Oct. 3, 1967 F. KALWAITES 3,345,243

APERTURED NONWOVEN FABRIC WITH CHANNELS BETWEEN APERTURES

Original Filed Nov. 1, 1963

Fig. 1.

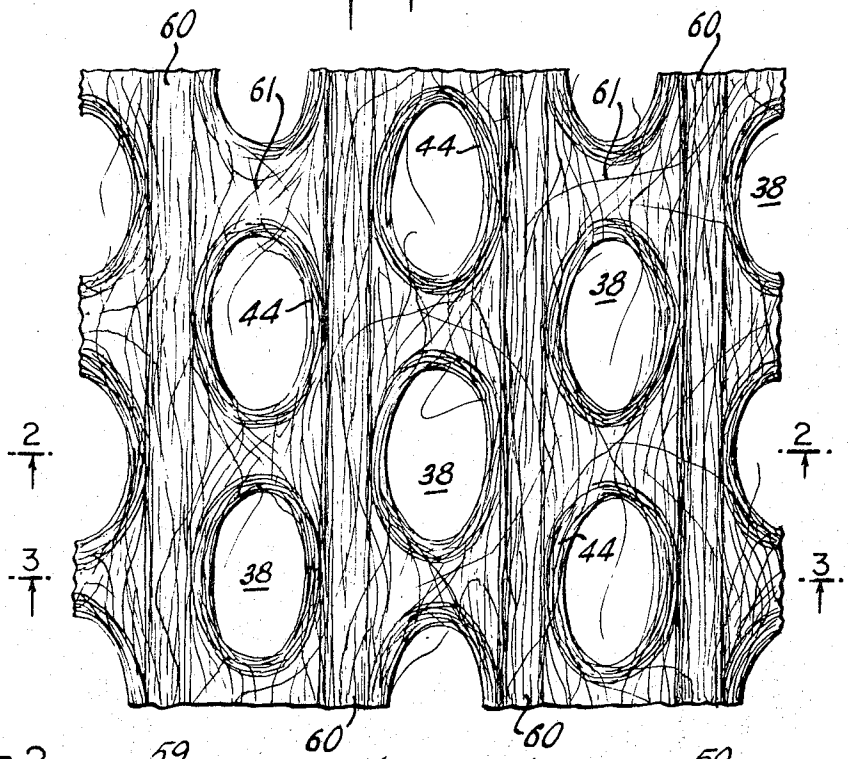
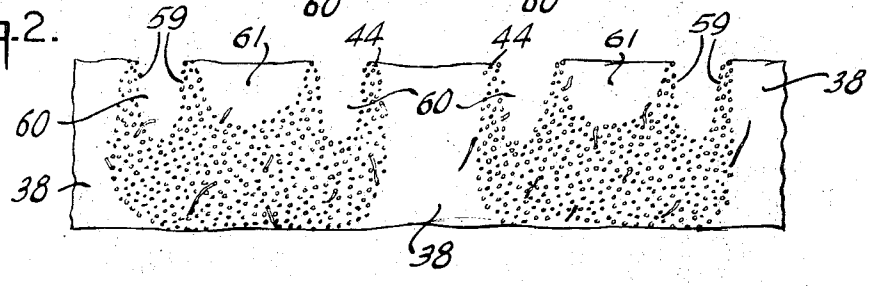


Fig. 2.



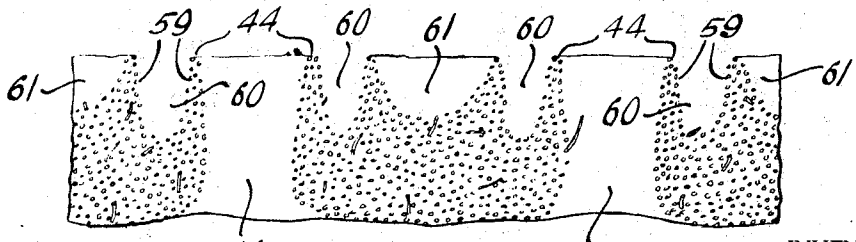


Fig. 3.

INVENTOR
FRANK KALWAITES
BY Hoke & Myers
ATTORNEY

United States Patent Office 3,345,243 Patented Oct. 3, 1967

3,345,243

APERTURED NONWOVEN FABRIC WITH CHANNELS BETWEEN APERTURES

Frank Kalwaites, Somerville, N.J., assignor to Johnson & Johnson, a corporation of New Jersey

Original application Nov. 1, 1963, Ser. No. 320,688, now Patent No. 3,255,496, dated June 14, 1966. Divided and this application Aug. 26, 1965, Ser. No. 482,869
4 Claims. (Cl. 161—109)

The present application is a division of my co-pending application Ser. No. 320,688, filed Nov. 1, 1963, now U.S. Patent No. 3,255,496 issued June 14, 1966.

This invention relates to nonwoven fabrics, i.e., fabrics produced directly from fibers without the use of conventional spinning, weaving, knitting, or like fabricating operations.

Heretofore, nonwoven fabrics have been essentially different in structure from fabrics which have been woven or knitted. In a woven or knitted fabric, the natural or synthetic textile fibers making up the fabric do not occur individually, but are spun or twisted into yarns or threads which, in turn, are woven or knitted into the finished fabric. In the well-known spinning operation, staple-length fibers are spun or twisted together tightly into mechanical and frictional engagement with one another to form yarns which are substantially circular in cross-section. It is these yarns, and not the fibers acting individually, which serve as the structural members of the resulting woven or knitted fabrics. Generally speaking, these fabrics comprise reticular structures of intersecting, intertwining yarns which define interstices or openings between them.

Nonwoven fabrics have been primarily of two main types, felts and bonded webs. In each of these, the fibers making up the fabric occur individually and act individually as structural members. This is true even though the fibers in many felts are so highly interlocked and compressed together that it is difficult to identify individual fibers. Hat felts, for instance, are extremely dense, relatively "hard" fabrics without apparent interstices, which are quite dissimilar in appearance and qualities to woven or knitted structures.

On the other hand, the fibers in bonded webs are usually flatly arranged or organized in one or more layers, either more or less oriented or aligned in one predominant direction as in a card web, or assembled in a "random" manner as in an air-laid or water-laid isotropic web. Various bonding agents have been used to print an intermittent binder pattern of spaced binder areas on such webs or to impregnate them completely over their entire surface to hold the individual fibers together. In these types of fabric, the fibers may remain relatively straight and overlapping one another with very little interlocking between them. They are usually arranged in a more or less uniformly spaced condition in the plane of the web in such a way that only very small randomly occurring interstices are apparent between the overlapped fibers and those fibers between interstices remain spaced and more or less flatly arranged possessing little similarity to the yarns of woven or knitted fabrics.

The present invention contemplates a nonwoven fabric wherein the fibers are arranged preferably in a predetermined pattern to define holes or openings with most of the fiber segments bordering the holes extending in substantial alignment or parallelism with portions of the perimeters of the holes. In general, the fibers are arranged in interconnected groupings or web areas extending between the holes in a pattern corresponding to the pattern of holes. Closer study of the nonwoven fabric of the present invention reveals, among other characteristics, generally annular or elliptical, raised lips of accumulated individual fibers immediately surrounding the holes, along with a plurality of channels comprising sloping sidewalls extending substantially uninterruptedly longitudinally of the nonwoven fabric between the holes and their raised lips. The resulting fabric may be made to resemble a particular woven or knitted fabric.

The groupings or groups are connected by fibers extending from one to another in such a way that they are common to a plurality of groupings. 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 predominantly comprise only parts or segments of the fibers passing through them. Preferably, the fibers average at least about ¼ inch in length or over and are textile-like in nature, extending up to about 2½ inches or even more in length. In general, the groupings are connected at junctures wherein the fibers extend in a plurality of diverse directions, while the fiber segments in the groups are relatively aligned or parallelized with respect to one another and more closely assembled than at the junctures.

In the foraminous structure formed by the interconnected fiber groupings, the fibers are in a state of mechanical equilibrium. The fibers are mechanically and frictionally engaged to the extent that the arrangement of fibers is one of equilibrium.

Due to their structure and appearance and other qualities, fabrics produced by the method and apparatus of this invention are particularly adapted for use in surgical dressings, absorbent dressings such as sanitary napkins and diapers, most suitably for covering sanitary napkins and diapers, in wiping cloths, toweling, filter materials, lining materials, industrial base fabrics, as a substitute for gauze and gauze-like fabrics in general, and a variety of other applications.

The nonwoven fabrics of the present invention, preferably having a predetermined pattern of holes or openings therein, may be made from a starting layer of irregularly arranged, dry fibers by first impaling the dry fibrous layer upon a group of prongs, pins or needles, preferably arranged in a predetermined pattern, then wetting the fibrous layer while impaled on the prongs, brushing the wet fibers into fiber accumulating zones and channels between the prongs, and finally removing the brushed layer of wet fibers from the group of prongs.

The starting fibrous layer may be a nonwoven web of fibers, for example, natural, synthetic or man-made fibers, preferably cellulosic fibers, such as rayon or cotton. The individual fibrous elements of the layer are capable of movement under the influence of an applied mechanical force. In general, any of the starting materials described in the following patents may be used as the starting materials in the methods and apparatus of this invention: Griswold U.S. Patent 3,081,514, dated Mar. 19, 1963; Griswold and Pearce U.S. Patent 3,081,515, dated Mar. 19, 1963; and Kalwaites U.S. Patent 2,862,251, dated Dec. 2, 1958. The preferred starting material is an unbonded fibrous web.

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

FIGURE 1 is a schematic, fragmentary plan view illustrating a nonwoven fabric produced by the apparatus and methods of the inventive concept;

FIGURE 2 is a cross-sectional view of the nonwoven fabric of FIGURE 1, taken on the line 2—2 thereof; and

FIGURE 3 is a cross-sectional view of the nonwoven fabric of FIGURE 1, taken on the line 3—3 thereof.

Consideration of FIGURES 1–3 will indicate the nature and the advantages of the nonwoven fabric of the present invention. The holes 38 and their surrounding slightly

raised lips **44** which are formed therein naturally affect the porosity of the fibrous layer and affect the flow of fluids therethrough. The continuous lengthwise channels **60** affect the flow of fluids along the surface of the fibrous layer and thus control and direct such flow in the lengthwise direction rather than in the widthwise direction. This is desirable when the fibrous layer is to be used as a cover for a sanitary napkin, or in a surgical dressing, etc.

A trough or dimple **61** is observed in the fibrous layer and is bounded by the raised lips **44** of two adjacent holes **38**, as measured in the length wise direction, and by the raised sidewalls **59** of two adjacent channels, as measured in a widthwise direction. This trough is dimple shaped and forms a depression in the fibrous layer.

The invention will be further illustrated in greater detail by the following specific examples. It should be understood, however, that although these examples may describe in particular detail some of the more specific features of the invention, they are given primarily for purposes of illustration and the invention in its broader aspects is not to be construed as limited thereto.

Example I

The starting fibrous layer is a 45-inch width oriented card web comprising a blend of 50% dull and 50% extra dull viscose rayon staple fibers having a staple length of about 2 inches and a denier of 1.5. The web weight is approximately 300 grains per square yard.

This fibrous layer is processed on a rotatable cylinder having a diameter of 27 inches and which is substantially identical to a doffing cylinder normally used in textile carding operations. Its peripheral surface is helically covered with stainless steel metallic card clothing. Five layers of 20 x 12 bleached cotton gauze are wrapped tightly around the rotatable cylinder.

The fibrous layer is impaled on the clothing and wet with water to which has been added about 0.1% by weight of a surface active agent. The water pick-up of the layer is about 150% by weight. The wet fibrous layer while impaled on the clothing is brushed with rotatable brushes having outside diameters of about 8 inches and bristles substantially identical to fancy roll clothing such as used in the textile industry.

The resulting perforated, brush nonwoven fabric has approximately 176 holes per square inch, each hole measuring about 0.020 x 0.050 inch. The brushed nonwoven fabric is over-all impregnated with a polyvinyl acetate binder.

It is noted that the holes naturally affect the flow of fluids through the nonwoven fabric whereas the raised lips around the holes and the substantially uninterrupted continuous lengthwise channels affect the flow of fluids along the surface of the nonwoven fabric, controlling and directing such flow in the lengthwise direction rather than in the widthwise direction. Such characteristics are desired in absorbent materials wherein flow control of fluids deposited thereon is required.

Example II

The procedures set forth in Example I are carried out substantially as set forth therein with the exception that cotton fibers having a staple length of about 1⅜ inches are used instead of the viscose rayon staple fibers in forming the starting fibrous layer. The results are comparable.

Example III

The procedures of Example I are followed substantially as set forth therein with the exception that the gauze fabric wrapped on the rotatable cylinder is removed and an atomizing spray nozzle is used to apply moisture to the fabrous layer. The results are generally comparable.

Although several specific examples of the inventive concept have been described, the same should not be construed as limited thereby nor to the specific techniques or elements mentioned therein but to include various other equivalent techniques and elements as set forth in the claims appended hereto. It is understood that any suitable changes, modifications and variations may be made without departing from the spirit and scope of the invention.

What is claimed is:

1. A nonwoven fabric having a longer length than width comprising fibers arranged in a predetermined pattern to define a plurality of holes and a plurality of channels extending between adjacent holes substantially uninterruptedly longitudinally of the nonwoven fabric, said holes affecting the flow of fluids through the nonwoven fabric and said channels affecting the flow of fluids along the surface of the nonwoven fabric.

2. A nonwoven fabric according to claim **1**, wherein the holes are substantially circular.

3. A nonwoven fabric according to claim **1**, wherein the holes are disposed in the fabric in a plurality of rows extending substantially longitudinally of the fabric.

4. A nonwoven fabric according to claim **1**, wherein the holes are substantially surrounded by raised lips of accumulated fibers.

References Cited

UNITED STATES PATENTS

3,081,515	3/1963	Griswold et al.	128—290 X
3,236,718	2/1966	Cohn et al.	161—109
3,253,517	5/1966	Such	161—109

RICHARD A. GAUDET, *Primary Examiner.*

C. F. ROSENBAUM, *Examiner.*