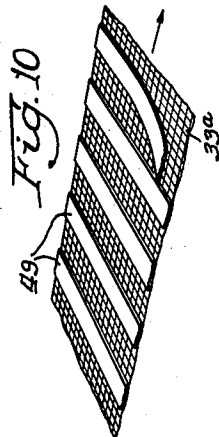
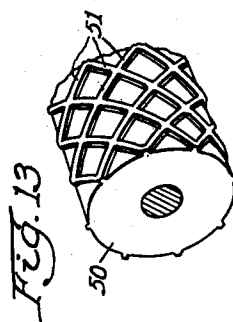
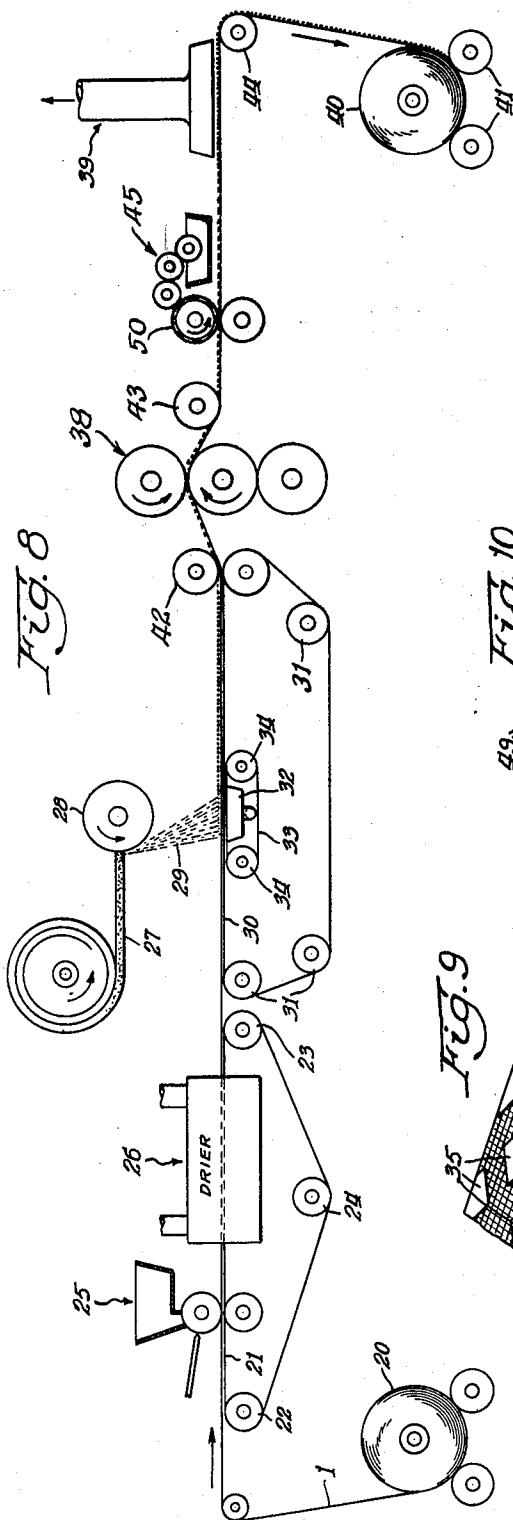
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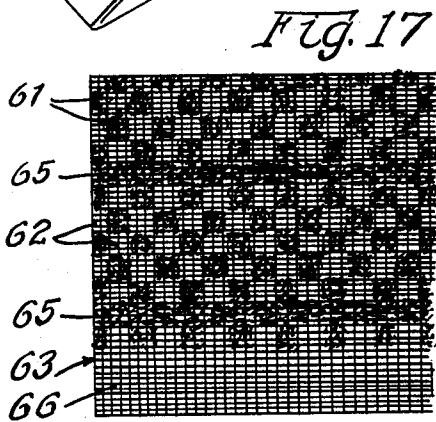
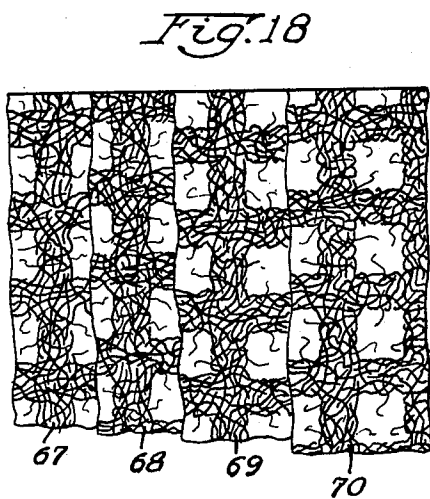
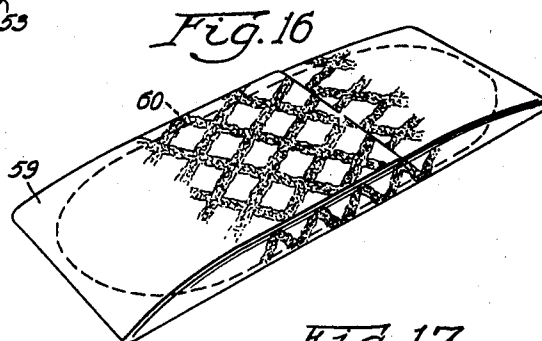
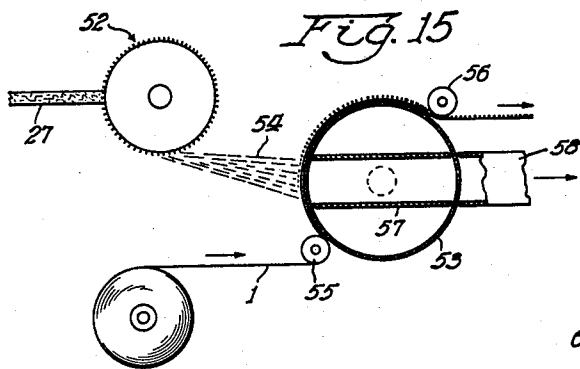
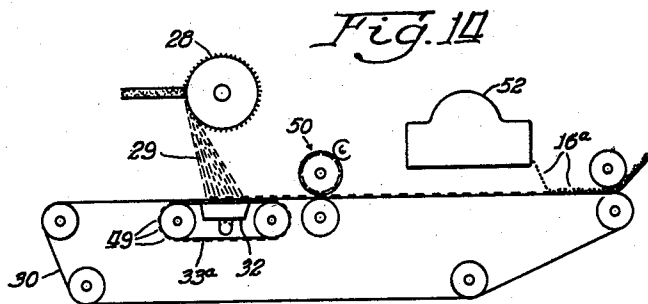
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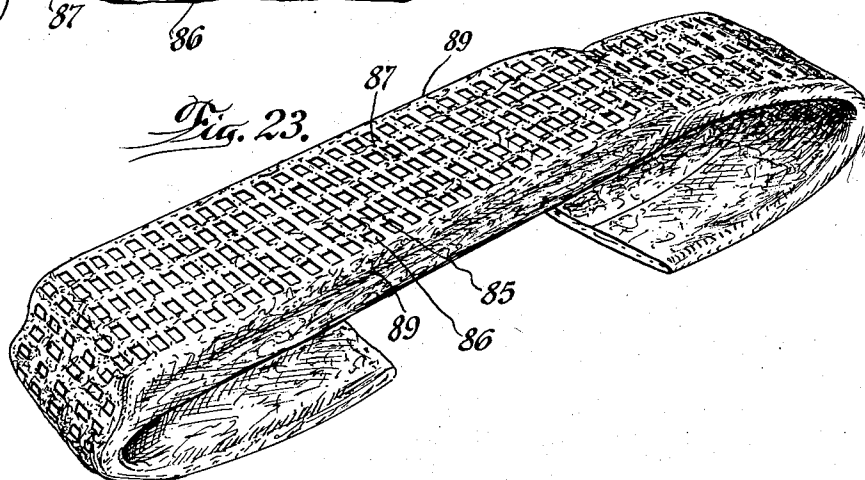
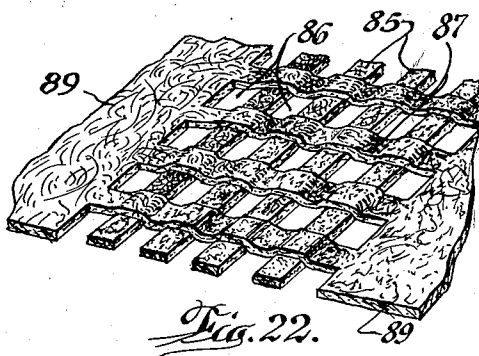
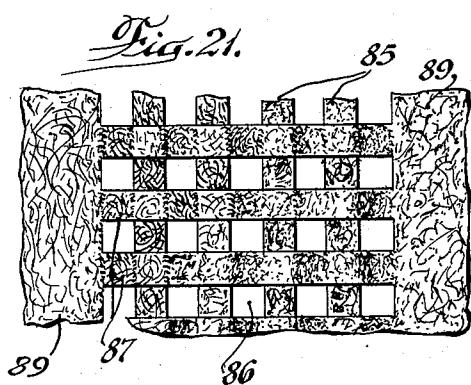
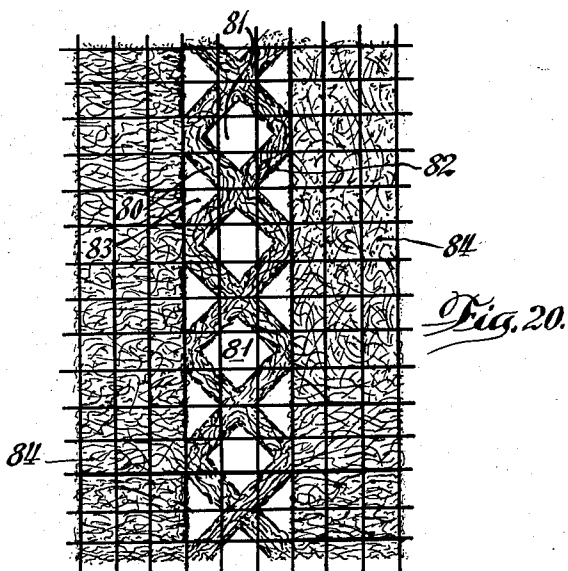
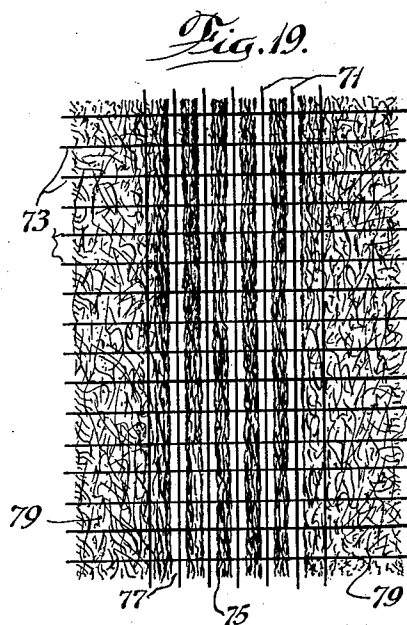
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CELLULOSIC PRODUCT

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Filed Apr. 30, 1959, Ser. No. 810,012
6 Claims. (Cl. 117-25)

This invention relates to improvements in fabric webs made wholly or partially of a layer of loosely matted cellulosic fibers, and it is also concerned with products in which the improved fabric is a component; and with methods and means for producing the new fabric.

This application is a continuation-in-part of my co-pending application Serial No. 421,538 filed April 7, 1954.

The main objects of the invention are to provide a fabric material of the character indicated, which presents desirable characteristics of flexibility or limpness and softness, smooth and non-abrasive feel on at least one side, high or rapid permeability by liquids, good appearance, and good tensile strength with due regard for the amount of fiber in the web; and to provide these and other desirable characteristics in material which may be manufactured economically and at low cost.

Further objects of the invention are to provide practical and efficient methods and apparatus for producing the aforesaid material, and to provide improved products fabricated wholly or in part of said material.

Other objects and advantages of the invention will be understood by reference to the following specification and accompanying drawings, in which:

FIGS. 1, 2, 3 and 4 are plan views of portions of fabric material respectively embodying different forms of the invention, these views being on substantially enlarged scales, about twice actual size, to better illustrate the respective constructions;

FIGS. 5 and 6 are respectively plan and side view illustrations of still another form of the fabric;

FIG. 7 is a plan view on an enlarged scale, about four times actual size, of one form of carrier web or backing sheet which may be employed in certain forms of fabric made according to the invention;

FIG. 8 is a schematic representation of a method and apparatus for producing the improved fabric;

FIGS. 9, 10, 11, 12, and 13 are schematic illustrations of various apparatus elements which may be employed to produce various forms of fabric according to the invention;

FIGS. 14 and 15 are schematic representations of other means for producing the improved fabric;

FIG. 16 is a perspective illustration of a catamenial napkin according to the invention;

FIG. 17 is a plan view of a portion of another form of sanitary napkin wrapper material according to the invention; and,

FIG. 18 is a plan view of padding material made according to the invention;

FIGS. 19 and 20 are plan views on an enlarged scale of a portion of sanitary napkin wrapper material embodying still different forms of the invention;

FIGS. 21 and 22 are plan and perspective views respectively on an enlarged scale of a portion of another embodiment of the invention especially suitable as a sanitary napkin wrapper; and

FIG. 23 is a perspective illustration of a catamenial napkin utilizing the wrapper of FIGS. 21 and 22.

The fabric construction represented in FIGURE 1 comprises a base or carrier web 1 of gauze-like fabric consisting of lengthwise and crosswise threads 2 and 3 respectively, which may or may not be interwoven, and an applique 4 of cellulosic fibers. The gauze web 1 is here represented as being 16 x 8 construction, that is to say,

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embodying 16 longitudinal threads per inch of width and 8 crosswise threads per inch of length of the fabric. The thread count of 16 x 8 is merely exemplary and not critical; it may be more open, such as 4 x 4, or less open, this detail being not critical but subject to variation to suit the end use for which the fabric is intended.

Secure attachment of the fiber applique to the carrier web is usually desired. Frictional attachment may be suitable for some purposes, but it is usually preferred that some form of adhesive attachment be employed.

When the carrier web is made of woven gauze, many desirable characteristics are obtained when adhesive is applied in such a manner that blobs (FIGURE 7) of adhesive will occur at alternate thread intersections where the crosswise threads 3 cross over lengthwise threads 2 on one side of the fabric, and so that ribbons 6 of adhesive occur along the lengthwise threads 2, such adhesive ribbons 6 being more or less discontinuous along the lengths of said threads, small breaks occurring at irregular intervals as indicated at 7.

The crosswise threads 3 are generally free of adhesive except where the blobs 5 occur, and this freedom from adhesive and the breaks along the longitudinal threads contribute substantially to preservation to high degree, of the normal flexibility or limpness and softness of the carrier web material. Said adhesive blobs 5 engage the intersecting thread portions so as to bind said threads together to thereby stabilize the relationship of the threads of the gauze. This stabilizing effect makes it highly practicable to use gauze of very open weave, such as, for example, 4 x 4, which otherwise is subject to such severe fraying as to be unusable for purposes where uniformity of appearance and of thread distribution is important.

The fiber applique will, of course, be bonded to the thread web wherever fibers engage adhesively coated portions of the web, such points of engagement occurring at intervals. To attain the most effective adhesive bonding, some form of pressing or calendering operation is usually employed to insure embedment of the fibers in the adhesive on the carrier web.

When the carrier web consists of unwoven longitudinal and crosswise threads, said longitudinal threads are preferably coated with adhesive along their lengths by suitable roller means whereby the adhesive will be caused to envelop less than the entire circumference of the threads, for example, about one-third or one-half the circumference. The extent of such envelopment is controllable by suitably adjusting the thickness or depth of adhesive coating carried by the applicator roll. When the adhesive is so applied to only a part of the circumference of the threads, twisting or turning of the threads on their own axes during the delivery thereof into the aforesaid cross-laid gauze-like formation, will cause some of the adhesively coated thread surface to appear on each face of the carrier fabric so that non-woven fiber appliques may be adhesively bonded to either or both faces of such carrier fabric, the bonding occurring at spaced points. Also, the threads will be bonded to each other at some but not all of their crossings and such bonded crossings will usually be fairly well distributed over the area of the web and be effective to stabilize the thread web in the form in which they are cross-laid. The lengthwise threads may also have adhesive applied thereto around their entire circumferences (for example, by being passed through a bath of adhesive) with correspondingly increased bonding of the cross threads to the longitudinal, adhesively coated threads, and of the fiber applique to the carrier web; this is desirable for some end uses of the composite web where the greatest flexibility is not required.

The adhesive, whether applied in the manner described or otherwise, is preferably of a permanently flexible kind, so that hardening and stiffening of the gauze fabric due to the presence of the adhesive is thereby further avoided to a substantial degree. Also, to this same end, said adhesive is preferably of a type which remains substantially surfaced on the threads and does not penetrate the same. The kind of adhesive used may vary according to the manufacturing processes to be used in producing the wrapper material and according to the characteristics desired in the finished product. Resinous adhesives which can be applied as organosols or plastisols have been found to be especially suitable, it being practicable to formulate the same to supply the required strength of bond, water insensitivity, permanent flexibility, and softness. Also, such adhesives embody thermoplastic properties which can be advantageously utilized. The said adhesives may also be formulated to have, in addition to the aforesaid characteristics, the tendency to remain surfaced on the threads rather than to soak into the same, this surfacing tendency being also helpful in avoiding hardening and stiffening of the fabric by the adhesive.

The fiber component 4 may consist of cotton fibers or other suitable fibers, or mixtures of fibers, which are selected to suit the end use of the product. Synthetic fibers comprising rayon, nylon and others, and natural jute and other known fibers may be employed if desired. This fiber component is in a patterned form, for example, in a network, formed in this instance, of intersecting, relatively perpendicularly but diagonally arranged sets of spaced parallel lines or bands 8 and 9. This pattern leaves openings 10 in which there may be practically no fibers or a relatively few fibers as compared with the quantity thereof in the areas 8 and 9 of fiber concentration. It should be observed that the two sets of intersecting lines or bands of fibers are, in this instance, simultaneously formed as an integral pattern and that the intersection areas 8a of the pattern are of the same weight as the other areas of said lines or bands.

In a carrier web backed fabric such as shown in FIGURE 1, the weight of fiber in the patterned applique may be within a very wide range; the limits of this range are not critical but depend upon the purpose for which the fabric is intended and upon the kind of fibers employed. For many purposes, the weight of the fiber applique may be so low that the applique would not be self-sustaining in web form.

When material according to FIGURE 1 is to be used as the wrapper around an absorbent pad, as in a catamenial napkin (FIGURE 16) in which high permeability of the wrapper is desired, the weight of fibers in the areas of fiber concentration, is preferably within a range of about $1\frac{1}{2}$ to 6 grams per square yard, basis weight, and the weight of fibers in the areas 10 may be much lighter, for example, at a rate of .5 gram and less basis weight, per square yard. The fibers in the applique may be of bleached comber cotton which usually includes fiber lengths ranging from about $\frac{1}{16}$ inch to about 1 inch or more, a large proportion of the fiber being of an intermediate length of around $\frac{7}{16}$ of an inch, and about 5% of the fibers being one inch or more in length. This fiber make-up is also of general utility for other applications of this invention in which other basis weights of fiber are used, but other kinds of fibers and blends of two or more kinds may also be used.

The weight of fiber in the various areas mentioned depends upon the design of the pattern employed, the width of the lines or bands 8 and 9 or the area of other design elements and the spacing thereof, the thickness or depth, and the density to which the fibers are deposited in said areas, the kind of fiber employed, and perhaps other factors. Because of the variable applique pattern factors, it is not practicable to specify the weight of non-woven fibers per square yard of the patterned fiber applique. The words "basis weight" as above and here-

inafter used, means that the fiber weight in the patterned areas is such that if like fibers were distributed to the same depth and density uniformly over an area of one square yard, the weight of the uniformly distributed fiber in such area of one square yard, would be the specified "basis weight" of the patterned applique.

Some of the fibers in said areas 8 and 9 may extend in the direction of the lines or bands but a large portion of said fibers, when deposited by air-laying, and even by carding, are disposed haphazardly in said areas so that a unitary, ungrained, velvety or felt-like appearance is produced in said areas. For some uses of the fabric, the amount of fibers collected in these areas 8 and 9 may be made quite heavy and for other uses, such as catamenial napkin wrappers as above referred to, the fiber weight may be held low enough to provide high permeability even in the areas of fiber concentration. The areas 10 may be practically devoid of fibers but when fibers are present in said areas, most of them extend out of the areas of fiber concentration. The relatively few fibers which occur in said openings or areas 10 do not materially affect the normal permeability of the carrier web in said areas.

When the material is destined for use as drapery, curtain, or camouflage purposes, the pattern, and the weight of fiber in the areas of fiber concentration and fiber paucity or dearth respectively will be selected to obtain the appearance and other characteristics desired. For example, for camouflage purposes wavy and irregular patterns are usually preferred, and the weight of fibers may be within a range of about 1 to 20 grams per square yard, basis weight, but usually within the lower portion of that range. Similarly, when the material is to be used for padding purposes, the weight of fibers in the fiber concentration areas may be substantially increased, for example, into the upper portion of said range of 1 to 20 grams or more. Also, the pattern in which the fibers are collected may be made to provide more fiber covered area than fiber-free area or vice versa, depending, of course, on the requirements of the use to which the material is to be put.

The amount of fiber required to form the patterned material is generally less than the amount required to produce material of equivalent utility in which the fiber is spread uniformly over the entire area of the fabric, i.e., without pattern. An important saving in the cost of fiber is accordingly attained by employing a patterned distribution of fiber, and high speed production of the fabric is more easily effected since a relatively small volume of fiber is required per unit of time to form a patterned arrangement.

The intertwined relationship of the fibers in the fiber component together with the adhesive bonding of fibers to the gauze web will cause the fiber component to be effectively held as an entirety to the carrier web. A few loose fibers may occur and if these are objectionable, they may be removed in any suitable manner, for example, by suction or blowing, by a shaking or beating operation, or by a combination of any of these. The occurrence of loose fibers which will dust off the web may be largely avoided by using fibers of suitable length so that all of the fibers will be more or less intertwined or interattached as aforesaid, some of the fibers being anchored to the thread carrier web by engaging adhesive carried by the latter. It may be observed that in 16 x 8 gauze, the longitudinal threads are spaced apart only one-sixteenth of an inch and that most of the fibers in the fiber applique will overlie several of the adhesive-bearing longitudinal threads so as to insure adequate bonding of the applique to the gauze. The few fibers in the intervening areas will also usually be similarly adhesively bonded to several of the longitudinal threads of the carrier web.

Another way in which the fibers may be bonded to the carrier web, whether in the form of transversely spaced longitudinal threads as in FIGURE 3 or woven

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or cross-laid longitudinal and transverse threads as in FIGURES 1 and 2, or some other form, is to incorporate a small percentage of thermoplastic fibers in the threads or other material of the carrier web component, and to subject the carrier web and fiber applique to a hot calendaring operation whereby the thermoplastic fibers in the carrier web are reactivated and some of the fibers of the applique pressed into such reactivated material to become bonded thereto, the reactivated material and said fibers also being thereby caused to become adhesively secured to adjacent elements of the carrier web.

Still another method for bonding the fiber applique to the carrier web is to incorporate a small percentage of thermoplastic fibers in the fiber applique and subject the assembled carrier web and fiber applique to the aforementioned hot calendaring operation to reactivate the thermoplastic fibers for adhesive bonding to other fibers and to contiguous portions of the carrier web. Thermoplastic fibers may, of course, be incorporated in both the carrier web and in the fiber applique. The use of thermoplastic fibers in either or both the carrier web and the fiber applique, produces satisfactory bonding for many purposes, and the use of such binder fibers and the said hot calendaring operation is advantageous in that it avoids the use of wet liquid adhesive and thereby avoids possible gumming up of the apparatus employed for producing the fabric, and the need for constant watchfulness and frequent cleaning to maintain satisfactory operating conditions. Such calendaring also attains other often desirable results such as smoothing of the faces of the fabric, flattening carrier web threads and especially the cross-over portions thereof in woven fabric, and generally improved integration or unification of the components in the material.

The hot calendaring operation for reactivating thermoplastic adhesive and fibers may be replaced by liquid or vapor solvent treatment of the thermoplastic material to render the same active for bonding purposes, and a calendaring operation may be employed to obtain embedment of the stable thread and fiber elements in the reactivated thermoplastic material.

When thermoplastic fiber is incorporated in the fiber applique for bonding purposes to the extent of as little as five percent of the total volume of fibers, a useful measure of fiber attachment to carrier web and of fiber to fiber bonding or fiber applique integration will be obtained. The percentage of thermoplastic fibers may be greater than five percent to obtain correspondingly increased bonding.

The fabric structure shown in FIGURE 2 is similar to that shown in FIGURE 1 in that the FIGURE 2 structure also embodies a thread carrier web or backing element 1 and a fiber applique designated 4a in somewhat different form than the applique 4 of FIGURE 1. The applique 4a comprises a plurality of transversely spaced, parallel lines or bands 11 of fibers, and intervening areas 12 which are substantially free of such fibers or contain only gossamer films thereof similar to the filling which occurs in the areas 10 of the FIGURE 1 structure. The bands 11 and intervening areas 12 extend longitudinally of the fabric. Some of the fibers of the bands which constitute the applique 4a, will contact adhesive applied to the carrier web component so that said applique will be adhesively bonded to the gauze. The bands 11 are preferably of a width greater than the spacing of the longitudinal threads of the carrier web so as to insure engagement of most of the fibers in each band with at least one such thread. For some purposes, the carrier web 1 may consist of only crosswise extending, longitudinally spaced threads to support the transversely spaced fiber bands in the desired spaced relationship, the fiber bands themselves being made strong enough to supply the required longitudinal strength.

The fabric structure shown in FIGURE 3 comprises a backing or carrier web 1a in the form of a plurality of

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longitudinally extending, transversely spaced threads indicated at 13 and an applique 4b of fibers in the form of a plurality transversely extending, longitudinally spaced bands, or areas 14 of fiber concentration between which are areas 15 in which there is a relative scarcity, if not an absence, of fibers. The longitudinally extending carrier web threads constitute means for holding the fiber sections 14 in spaced relation, said fiber sections being preferably adhesively attached to said threads although mere frictional attachment may be sufficient for some purposes.

The fabric construction represented in FIGURE 4 is an all unspun, separated fiber construction comprising fibers deposited in a network pattern consisting mainly of mutually spaced lengthwise and crosswise fiber concentration bands or areas 16 and 17 respectively, which leave opening areas 18 having a relatively small number of fibers therein.

The fiber arrangement in the FIGURE 4 construction is very similar to that described above in connection with FIGURE 1 but in this instance the lengths of relatively transverse areas of fiber concentration are respectively parallel and normal to the length of the fabric, but it should be observed that they may be diagonally arranged as in FIGURE 1 if preferred.

In the light weight fabrics made entirely of unspun fiber, such as typified by the structure shown in FIG. 4, the fabric requires strengthening or reinforcement for most purposes. One way to effect such reinforcement is to apply lines of adhesive binder material as indicated at 19 to the fiber bands 16 and 17, to provide for adhesively bonding the fibers in said bands to each other. The adhesive may be of a type which will maintain ribbon-like continuity and of itself impart tensile strength to the fabric, but because of the discontinuous form in which the adhesive is preferably applied, its main strengthening effect is probably incident to said bonding of some of the fibers to each other. Such lines of binder should be in such spaced relationship that a very large proportion of the fibers will be engaged by at least one line of adhesive; when so spaced, it will be found that substantial longitudinal and crosswise tensile strength is imparted to the fabric. The spacing of the lines of binder will, of course, be dependent largely on the lengths of the fibers in the applique. This method of strengthening a non-woven web of fibers is particularly applicable to webs having a basis weight of about 4 grams or more per square yard. Below that weight, it is difficult to print adhesive on the web in a commercially practicable sense, and a suitable carrier web is indicated for reinforcing purposes. This discontinuous adhesive bonding is especially desirable in connection with wholly non-woven fabrics such as represented in FIGURES 4 and 5, but it may also be applied to the carrier backed fabrics of FIGURES 1 to 3 inclusive. A method and means for applying adhesive in the illustrated pattern will hereinafter be explained.

The fabric illustrated in FIGURES 5 and 6 is similar to that shown in FIGURE 4 in that it involves a network formed of longitudinally and transversely extending bands and ribbons of fiber respectively designated 16a and 17a but in this instance, the ribbons 16a are formed independently of the bands 17a so that the ribbons 16a cross over the bands 17a and produce increased thickness portions 16b in the cross-over areas. The areas 18a surrounded by the fiber areas 16a and 17a may be totally devoid of fibers or they may have a relative paucity thereof as compared with the areas 16a and 17a. The fiber areas 16a and 17a may be adhesively bonded together by the application of adhesive in the manner represented in FIGURE 4, either on top of the overlying fiber bands 16a or on top of the bands 17a prior to application of the fiber ribbons 16a. If the adhesive is applied over the ribbons 16a, then it should be of such a character that it will sufficiently penetrate the said ribbons to effect

the required bonding to the underlying bands 17a. If the adhesive is applied to the bands 17a, then it should be of the above mentioned character which will remain substantially surfaced on the fibers for efficient bonding engagement with the subsequently applied fiber ribbons 16a. The word "ribbons" is used in reference to the fiber areas 16a to indicate fairly sharply defined self sustaining webs of fibers formed, for example, by a carding engine, whereas the term "band" has been applied to fiber areas which may be of lighter weight and lesser integration, formed, for example, by air laying. However, it should be observed that it is not necessary that these two specifically different forms of fiber areas be employed. All of the fiber areas may be produced by air laying if desired.

The increased thickness cross-over areas 16b are especially desirable in connection with the production of packaging material as hereinafter explained in connection with FIGURES 17 and 18 of the drawings.

If fabric material according to FIGURES 5 and 6 is combined with a carrier web of gauze such as represented in FIGURE 7, and the combined material used as the wrapper of a sanitary napkin, said extra thickness fiber portions 16b may be advantageous in their amplified effect in shielding the gauze threads from engagement with the body. In the fabric constructions represented in FIGURES 4 and 5, portions of one set of the fiber bands or sections which extend between and interconnect the bands or sections of the other set constitute means for holding the latter in spaced relation.

The fiber supply for the described wholly non-woven fabrics may be the above mentioned comber cotton. In some instances, it may be preferred to employ fibrous material having a larger percentage of long fibers.

The fiber patterns represented in FIGURES 1 to 6 inclusive embody straight lines or bands and ribbons of fiber which impart to the fabric tensile strength in the direction of the lengths of such lines or bands. The criss-cross line patterns of FIGURES 1 and 4 provide good tensile strength in two relatively transverse directions and result in good tensile strength in all directions. However, it is not essential that the pattern be based on straight line fiber formations since curved or undulating lines, and any desired regular, symmetrical or irregular unsymmetrical pattern may be employed. However, when tensile strength is desired in non-woven fabric (without a backing web) it appears to be best obtained by patterns embodying straight line applications of fibers in which the lines extend continuously in the direction in which strength is desired.

Fabrics as in FIGURES 1, 2, and 3, will usually be substantially inextensible in the direction of the threads of the carrier web. Extensible or inextensible webs of other materials (for example a paper web) may be employed as the backing web and will impart its particular characteristics to the composite web. When a thread, gauze, paper or other sufficiently continuous backing web is employed, the unspun fiber component may be in discontinuous pattern embodying dots, dashes, circles and an endless variety of other forms, and one or more different fiber area shapes may be employed in the fabric. For some purposes the backing material of fabric constructions such as shown in FIGS. 1, 2 and 3, may be formed of threads of adhesive material suitably deposited and on which the fiber applique may be deposited. If such adhesive material threads are of thermoplastic adhesive, effective bonding of the fibers to the threads may be insured by subjecting the fabric to a hot calendering or other operation whereby the thermoplastic material is reactivated and the unspun fibers embedded in the reactivated material.

In a typical arrangement for producing the new fabric, the selected carrier web material 1, such as a woven gauze web or a gauze-like web of cross laid threads (or carrier web material 1a consisting of a plurality of parallel

threads), is withdrawn from a suitably mounted supply roll 20 (FIGURE 8) or otherwise suitably delivered to and carried forwardly by the horizontal upper reach of a conveyor belt 21 which is suitably, preferably continuously, propelled. The belt 21 travels around suitably positioned guide rolls 22, 23, and 24. One or more of these rolls may be adjustably mounted or suitably biased to act as a take-up roll for maintaining the horizontal upper reach of the belt as taut as desired. Additional supporting or guide rolls may be provided as needed.

Frictional engagement between the conveyor belt 21 and the carrier web material is usually sufficient to cause the carrier web to follow the conveyor belt but suitable pressure rolls may be employed if needed or desired, for effecting driving engagement of the carrier web with the conveyor belt.

Adhesive is applied to said carrier web 1 while it is supported by said conveyor belt, by means of adhesive applying or printing equipment represented at 25 which is constructed and operated to apply the adhesive in the desired manner, for example as described in connection with FIGURE 7. A drying device 26, suitable for partially drying or setting the kind of adhesive employed, is provided. When the adhesive is of a character which permits it, such as a resinous, thermoplastic adhesive in plastisol or organosol form, the drier 26 is so operated that the adhesive remains active at least on its surface during the passage of the carrier web into and through the area of operation of apparatus by means of which the fiber component is applied to the web.

A bat 27 of the selected comber cotton or other fibers or blends of fibers is withdrawn from a suitably supported supply thereof and fed into engagement with a picker or other suitable divellicating roll 28 which is rotated at high speed, thereby to break the bat 27 down into a stream 29 of separated fibers which stream flows toward the foraminous web 1 which, as indicated in FIG. 8, is now carried crosswise of said fiber stream by another conveyor 30, to intercept the fibers and collect the same on said web 1. The conveyor belt 30 is a foraminous or screen wire belt which is continuously propelled and guided by suitable rolls 31. A suction box 32 placed under this forming belt or screen, aids the deposition of the fibers on the carrier fabrics. The divellicating apparatus may include provision in addition to the suction box for inducing air currents to carry the fibers and to guide or control the path of said stream of fibers.

The pattern or net-like arrangement in which the fibers are deposited is determined by the pattern of the forming screen. The network fiber pattern shown in FIGURE 1 may be produced by filling in the forming screen areas corresponding to the openings 10 so as to leave permeable lines or strips in the screen substantially corresponding to the fiber band areas 8 and 9. The foraminous screen 30 is usually quite long and costly and such treatment of the screen would itself be quite costly and would limit the use of the screen to the production of a single fiber pattern. This objection may be avoided by incorporating the desired pattern in an auxiliary or pattern screen 33 of much shorter length than the screen 30.

Such an auxiliary or pattern screen 33 may be guided around suitable guide rolls 34 in such a manner that the upper reach of said pattern screen is disposed intermediate the suction box 32 and the upper reach of said forming screen 30, preferably in engagement with or close proximity to said forming screen. The pattern screen 33 may be driven at the same linear speed as the forming screen 30 or, in some instances, said screens may be operated at different rates of travel. The pattern screen 33 may be of the same construction as the forming screen 21, but said pattern screen has appropriate areas closed by being filled with solder or flexible plastic material, or such areas are blocked out by being covered with imperforate elements suitably secured to the screen belt. Said pattern screen may also be in the form of a

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solid metal or other belt perforated to provide the desired pattern. In FIGURE 9, the pattern member 33 is represented as having areas 35 closed to leave an open pattern of perforated or foraminous forming wire as indicated at 36, such pattern corresponding substantially to the network pattern of the fiber bands 8 and 9 of the material shown in FIGURE 1.

The pattern screen or wire 33, travelling in close contact and in unison with the overlying forming screen 30 will, in effect, impart to said screen 30 the same pattern as occurs on the pattern screen so that the fiber in the stream 29 will be collected in concentrations coinciding with the pervious pattern areas 36 on the pattern screen 33. Some fiber will, however, tend to spill or fall over the imperforate areas 35 so that in such areas, which correspond to the areas 10 in the FIG. 1, product, there will usually be a few overlying fibers. In some instances, some or all of the imperforate areas 35 may be provided with one or more perforations, such as an opening 37 represented in dotted lines in FIGURE 9, to induce the disposition of a few fibers in said areas.

In addition to the above mentioned reduced cost of preparing the shorter pattern screen 33 instead of the longer forming screen 30, and the indicated feasibility of providing as many as may be desired of the shorter pattern screens for versatility in respect to the patterns which may be produced, the provision of such shorter pattern screen greatly facilitates the changing of the pattern screen. A short screen belt may be removed and replaced by another with much less work than is required for similarly handling a long, full length screen like the forming screen 30; hence, pattern changing may be speedily effected and idle time of the apparatus because of such changing, held to a minimum.

Fibers pneumatically deposited in the manner represented in FIGURE 8, will be more or less intertwined and cohesively interattached so that they will form a substantially continuous web. When the weight of fibers in the main fiber areas is within the lower portion of the hereinbefore indicated weight range of 1½ to 20 grams per square yard, basis weight, a large proportion of the fibers will engage the adhesive carried by threads of the gauze web, whereby the fiber applique, as an entirety, will be strongly bonded to the gauze or other carrier web; this bonding may be improved somewhat by the application of either or both heat and pressure to the composite web, as by means of a calendering operation.

A calendering operation may be performed by means of a suitable calender roll stack 38, the composite fabric being passed between a pair of the rolls thereof so as to cause the adhesive engaging fibers to be pressed into the adhesive, thereby to improve the adhesive fiber-to-carrier web bond and also the adhesive fiber-to-fiber bond wherever such a bond occurs. One or more of the calender rolls may be heated to the temperature required to soften or reactivate the thermoplastic adhesive material to facilitate embedment of the fibers as aforesaid and means, such as a pneumatic device 39 may be provided in operative relation to the travel of, the composite web from the calender stack, to cause air to flow through the web or across one or both surfaces thereof to remove loose fibers and to cool and set the thermoplastic adhesive, after which the composite web may be wound into a roll 40 by suitable winding mechanism typified by rollers 41. Guide rolls such as indicated at 42, 43, and 44 may be employed for guiding web to and from the calender stack and to the winding mechanism. (Printing equipment indicated at 45 is not used in the preparation of composite fabric according to FIGURE 1 although it may be used to add reinforcing lines of adhesive similar to those described in connection with FIG. 4.)

The longitudinally ribbed or banded fiber applique in the product shown in FIGURE 2 may be produced by

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the apparatus above described except that the pattern screen 33 is eliminated and a series of longitudinally extending parallel, transversely spaced baffle bars 46 (FIG. 11) are provided immediately above the forming screen 30 to cause fiber to be deposited primarily in the bandforming areas between said baffle bars. The baffle bars may be supported by suitable frame work or, as illustrated in FIG. 11, by the walls of a housing 47 which encloses the area of fiber deposition above the suction box 32. A small amount of the fiber will be carried under such bars by air currents drawn thereunder and thence into the suction box 32 so that the areas intermediate said main band areas will usually present at least a few fibers. This longitudinally ribbed pattern of fiber facing may also be produced by omitting the pattern screen 33 and providing a series of longitudinally extending, transversely spaced baffle bars 48 across the top of the suction box as shown in FIGURE 12.

A very sharp edged longitudinally ribbed pattern exhibiting substantially fiber free areas intermediate the bands of fiber concentration, may be produced by employing simultaneously, the baffles 46 in the bottom of the forming chamber and the baffles 48 at the top of the suction chamber, the baffles 46 being registered with the baffles 48 in vertically superposed relationship. Such an arrangement evidently prevents the flow of fiber-bearing air under the baffles 46 and accordingly produces very sharply defined fiber bands corresponding to the fiber bands 11 in FIGURE 2.

The web shown in FIGURE 3, with its crosswise extending bands of fiber, may be manufactured on apparatus such as represented in FIGURE 8, the pattern screen belt 33 being replaced by a similar belt 33a (FIGURE 10) having crosswise extending ribbon-like areas 49 closed or blocked out in a manner similar to that in which the areas 35 (FIGURE 9) are closed. If desired, the areas 49 may be blocked out by applying suitable tape strips (as indicated in FIGURE 10) to the screen belt, such tape strips being adhesively or otherwise secured in place on the screen. If the longitudinal thread carrier web of FIG. 3 is desired, threads to form the parallel thread backing 1a would, of course, be substituted for the gauze web 1 and such threads may be coated with adhesive by means of a roller applicator as indicated in FIGURE 8 or by being passed through a bath of adhesive.

The adhesive bonding lines 19 in the FIGURE 4 fabric construction may be applied by employing the printing mechanism 45 in the apparatus represented in FIGURE 8. The said printing mechanism comprises a printing roll 50 (See also FIGURE 13) having raised printing surfaces or ribs 51. The printing roll being properly adjusted relative to the path of travel of the fiber web, will print only on the raised areas produced by the fiber bands 16 and 17 so as to produce the discontinuous adhesive bonding pattern represented at 19 in FIGURE 4. The areas 18, (FIGURE 4) having but little or no fiber, will receive no adhesive imprint. Adhesive binder applied in the manner just described, when dried, naturally or artificially, will effectively bond fibers together at intervals along the lengths of the bands. When the printing unit is used, it is preferable that it print on the web after calendering thereof as shown in FIG. 8, whereby a better printing surface is imparted to the fiber applique.

Intermittent bonding, as produced by printing adhesive on the fiber band areas in the manner just described, may also be effected when the fiber bands are made wholly or partially of thermoplastic fibers, by employing the printing roll 50 as a hot calender roll to heat and reactivate portions of thermoplastic fibers which occur in such positions as to be affected by the rib areas 51 of the roll. Subsequent calendering of the fabric, although not essential, will insure effective adhesive interengagement of the softened thermoplastic material and contiguous threads and fibers.

The fabric shown in FIGURES 5 and 6 may be produced by apparatus such as represented in FIGURE 14. The transverse fiber ribbons 17a are formed by deposition from suitably divellicating mechanism 28 which delivers the fiber stream 29 to the forming wire 30. A pattern screen of the form represented at 33a in FIG. 10, provided with transverse bars or closure strips 49, is associated with said forming wire 30 so that the fibers will be collected on said forming screen in said transverse bands 17a, the suction box 32 being employed to aid the deposition of the fibers on the forming wire. The longitudinally extending fiber ribbons 16a are formed independently of the bands 17a, by means of a carding engine 52 which delivers a plurality of mutually independent fiber ribbons or webs 16a separated from each other according to the spacing desired, the ribbons being delivered on top of the bands 17a. These separated fiber ribbons are obtained from the card by the use of appropriate doffing combs. Printing mechanism 45 may be interposed between the divellicating mechanism and the card as shown in FIG. 8, or positioned after the card, to apply adhesive respectively to the transverse fiber bands 17a before overlaying the card-formed ribbons 16a, or to the latter, as may be desired. If desired, the web may be calendered before printing to improve the printing surface on the fiber bands or ribbons. It will also be apparent that thermoplastic fibers may be incorporated in either or both sets of fiber bands and such thermoplastic fibers reactivated to bond the crossing portions of said bands together by the application of either or both heat and pressure or by any other suitable means.

The FIGURE 15 apparatus comprises fiber bat divellicating means 52 substantially like that employed in the FIGURE 8 apparatus, but instead of the costly forming belt 30 and pattern screen 33 of FIGURE 8, there is provided a foraminous forming cylinder 53 suitably rotatably mounted and rotated in the path of the stream 54 of separated fibers produced by the divellicating mechanism. If the fabric is to be formed on a backing web 1, such a web may be guided by rolls 55 and 56 to and from the forming cylinder. A suction tube 57 arranged diametrically of the forming cylinder and connected by suitable conduit means 58 to a suction fan, may be provided to aid the deposition and matting of the fibers on the surface of said roll. Said roll surface may be made of screen wire or other foraminous material provided with the desired pattern forming pervious and impervious areas.

One example of utility of the described fabrics is represented in FIGURE 16 in which the gauze reinforced fabric of FIGURE 1 constitutes the wrapper 59 around an absorbent pad 60 in a catamenial napkin. This wrapper 59 is highly permeable as above explained and permits the menstrual exudate to readily penetrate the wrapper to be absorbed by the pad 60. The highly permeable character of the wrapper material tends to avoid the accumulation of moisture on the surface of the napkin and this respect contributes a highly desirable comfort characteristic to the napkin. Also, the bands or ribs of fiber provide a sheathing or shielding effect over the threads of the gauze or other thread-formed backing web so that the threads are held out of direct engagement with the body of the wearer of the napkin. The very uncomfortable abrasive effect of threads in a gauze or other thread containing sanitary napkin wrapper is thereby eliminated from the napkin represented in FIGURE 16. The said sheathing effect is also applicable to other sanitary napkin wrapper webs such as paper or other webs which, in the absence of suitable protective means, tend to chafe. The described constructions provide surface smoothness and softness or anti-abrassiveness equivalent to that of wrappers containing substantially greater amounts of fiber distributed uniformly over the entire area of the wrapper. Hence, the described

patterned fiber lay construction attains improved results and also economy by the use of a reduced amount of fiber.

For the greatest anti-chafing effect, it is preferred that the areas of fiber paucity have a light lay of fibers and this may be attained as an incident to production of the fabric by means of the described methods and apparatus and by selecting a pattern in which the fiber concentration areas are not too greatly spaced and whereby the desired amount of fiber will extend over said areas of fiber paucity.

The unspun fiber applique is preferably on the outside of the wrapper 59 to attain the maximum effect thereof but it may be located on the inside of the wrapper in the normal use of the napkin without wholly sacrificing the beneficial attributes of the wrapper. Many of the fibers of the applied bands project through the carrier web to provide said chafe preventing, thread sheathing effect on the side of the fabric opposite to that on which the fibers are deposited. Permeability will remain about the same whichever side of the wrapper carries the fiber applique but the chafe-preventing effect thereof will best be attained when the fiber component is on the outside.

The unspun fiber component also imparts to the surface of the napkins a desirable overall smooth feel notwithstanding the presence of areas in which there are but few fibers. The overallness of this smooth feel is probably somewhat dependent on the thickness and kind of fiber deposited in the fiber ribbon areas and the spacing thereof from each other, and it is accordingly capable of adjustment by appropriate selection in respect to these details.

The provision of the areas of fiber dearth or relative fiber paucity, contributes to the preservation in the wrapper material of a large proportion of the normal softness or limpness of the open mesh gauze material forming the carrier web or base of the wrapper. Such limpness of the material greatly facilitates folding of the material about the pad, especially by high speed automatic machinery. This limpness characteristic is also desirable in that it permits the wrapper to conform closely to the enclosed pad body whereby good appearance of the catamenial napkin is obtained.

The reduced amount of fiber in the wrapper also results in reduced bulk in napkin end tabs with attendant benefits to the wearer of the napkin.

Another form of sanitary napkin wrapper fabric shown in FIG. 17 embodies areas of relative fiber concentration and dearth 61 and 62 respectively in a checker-board pattern of fiber applique on a carrier web 63 which may be of any suitable open mesh or highly pervious material.

The wrapper shown in FIG. 17 also has fiber applique bands 65 which extend lengthwise of the wrapper and are adapted to cover the side edges of the absorbent pad when the wrapper is folded around such pad. One longitudinal margin, 66, of the carrier web is left free of fiber applique material so that when the wrapper is folded around a pad and said margin is lapped over the opposite margin there will be but a single thickness of fiber applique material in the area of said lapped margins.

The wrapper of FIG. 17 may be applied to the pad with the fiber applique either inside of the wrapper or on the outside thereof. The fiber applique may be bonded to the carrier web by means of thermoplastic or other suitable adhesive, for example, one in the form of a plastisol or an organosol as previously mentioned herein, and this adhesive bonding is especially desirable when the fiber applique is on the outside of the wrapper. The described methods of producing patterned fiber area webs facilitates the production of wrappers like that shown in FIG. 17 with fiber applique areas arranged to fit and cover selected pad areas. If desired, the band areas 65 may be made of a length which corresponds to the length of the pad edges so as to reduce fiber applique bulk in the attachment tab end portions of the wrapper.

Other embodiments of fabrics of this invention, especially suitable for use as sanitary napkin wrappers, are

shown in FIGS. 19-22. The fabrics shown have relatively open central portions extending longitudinally thereof, those portions being of patterned configuration and flanked on each side with integral relatively closed areas of uniformly distributed fibers, the fibers in both the open and closed areas being haphazardly disposed. When a fabric of this type is folded around an absorbent pad, as in a catamenial napkin such as is shown in FIG. 23, the open-patterned, highly permeable portion of the fabric wrapper is located in the central area of the pad surface where the menstrual exudate normally makes contact, permitting rapid penetration of the exudate into the absorbent pad. This type of construction has particular advantages in that a highly permeable central portion of the wrapper permits rapid fluid penetration at the desired location. In addition, non-patterned areas are located laterally of the patterned area of the pad wrapper to present a soft smooth non-chafing surface where the wrapped pad is in rubbing contact with the thighs.

The fabric of FIG. 19 comprises a fiber carrying web made up of warp and woof threads 71 and 73 to which is applied an applique of haphazardly deposited fibers in a patterned configuration defining a relatively open central portion flanked on each side by a relatively closed portion 79. The central portion includes elongate slot-like areas 77, which are substantially free of deposited fibers, and intervening rib- or strand-like areas 75 made up of substantial fibrous deposits. The fibers throughout areas 75 and 79 are interbonded, at least in part, to the warp and woof threads 71 and 73 respectively, and may also be bonded to each other. The fiber arrangement shown defines a central area of a high fluid permeability and attractive appearance.

FIG. 20 illustrates an alternate embodiment of the invention wherein a plurality of fibrous strands 80 are obliquely disposed to extend across a central longitudinally disposed area to intersect a plurality of obliquely disposed strands 82 disposed in reversed angularity thereacross. The resulting patterned configuration throughout the central area defines a plurality of relatively open areas 81 and 83 intermediate the strands thus disposed. A central row of diamond-shaped openings 81 is flanked on each side in the pattern shown by rows of triangularly shaped openings 83 to present a fabric of attractive appearance with relatively high fluid permeability in the central portion thereof.

As in the fabric of FIG. 19 the relatively open central area is flanked on either side by relatively closed areas 84 wherein the fibers are haphazardly but uniformly deposited. Obviously, many variations of patterns incorporating adjacent open areas and closed areas can be used in the longitudinal central portion of the fabric.

The apparatus of FIG. 8 may be utilized to make the fabrics of FIGS. 19 and 20 by restricting the patterned area of the patterned screen belt 33 to the central longitudinal portion.

FIGS. 21 and 22 are fragmentary representations of another embodiment of the fabric with the pattern restricted to the central portion. In this embodiment no thread carrier web is used, FIG. 21 being a plan view while FIG. 22 is in perspective. The fabric is made up of a patterned central portion consisting of a network of independently formed longitudinally and transversely extending bands 85 and ribbons 87 of fibers and open areas 86. The ribbons 87 are formed independently of the bands 85 as in the fabrics of FIGS. 5 and 6. Marginally flanked portions 89 consist of haphazardly arranged intermeshed fibers of substantially equal distribution to provide relatively closed areas.

The apparatus of FIG. 14 may be used to make the fabrics of FIGS. 21 and 22 by restricting the pattern of the patterned screen belt 33a to the central longitudinal portion.

FIG. 23 shows the fabric of FIGS. 21 and 22 in use as a wrapper for a catamenial napkin with identifying

numbers in FIG. 23 referring to similar portions of the fabric FIGS. 21 and 22.

Another example of utility of the described fabric is shown in FIGURE 18 where there is represented a form of padding or cushioning material for protecting goods packaged for shipment. The illustrated example of packaging material comprises superposed plies 67, 68, 69, and 70 of all unspun fiber fabric made according to FIGURE 4. The assembled plies provide a cushion of substantial thickness or bulk and very light weight. As indicated in said FIGURE 18, the fiber bearing areas of the assembled plies need not be registered with one another and will nevertheless build up a thick soft pad. The plies may be adhesively bonded together if desired, but the normal tendency of fibers to cling to each other provides ply adhesion which may be sufficient for many purposes.

The all over cushioning effect obtained by the spaced areas of higher fiber density permits a reduction in the total amount of fiber employed, thereby attaining economy in manufacture.

The various patterned unspun, low density fiber component fabrics illustrated, including the all unspun fiber fabrics of FIGURES 4 and 5, may be used for each of the specific applications mentioned and for many others. The fiber patterns illustrated were selected to typify the general character of the fabrics which may be produced according to this invention and to facilitate explanation of various means which may be employed for producing the fabric. Similarly, the specific thread carrier web constructions shown are selected as representative constructions for explanation purposes, and other forms of interlaced and cross thread webs may be used. It is not intended that the scope of the invention be restricted to the specific carrier web constructions described or to the specific fiber applique patterns described since, as already indicated, an almost limitless number of patterns of network and other forms may be produced. Modifications of the described apparatus and method for producing the fabric may also be made while employing the principles of the invention.

In the following claims, unless otherwise indicated, the words "carrier web" are used to signify a supporting web of interwoven threads as typified by gauze, of non-woven webs comprising crossed but not interwoven threads, of interlaced threads typified by both interwoven and knitted threads, of parallel or other non-crossing threads, and of other material which provides the desired tensile strength or support for the fiber applique. Again, since there is no critical relationship between the amount of fiber in the areas of fiber concentration, such as the bands 8 and 9 in the FIGURE 1 fabric, and in the areas of fiber paucity or dearth, such as in the areas 10 in the FIGURE 1 fabric, the reference in the appended claims to a "relative dearth" of fibers is meant to signify a substantial difference in volume of fiber resulting from the provision of a significant amount of fibers in some areas and very little and even no fibers in other areas. The term "network" is employed to signify any pattern which results in areas having little or no fiber wholly surrounded by areas of fiber concentration. Also, the word "applique," unless otherwise indicated, is used to refer to a deposit of fibers whether applied in haphazard or more or less parallel relation to each other and without reference to the process or means by which the deposit is formed.

I claim:

1. Non-woven fibrous fabric of a network-like patterned configuration formed by directing a stream of separated fibers onto a partially screened out foraminous member, said fabric consisting of a web-like layer of haphazardly deposited textile fibers of more than $\frac{1}{16}$ " in length arranged to define spaced areas throughout which the fibers are sparsely deposited and intervening areas throughout which the fibers are deposited in sufficient numbers to provide substantially closed relatively uniform

web portions, some of the fibers in said intervening areas being adhesively interconnected, and the fabric thus formed having a basis weight of 1 to 20 grams per square yard.

2. A non-woven fabric comprising in combination an open mesh thread web and a non-woven web of unspun textile fibers of more than $\frac{1}{16}$ " in length formed by directing a stream of separated textile fibers partially screened out in patterned configuration onto said thread web to effect the deposit thereon of said non-woven web in a predetermined configuration, and means bonding discrete areas of said non-woven web to said thread web.

3. The fabric of claim 2 wherein the non-woven web of unspun textile fibers comprises a longitudinally disposed central portion of regularly spaced open formation and laterally disposed integral portions of relatively closed formation.

4. A highly permeable light weight fabric comprising a carrier web and textile fibers more than $\frac{1}{16}$ " in length deposited in a predetermined pattern on said carrier web, said fibers being adhesively bonded to said web throughout discrete areas, said predetermined pattern including a longitudinally extending central area throughout which said fibers are haphazardly deposited and interbonded to define open areas therebetween, and closed marginal areas throughout which the fibers are substantially uniformly deposited, said fabric having been formed by causing said carrier web to intercept a stream of entrained textile fibers which stream had, prior to said interception, been subjected to the influence of a screening element of patterned configuration with resultant deposit of said textile fibers on said carrier web in the patterned configuration of said screening element.

5. A sanitary napkin wrapper comprising a carrier web of spaced threads of relatively high tensile strength, and a thin, non-woven layer of unspun textile fibers of more than $\frac{1}{16}$ " in length anchored to said carrier web to provide the outer wrapper surface, the fibers being disposed on said carrier web in a selected pattern having distinguishable areas in which there are respectively, a relative paucity and a concentration of fibers, said areas of fiber concentration being fluid permeable and said areas of fiber paucity being substantially non-resistant to penetration by fluid, said fabric having been formed by causing said carrier web to intercept a stream of fluid entrained textile fibers which stream had, prior to said interception,

been subjected to the influence of a screening element of patterned configuration with resultant deposit of said textile fibers on said carrier web in the patterned configuration of said screening element.

6. A sanitary napkin wrapper comprising an open mesh carrier web comprising two sets of non-woven threads with one set crossing the other, a non-woven applique of unspun textile fibers of more than $\frac{1}{16}$ " in length on one face of said carrier web, the fibers of said applique being bonded to one set of said threads and to the cross-over portions of said other set, the adhesive at said cross-over portions also bonding one set of threads to the other, said second mentioned set of threads being substantially free of adhesive intermediate said cross-over portions thereof, the fibers in said applique being disposed in a selected pattern having distinguishable areas in which there are respectively, a relatively paucity and a concentration of fibers, said areas of fiber concentration being highly permeable and said areas of fiber paucity being substantially non-resistant to penetration by menstrual fluid, said fabric having been formed by causing said carrier web to intercept a stream of fluid entrained textile fibers which stream had, prior to said interception, been subjected to the influence of a screening element of patterned configuration with resultant deposit of said textile fibers on said carrier web in the patterned configuration of said screening element.

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