Oct. 2, 1962 I. S. NESS 3,056,406

ABSORBENT DRESSING

Filed Sept. 25, 1957 2 Sheets-Sheet 1

Fig. 1.

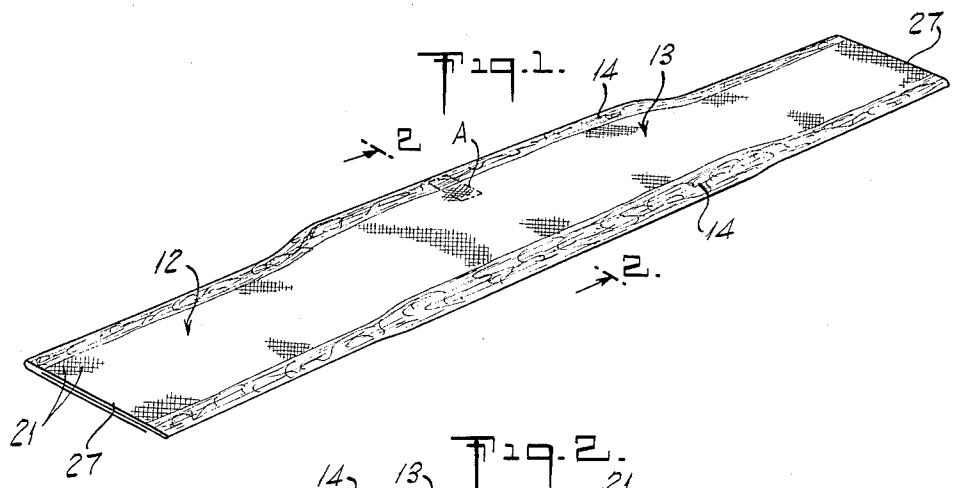

Fig. 2.

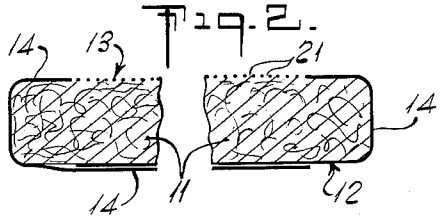

Fig. 3.

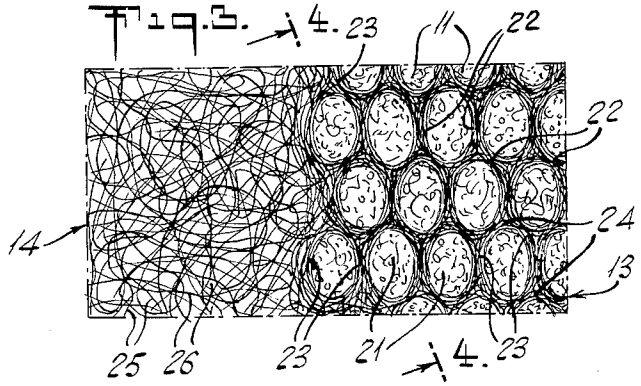

Fig. 4.

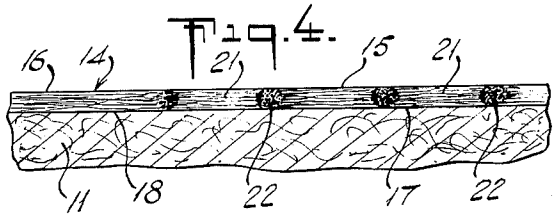

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Fig. 5.

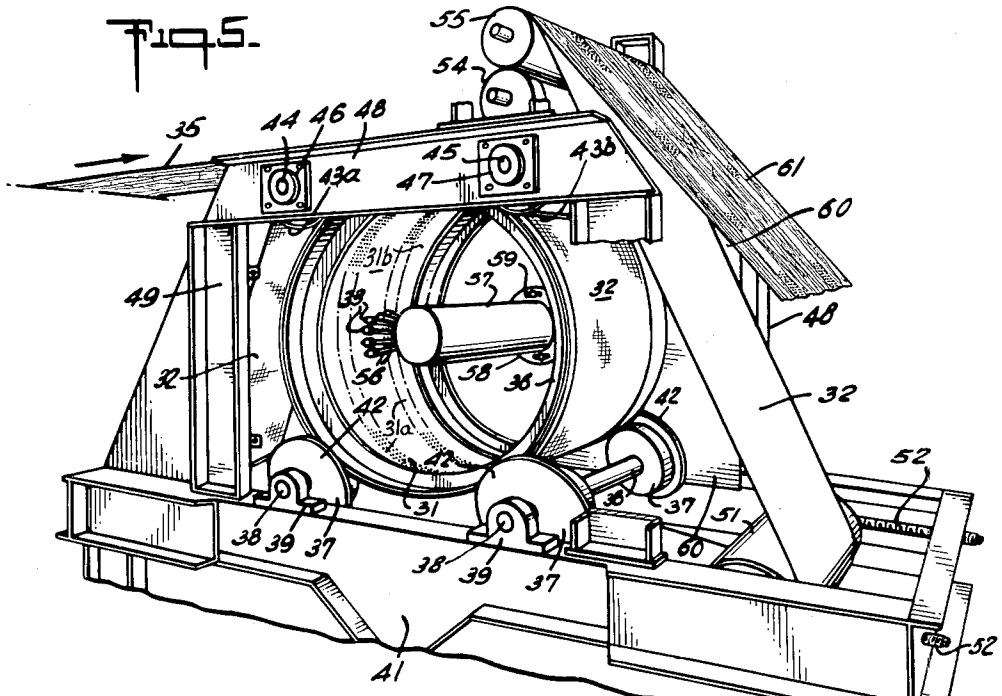


Fig. 6.

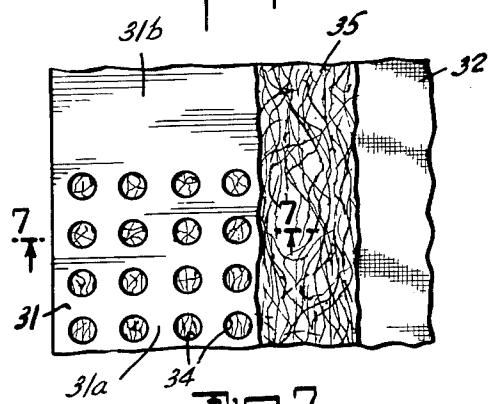


Fig. 7.

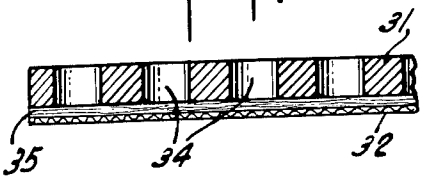


Fig. 8.

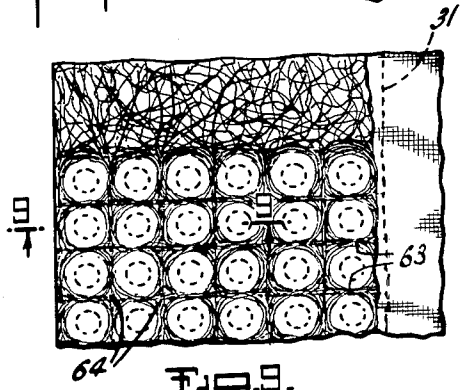
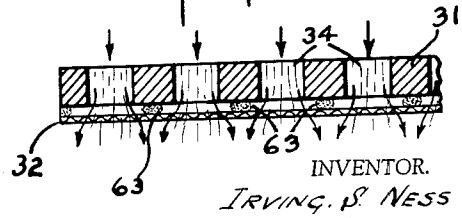


Fig. 9.



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3,056,406

ABSORBENT DRESSING

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Filed Sept. 25, 1957, Ser. No. 686,064
7 Claims. (Cl. 128—290)

The present invention relates to absorbent dressings or pads of the type which are used as sanitary napkins and which are worn or used next to the skin in sensitive areas of the human body. In general, these dressings are of the type which comprise an absorbent core or layer covered with a permeable facing material.

This invention contemplates a pad or dressing which comprises an absorbent core and a soft, smooth, and stable nonwoven fabric cover possessing textile-like hand and drape wrapped around the core. By a nonwoven fabric, I mean a fabric produced from unspun fibers without the use of conventional spinning, weaving, or knitting operations. The cover is uniformly and highly permeable and open in that portion of its area which normally comes into direct contact with fluid discharge and substantially less permeable and relatively closed in those portions which cover the sides of the core and normally do not come into contact with fluid discharge. Thus, the pad is most permeable in those areas where a high degree of permeability is needed and considerably less permeable where permeability is not normally needed and may even be undesirable. In one form of pad, a sanitary napkin, it is most important that the cover be very permeable in the area where the fluid discharge first comes into direct contact with the surface of the pad to allow the fluid to penetrate the cover quickly and become absorbed into the core, and it is advantageous that the cover be less permeable or even relatively impermeable around the sides of the pad to resist leakage through the sides of the dressing when the absorbent pad approaches saturation or if liquid tends to flow through the sides of the pad for any other reason.

The highly permeable portion and the relatively closed less permeable portions of the cover, preferably, are integral and connected by fibers extending substantially in the plane of the cover from one portion to the other. The highly permeable and the less permeable portions of the cover may be laminated at their edges or otherwise secured together, but this is not preferred because some of the advantages inherent in the preferred cover are lost. Both portions of the cover are soft and dimensionally stable. The outer surfaces of both portions of the cover are smooth and flat and therefore particularly adapted for contact with the wearer and the inner surfaces of both portions of the cover also are smooth and flat and therefore particularly adapted for substantially continuous contact with the surfaces of the absorbent core.

The highly permeable portion of the cover comprises fibers oriented to define a multiplicity of substantially uniformly arranged holes and interconnected groups of fiber segments between the holes. The fiber segments bordering the holes preferably are in substantial parallelism with corresponding portions of the perimeters of the holes. thereby providing a substantially continuous fibrous border for each hole which gives the hole definite identity. The groups of fiber segments are interconnected by fibers common to a plurality of groups at junctures wherein the fibers extend in a plurality of diverse directions substantially in the plane of the fabric, with the groups and the junctures each lying in the same general plane, thereby forming a dimensionally stable integral structure of unspun fibers. Preferably, the fiber segments in the groups are substantially parallelized and closely associated or laterally compacted in the groups and the holes are substantially uniformly regular and uniformly spaced and arranged in a predetermined pattern. Thus, this portion of the cover is highly permeable and relatively open due to the multiplicity of substantially uniformly arranged holes it contains. This portion of the cover also possesses substantially uniform moisture conducting power due to the uniform arrangement of holes and the uniform arrangement of the groups of fiber segments between the holes, as well as the substantially parallel and laterally compacted arrangement of the fiber segments in the groups.

In the highly permeable portion of the cover, the fiber groupings possess thickness through the fabric with the result that the cover has appreciable depth and the wearer primarily will contact the outer surface of the cover rather than the absorbent core through the holes in the cover. This portion of the cover does not present a continuous fibrous surface which will feel wet, but, on the contrary, presents an intermittent ararngement of fiber groupings defining holes extending through the depth of the cover which, as described above, do not retain the fluid but together distribute it rapidly and effectively to the core.

The less permeable portion of the cover comprises fibers which are flatly assembled in overlapping crossing relation with one another, defining only very small, irregular and randomly arranged interstices between them. Since the interstices between the fibers in this portion of the cover are very small and in some cases hardly distinguishable to the naked eye, the surface of this portion of the cover is relatively closed in appearance, as compared with the open appearance of the highly permeable portion of the cover. The surfaces of the less permeable portions of the cover are substantially continuous and smoother than the surfaces of the highly permeable portion since they are not interrupted by holes of any appreciable size. This is of particular advantage in a sanitary napkin since the smoother, less permeable portions on one or more sides of the napkin are in continual contact with the wearer.

Advantageously, the less permeable portions of the cover may be impregnated or coated with a water resistant material or an agent which renders these portions of the cover resistant to the passage of fluid in order to further decrease their permeability or even make them substantially impermeable. Similarly, the whole cover may be impregnated with a water or fluid resistant material of the type which will minimize the permeability of the less permeable portions of the cover due to the very small interstices they contain, and not seriously affect the permeability of the highly permeable portion thereof, since the highly permeable portion comprises a multiplicity of relatively large holes substantially uniformly arranged therein.

It is also advantageous that the open portions of the cover which contain the interconnected groups of fiber segments extend into the areas of the cover which may receive pins for securing the pad or napkin during use, since the interconnected fiber groups of the cover will tend to resist tearing thereof when pinned, thus contributing improved pinning strength to that portion of the dressing.

It is preferable that in the foraminous cover formed by the interconnected fiber groupings in accordance with the invention, the fibers be in relatively unstressed positions where they lie in a state of mechanical equilibrium. In this state, in the interconnected groups of fiber segments of the highly permeable portion of the cover, the fibers are mechanically engaged both frictionally and/or by interlocking, to the extent that the arrangement of the fibers is one of equilibrium, in that the fibers themselves have substantially no in-built tendency to depart from their configurations in the structure. As a result, the

moisture absorptive and conducting properties of the cover are improved and the moisture retentive properties minimized. Thus, the menstrual fluid and the like is quickly delivered by the cover to the absorbent core and is quickly taken up thereby. The overlapping crossing relationship of the randomly arranged fibers in the less permeable portions of the cover is inherently very weak and while the frictional engagement and interlocking between the fibers in the groupings contributes strength to the highly permeable portion of the cover, the cover still lacks the strength required for use in a sanitary napkin. For this reason, a bonding material or binder is applied by means such as printing or impregnation to provide sufficient strength to the cover.

Advantages of the invention other than those generally described above will be apparent from the following description and claims taken together with the drawings wherein:

FIGURE 1 is a schematic view in perspective of a sanitary napkin according to this invention;

FIG. 2 is a broken schematic sectional view along the line 2—2 of FIG. 1;

FIG. 3 is a greatly enlarged fragmentary plan view of the portion of the surface of the napkin of FIG. 1 within the indicated areas A of the cover of FIG. 1, taken generally along the line 2—2 of FIG. 1, showing the juncture of the highly permeable portion of the cover and one of the less permeable portions of the cover at one side of the pad and a view of the absorbent core through the holes in the core;

FIG. 4 is a fragmentary sectional view of a portion of the cover of FIG. 1 along the plane of the line 4—4 of FIG. 3;

FIG. 5 is a partially cut away schematic view in perspective of apparatus for forming cover fabric according to this invention;

FIG. 6 is a fragmentary partially cut away schematic plan view of a developed segment of the drum of FIG. 5, showing a fibrous layer of starting material positioned between the drum and the foraminous backing screen of this figure;

FIG. 7 is an enlarged schematic sectional view taken along the line 7—7 of FIG. 6;

FIG. 8 is a schematic view similar to FIG. 6 with the drum portion shown in phantom, showing the layer after it has been formed into a fabric according to this invention; and

FIG. 9 is an enlarged schematic sectional view taken along the line 9—9 of FIG. 8.

Referring to FIGS. 1 and 2 of the drawings, there is shown an absorbent dressing in the form of a sanitary napkin which comprises an absorbent core or layer **11** covered with a soft, smooth, and stable nonwoven fabric cover **12**, which cover possesses textile-like hand and drape and thereby conforms well to the core and is textile-like in use. The core or absorbent layer **11** may comprise any material capable of distributing the fluids to be absorbed by the pad. For instance, it may comprise a layer of comminuted material such as fluffed woodpulp or it may be laminated and consist of several layers of creped cellulose, or it may be a mixture of these. While a rectangular pad having a rectangular cross section is shown, the pad may be of an entirely different shape which is better suited for the purposes for which it is intended. Special internal constructions, not shown, may be employed to help distribute or channel the flow of liquids inside the dressing, and the absorbent core, or layer, first may be wrapped with an inner cover of absorbent material, also not shown, such as creped cellulose, and then with the aforementioned permeable, nonwoven outer cover.

The cover **12** comprises a uniformly and highly permeable and open portion **13** in the form of a panel centrally located in the top face, and extending from end to end, of the dressing. Substantially less permeable and relatively closed portions **14** of the cover adjoin the highly permeable portion **13** and surround the sides of the pad from end to end of the dressing. The less permeable portions **14** continue across the bottom of the pad overlapping one another to form a double thickness cover for the bottom face of the dressing. This construction is preferred when the absorbent dressing of this invention is in the form of a sanitary napkin, as shown. However, for certain other uses and in some cases for sanitary napkins, it may be desirable to have a highly permeable portion of the cover facing the bottom, as well as the top, of the pad. Thus, both of the overlapping portions of the cover of the napkin of FIGS. 1 and 2 might be highly permeable, or only one of these need be permeable with the overlapping occurring on or near one side of the napkin or pad. In addition, while it may be preferred in a sanitary napkin that the highly permeable portion extend in the form of a panel to the ends of the pad for reasons which will appear hereinafter, the highly permeable portion of the cover may be in the form of a shorter rectangle, a square, an oval, or another suitable shape located in the cover in that portion of its area which normally comes into direct contact with fluid discharge in the particular napkin or pad of which it is a part.

The highly permeable portion **13** and the relatively closed less permeable portions **14** of the cover, preferably, are integral and connected by fibers extending substantially in the plane of the cover from one portion to the other, as shown in the drawings. Thus, these portions are not laminated or secured together by any other means or additional material, but are formed from the same basic layer or body of fibrous starting material and are joined together by fibers which enter into the structure of and are integral with both of the portions. Both portions of the cover are fibrous and soft and are connected and constructed in such a way that the cover inherently is dimensionally stable, i.e., the fibers tend to remain in the positions in which they lie in the cover and not move relative to one another, as will be explained more fully hereinafter.

Referring to FIGS. 2 and 4, the outer surfaces **15** and **16** of both portions of the cover are smooth and flat and therefore particularly adapted for contact with the wearer and the inner surfaces **17** and **18** of both portions of the cover also are smooth and flat and therefore particularly adapted for substantially continuous contact with the surfaces of the absorbent core **11**.

Referring to FIGS. 1–4, the highly permeable portion **13** of the cover of the napkin of FIG. 1 comprises fibers oriented to define a multiplicity of substantially uniformly arranged holes **21** and groups **22** of fiber segments between the holes. Preferably, the holes **21** are substantially uniformly regular and uniformly spaced and arranged in a predetermined pattern. They may be somewhat egg-shaped or oval, as shown, round, square, triangular, or of some other configuration. They may be arranged as on the points of a diamond in intersecting parallel and straight rows of holes with the long and short axes of the diamonds extending longitudinally and transversely, respectively, of the napkin, as shown in FIGURES 1 and 3; as on the corners of squares or rectangles in intersecting parallel and straight rows of holes, as shown in FIGURE 8, which rows may extend longitudinally and transversely of the pad or be inclined thereto; or in any predetermined pattern which is suitable for the purposes intended.

In FIGS. 1–4, the shape and arrangement of the holes and of the interconnected groups **22** of fiber segments are such that the cover is extensible in the direction of the length and the width of the pad and therefore may be made to stretch over and conform more readily to the shape of the absorbent core. This is of particular importance in a pad such as a sanitary napkin. Preferably, for increased extensibility transversely of the pad or napkin, the groups **22** in the highly permeable portion **13** are

inclined at an angle less than 45° to the length of the pad, as shown in FIGURES 1 and 3. This allows the cover to be fitted snugly around the napkin in relatively intimate contact with the surfaces of the absorbent core, as shown in FIG. 2, and to adjust itself to changes in the shape of the napkin which may occur during use. To take full advantage of the transverse extensibility of the highly permeable portion 13 of the cover, it is advantageous that this portion be in the form of a panel extending from one end of the dressing to the other, as shown in FIG. 1.

Referring particularly to FIG. 4, most of the fiber segments 23 bordering the holes 21 are in substantial parallelism with corresponding portions of the perimeters of the holes and provide a substantially continuous fibrous border for each hole which gives the holes definite identity. That is to say, they extend around the holes 21 and do not present ends adjacent the perimeters of the holes. Thus, the holes normally are distinct and substantially free of fibers. However, it may be advantageous in a sanitary napkin, for instance, that the cover have a fuzzy appearance, in which case certain free fiber segments, not shown, extending from the main structure of fiber groupings into or across the holes may give this effect.

The groups 22 of fiber segments are interconnected by fibers common to a plurality of groups at junctures 24 wherein the fibers extend in a plurality of diverse directions substantially in the plane of the fabric, with the groups 22 and the junctures 24 each lying in the same general plane. Thus, the interconnected groups 22 form an integral structure of unspun fibers. It is preferred that the average length of the fibers be considerably greater than the lengths of the groups containing them, with the result that the groups predominately comprise only parts or segments of the fibers passing through them and most fibers extend through and interconnect several groups 22.

The fiber segments in the groups 22 are substantially parallelized and laterally compacted in the groups with the result that the groups are somewhat yarn-like in cross section. Referring to FIG. 4, for example, cross sections through several groups 22 of fiber segments show cross sections of fibers spaced relatively close to one another and in some cases touching one another. Also, the fiber groupings 22 possess thickness through the fabric due to the compacting of the fiber segments with the result that the highly permeable portion 13 of the cover has appreciable depth and the wearer will primarily contact the outer surface 15 of this portion of the cover rather than the absorbent core 11 through the hole in the cover. The highly permeable portion of the cover presents an intermittent arrangement of fiber groupings 22 and holes 21 extending through the depth of the cover which do not retain the fluid, but distribute it rapidly and effectively to the core 11.

The fiber segments in the fiber groupings 22 may be substantially parallelized and laterally compacted about the axes of the fiber groupings to the extent that they appear to be in substantial contact with one another along their length when viewed by the naked eye or under a microscope at low magnification. As mentioned above, in connection with FIG. 4, the segments may be so closely arranged or compacted in overlapping relationship about the axes of the groupings that the groups possess yarn-like thickness and generally are yarn-like in cross section. However, the fiber groupings between the holes may remain somewhat web-like though the segments in the groups generally are more parallelized and closely assembled than those passing through the junctures.

The highly permeable portion 13 of the cover is uniformly and highly permeable and open due to the multiplicity of substantially uniformly regular and uniformly spaced holes 21 it contains and due to the correspondingly uniform arrangement of the interconnected groups 22 of fiber segments which define the holes. This portion of the cover possesses the capacity to distribute liquids striking the cover in this area uniformly into the absorbent pad by virtue of the uniform arrangement of the holes 21 and the aforesaid groups 22 of fiber segments and the capillary effect of the parallel fiber segments in the fiber groupings. Thus, liquids and even fluids containing solids pass readily through the holes in the cover and are distributed to the absorbent core rapidly and uniformly. The highly permeable portion 13 of the cover, due to its flat inner surface 17, lies flat on the absorbent core 11 and therefore cooperates with the absorbent core in the distribution and absorption of liquid striking the dressing.

Referring again to FIGS. 3 and 4, in particular, the fibers passing through the groups 22 of fiber segments are in relatively unstressed positions and in mechanical engagement with one another with the result that the fabric structure is in mechanical equilibrium. The fibers themselves possess no in-built tendency to depart from the configurations in the structure. The fibers are in frictional engagement with one another and their bent or curled configurations are entangled or interlocked and resist separation. In general, the frictional engagement and interlocking between the fibers is greater when they lie in groupings which are more yarn-like. In other words, both frictional engagement and interlocking are a function of the tightness or looseness of the fiber groupings. Obviously, the longer the fibers, the more segments there will be in frictional engagement and the more bends or curls will be entangled. Thus, the strength of the cover is a function of fiber length as well as other variables. Since the groups 22 of fiber segments are connected by common fibers extending from group to group through the junctures 24 and are in mechanical equilibrium, the highly permeable portion 13 of the cover resists deformation and is dimensionally stable, retaining its smoothness and its uniform and high permeability.

Still referring to FIGS. 3 and 4, the less permeable portions 14 of the cover comprise fibers 25 which are flatly assembled in overlapping crossing relation with one another, defining only very small, irregular, and randomly arranged interstices 26 between them. This portion of the cover is relatively closed in appearance as compared with the open highly permeable portion 13 of the cover. Both surfaces 16 and 18 of the less permeable portion of the cover are smoother than the surfaces of the highly permeable portion of the cover in that the less permeable portion consists of a substantially continuous layer of flatly assembled fibers and is not interrupted by holes of any appreciable size. This may be advantageous in the sanitary napkin of FIG. 1 since the smoother less permeable portions 14 are located on the sides of the napkin which normally are in continual contact with the wearer. On the other hand, the highly permeable portion 13 is located in the area of the napkin which will come into direct contact with fluid to be absorbed.

It is advantageous, as illustrated in FIG. 1, that the highly permeable portion of the cover extend to the ends of the napkin, or at least that a portion of the cover at each of the ends of the napkin be of the same construction as the highly permeable portion, since these portions of the napkin are designed to be used as pinning tabs 27. The aforesaid arrangement of interconnected groups 22 of fiber segments is advantageous in the pinning tabs 27 since the substantially parallelized and closely associated fiber segments in the groups 22 tend to cooperate to resist tearing or failure due to pinning.

The fibers 25 in the less permeable portion of the cover 14 of the napkin of FIGURES 1–4 also are in mechanical equilibrium in that they lie in relatively unstressed positions therein. However, the mere overlapping crossing relationship of the fibers 25 provides a structure which is relatively weak. Thus, the cover contains a bonding material which is distributed in such a way as to provide adequate napkin cover strength in both

the highly permeable and less permeable portions of the cover.

Cover fabrics for dressings according to this invention may be produced inexpensively in accordance with the teachings of Kalwaites application No. 567,275, filed February 23, 1956, now United States Patent No. 2,862,-251. The Kalwaites method and apparatus, as it applies to this invention, will be described briefly below.

The cover fabrics may be made from natural fibers such as fibers of cotton, wood, wool, jute, ramie, or abaca; or artificial fibers of viscose rayon, cuprammonium rayon, cellulose acetate, nylon, dynel, or other materials, alone or in combination with one another. While relatively long textile-type fibers above normal papermaking lengths, of close to normal textile length or over, say of about ¼ inch to 2 inches or longer, are advantageous from the standpoint of strength, shorter fibers, below ¼ inch in length, within the paper range, may be used. It is advantageous that the shorter papermaking fibers be unbeaten or substantially unhydrated. Shorter fibers of woodpulp, for instance, may be mixed with longer fibers in such a way that the longer fibers will predominate in holding the cover together and determining its characteristics and the use of shorter fibers will decrease the cost of the cover.

In FIG. 5 there is shown an illustrative embodiment of a method and apparatus employing fluid forces for producing cover fabrics according to this invention. This method and apparatus are shown and described in detail and claimed in the above referred to application of Kalwaites.

Referring to FIG. 5, the apparatus comprises a foraminous forming member in the form of a perforated drum **31** having perforations **34** arranged in circumferential strips **31***a* separated by solid circumferential portions **31***b* of the drum, a foraminous backing member in the form of a continuous screen belt **32**, and spray nozzles **33** inside the drum for projecting streams of a fluid such as a gas or liquid, water especially, through its perforations **34**. The widths of the circumferential strips **31***a* of perforations **34** correspond to the widths of the highly permeable portions in the napkin covers to be formed, while the widths of the solid circumferential portions **31***b* correspond to twice the widths of the less permeable portions to be formed. A layer **35** of starting material, suitably in the form of a three-ply laminate of webs of carded cotton fibers, for example, may be sandwiched between the drum and the belt to be formed into cover fabrics of this invention by the fluid being projected through the drum, it being water in the case of the illustrative embodiment disclosed herein. Normally, the fibers in the layer **35** of starting material are in relatively unstressed positions in mechanical equilibrium where they lie in the layer.

The drum, which may have flanges **36** at each end for reinforcing purposes, is mounted in the cradle formed by two pairs of spaced flanged wheels **37**. Each pair comprises a wheel **37** at each end of the drum fixed to a common shaft **38** which in turn is free to rotate in stationary bearings **39** mounted on a fixed foundation frame **41**. The axles or shafts **38** supporting each pair of wheels are spaced to provide stable support for the drum **31**. Each wheel includes an external flange **42** extending upwardly from its supporting surface beyond one of the ends of the drum **31** and adjacent thereto, thereby holding the drum in position axially.

The screen **32** passes around a major segment of the drum and is held in position thereon by positioning rollers located above the drum and close to its surface. The first positioning roller **43***a* appears at the left and the second roller **43***b* appears at the right in FIG. 5. These rollers are fixed to shafts **44** and **45**, respectively, which are free to rotate in bearings **46** and **47** mounted on horizontal frame members **48** supported from the foundation frame member **41** by vertical uprights **49** at each end of the drum. The belt also passes around adjustable guide rollers **51** below the drum which may be mounted on shafts free to rotate in bearings (not shown) which are mounted in the foundation frame member **41**. The position of at least one of the rollers **51** may be adjusted by positioning bolts **52** which are threaded through the foundation. The position of one or more of these rollers may be adjusted to remove or replace a belt and tension it in position.

The screen belt **32**, after passing around the drum **31**, turns around the second positioning roller **43***b* and thence around and through the nip between a pair of squeeze rollers **54** and **55**. Preferably, the bottom roller **54** is driven from a power source, not shown, through conventional means such as a belt, chain or a chain of gears, also not shown. The pressure at the nip between the rollers **54** and **55** may be controlled by any suitable means.

Preferably, the nozzles **33** for supplying liquid in streams to the inside wall of the perforated drum **31** are mounted at the ends of tubes **56** arranged in banks along the length of a pressure cylinder **57** which in turn has a flange **58** at one end attached to the main frame through a vertical upright, not shown. The flange **58** possesses slotted bolt holes **59** to allow the cylinder **57** to be positioned properly with respect to the axis of the drum. The nozzle assemblage is stationary and the drum revolves about the same.

Fluid under pressure may be applied to the interior of this cylinder from any suitable source, not shown. There may be one line or bank of nozzles positioned partly or entirely across the perforated wall of the drum, but it is preferred that a least two banks of nozzles be employed. Three, four, or even more banks of nozzles may be advantageous under certain conditions since they tend to increase the range of speed of the machine. Various conventional forms of nozzles may be employed, although solid cone nozzles are preferred. The foundation frame member **41** itself may act as a sump for the liquid passing through the portions of the screen in the way of the nozzles, or subsequently falling from the screen, drum, or the pressure nip. However, separate means, not shown, defining a pan or sump in or around the foundation frame, may be employed. Splash plates such as shown at **60** may be attached to the frame at both ends of the drum and similar plates or shields may be designed to fit around the screen to provide a splashproof enclosure.

In operation, the layer of starting material **35**, which may be a web of carded cotton fibers, for example, may be passed over the first positioning roller and into contact with the continuous screen **32**. The screen, carrying the web, may be passed around the portion of the drum **31** in the way of liquid being projected through the perforations **34** in the circumferential strips **31***a* of the drum, then around the drum, over the second positioning roller **43***b*, and thence through the nip formed by the squeeze rollers **54** and **55**. The bottom squeeze roller **54** drives the screen **32** and the screen carries the web and drives the drum **31** with no slip between the drum and the screen. The web **35** of material is formed into a fabric **61** according to this invention as it passes in the way of the liquid, preferably water, being projected through the perforations in the drum. The fabric retains some of this liquid as it passes around the drum, although most of it passes through the screen and drops into the collecting sump before the screen carrying the layer reaches the pressure nip. At the pressure nip the major portion of the remaining liquid is squeezed from the fabric **61**. The fabric is separated from the backing screen **32** after the screen and the fabric have passed from the pressure nip and have moved around and over the roller **55**.

A portion of the sandwich formed by the drum, web **35**, and screen **32** is shown in FIGS. 6 and 7. In FIG. 6, as well as in FIG. 8, which will be described more fully

hereinafter, the sandwich is shown where one of the circumferential strips 31*a* of perforations 34 adjoins one of the solid circumferential portions 31*b* of the drum. The perforations 34 in the circumferential strips 31*a* of the drum are round and arranged in a regularly spaced square pattern. However, they may be arranged in a different pattern such as the diamond pattern of the cover fabric of FIGS. 1–4, in which case the long axes of the diamonds will extend in the direction of the circumference of the drum. In general, it is preferred that the dimension of the foramina or openings in the foraminous screen be substantially less than the dimension of the openings in the drum, and for best results it is preferred that the openings in the screen be considerably smaller than the openings in the drum. For example, with the drum having uniform openings in the order of about 1/32 of an inch in diameter, good results may be obtained where openings in the foraminous screen may vary from about 900 openings per square inch to about 50,000 openings per square inch, preferably from about 10,000 openings to 40,000 openings per square inch.

As shown in FIG. 9, the liquid is projected through the perforations 34, in spaced streams which pass through the web, striking the screen 32, to spread sideways and then pass through the openings in the screen. The fibers in the web in the way of the streams are moved sideways by the streams beyond the edges of the perforations 34 and under the solid portions of the drum between perforations as well as under the edge of the adjacent solid circumferential portion 31*b* of the drum. As illustrated in FIGS. 8 and 9, the fibers between the perforations may be arranged in yarn-like groups 63 of closely associated and substantially parallelized fiber segments. The groups 63 are interconnected by fibers common to a plurality of bundles at junctures 64 wherein the fibers are oriented in a plurality of diverse directions generally in the direction of the lay of the web, forming the highly permeable portion of a cover fabric according to this invention. The groups may be yarn-like in cross section as shown in FIG. 9, particularly midway between junctures where they appear to be most parallelized. On the other hand, the fibers behind the adjacent solid portion 31*b* of the drum are more or less undisturbed except under the edge of the solid portion 31*b* where it adjoins the perforated circumferential strip 31*a*.

The fibers are in mechanical engagement in relatively unstressed positions in the cover fabric structure to the extent that they are in mechanical equilibrium and have substantially no in-built tendency to revert to their former positions in the web. The fibers in the rearranged highly permeable portions of the cover fabric are brought to the aforesaid condition of mechanical equilibrium by virtue of the movement of individual fibers in the direction of their respective longitudinal axes and with respect to other fibers in the web with which they are mechanically and frictionally engaged. The aforesaid movement is caused by the fiber rearranging forces applied by the particles of water impinging upon drum 31, web 35, screen 32 as streams of water are sprayed under pressure from the nozzles 33. This movement of the fibers in the direction of their axes permits individual fiber segments to remain in mechanical equilibrium and relatively unstressed condition in the most extreme lateral positions into which they are moved by the fiber rearranging forces. The relatively undisturbed fibers under the solid portions 31*b* of the drum in the less permeable portions of the cover fabric of this invention remain in the state of mechanical equilibrium in which they were arranged in the fibrous layer 35 of starting material, except at the very edges of these portions where they are rearranged into new positions of mechanical equilibrium, as described above for the fibers in the highly permeable portions of the cover fabric of this invention.

After it is removed from the backing screen 32, the cover fabric 61 may be strengthened by the application of an adhesive bonding material in spaced areas thereof as disclosed in Goldman United States Patent No. 2,039,312 or Ness et al. United States Patent No. 2,705,688 and then dried by conventional drying means such as a series of steam cans. After drying, the fabric 61 may be cut or slit by a knife or a conventional slitter to form covers for dressings according to this invention. To form covers for dressings, such as shown in FIGS. 1–4, the less permeable or relatively undisturbed portions of the fabric 61 are slit lengthwise halfway between the highly permeable strips of interconnected fiber groupings 63 and the resulting slit strips are cut to the proper length for the dressings or napkins to be formed. The covers then may be wrapped around absorbent cores by hand or by a device which is conventional for this purpose in the manufacture of dressings such as sanitary napkins.

Having now described the invention in specific detail and exemplified the manner in which it may be carried into practice, it will be readily apparent to those skilled in the art that innumerable variations, applications, modifications, and extensions of the basic principles involved may be made without departing from its spirit or scope.

The claims are:

1. An absorbent pad comprising an absorbent core and a soft, smooth, and dimensionally stable nonwoven fabric cover possessing textile-like hand and drape wrapped around the core, said cover comprising a uniformly and highly permeable open portion facing at least one surface of the pad and portions which are substantially less permeable and relatively closed covering sides of the pad, the highly permeable and the relatively closed less permeable portions of the cover being integral and connected by fibers extending substantially in the plane of the cover from one portion to the other, the highly permeable portion comprising fibers rearranged to define a multiplicity of substantially uniformly arranged holes and groups of fiber segments between said holes, the fiber segments bordering the holes being in substantial parallelism with corresponding portions of the perimeters of the holes, said groups being interconnected by fibers common to a plurality of groups forming a dimensionally stable integral structure of unspun fibers, said less permeable portion comprising fibers flatly assembled in overlapping crossing relation with one another, defining only very small, irregular, and randomly arranged interstices between them, said highly permeable and said less permeable portions of the cover possessing the same fiber content and the same fiber weight per unit area.

2. An absorbent pad comprising an absorbent core and a soft, smooth, and dimensionally stable nonwoven fabric cover possessing textile-like hand and drape wrapped around the core, said cover comprising a uniformly and highly permeable open portion facing at least one surface of the pad and portions which are substantially less permeable and relatively closed covering opposite sides of the pad, the highly permeable and the relatively closed less permeable portions of the cover being integral and connected by fibers extending substantially in the plane of the cover from one portion to the other, the outer surfaces of both portions of the cover being smooth and flat and therefore particularly adapted for contact with the wearer and the inner surfaces of both portions of the cover also being smooth and flat and therefore particularly adapted for substantially continuous contact with the surfaces of the absorbent core, the highly permeable portion comprising fibers rearranged to define a multiplicity of substantially uniformly arranged holes and groups of fiber segments between said holes, the fiber segments bordering the holes being in substantial parallelism with corresponding portions of the perimeters of the holes, said groups being interconnected by fibers common to a plurality of groups at junctures wherein the fibers extend in a plurality of diverse direc-

tions substantially in the plane of the fabric forming a dimensionally stable integral structure of unspun fibers, said groups and said junctures each lying in the same general plane, said less permeable portion comprising fibers flatly assembled and randomly arranged in overlapping crossing relation with one another, defining only very small, irregular, and randomly arranged interstices between them, the fibers interconnecting the highly permeable and the less permeable portions of the cover being common to said less permeable portion and the adjacent groups of fiber segments in said highly permeable portion, said highly permeable and said less permeable portions of the cover possessing the same fiber content and the same fiber weight per unit area.

3. An absorbent pad comprising an absorbent core and a soft, smooth, and dimensionally stable nonwoven fabric cover possessing textile-like hand and drape wrapped around the core, said cover comprising a uniformly and highly permeable open portion facing at least one surface of the pad and portions which are substantially less permeable and relatively closed covering sides of the pad, the highly permeable and the relatively closed less permeable portions of the cover being integral and connected by fibers extending from one portion to the other, the highly permeable portion comprising fibers rearranged to define a multiplicity of substantially uniformly regular and uniformly spaced holes arranged in a predetermined pattern and groups of substantially parallelized and closely associated fiber segments between said holes, the fiber segments bordering the holes being in substantial parallelism with corresponding portions of the perimeters of the holes, said groups being interconnected by fibers common to a plurality of groups at junctures wherein the fibers extend in a plurality of diverse directions substantially in the plane of the fabric forming a dimensionally stable integral structure of unspun fibers, said less permeable portion comprising fibers flatly assembled and randomly arranged in overlapping crossing relation with one another, defining only very small, irregular, and randomly arranged interstices between them, the fibers in the cover being in mechanical engagement with one another in relatively unstressed positions and in mechanical equilibrium therein, said highly permeable and said less permeable portions of the cover possessing the same fiber content and the same fiber weight per unit area.

4. An absorbent pad comprising an absorbent core and a soft, smooth, and dimensionally stable nonwoven fabric cover possessing textile-like hand and drape wrapped around the core, said cover comprising a uniformly and highly permeable open portion facing at least one surface of the pad and portions which are substantially less permeable and relatively closed covering sides of the pad, the highly permeable and the relatively closed less permeable portions of the cover being integral and connected by fibers extending from one portion to the other, the highly permeable portion comprising fibers rearranged to define a multiplicity of substantially uniformly arranged holes and groups of fiber segments between said holes, said cover in said highly permeable portion having appreciable depth and said holes extending through the depth of the cover, the fiber segments bordering the holes being in substantial parallelism with corresponding portions of the perimeters of the holes, said groups being interconnected by fibers common to a plurality of groups in forming a dimensionally stable integral structure of unspun fibers, said less permeable portion comprising fibers flatly assembled and randomly arranged in overlapping crossing relation with one another, defining only very small, irregular, and randomly arranged interstices between them, the fibers in the cover being in mechanical engagement with one another in relatively unstressed positions and in mechanical equilibrium therein, said highly permeable and said less permeable portions of the cover possessing the same fiber content and the same fiber weight per unit area.

5. An absorbent pad comprising an absorbent core and a soft, smooth, and dimensionally stable nonwoven fabric cover possessing textile-like hand and drape wrapped around the core, said cover comprising a uniformly and highly permeable open portion facing at least one surface of the pad and portions which are substantially less permeable and relatively closed covering the sides of the pad, the highly permeable and the relatively closed less permeable portions of the cover being integral and connected by fibers extending substantially in the plane of the cover from one portion to the other, the outer surfaces of both portions of the cover being smooth and flat and therefore particularly adapted for contact with the wearer and the inner surfaces of both portions of the cover being smooth and flat and therefore particularly adapted for substantially continuous contact with the surfaces of the absorbent core, the highly permeable portion comprising fibers rearranged to define a multiplicity of substantially uniformly regular and uniformly spaced holes arranged in a predetermined pattern and groups of substantially parallelized and laterally compacted fiber segments between said holes, said cover in said highly permeable portion having appreciable depth and said holes extending through the depth of the cover, the fiber segments bordering the holes being in substantial parallelism with corresponding portions of the perimeters of the holes, said groups being interconnected by fibers common to a plurality of groups at junctures wherein the fibers extend in a plurality of diverse directions substantially in the plane of the fabric forming a dimensionally stable integral structure of unspun fibers, said groups and said junctures each lying in the same general plane, said less permeable portion comprising fibers flatly assembled and randomly arranged in overlapping crossing relation with one another, defining only very small, irregular, and randomly arranged interstices between them, the fibers interconnecting the highly permeable and the less permeable portions of the cover being common to said less permeable portion and the adjacent groups of fiber segments in said highly permeable portion, said highly permeable and said less permeable portions of the cover possessing the same fiber content and the same fiber weight per unit area.

6. A sanitary napkin comprising an elongated absorbent core and a soft, smooth, and dimensionally stable nonwoven fabric cover possessing textile-like hand and drape wrapped around the core, said cover extending beyond each end of the core to provide pinning tabs, the cover comprising a uniformly and highly permeable open portion facing the top surface of the napkin and extending from end to end of the napkin, and portions which are substantially less permeable and relatively closed covering the sides of the napkin, the highly permeable portion comprising fibers rearranged to define a multiplicity of substantially uniformly arranged holes and groups of fiber segments between said holes, the fiber segments bordering the holes being in substantial parallelism with corresponding portions of the perimeters of the holes, said groups being interconnected by fibers common to a plurality of groups forming a dimensionally stable integral structure of unspun fibers, said less permeable portion comprising fibers flatly assembled and randomly arranged in overlapping crossing relation with one another, defining only very small, irregular, and randomly arranged interstices between them, said highly permeable and said less permeable portions of the cover possessing the same fiber content and the same fiber weight per unit area.

7. A sanitary napkin comprising an elongated absorbent core and a soft, smooth, and dimensionally stable nonwoven fabric cover possessing textile-like hand and drape wrapped around the core, said cover comprising a uniformly and highly permeable open portion facing the

top surface of the napkin and portions which are substantially less permeable and relatively closed covering the sides of the napkin, the highly permeable and the relatively closed less permeable portions of the cover being integral and connected by fibers extending substantially in the plane of the cover from one portion to the other, the outer surfaces of both portions of the cover being smooth and flat and therefore particularly adapted for contact with the wearer and the inner surfaces of both portions of the cover being smooth and flat and therefore particularly adapted for substantially continuous contact with the surfaces of the absorbent core, the highly permeable portion comprising fibers rearranged to define a multiplicity of substantially uniformly regular and uniformly spaced holes arranged in a predetermined pattern and groups of fiber segments between said holes, said cover in said highly permeable portion having appreciable depth and said holes extending through the depth of the cover, the fiber segments bordering the holes being in substantial parallelism with corresponding portions of the perimeters of the holes, said groups being interconnected in the same general plane by fibers common to a plurality of groups forming a dimensionally stable integral structure of unspun fibers, said groups and said junctures each lying in the same general plane, said less permeable portion comprising fibers flatly assembled and randomly arranged in overlapping crossing relation with one another, defining only very small, irregular and randomly arranged interstices between them, the fibers interconnecting the highly permeable and the less permeable portions of the cover being common to said less permeable portion and the adjacent groups of fiber segments in said highly permeable portion, said highly permeable and said less permeable portions of the cover possessing the same fiber content and the same fiber weight per unit area.

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