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(71) Applicant: **CHICOPEE**, 317 George Street, New Brunswick, New Jersey 08903 (US)

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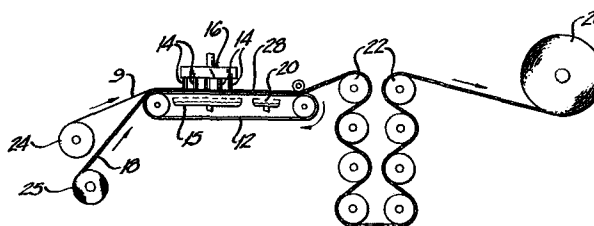
(72) Inventor: **Anderson, John W.**, 85 Tices Lane Apt. 30, East Brunswick, NJ 08816 (US)
Inventor: **Malaney, Frank Edward**, 50 Red Hill Road, Warren NJ 07060 (US)

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(74) Representative: **Jones, Alan John et al, CARPMAELS & RANSFORD** 43 Bloomsbury Square, London, WC1A 2RA (GB)

(54) **Fabrics exhibiting a surface pattern of a decorative or active nature.**

(57) An entangled composite fabric having a sharply delineated pattern on the upper surface, and a method for producing same without any additional off-line finishing step. The fabric of the invention has the feel of a soft linen.



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PATTERNED PRINTED OR ACTIVE FABRICS

5 This invention relates to an entangled composite fabric
having a clearly delineated patterned print on the upper
surface, and a method for producing same without any
additional off-line finishing step. The fabric of the
invention is preferably non-woven and has the feel of soft
linen. The expression "patterned print" as used herein
designates either a visible print or a print of an active
10 agent which is generally not visible.

Background of the Invention

15 Methods for preparing non-woven fabrics by means of fluid
rearrangement and entangling of fibers are well known.
See for instance, Kalwaites U.S. Patent Nos. 2,862,251 and
3,033,721; Griswold et al. U.S. Patent No. 3,081,500;
Evans U.S. Patent No. 3,485,706; Bunting et al. U.S.
Patent No. 3,493,462 and Boulton U.S. Patent No.
20 4,144,370. This basic technology has been used to produce
a wide variety of non-woven fabrics. The present inven-
tion utilizes fluid rearrangement and entanglement to
provide a novel fabric having the appearance of linen and
having a clearly delineated pattern thereon, by inter-
25 entangling a base layer of textile fabric (which is pre-
ferably non-woven) with a paper sheet preprinted on at
least one surface thereof with a water insoluble patterned
print or design. It is extremely surprising that the
preprinted pattern on the paper sheet retains its clear
30 delineation even after having been passed through the
harsh conditions required for the fluid rearrangement and
entangling of the paper fibers with the base layer while
the process for preparing the non-woven fabric is carried
out.

Summary of the Invention

In accordance with the present invention there is provided an entangled composite fabric having upper and lower surfaces, there being a sharply delineated patterned print on the upper surface, the fabric having been derived from a base layer of textile fabric covered on the upper side thereof with a second layer derived from a repulpable paper sheet preprinted on at least one face thereof with a water insoluble patterned print, the second layer being integrally entangled with the base layer. The process of the invention is effective utilizing a base layer fabric having an open area of up to about 50% of the total area of the base layer. The print on the upper surface of the composite fabric may be decorative or it may constitute an active agent and it is substantially a replication of the preprint on the repulpable paper sheet. The term "repulpable" refers to paper which is capable of being put back into slurry condition in water. The fibers of the base layer (which is preferably non-woven) may preferably be prepared from cotton, cellulose acetate, polyester, rayon, polypropylene, nylon or acrylic. When the print is that of an active agent, the base layer may also be prepared from polyester/polyethylene conjugate fibers. The fabric of the invention has a linen-like hand and preferably weighs between 50.9 and 135.6 g/m² (1.5 and 4.0 oz/yc²). Preferably, the fibers of the base layer are polyester fibers. The term "non-woven" used herein refers to any planar assembly of textile fibers held together either by mechanical interlocking in a random web or mat, by fusing or by bonding with a cementing medium. The fibers may be preferentially oriented in one direction or may be deposited in a random manner. The term "non-woven" includes "card and bind", "wet-form" (see U.S. Patent No. 3,778,341) (non-woven made by paper making techniques), "spun-bond" (see U.S. Patent No. 3,117,056), "melt-blown",

"entangled fiber" fabrics and "needled" fabrics (see U.S. Patent No. 3,090,099).

Preferred active agents which may be used in accordance with the present invention comprise bactericides, hemostatic agents, water repellent agents, herbicides, lubricant cleaners, photo opaque agents, photo activated agents, tissue growth enhancers, indicators for solution activity, temperature sensitive chromophores and marking agents not visible to the eye for mechanical reading. A preferred fabric of the present invention contains a hot melt wax repellent as the active agent, the pattern being in the form of a grid covering at least 40% of the upper surface of the fabric.

In accordance with a preferred process of the present invention, a fabric having a sharply delineated pattern on the upper surface thereof is prepared by placing a base layer and a second layer on a foraminous support member, the base layer comprising a non-woven textile fabric having an open area of up to about 50% of the total area of the base layer, the second layer comprising a repulpable paper sheet preprinted on at least one face thereof with a water insoluble patterned print, the second layer being located on top of the base layer, the foraminous support member having from 1.97 to 78.74 openings per linear centimeter (5 to 200 per linear inch) and from 10% to 75% open area, traversing the laminate while supported on the foraminous member with streams of liquid to interentangle the fibers of the second layer with those of the base layer to produce a composite fabric, without substantially affecting the clear delineation of the print on the second layer. Columnar jets of water are preferably used in accordance with the present process. The jets of water are directed against the laminate at a pressure of at least 13.79 bar (200 psi). In accordance with a preferred process

of the invention, the laminate is subjected to transversely moving jets of water in the following sequence:

- 3 passes at : 6.89 bar (100 psi)
- 5 3 passes at 27,58 bar (400 psi)
- 12 passes at 41.37 bar (600 psi)
- 12 passes at 55.16 par (800 psi)

The laminate is moved relative to the jets of water at a
10 line speed of between 18.23 and 274.32 metres (20 and 300 yards)
per minute (but preferably at about 91.44 metres (100 yards)per
minute) A vacuum of between 25.4 and 228.6 cm (10 and 90 in)
of water is maintained beneath the foraminous support member
opposite the transversely spaced jets of water, the preferred
15 vacuum being about 127 cm (50 in) of water. The foraminous
support member preferably comprises a bronze twill belt
(100 x 92).

The base layer is preferably initially prepared from a web
produced by an air-laid system and entangled by
20 conventional non-woven fabric forming means on a non-
apertured forming surface.

The repulpable second layer may comprise preprinted paper,
an example being a two-ply screen printed paper towel
25 stock. However, single-ply decorative printed bathroom
tissue stock is also suitable.

Alternatively, the repulpable second layer may comprise
paper stock which has been preprinted with an appropriate
30 active agent in a desired pattern by means of a
rotogravure process.

The fabric of the present invention is a soft, absorbent,
strong and durable textile-like fabric which retains the
35 fine line reproduction of the print initially present on
the paper.

Depending upon the type of in-line treatment system (repellent finish, fire retardant finish etc.) and print or design, the fabric of the invention may be used for wall coverings, home furnishings, draperies, tablecloths, dinner napkins, place mats, aprons, surgical gowns or drapes, scrub apparel and head coverings (in the instance wherein the print is decorative).

In accordance with one alternative process of the invention, (for preparing non-stick dressings) an active agent is selected which is a hot melt wax repellent, the pattern being in the form of a grid covering at least 40% of the upper surface of the second layer.

Other suitable uses of the present invention (when the print is that of an active agent) are as follows:

This invention provides the opportunity to apply a non-water soluble bactericide which could be used in a fenestration drape but which would not be applied in the immediate area of the fenestration, thus avoiding contamination of the operative site. An alternative approach would be to print in specific areas, an active ingredient such as a hemostatic agent or tissue growth enhancer while the surrounding areas form part of the bandage. Conversely, the positioning of an absorbant pad material with an active ingredient might be sandwiched between a silicone or fluorichemical treated section which would provide surface for release properties or repellency.

In an industrial application, herbicides may be positioned adjacent to sections of seed encapsulated material for the controlled release of agents to retard weed growth. A further concept involves the side-by-side positioning of reactive materials which would be activated through the

application of a solution of an appropriate solvent to allow intermingling. This may be the basis for a wound dressing or an industrial material such as an indicator for solution activity.

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In the electronics industry, it would be possible to specifically position rows or bars of lubricants followed by free fiber cleaner in order to enhance product performance in products such as floppy discs, video and cassette
10 tape cleaners etc.

In functional or decorative fabrics, the present invention makes it possible to position photo opaque or photo activated chemicals in order to deliver shading properties
15 in horticultural applications or decorative window coverings for homes and institutions. It is also possible, in accordance with the present invention, to print different temperature sensitive chromophores to provide surface temperatures useful in patient thermometers with fabric
20 backing for durability and comfort.

The present invention may also be used for positioning of precise bars or dots of material not visible to the eye that would permit a mechanical reading (X-ray, U.V.
25 sensor, etc.) for pattern plotting, precision cutting or even material measurement.

The Prior Art

30 In the DuPont Defensive Publication No. 17060 there is disclosed a web of synthetic fibers united by means of fluid entanglement with paper sheets providing a composite structure. The fibrous webs which may be unbonded are made of continuous filaments of polyester or polypropylene.
35 It is stated that the composite can be made by hydraulic entangling techniques such as those of U.S.

Patent No. 3,485,706. There is no disclosure in the above DuPont publication concerning the use of paper sheets having any patterned prints preprinted thereon.

5 Brief Description of the Drawings

Figure 1a is a schematic side elevation of one form of an apparatus suitable for producing the base layer which is utilized in preparing the fabric of the invention; and

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Figure 1b is a further schematic side elevation of the apparatus shown in Figure 1a, but slightly modified so that it is suitable for producing the final fabric of the invention.

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Detailed Description of the Invention

Referring first to Figure 1a, an air-laid web 10 of polyester staple fibers is passed onto a liquid pervious support member, such as an endless woven belt 12. The belt 12 carries the web of fibers 10 under a series of high pressure, fine, essentially columnar jets of water 14. The high pressure water is supplied from a manifold 16. The jets 14 are arranged in rows disposed transversely across the path of travel of the belt 12. Preferably there is a vacuum means 15 pulling a vacuum of e.g. 228.6 cm (90 inches) of water, beneath the belt 12, with a vacuum slot positioned directly under each row of jets 14. The fibers in the web 10 are rearranged and entangled by the jets 14 as the liquid from the jets 14 passes through the fibrous web 10 and then through the belt 12. The fabric 18 is carried by the belt 12 over a vacuum dewatering station 20 and then proceeds to a wind-up 23 prior to the next stage of the process.

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The fabric 18 on the wind-up 23 constitutes one suitable base layer for the final fabric of the invention.

Referring to Figure 1b, the base layer 18 is let off from a suitable roll 25 and placed on the liquid pervious conveyor belt 12. A low cost embossed paper towel or paper sheet 9 having a preprinted design or pattern thereon is placed on top of the base layer 18. The composite layer 28 is treated by passing the layer 28 under a plurality of liquid streams 14. Preferably these streams are under a fairly high pressure of at least 13.79 bar (200 psi). The orifices used to direct the streams may have a round configuration and a diameter of from 76.2 μ m to 0.51 mm (0.003 to 0.020 in). Other configurations of liquid delivery means such as square orifices, rectangular orifices, fan jets, etc. may also be used. The orifice streams are longitudinally and transversely spaced over the composite layer 28 and are directed from manifolds 16. About 3.9 to 19.7 orifices per cm² (10 to 50 per inch) of width of the composite layer 28 are used for round orifices having diameters of 76.2 μ m to 0.51 mm (0.003 to 0.20 in) respectively. The density of the orifices may vary widely depending on the number of manifolds used and the number of rows of orifices in each manifold.

The liquid pervious belt 12 on which the composite layer 28 is placed has certain desirable parameters in order to best obtain the advantages of the present invention. The conveyor 12 should contain from about 1.97 to 78.74 openings per linear cm (5 to 200 per linear in) and should have an open area of from 10% to 75%. After having been passed under the liquid streams 14, the composite layer 28 is passed over the vacuum slot 20 to remove excess water. The composite layer 28 then passes about a series of drying cans 22 to dry the fabric and the resultant integral fabric is wound up on a standard wind-up mechanism 26.

Although one method for the preparation of the base web 18 is disclosed herein (as illustrated in Figure 1a), a number of different methods for preparing non-woven fabrics may also be utilized for producing the base web
5 used in the present process. Furthermore, a woven textile may be utilized as the base web, if desired.

It is more cost effective and considerably more efficient to utilize the process of the invention rather than to
10 prepare a composite fabric in which the upper layer is unprinted paper and then to attempt to print the composite with a decorative pattern or an active agent at a later stage. The printing of a multiple layer fabric is a more difficult procedure than the printing of a paper sheet.
15 Furthermore, the cost of any waste material is obviously much less when paper is first printed rather than if the composite fabric (or fabric on its own) is directly printed. This is due to the fact that normal waste in any finishing steps will apply only to the inexpensive paper
20 carrier rather than to a much more costly textile.

The preprinted paper sheets used in the present process for decorative purposes are preferably printed with inks containing cationic dyes in the formulations, which have
25 good affinity for pulp.

When active agents are used, the preprinted paper sheets are preferably printed with those active agents which are reasonably substantive to the pulp and thus are desirably
30 cationic. However, the present invention also encompasses chemical reactant systems which are able to permanently attach certain of the active agents to the pulp fiber without interfering with repulpability in order to enhance their retention in the final structure. In this connec-
35 tion, lower pressures may be utilized when passing the composite structure under the liquid streams in order to

reduce the likelihood of wash-out of nonsubstantive additives. The paper used in the present process should weigh at least 11.6 g/m^2 (150 grains/yd^2), 46.50 g/m^2 (600 grains/yd^2) being preferred.

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The invention will be further illustrated in greater detail by the following examples. It should be understood, however, that although the 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.

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Example 1

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100% Fortrel polyester 310 (polyethylene terephthalate) 1.67 dTex (1.5 denier), 3.81 cm (1.5 in) staple polyester obtained from Celanese, is processed through an opener-blender and fed to a conventional random air-layering unit which deposits a 31 g/m^2 (400 grains/yd^2) $\pm 10\%$ web onto a bronze 1 x 2 twill forming belt having 39.4 warp monofilaments per cm and 36.2 shute monofilaments per cm (100 and 92 per in respectively).

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Using an apparatus similar to that shown in Figure 1a, the web is passed under a water weir to wet the fiber and is then carried at a speed of 91.44 meters (100 yards) per minute under 30 rows of orifice strips each of which contains 19.7 holes per cm (50 per in) of $127 \mu\text{m}$ (0.005 in) diameter. Water at 60°C (140°F) is jetted through the orifices at 20.69 bar (300 psi) for the first three rows, 41.37 bar (600 psi) for the next nine rows, 62.06 bar (900 psi) for the next six rows, 82.74 bar (1200 psi) for the next six rows and 93.08 bar (1350 psi) for the remaining rows.

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The web is dewatered by passing over a vacuum slot, the vacuum being 63.5 cm (25 inches) of water. It is not necessary to

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dry the web since the still relatively wet web may be used directly in the next stage of the process.

- 5 The web, which is to be used as the base layer of the ultimate composite fabric, is then placed on the same forming belt described above. A 2-ply embossed Scott Towel having an "Arts of Flower" decorative print thereon and weighing 65.9 g /m² (850 grains/yd²) is placed on top of the base layer. Water at 60°C (140°F) is jetted through the orifices at 6.89 bar (100 psi) for the first three rows; 27.58 bar (400 psi) for the next three rows; 41.37 bar (600 psi) for the following twelve rows and 55.16 bar (800 psi) for the remaining rows. A vacuum of 216 cm (85 in) of water is maintained under the forming belt.
- 10
- 15 The composite fabric is then dewatered and subsequently dried by being passed over a vacuum slot and then over two stacks of steam cans. The stacks of steam can are operated at 6.2 and 5.9 bar (90 psi and 85 psi) steam pressure respectively. The final product is then collected on a conventional
- 20 wind-up. The fine line reproduction of the "Arts of Flowers" print is retained in the resultant fabric. The product has a soft linen-like hand, and is stronger and more durable than the original paper towel.

25 Example 2

- The procedure of Example 1 is repeated in every respect except that the pulp source is a 2-ply embossed Scott Towel Bicentennial Print and the base layer is 100% air
- 30 laid web Fortrel polyester 310 1.67 d Tex x 3.81 cm (1.5 denier x 1.5") staple fiber. The prints are retained in fine detail in the resultant fabric.

- Similar results are obtained by replacing the pulp source
- 35 with a 2-ply embossed Scott Towel flower print in the first instance, and a single-ply honeycomb embossed

Waldorf Flower printed bathroom tissue stock in the second instance. The base layer in each case is 100% air laid web Fortrel polyester 310, 1.67 dTex x 3.81 cm (1.5 denier x 1.5") staple fiber.

Example 3

Avtex SN 1913 1.67 dTex, 2.86 cm, (1.5 denier, 1 1/8 inch) staple rayon is processed through an opener-blender and fed to a conventional random air-layering unit which deposits a 31 g/m² (400 grains/yd²) $\pm$ 10% web onto a bronze 1X2 twill forming belt having 39.4 warp monofilaments per cm and 92 shute monofilaments per cm (100 and 97 per in) respectively. Using an apparatus similar to that shown in Figure 1a, the web is passed under a water weir to wet the fiber and is then carried at a speed of 91.44 meters (100 yards) per minute under 30 rows of orifices each of which contains 19.7 holes per cm of 127 μ m diameter (50 holes per in of 0.005 in diameter). Water at 60°C (140°F) is jetted through the orifices at 20.69 bar (300 psi) for the first three rows, 41.37 bar (600 psi) for the next nine rows, 62.06 bar (900 psi) for the next six rows, 82.74 bar (1200 psi) for the next six rows and 93.08 bar (1350 psi) for the remaining rows.

The web is dewatered by passing over a vacuum slot, the vacuum being 63.5 cm (25 in) of water. It is not necessary to dry the web since the still relatively wet web may be used directly in the next stage of the process.

The web, which is to be used as the base layer of the ultimate composite fabric, is then placed on the same forming belt described above. Tissue stock printed with a grid of hot melt wax (from Eastern Chemical Products, Eastobond M-5005), is placed on top

of the base layer. The grid of hot melt wax covers 50% of the surface area of the tissue stock, the grid comprising 11.8 x 11.8 lines of hot melt wax per cm² (30 x 30 per in²). Water at 60°C (140°F) is jetted through the orifices at 6.89 bar (100 psi) for the first three rows; 27.58 bar (400 psi) for the next three rows; 41.37 bar (600 psi) for the following twelve rows and 55.16 bar (800 psi) for the remaining rows. A vacuum of 216 cm (85 in) of water is maintained under the forming belt.

The composite fabric is then dewatered and subsequently dried by being passed over a vacuum slot and then over two stacks of steam cans. The stacks of steam cans are operated at 6.2 and 5.9 bar (90 psi and 85 psi) steam pressure respectively. The final product is then collected on a conventional wind-up. The fine line grid work of hot melt wax is retained in the resultant fabric. The product has a soft, linen-like hand, and is suitable for use in nonstick dressings.

CLAIMS

1. An entangled composite fabric having upper and lower surface, there being a sharply delineated patterned print on the upper surface, said fabric
5 having been derived from a base layer of textile fabric covered with a second layer derived from a repulpable paper sheet preprinted on at least one face thereof with a water insoluble patterned print, said second layer being integrally entangled
10 with said base layer.
2. The fabric of claim 1, in which the base layer has an open area of up to about 50% of the total area thereof.
3. The fabric of claim 1 or claim 2 in which the
15 base layer is nonwoven, and the print on said upper surface of said composite fabric is substantially a replication of the preprint on the repulpable paper sheet..
4. The fabric of claim 3, in which the print is
20 that of an active agent.
5. The fabric of claim 4, in which the active agent is a bactericide, hemostatic agent, water repellent agent, herbicide, lubricant cleaner, photo opaque agent, photo activated agent, tissue
25 growth enhancer, indicator for solution activity, temperature sensitive chromophore or marking agent not visible to the eye for mechanical reading.
6. The fabric of claim 5, in which the active
30 agent is a hot melt wax repellent, the pattern being in the form of a grid covering at least 40% of the upper surface of the fabric.
7. A method of preparing an entangled composite fabric, having a sharply delineated print on the
35 upper surface thereof comprising placing a laminate

- consisting of a base layer and a second layer on a liquid pervious support member, said base layer comprising a textile fabric, having an open area of up to about 50% of the total area of said base layer, said second layer comprising a repulpable paper sheet preprinted on at least one face thereof with a water insoluble patterned print, said second layer being located on top of said base layer, said liquid pervious support member having from 1.97 to 78.74 openings per linear cm (5 to 200 per linear in) and from 10% to 75% open area, traversing said laminate, while supported on said liquid pervious support member, with longitudinally and transversely spaced streams of liquid to inter-entangle the fibers of said second layer with those of said base layer to produce a composite fabric, without substantially affecting the sharp delineation of the print of the second layer.
8. The method of claim 7, wherein the spaced streams of liquid are jets of water, and the base layer comprises a non-woven textile fabric.
9. The method of claim 7 or claim 8, in which the second layer comprises a 2-ply printed paper towel stock.
10. The method of claim 7 or claim 8 in which the second layer comprises a single-ply printed bathroom tissue stock.

