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(54) **NON-WOVEN BASED ON EXPLODED OR SPLITTABLE MULTICOMPONENT FIBERS**

FASERVLIES AUS EXPLODIERTEN ODER SPALTBAREN MEHRKOMPONENTENFASERN

NON-TISSE A BASE DE FIBRES A COMPOSANTS MULTIPLES, ECLATEES OU SUSCEPTIBLES D'ETRE DIVISEES

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(73) Proprietor: **Suominen Corporation**
00180 Helsinki (FI)

(72) Inventors:
- **ORLANDI, Vittorio**
I-20121 Milano (IT)
- **PEDOJA, Roberto**
I-21050 Cuasso al Monte (IT)

(74) Representative: **Langenskiöld, Tord Karl Walter**
Oy Jalo Ant-Wuorinen Ab
Iso-Roobertinkatu 4-6 A
00120 Helsinki (FI)

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to the field of multi-layer non-wovens, which can be used as an absorbent material, particularly in the field of surface cleaning, personal hygiene or for the formation of garments.

BACKGROUND OF THE ART

[0002] A non-woven is widely used as a replacement for traditional textile products in a number of sectors, for example in the field of cleaning and protection of surfaces, or in the production of garments. Compared to traditional fabrics, the non-woven have the advantage of lower production costs, outstanding-mechanical properties and a high biocompatibility with skin.

[0003] Non-wovens are formed by synthetic, natural or naturally-derived material fibers, which are arranged on a mat in a molten state and left to solidify in the form of a layer; the thus obtained structure can be consolidated by dynamic treatments such as point-bonding or calendering or by water jets (hydro-entangling); other prior art bonding processes are mechanic needling, thermobonding, chemical bonding, etc.

[0004] Non-woven fibers generally consist of a single component; however for particular applications they may also be produced in a multi-component form, through the joint extrusion of different polymers.

[0005] The non-woven fibers are used in the form of single-ply or in the form of multi-layer composites; of the multi-layer composites those containing one or more layers of non-woven, associated to a layer of cellulose fibers are known: in these cases the final composite advantageously combines the non-woven mechanical properties to the absorbent properties of cellulose fibers.

[0006] Unfortunately, the manufacture of these composites entails particular problems: in fact, the cellulose layer (that is typically formed by short fibers and is poorly reactive to the entangling processes), is very mobile and poorly cohesive with the other layers; therefore problems of cellulose material loss during the formation of the multi-layer composite are frequent, thus requiring to increase the amount of cellulose fibers used to compensate the losses; besides in the final composite one encounters problems of migration of the cellulose fibers thus creating areas that are richer and areas that are poorer in pulp inside the multi-layer non-woven and excessive pulp loss during hydro-entangling. In addition the cases of composite delamination due to insufficient entangling between the different layers and between the continuous thread fibers on the outer surfaces are frequent. In other words, the continuous thread fibers of each of the outer layers of non-woven do not entangle suitably either with one another or with the fibers of different layers but rather they protrude from the respective outer surfaces in the form of tiny slots. In this way, when a non-woven sheet comes into contact with a rough surface such as a person’s hand, the non-woven tends to stick in a bothersome way to the rough surface due to miniscule contacts between said slots and the ribs of the rough surface.

[0007] In order to resolve these problems, US patent 5,587,225 (Griesbach et al.) discloses a composite formed by a cellulose layer interposed between two outer non-woven layers, in which the non-woven fibers are not smooth, but have a series of creases or "crimps" per unit length of the fiber. The outer layers are then made integral with the cellulose layer by hydro-entangling, and final fixing of the 3 layers made adhesively or thermally (calendering). In any case, the crimping and creasing processes make the composite preparation process longer and more expensive, and they considerably reduce the softness of the product.

[0008] WO-A-01/63032 (Orlandi-Fleissner) discloses a multi-layer cellulose/non-woven composite wherein the layer of non-woven is carded and pre-consolidated separately by means of calendering. The different layers of the composite are thus overlapped and entangled by means of hydro-entangling. Also in this case it is necessary to resort to additional processes of non-woven calendering and pre-consolidation in order to obtain a multi-layer composite with acceptable performance, and limit the loss of pulp during hydro-entangling.

[0009] WO 02/099176 discloses a method for producing reinforced nonwoven fabric starting from microfibers of a melting polymer which is exploded into microfibers and laid as continuous filaments on a web. This web is then hydroentangled. The final product is a single layer nonwoven which is reinforced and avoids the pilling effect. EP 1156147 discloses a composite nonwoven fabric comprising at least one air-laid absorbing layer and at least one spunbonded layer, which are consolidated by hydroentanglement to improve mechanical and physical characteristics. The spunbonded layer can be formed by bicomponent polymer fibers or splittable microfibers.

[0010] Common to all the solutions proposed is the need to perform many adhesion processes and/or pre-treatment of the fibers in order to obtain a sufficiently cohesive multi-layer product: this entails an increase in process time and costs and moreover an excessive rigidity of the final product when additional thermo-welding processes are followed.

SUMMARY

[0011] The object of the present invention is therefore to overcome all the inconveniences mentioned with reference to the multi-layer non-wovens obtained according to the state of the art and particularly according to the processes described above.
[0012] This object is achieved by a process as detailed in the independent claims appended hereto.
[0013] It was surprisingly noted that the use of particular polymer fibers for the formation of the outer layers of single-layer non-woven allows to resolve the abovementioned drawbacks and advantageously improve the functional and tactile characteristics of the product itself.
[0014] Particularly, multi-layer non-woven fabric is of a hydro-entangled type based on exploded continuous thread or splittable multi-component continuous thread fibers. The thus obtained fabric has for example high characteristics of softness and resilience.
[0015] By "continuous thread fibers " is meant herein a single continuous fiber composed of one or more synthetic or natural polymer components that may be decomposed into single micro-fibers, or filaments, according to the type of fiber used. Accordingly, both the splittable multi-component polymer fibers and the exploded polymer fibers give origin to micro-fibers, which are thinner than the fibers from which they derive.

DESCRIPTION OF THE FIGURES

[0016] Further characteristics and the advantages of the non-woven in accordance with the present invention will be better understood in the following detailed description of embodiments provided by way of non-limiting examples with reference to the appended figures, wherein:

- Figure 1A represents a schematic view of the production line and of the manufacturing steps of the single-layer non-woven;
- Figure 1B represents a schematic view of the production line and the manufacturing steps of three-layer non-woven composite according to the present invention;
- Figure 1C represents a schematic view of the production line and the manufacturing steps of a three-layer non-woven composite with pre-hydro-entangling of one layer according to the present invention;
- Figure 2 represents a perspective view of two embodiments of the mat on which the fibers according to the present invention are arranged;
- Figure 3 represents a microscope image of a polymer fiber before (3a) and after (3b) the treatment according to the process described in patent application WO 00/20178 in the name of Hills, Inc and Fiber Innovation Technology, Inc.;
- Figure 4A represents a microscope image of the polymer fiber obtained with Nanoval technology comprising polypropylene and Fluff Pulp described in patent application WO 02/052070;
- Figure 4B represents a microscope image of the spun-bond type polymer fiber with a diameter of 2.2 dtex of the continuous thread type and 80 g/mt^2 PES weight;
- Figure 4C represents a microscope image of the polypropylene polymer fiber obtained with Nanoval technology according to the patent application WO 02/052070;
- Figure 4D represents a microscope image of the polymer fiber obtained with Nanoval technology according to patent application WO 02/052070 with different process parameters that determine a different "explosion" effect, according to one variant of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0017] A first object of the present invention is therefore to provide a process for the production of a multi-layer hydro-entangled non-woven comprising exploded fibers or splittable multi-component fibers.
[0018] A second object of the present invention is a hydro-entangled multi-layer non-woven, based on exploded fibers or based on splittable multi-component fibers.
[0019] The fiber forming the non-wovens of the present invention is a continuous fiber and is generally produced by three technologies:

a. production of bi-component synthetic polymer fibers (multisegments), that are can be split with a hydro-entangling machine;
b. production of synthetic polymer fibers with explosion effect, for example polyester, polypropylene, polyethylene (technology known as "Nanoval" described in patent applications WO-A-02052070 and DE-A-19929709, incorporated herein for reference) ;
c. production of natural fibers with explosion (such as Lyocell, PLA, etc.) by "Nanoval" technology described above.

1. Production of splittable synthetic polymer fibers

[0020] As for the production of a single layer, as represented schematically in figure 1A, the manufacturing steps generally comprise the supply of the non-woven layer T_1 in the form of fibers by means of a spinneret 1 (extruder) coupled up to a conventional suction fan A, a hydro-entangling station 2, a drying station 3 and a rewinding station 4 of the hydro-entangled layer into a roll. For the details of each step, reference should be made to the following description with reference to figures 1B and 1C in which the steps with similar names are identical to those outlined above.
[0021] The process for the production of a non-woven, comprises the following manufacturing steps;

a) preparing at least one layer (T_1) of splittable multi-component polymer fibers;
b) hydro-entangling said at least one layer such as to obtain a non-woven where the multi-component polymer fibers are split into mono-component micro-fibers entangling with one another,

characterized in that step a) comprises:

- preparing at least one layer (T_1) of splittable multi-component polymer fibers;
- laying at least one layer of fibers of absorbent material (T_3) on said at least one layer (T_1) ;
- laying at least one further layer (T_2) of splittable multi-component polymer fibers on said at least one layer of fibers of absorbent material, whereby the hydro-entangling step b) takes place such as to obtain a multi-layer non-woven where the multi-component polymer fibers are split into individual mono-component micro-fibers entangling both with one another and the fibers of the absorbent material, and

wherein each preparation step of the polymer fibers and laying of the fibers of absorbent material is made on a support (S) having a surface comprising sections with a profile substantially perpendicular to the vertical laying flow of the fibers interspaced by sections with an inclined profile of 10°-50° in relation to said vertical flow.
[0022] The production of a multi-layer composite in accordance with the present invention (figure 1B) generally provides, on the other hand, the supplying of the first layer of non-woven T_1 by means of a special spinneret 5, one or more stations 6 for the laying of cellulose pulp 60, the laying of a second layer of non-wowen fabric T_2 by means of a special spinneret 7, hydro-entangling 8, drying 9 and rewinding 10.
[0023] Referring to a multi-layer product, it is widely known that splittable multi-component fibers may be produced through extrusion by spinnerets of polymer materials such as to form continuous fibers, in accordance with the technology a. identified above. These fibers when exiting from the spinnerets are hit by a jet of compressed air that causes the elongation and the electrostatic charging thereof such to cause a mutual repulsion causing them to fall randomly onto a conveyor belt.
[0024] With reference to figure 1B, a process for the production of multi-layer non-woven fabric comprising outer layers made with splittable fibers according to the abovementioned technology will now be described.
[0025] Particularly, splittable multi-component synthetic fibers may be formed for the separate extrusion of the individual polymers in a molten state in the form of threads 50, 70 that protrude from orifices, of capillary dimensions, of a spinneret 5, 7 and the union thereof below the spinneret. The polymers at the molten state are linked in a single fiber combined by extrusion of the individual polymer threads in directions such as to cause the contact thereof and the adhesion thereof, as described in patent US 6,627,025. A suction fan A positioned below the spinneret has the function of sucking and conveying the individual threads of extruded polymer in order to favour the bonding thereof into a single fiber.
[0026] The synthetic fibers may be composed of at least two threads of a single polymer up to 16 threads of different polymers, be they homopolymers, copolymers or mixtures thereof. The polymers may be selected from polyesters, polyamides, polyolefins, polyurethane, polyester modified with additives, polypropylene, polyethylene, polypropylene terephthalate, polybutylene terephthalate.
[0027] Preferably, such polymers may be selected such that in the fibers adjacent polymers cannot mix or in any case have poor affinity in order to favour the subsequent separation thereof. Alternatively, the polymers may be additized with lubricants that prevent the adhesion thereof. In addition, as the longitudinal, axial portion of the fiber usually has a greater force of cohesion than the peripheral portion, it may be advantageous to spin multi-component fibers such as to leave an axial hole or in any case a weakened axial portion.
[0028] As shown in figure 1B, once a layer of splittable multi-component polymer fibers has been laid through the special spinneret 5 onto a conveyor belt S such as to create a first layer of spun-bonded non-woven fabric T_1, one layer of absorbent material T_3 such as cellulose pulp is laid on said layer of non-woven fabric.
[0029] Subsequently, a second layer T_2 of non-woven fabric substantially identical to that prepared previously is laid on the layer of cellulose pulp T_3, as represented in figure 1B by the station identified with reference number 7.
[0030] At this point, the fibers are subject to hydro-entangling at the hydro-entangling station 8. This treatment, widely known per se, advantageously enables to split the polymer fibers that compose the outer layers of non-woven in micro-

fibers and to entangle them with one another and with the cellulose pulp fibers.

[0031] Preferably, the hydro-entangling is made not only on side S_1 of the support S on which the fibers are laid but also on side S_2, opposite side S_1, through special through holes (not shown in the figures) and suitable equipment positioned on said side S_2 (not shown).

[0032] Figures 1B and 1C also schematically represent a conventional filtering device 20 for the water originating from the hydro-entangling machines positioned after the cellulose pulp laying step. Said device has the function of recovering the water of the hydro-entangling machine and filtering it of any cellulose pulp fibers.

[0033] Figure 3 shows the splittable multi-component polymer fiber before (3a) and after(3b) the hydro-entangling treatment.

[0034] Further examples of splittable multi-component fibers are described in patent applications US-A-5970583, DE-A-19846857 and WO 00/20178, incorporated herein for reference.

[0035] It is understood that with this treatment the free spaces between the polymer fibers laid on the conveyor belt are considerably reduced. Therefore, there is less cellulose pulp loss during hydro-entangling. It results that a greater amount of cellulose pulp may be withheld in the final multi-layer product with a resulting considerable increase in the absorbent power and softness and with advantages of reduction of cellulose pulp loss in the abovementioned filtering system.

<u>2 . Production of exploded synthetic polymer fibers</u>

[0036] The process for the production of non-woven based on exploded polymer fibers comprises the following manufacturing steps:

[0037] The process for the production of a non-woven, comprising the following manufacturing steps;

i) preparing at least one layer (T_1) of exploded polymer fibers;
ii) hydro-entangling said at least one layer such as to obtain a non-woven where the polymer fibers are exploded into micro-fibers entangling with one another, characterized in that step i) comprises:

- preparing at least one layer (T_1) of exploded polymer fibers;
- laying at least one layer of fibers of absorbent material (T_3) on said at least one layer (T_1) ;
- laying at least one further layer (T_2) of exploded polymer fibers on said at least one layer of fibers of absorbent material,
  whereby the hydro-entangling step ii) takes place such as to obtain a multi-layer non-woven in which the polymer fibers exploded into individual micro-fibers entangle both with one another and the fibers of the absorbent material, and
  wherein each preparation step of the polymer fibers and laying of the fibers of absorbent material is made on a support (S) having a surface comprising sections with a profile substantially perpendicular to the vertical laying flow of the fibers interspaced by sections with an inclined profile of 10°-50° in relation to said vertical flow.

[0038] According to Nanoval technology, the explosion of the fiber (just extruded at the molten state) is obtained when it comes into contact with air at room temperature.

[0039] Generally, as described in patent application WO 02/052070, Nanoval technology consists in producing molten polymer threads protruding from spinning holes arranged in one or more rows placed in a chamber with a given pressure value separated from the outside environment and filled with gas, generally air. Said threads come to an area of rapid acceleration of this gas when exiting from the camera, the outlet being made in the form of a Laval nozzle.

[0040] The forces that are transmitted to the respective threads along the route, following tangential stress, increase, while the diameter of the threads drops strongly and the pressure in their still fluid inner portion increases intensely in an inversely proportionate manner to the effect of surface stress. Following the acceleration of the gas, pressure drops according to hydrodynamic laws. Besides, the temperature conditions of the molten mass, the gas flow and the rapid acceleration thereof adapt with one another, so that the thread before being cured reaches an inner hydrostatic pressure which is greater than the pressure outside the chamber, whereby the thread explodes into a plurality of micro-fibers or fine filaments. Through a slit in the bottom of the chamber, both the threads and the air can be released from the chamber.

[0041] The raw materials that can be spun are both of natural origin, such as cellulose Lyocell, PLA, and synthetic or such as polypropylene, polyethylene, polyamide, polyester.

[0042] Alternatively, the spinning mass is forced through a elongated nozzle in the form of a slit into a chamber separated from the environment with a given pressure, as above, into which gas, for example air, is introduced. The film that is released from said nozzle reaches an area of rapid acceleration of the gas released from said camera. Below the acceleration area, i.e. in the stress release area, the film explodes and substantially endless micro-fibers or filaments are obtained. In any case, unlike those formed by single threads, they have very different diameters and thickenings in the shape of knots.

[0043] Preferably, the Laval nozzle is cylindrical and elongated with a convergent edge so that the transversal section thereof is narrow upstream and then rapidly widens downstream. In the narrowest portion, by selecting the pressure value in the chamber (in the case of air about twice environmental pressure), flow speeds near to those of sound are obtained whereas in the wider part of the Laval nozzle speeds are higher than those of sound.

[0044] It is understood that a man skilled in the art will be able to set the working parameters for example, the flow rate of the polymer melted in the spinneret, the temperature inside said spinneret and the gas flow rate in order to adapt them to the type of polymer used and to the specific requirements for obtaining diameters of the individual micro-fibers or filaments.

[0045] With regards to the laying of the exploded fibers to form a first layer and the further manufacturing steps, the same references are valid as made to figures 1A, 1B and 1C in which the suction fan A is eliminated and the spinnerets 5, 7, 11, 15 are each fitted with the abovementioned Laval nozzle (not shown) in order to obtain the explosion effect.

[0046] The advantage of use of the Nanoval technology lies in the possibility of producing very fine micro-fibers with diameters of less than 10 μm, for example between 2 and 5 μm in a simple and cost effective way without the aid of jets of gas (air) heated beyond the polymer's melting point, as occurs for example with meltblown technology. Besides, the micro-fibers are not damaged in their molecular structure by the use of high temperatures. Accordingly, the end product has greater resistance and therefore shows slower wear over time.

[0047] A further advantage also in relation to the technology that employs splittable polymer fibers lies in the fact that a greater density of individual micro-fibers per each fiber is obtained. In other words the fiber divides into a number of components with equal initial diameters, i.e. the micro-fibers (filaments) that are obtained are at least 10 times finer, preferably up to 100 times finer.

[0048] Regardless of the type of splittable or exploded fiber used, if it is desired to pre-hydro-entangle the non-woven before bonding it into the form of a multi-layer composite (figure 1C), the steps are as follows: laying the first layer T_1 by means of the spinneret 11, pre-hydro-entangling through equipment 12, drying through equipment 13, laying cellulose pulp T_3 through equipment 14, laying the second layer T_2 through spinneret 15, hydro-entangling with hydro-entangling machine 16, drying through equipment 17 and rewinding onto a roller 18. The production process and system may also provide a dewatering step or station 19 associated to the drying step or station. The advantage of a pre-hydro-entangling step is that it allows to create a first layer of split or exploded polymer fibers that, thanks to the greater density of the entangling of the micro-fibers of said fiber, helps to lay fibers of absorbent material and prevents the partial loss thereof through spaces too wide, which are left by prior art technologies.

[0049] As mentioned previously, the step of laying fibers of absorbent material is preferably made with cellulose pulp fibers having a length that may vary from 0, i.e. cellulose powder, to 2.5 mm, preferably from 1 to 2 mm.

[0050] In addition, the process according to the invention may provide a drying step after the hydro-entangling step and, preferably also after the pre-hydro-entangling step.

[0051] A further step may consist in the elimination of the water contained in the fibers by means of a dewatering step. Particularly, said step consists in arranging a condenser 19 below support S for the non-woven fibers to which a completely conventional suction fan (not shown) is usually coupled up. The air sucked through the holes made on said support is conveyed into said condenser where it releases the water contained therein. Equipment of this type is described for example in patent application PCT/IT2004/000127 of the same applicant.

[0052] The process may also comprise an embossing step of the multi-layer non-woven. Particularly, the embossing may consist in a calendering treatment made by making the non-woven being heated and pass under pressure between a pair of engraved rollers, in accordance with conventional techniques, or through a further step in a hydro-entangling machine. It should be noted that the term "embossing step" does not mean a consolidation of the non-woven as occurs according to the prior art mentioned previously but simply constitutes a step enabling to make captions and/or three dimensional drawings in order to personalize or decorate the non-woven through a "thermoembossing" or "hydroembossing" calender.

[0053] Preferably, the process comprises sucking the air at room temperature through the abovementioned through holes (non shown in the drawings) made in the support S for the fibers. In this way, the splittable or exploded polymer fibers, laid at the molten state, are cooled and cured. In the case in which exploded fibers are used a humidifier (not shown) can be arranged, which humidifies the exploded fibers immediately before laying them on the support S either to help or improve the softness of the end product.

[0054] Even more preferably, said process may comprise one or more of the following final steps, known per se, in order to increase or add additional characteristics to the end product: coloring or finishing of a chemical nature as the anti-pilling treatment and the hydrophile treatment, antistatic treatment, improvement of flame proof properties, substantially mechanical treatments such as napping, sanforizing, emerizing.

[0055] In addition, the non-woven may be subject to a further process of multicolor printing using the equipment described in patent application PCT/IT2004/000127 of the same applicant. In this case, a sheet of non-woven at the end of the process described above, may be printed directly in-line following the steps of:

- providing equipment for printing of non-woven comprising a moving support for the transport of said non-woven and at least one moving print organ;
- providing said equipment with said sheet of non-woven;
- performing the printing on said non-woven under the command and control of a command and control unit, in which said command and control unit is operatively connected with said support and at least one printing organ in order to detect electrical signals originating from said support and at least one print organ, transforming said signals into numerical values representative of the state of their angular speed and torsional moment, comparing said numerical values with ratios of preset numerical values of said angular speeds and torsional moments and sending signals to said support and at least one print organ in order to correct any variation of said values that fall outside said ratios.

[0056] Finally, the process in accordance with the present invention may comprise a step of winding the non-woven on to a roller 18.

[0057] It must be considered that a "crimp" effect can be advantageously obtained avoiding the use of engraved calenders or machines for mechanical "crimping", by simply laying all the fibers that compose the multilayer non-woven on a support (figure 2A and 2B) having a surface comprising at least one section with a substantially perpendicular profile to the vertical flow of laying of said fibbers interspaced by at least one section with an inclined profile of 10°-50° in relation to said vertical flow. Obviously the profile of the support may be modified such as to create geometrical forms or figures and captions in relief as desired.

[0058] The process of the present invention enables to obtain multi-layer fabric with single-layer hydro-entangling or three hydro-entangling steps with pre-hydro-entangling. The product may for example be a three-layer multi-layer one, of which has one central cellulose pulp layer and the outer layers have different combinations of the technologies illustrated above.

<u>I. Splittable multi-component polymer synthetic fibers</u>

[0059] Preferably, the splittable multi-component polymer fibers are composed of micro-fibers or filaments of polymer such as those described above with reference to the manufacturing process. The micro-fibers may have a diameter of between 0.1 dTex and 0.9 dTex and the corresponding fibers may vary according to the number of micro-fibers composing it but generally their size ranges between 1.7 dTex and 2.2 dTex. The number of micro-fibers in said fibers generally ranges between 2 and 16.

[0060] Referring to a three-layer non-woven having an inner layer of cellulose pulp fibers and two outer layers of polymer fibers consisting of two different splittable polymer components such as polypropylene/polyethylene, analytical tests have shown the following physical characteristics:

- weight in grams per square meter ranging between 50 and 70, preferably between 55 and 65;
- tensile strength in the machine direction expressed in Newton per 5 cm (N/5cm) between 50 and 150, preferably between 60 and 120, whereas in the cross-direction between 20 and 75, it is preferably between 30 and 65;
- elongation, calculated as a percentage of the length in a relaxed state, ranged between 35% and 85% in machine direction (MD), preferably between 45% and 75%, whereas it ranged between 70% and 100% in the cross-direction (CD), preferably between 80% and 90%;
- final content of the cellulose pulp fiber ranged between 50% and 75% of the total weight of the non-woven;
- power of absorption calculated as a percentage of total weight in relation to the weight of the dry non-woven was between 600% and 700% (according to the percentage of pulp in the end product).

<u>II. Exploded polymer synthetic fibers</u>

[0061] Referring to the exploded fibers, it was observed that the micro-fibers (filaments) have a diameter ranging between 1 micron and 5 micron, preferably between 2 and 4 micron. Obviously said values may vary according to the type of preset characteristics for the end product and will depend on the production parameters selected, as described above, and in any case known to a man skilled in the art.

[0062] As to a three-layer non-woven having one inner layer of cellulose pulp fibers and two outer layers of polymer fibers consisting of a single exploded polymer component, analytic tests showed the following physical characteristics given in the table:

Total weight (grams)	Weight of upper layer (g/m^2)	Pulp weight (g/m^2)	Weight of lower level (g/m^2)	MD Tensile strength (N/5cm)	CD Tensile strength (N/5cm)	Thickness (cm)
48-65	11-13	26-39	11-13	18-27	7-14	0,40-0,65

[0063] Regardless of the type of polymer fibers used, the final thickness of the multi-layer non-woven advantageously reaches values of up to 0.65 mm and a tensile strength of 27 N/5cm.

[0064] It was observed that the non-wovens that are obtained by employing the technology relating to the exploded fibers advantageously enable to make a product that is softer and has a better appearance with regards to the compactness and evenness compared to a product obtained with split fibers, albeit of good quality. In addition it was noted that the filtering of the water originating from hydro-entangling is also improved, i.e. it contains fewer cellulose pulp fibers.

[0065] The products obtained according to the present invention have a plus of resistance, softness and have a better appearance. Besides the thickness is increased either by the explosion effect (Nanoval technology), or (splittable fibers) by the split effect, and by a technology of laying continuous thread fibers on the mat: the type of the mat (not smooth) may be as illustrated in figure 2.

[0066] Particularly, the abovementioned characteristics result from the combination of the use of splittable multi-component polymer fibers or of exploded polymer fibers in a process of hydro-entangling to obtain a multi-layer non-woven.

[0067] In fact as mentioned above, it was surprisingly found that despite the final structure of the non-woven being the result of a close weave of micro-fibers or fine filaments composing the polymer fibers, the hydro-entangling process is not substantially altered and, at the same time, it allows to obtain hand and functional characteristics better than any multilayer non-woven obtained with prior art technologies.

[0068] The weave of the micro-fibers or the individual filaments of the polymer fibers allows to withhold a greater amount of cellulose pulp fibers thus increasing both the thickness of the end product and the absorbent capacity thereof. Besides it is understood that at the same time, during the hydro-entangling process the loss of cellulose pulp is generally reduced by 50% compared to the usual technologies and, in the case of process according to the technology described in patent application WO-A-01/63032, the loss is substantially identical to the advantage of a product considerably better from the point of view of the softness, thickness and homogeneity.

[0069] The weave of said micro-fibers also considerably increases the bonding points per surface unit so that the resistance is far greater than single- or multi-layer products in which whole fibers are hydro-entangled.

[0070] As stated in the introductory part of this description, the drawback of the bothersome "pilling" effect is also overcome thanks to the high number of weaves between filaments, far finer than the whole fibers, the abovementioned tiny slots do not form.

[0071] In addition, the process of the present invention advantageously allows to eliminate the lengthy and costly steps of adhesion and/or pre-treatment of the fibers according to the prior art in order to obtain a sufficiently cohesive multi-layer product.

[0072] Below is a non-limiting example of one embodiment of the process according to the present invention.

<u>EXAMPLE</u>

[0073] In an extruder a 13% cellulose solution is placed in an NMMO (N-methylmorpholin-N-oxide) aqueous solution of 75% and 12% of water in a spinning device consisting of a spinneret with a hole and a round Laval nozzle, in which the single spinning hole has a diameter of 0.5mm. The solution was introduced directly through pumps in a dosed way in a spinning device. The temperature of the Lyocell spinning mass exiting the extruder was set at 94°C. On the lower part of the tip of the nozzle and electrical resistance was applied. The elongation of the fiber filaments of the exiting fibers the nozzle was made with air at room temperature of approximately 22°C and at a pressure, measured before the acceleration in the nozzle of Laval, between 0,05 and 3 bar above atmospheric pressure. The spinning speed is about 500 m/min. The fibers exiting the spinneret undergo an explosion effect, caused by the difference of temperature and pressure between the process of extrusion and spinning and room temperature, thus opening into numerous threads that are hit by humidified air by means of a humidifier that causes moist air containing about 5% of water to pass through the extruded threads. After humidification and next to the spinneret, the threads of the exploded polypropylene fibers are sucked onto a conveyor belt which is perforated and has its surface covered with cubical shaped ribs. The suction takes place through a fan positioned below said conveyor belt and in correspondence with the spinneret. At this point, the exploded fibers are arranged on said support in the form of a first continuous layer in amount of 11.5 g/m^2. Then, said layer is subject to hydro-entangling by means of a device sold by FLEISSNER and equipped with five sequential injectors mounted on special rollers on both surfaces of said support. Said injectors work at respective pressures of

15,50-100-100-100-150 bar and have a diameter of the injection hole from 100 to 140 microns. Subsequently, said pre-water-entangled layer passes under a cellulose pulp fiber laying station. The laying of the cellulose fibers takes place through a device sold by FLEISSNER of the "air-laid" type in which the fibers laid are fibers with a diameter of 3 micron and laid in amounts of 37.25 g/m^2. Subsequently, a further layer of exploded polypropylene fibers is laid on said layer of cellulose pulp fibers in the same way as described with reference to the first layer of exploded fibers. At this point, the three layers are interconnected through hydro-entangling by means of a device identical to that described previously and at the same conditions. At the end of the hydro-entangling process, the thus formed three-layer non-woven passes inside a drying station in which a perforated drum receives and transports the non-woven being hit by a hot air flow of approximately 120°C. When exiting from the dryer, the non-woven is wound on a winding roller. The feeding speed of the conveyor belt along the whole non-woven manufacturing steps is maintained at approximately 500 m/min. The end product obtained has the following physical characteristics:

Total weight (grams)	Weight of upper layer (g/m^2)	Pulp weight (g/m^2)	Weight of lower layer (g/m^2)	MD Tensile strength (N/5cm)	CD Tensile strength (N/5cm)	Thickness (cm)
60,25	11,50	37,25	11,50	21,93	8,01	0,58

[0074] As may be appreciated from what described above, the present patent application provides a process for the production of a multi-layer non-woven and a non-woven obtainable with said process that allows to overcome the drawbacks mentioned in the introductory part with reference to the prior art.

[0075] Besides, a man skilled in the art may perform numerous modifications both to the process and to the non-woven all being within the scope of protection of the claims appended herein.

Claims

1. A process for the production of a non-woven, comprising the following manufacturing steps;

a) preparing at least one layer (T_1) of splittable multi-component polymer fibers;
b) hydro-entangling said at least one layer such as to obtain a non-woven where the multi-component polymer fibers are split into mono-component micro-fibers entangling with one another,

characterized in that step a) comprises:

- preparing at least one layer (T_1) of splittable multi-component polymer fibers;
- laying at least one layer of fibers of absorbent material (T_3) on said at least one layer (T_1) ;
- laying at least one further layer (T_2) of splittable multi-component polymer fibers on said at least one layer of fibers of absorbent material,

whereby the hydro-entangling step b) takes place such as to obtain a multi-layer non-woven where the multi-component polymer fibers are split into individual mono-component micro-fibers entangling both with one another and the fibers of the absorbent material, and
wherein each preparation step of the polymer fibers and laying of the fibers of absorbent material is made on a support (S) having a surface comprising sections with a profile substantially perpendicular to the vertical laying flow of the fibers interspaced by sections with an inclined profile of 10°-50° in relation to said vertical fllow.

2. The process according to claim 1, wherein said step a) is made through separate extrusion of at least two polymers by a suitable spinneret (5,7,11,15) below which said at least two polymer components are linked such as to form a single splittable multi-component fiber.

3. The process according to claim 2, wherein said splittable multi-component fiber is obtained by spinning and subsequently linking up to 16 continuous threads of different polymers.

4. The process according to any of claims 1 to 3, wherein said polymer fibers derive from at least two threads of a single polymer up to 16 threads of different polymers, be they homopolymers, copolymers or mixtures thereof.

5. The process according to claim 4, wherein said polymers are selected from polyesters, polyamides, polyolefins, polyurethane, polyester modified with additives, polypropylene, polyethylene, polypropylene terephthalate, polybutylene terephtalate.

6. The process for the production of a non-woven, comprising the following manufacturing steps;

i) preparing at least one layer (T_1) of exploded polymer fibers;
ii) hydro-entangling said at least one layer such as to obtain a non-woven where the polymer fibers are exploded into micro-fibers entangling with one another, **characterized in that** step i) comprises:

- preparing at least one layer (T_1) of exploded polymer fibers;
- laying at least one layer of fibers of absorbent material (T_3) on said at least one layer (T_1) ;
- laying at least one further layer (T_2) of exploded polymer fibers on said at least one layer of fibers of absorbent material,

whereby the hydro-entangling step ii) takes place such as to obtain a multi-layer non-woven in which the polymer fibers exploded into individual micro-fibers entangle both with one another and the fibers of the absorbent material, and
wherein each preparation step of the polymer fibers and laying of the fibers of absorbent material is made on a support (S) having a surface comprising sections with a profile substantially perpendicular to the vertical laying flow of the fibers interspaced by sections with an inclined profile of 10°-50° in relation to said vertical flow.

7. The process according to claim-6, wherein the exploded polymer fibers are obtained through the passage of polymer fibers through a Laval nozzle.

8. The process according to claim-6 or 7, wherein the polymers of the exploded fibers are selected from natural or synthetic polymers.

9. The process according to claim 8, wherein the natural polymers are selected from cellulose, Lyocell and PLA, whilst the synthetic polymers are selected from polypropylene, polyethylene, polyamide and polyester.

10. The process according to any of claims 1 to 9, wherein said laying of absorbent material fibers takes place with cellulose pulp fibers.

11. The process according to any of claims 1 to 10, further comprising a drying step after the hydro-entangling step.

12. The process according to claim 11, further comprising a step of winding the non-woven fabric onto a roller after said drying step.

13. The process according to any of claims 1 to 9, further comprising a pre-hydro-entangling step after said step of preparing at least one layer (T_1) of polymer fibers.

14. The process according to claim 13, Further comprising a drying step after said pre-hydro-entangling step.

15. The process according to any of claims 11 to 14, further comprising a dewatering step simultaneous or subsequent to said drying step.

16. The process according to any of claims 12 to 15, further comprising a thickening step before the winding step.

17. The process according to claim 16, wherein said thickening step takes place through calendering or hydro-entangling.

18. The process according to any of claims 1 to 17, wherein air is sucked at a temperature equal to or lower than room temperature through said polymer fibers in order to cool and cure them.

19. The process according to any of claims 6 to 18, wherein said exploded fibers are humidified before being hydro-entangled.

20. The process according to any of claims 1 to 19, further comprising a non-woven finishing step.

21. The process according to any of claims 1 to 20, further comprising a multicolor printing step of the non-woven.

22. A hydro-entangled multi-layer non-woven which is obtainable according to the process in accordance with any of claims 1 to 21.

23. The non-woven fabric according to claim 22, comprising at least one micro-fiber layer.

24. The non-woven fabric according to claim 22 or 23, wherein said micro-fibers have a diameter of between 0.1 dTex and 0.9 dTex.

25. The non-woven according to claim 22 or 23, wherein said micro-fibers have a diameter of between 1 and 5 micron.

26. The non-woven according to any of claims 22 to 25, wherein the weight in grams per meter is between 50 and 70, the tensile strength in the machine direction expressed in Newton per 5 cm (N/5cm) is between 50 and 150, whereas in the cross-direction of between 20 and 75, the elongation calculated as a percentage in relation to the length in a relaxed state is between 35% and 85% in machine direction (MD), whereas it is between 70% and 100% in the cross-direction (CD), the final content of the cellulose pulp fiber is between 50% and 75% by weight of the total weight of the non-woven, the absorption power calculated as a percentage of the total weight of the weight of the dry non-woven is between 600% and 700%.

27. The non-woven according to any of claims 22 to 25, wherein said non-woven is of a three-layer type having a total weight in grams of between 48 and 65, a weight of the upper layer in grams per square meter of between 11 and 13, a weight of the inner layer of cellulose pulp fiber of between 26 and 39 grams per square meter, a weight of the lower layer in grams per square meter of between 11 and 13, a MD tensile strength of between 18 and 27 N/5cm, a CD tensile strength of between 7 and 14 N/5cm and a thickness of between 0.40 and 0.65 mm.

Patentansprüche

1. Verfahren zur Herstellung eines Vlies umfassend die folgenden Herstellungsschritte;

   a) Herstellen mindestens einer Schicht (T_1) aus spaltbaren Mehrkomponenten-Polymerfasern;
   b) Wasserverfestigen der mindestens einen Schicht derart, dass ein Vlies erhalten wird, wobei die Mehrkomponenten-Polymerfasern in Einkomponenten-Mikrofasern gespalten werden, die sich gegenseitig umwickeln,

   dadurch gekennzeichnet, dass Schritt a) umfasst:

   - Herstellen mindestens einer Schicht (T_1) aus spaltbaren Mehrkomponenten-Polymerfasern;
   - Legen mindestens einer Schicht aus Fasern aus absorbierendem Material (T_3) auf die mindestens eine Schicht (T_1),
   - Legen mindestens einer weiteren Schicht (T_2) aus spaltbaren Mehrkomponenten-Polymerfasern auf die mindestens eine Schicht aus Fasern aus absorbierendem Material,

   wobei der Wasserverfestigungsschritt b) derart stattfindet, dass ein mehrschichtiges Vlies erhalten wird, in dem die Mehrkomponenten-Polymerfasern in einzelne Einkomponenten-Mikrofasern gespalten werden, die sowohl sich gegenseitig als auch die Fasern des absorbierenden Materials umwickeln und
   wobei jeder Herstellungsschritt der Polymerfasern und Legen der Fasern aus absorbierendem Material auf einem Träger (S) stattfindet, der eine Oberfläche aufweist, die Abschnitte mit einem Profil umfasst, das im Wesentlichen senkrecht zum vertikal liegenden Fluss der Fasern ist, die durch Abschnitte mit einem geneigten Profil von 10°-50° im Verhältnis zum vertikalen Fluss getrennt sind.

2. Verfahren nach Anspruch 1, wobei Schritt a) mit getrennter Extrusion von mindestens zwei Polymeren durch eine geeignete Spinndüse (5, 7, 11, 15) durchgeführt wird, unter der die mindestens zwei Polymerkomponenten derart verknüpft sind, dass sie eine einzelne spaltbare Mehrkomponentenfaser bilden.

3. Verfahren nach Anspruch 2, wobei die spaltbare Mehrkomponentenfaser durch Spinnen und anschließendes Verknüpfen von bis zu 16 fortlaufenden Fäden aus verschiedenen Polymeren erhalten wird.

4. Verfahren nach einem der Ansprüche 1 bis 3, wobei die Polymerfasern von mindestens zwei Fäden eines einzelnen Polymers bis zu 16 Fäden verschiedener Polymere stammen, die Homopolymere, Copolymere oder Mischungen davon sind.

5. Verfahren nach Anspruch 4, wobei die Polymere ausgewählt sind aus Polyestern, Polyamiden, Polyolefinen, Polyurethan, Polyester modifiziert mit Zusätzen, Polypropylen, Poylethylen, Polypropylen-terephthalat, Polybutylenterephthalat.

6. Verfahren zur Herstellung eines Vlies umfassend die folgenden Herstellungsschritte;

i) Herstellen mindestens einer Schicht (T_1) aus explodierten Polymerfasern;
ii) Wasserverfestigen der mindestens einen Schicht derart, dass ein Vlies erhalten wird, wobei die Polymerfasern in Mikrofasern explodiert werden, die sich gegenseitig umwickeln,

dadurch gekennzeichnet, dass Schritt i) umfasst:

- Herstellen mindestens einer Schicht (T_1) aus explodierten Polymerfasern;
- Legen mindestens einer Schicht aus Fasern aus absorbierendem Material (T_3) auf die mindestens eine Schicht (T_1),
- Legen mindestens einer weiteren Schicht (T_2) aus explodierten Polymerfasern auf die mindestens eine Schicht aus Fasern aus absorbierendem Material,

wobei der Wasserverfestigungsschritt ii) derart stattfindet, dass ein mehrschichtiges Vlies erhalten wird, in dem die Polymerfasern, die in einzelne Mikrofasern explodiert wurden, sowohl sich gegenseitig als auch die Fasern des absorbierenden Materials umwickeln und
wobei jeder Herstellungsschritt der Polymerfasern und Legen der Fasern aus absorbierendem Material auf einem Träger (S) stattfindet, der eine Oberfläche aufweist, die Abschnitte mit einem Profil umfasst, das im Wesentlichen senkrecht zum vertikal liegenden Fluss der Fasern ist, die durch Abschnitte mit einem geneigten Profil von 10°-50° im Verhältnis zum vertikalen Fluss getrennt sind.

7. Verfahren nach Anspruch 6, wobei die explodierten Polymerfasern mittels des Durchgangs von Polymerfasern durch eine Lavaldüse erhalten werden.

8. Verfahren nach Anspruch 6 oder 7, wobei die Polymere der explodierten Fasern ausgewählt sind aus natürlichen oder synthetischen Polymeren.

9. Verfahren nach Anspruch 8, wobei die natürlichen Polymere ausgewählt sind aus Cellulose, Lyocell und PLA, während die synthetischen Polymere ausgewählt sind aus Polypropylen, Polyethylen, Polyamid und Polyester.

10. Verfahren nach einem der Ansprüche 1 bis 9, wobei das Legen von Fasern aus absorbierendem Material mit Cellulose-Zellstofffasern stattfindet.

11. Verfahren nach einem der Ansprüche 1 bis 10, weiter umfassend einen Trocknungsschritt nach dem Wasserverfestigungsschritt.

12. Verfahren nach Anspruch 11, weiter umfassend einen Schritt Wickeln des Vliesstoffs auf eine Walze nach dem Trocknungsschritt.

13. Verfahren nach einem der Ansprüche 1 bis 9, weiter umfassend eine Vor-Wasserverfestigungsschritt nach dem Schritt Herstellen mindestens einer Schicht (T_1) aus Polymerfasern.

14. Verfahren nach Anspruch 13, weiter umfassend einen Trocknungsschritt nach dem Vor-Wasserverfestigungsschritt.

15. Verfahren nach einem der Ansprüche 11 bis 14, weiter umfassend einen Entwässerungsschritt gleichzeitig zu dem oder anschließend an den Trocknungsschritt.

16. Verfahren nach einem der Ansprüche 12 bis 15, weiter umfassend einen Verdickungsschritt vor dem Wickelungsschritt.

17. Verfahren nach Anspruch 16, wobei der Verdickungsschritt durch Kalandrieren oder Wasserverfestigen stattfindet.

18. Verfahren nach einem der Ansprüche 1 bis 17, wobei Luft bei einer Temperatur gleich zu oder niedriger als Raumtemperatur durch die Polymerfasern gesaugt wird, um sie zu kühlen und zu härten.

19. Verfahren nach einem der Ansprüche 6 bis 18, wobei die explodierten Fasern befeuchtet werden, bevor sie wasserverfestigt werden.

20. Verfahren nach einem der Ansprüche 1 bis 19, weiter umfassend einen Vlies-Endbearbeitungsschritt.

21. Verfahren nach einem der Ansprüche 1 bis 20, weiter umfassend einen Vielfarben-Druckschritt des Vlies.

22. Wasserverfestigtes vielschichtiges Vlies, das gemäß dem Verfahren nach einem der Ansprüche 1 bis 21 erhältlich ist.

23. Vliesstoff nach Anspruch 22, umfassend mindestens eine Mikrofaserschicht.

24. Vliesstoff nach Anspruch 22 oder 23, wobei die Mikrofasern einen Durchmesser von zwischen 0,1 dtex und 0,9 dtex aufweisen.

25. Vlies nach Anspruch 22 oder 23, wobei die Mikrofasern einen Durchmesser von zwischen 1 und 5 Mikrometer aufweisen.

26. Vlies nach einem der Ansprüche 22 bis 25, wobei das Gewicht in Gramm pro Meter zwischen 50 und 70 ist, die Reißfestigkeit in der Maschinenrichtung ausgedrückt in Newton pro 5 cm (N/5cm) zwischen 50 und 150 ist, wobei im Querschnitt von zwischen 20 und 75, die Verlängerung, die als Prozentsatz im Verhältnis zur Länge in einem entspannten Stadium errechnet wird, zwischen 35% und 85% in Maschinenrichtung ("machine direction", MD) ist, wobei sie zwischen 70% und 100% in der Kreuzrichtung ("cross-direction", CD) ist, wobei der Endgehalt der Cellulose-Zellstofffasern zwischen 50 Gewichts-% und 75 Gewichts-% des Gesamtgewichts des Vlies ist, wobei die Absorptionskraft, die als Prozentsatz des Gesamtgewichts des Gewichts des trockenen Vlies errechnet wird, zwischen 600% und 700% ist.

27. Vlies nach einem der Ansprüche 22 bis 25, wobei das Vlies aus einem Dreischicht-Typ besteht, der ein Gesamtgewicht in Gramm zwischen 48 und 65, ein Gewicht der oberen Schicht in Gramm pro Quadratmeter von zwischen 11 und 13, ein Gewicht der inneren Schicht aus Cellulose-Zellstofffaser von zwischen 26 und 39 Gramm pro Quadratmeter, ein Gewicht der unteren Schicht in Gramm pro Quadratmeter von zwischen 11 und 13, eine MD-Reißfestigkeit von zwischen 18 und 27 N/5cm, eine CD-Reißfestigkeit von zwischen 7 und 14 N/5cm und eine Dicke von zwischen 0,40 und 0,65 mm aufweist.

Revendications

1. Procédé de production d'un tissu non-tissé, comprenant les étapes de fabrication suivantes :

a) préparation d'au moins une couche (T_1) de fibres polymères à plusieurs composants pouvant être séparées ;
b) enchevêtrement hydraulique de ladite au moins une couche de manière à obtenir un tissu non tissé dans lequel les fibres polymères à plusieurs composants sont séparées en micro-fibres à composant unique enchevêtrées les unes aux autres,

caractérisé en ce que l'étape a) comprend :

- la préparation d'au moins une couche (T_1) de fibres polymères à plusieurs composants pouvant être séparées ;
- l'agencement d'au moins une couche de fibres du matériau absorbant (T_3) sur ladite au moins une couche (T_1) ;
- l'agencement d'au moins une autre couche (T_2) de fibres polymères à plusieurs composants pouvant être séparées sur ladite au moins une couche de fibres de matériau absorbant,

de telle sorte que l'étape b) d'enchevêtrement hydraulique est mise en oeuvre de manière à obtenir un tissu non tissé à couche multiple dans lequel les fibres polymères à plusieurs composants sont séparées en micro-fibres à composant unique individuelles s'enchevêtrant à la fois les unes aux autres et avec les fibres du matériau absorbant,

et
dans lequel chaque étape de préparation des fibres polymères et d'agencement des fibres de matériau absorbant est réalisée sur un support (S) présentant une surface comprenant des sections avec un profil sensiblement perpendiculaire au flux d'agencement vertical des fibres séparées par des sections avec un profil incliné de 10° à 50° par rapport audit flux vertical.

2. Procédé selon la revendication 1, dans lequel ladite étape a) est réalisée par extrusion séparée d'au moins deux polymères par une filière appropriée (5, 7, 11, 15) au-dessous de laquelle lesdits au moins deux composants polymères sont liés de manière à former une fibre à plusieurs composants pouvant être séparée.

3. Procédé selon la revendication 2, dans lequel ladite fibre à plusieurs composants pouvant être séparé est obtenue par filage et liaison consécutive de jusqu'à 16 fils continus de différents polymères.

4. Procédé selon l'une quelconque des revendications 1 à 3, dans lequel lesdites fibres polymères dérivent d'au moins deux fils d'un seul polymère et de jusqu'à 16 fils de différents polymères, que ce soit leurs homopolymères, copolymères ou des mélanges de ceux-ci.

5. Procédé selon la revendication 4, dans lequel lesdits polymères sont sélectionnés à partir de polyesters, polyamides, polyoléfines, polyuréthane, polyester modifié par des additifs, polypropylène, polyéthylène, polypropylène téréphtalate, polybutylène téréphtalate.

6. Procédé de production d'un tissu non tissé, comprenant les étapes de fabrication suivantes :

i) préparation d'au moins une couche (T_1) de fibres polymères éclatées ;
ii) enchevêtrement hydraulique de ladite au moins une couche de manière à obtenir un tissu non tissé dans lequel les fibres polymères sont éclatées en micro-fibres enchevêtrées les unes entre les autres,

caractérisé en ce que l'étape i) comprend :

- la préparation d'au moins une couche (T_1) de fibres polymères éclatées ;
- l'agencement d'au moins une couche de fibres de matériau absorbant (T_3) sur ladite au moins une couche (T_1) ;
- l'agencement d'au moins une autre couche (T_2) de fibres polymères éclatées sur ladite au moins une couche de fibres de matériau absorbant,

de telle sorte que l'étape d'enchevêtrement hydraulique ii) est mise en oeuvre de manière à obtenir un tissu non tissé à couches multiples dans lequel les fibres polymères éclatées en micro-fibres individuelles s'enchevêtrent à la fois les unes avec les autres et avec les fibres du matériau absorbant, et
dans lequel chaque étape de préparation des fibres polymères et d'agencement des fibres du matériau absorbant est réalisée sur un support (S) présentant une surface comprenant des sections avec un profil sensiblement perpendiculaire au flux d'agencement vertical des fibres séparées par des sections avec un profil incliné de 10° à 50° par rapport audit flux vertical.

7. Procédé selon la revendication 6, dans lequel les fibres polymères éclatées sont obtenues par le passage de fibres polymères à travers une tuyère de Laval.

8. Procédé selon la revendication 6 ou 7, dans lequel les polymères des fibres éclatées sont sélectionnées à partir de polymères naturels ou synthétiques.

9. Procédé selon la revendication 8, dans lequel les polymères naturels sont sélectionnés à partir de la cellulose, de Lyocell et de PLA, alors que les polymères synthétiques sont sélectionnés à partir du polypropylène, du polyéthylène, du polyamide et du polyester.

10. Procédé selon l'une quelconque des revendications 1 à 9, dans lequel ledit agencement de fibres de matériau absorbant est mis en oeuvre avec des fibres de pulpe de cellulose.

11. Procédé selon l'une quelconque des revendications 1 à 10, comprenant en outre une étape de séchage après l'étape d'enchevêtrement hydraulique.

12. Procédé selon la revendication 11, comprenant en outre une étape d'enroulement du tissu non-tissé sur un rouleau après ladite étape de séchage.

13. Procédé selon l'une quelconque des revendications 1 à 9, comprenant en outre une étape de pré-enchevêtrement hydraulique après ladite étape de préparation d'au moins une couche (T_1) de fibres polymères.

14. Procédé selon la revendication 13, comprenant en outre une étape de séchage après ladite étape de pré-enchevêtrement hydraulique.

15. Procédé selon l'une quelconque des revendications 11 à 14, comprenant en outre une étape de déshydratation simultanée ou consécutive à ladite étape de séchage.

16. Procédé selon l'une quelconque des revendications 12 à 15, comprenant en outre l'étape d'épaississement avant l'étape d'enroulement.

17. Procédé selon la revendication 16, dans lequel ladite étape d'épaississement est mise en oeuvre par l'intermédiaire d'un calandrage ou enchevêtrement hydraulique.

18. Procédé selon l'une quelconque des revendications 1 à 17, dans lequel de l'air est aspiré à une température inférieure ou égale à la température ambiante à travers lesdites fibres polymères dans le but de les refroidir et de les durcir.

19. Procédé selon l'une quelconque des revendications 6 à 18, dans lequel lesdites fibres éclatées sont humidifiées, avant l'enchevêtrement hydraulique.

20. Procédé selon l'une quelconque des revendications 1 à 19, comprenant en outre une étape de finition de tissu non tissé.

21. Procédé selon l'une quelconque des revendications 1 à 20, comprenant en outre une étape d'impression à plusieurs couleurs du tissu non tissé.

22. Tissu non tissé à couches multiples, enchevêtré hydrauliquement qui peut être obtenu suivant le procédé selon l'une quelconque des revendications 1 à 21.

23. Tissu non-tissé selon la revendication 22, comprenant au moins une couche de micro-fibres.

24. Tissu non-tissé selon la revendication 22 ou 23, dans lequel lesdites micro-fibres présentent un diamètre compris entre 0,1 dTex et 0,9 dTex.

25. Tissu non tissé selon la revendication 22 ou 23, dans lequel lesdites micro-fibres présentent un diamètre compris entre 1 et 5 microns.

26. Tissu non tissé selon l'une quelconque des revendications 22 à 25, dans lequel le poids en grammes par mètre est compris entre 50 et 70, la résistance à la traction suivant la direction de la machine, exprimée en newton pour 5 cm (N/5cm) est comprise entre 50 et 150, alors qu'elle est, suivant la direction transversale, comprise entre 20 et 75, l'allongement calculé en pourcentage par rapport à la longueur dans un état relaxé est compris entre 35 % et 85 % suivant la direction de la machine (MD), alors qu'il est compris entre 70 % et 100 % suivant la direction transversale (CD), la teneur finale de la fibre de pulpe de cellulose est comprise entre 50 % et 75 % en poids du poids total du tissu non tissé, le facteur d'absorption calculé en pourcentage du poids total du poids du tissu non tissé sec est compris entre 600 % et 700 %.

27. Tissu non tissé selon l'une quelconque des revendications 22 à 25, dans lequel ledit tissu non tissé est du type à trois couches présentant un poids total en grammes compris entre 48 et 65, un poids de la couche supérieure en grammes par mètre carré compris entre 11 et 13, un poids de la couche interne de la fibre de pulpe de cellulose compris entre 26 et 39 grammes par mètre carré, un poids de la couche inférieure en grammes par mètre carré compris entre 11 et 13, une résistance à la traction suivant la direction MD comprise entre 18 et 27 N/5cm, une résistance à la traction suivant la direction CD comprise entre 7 et 14 N/5cm et une épaisseur comprise entre 0,40 et 0,65 mm.

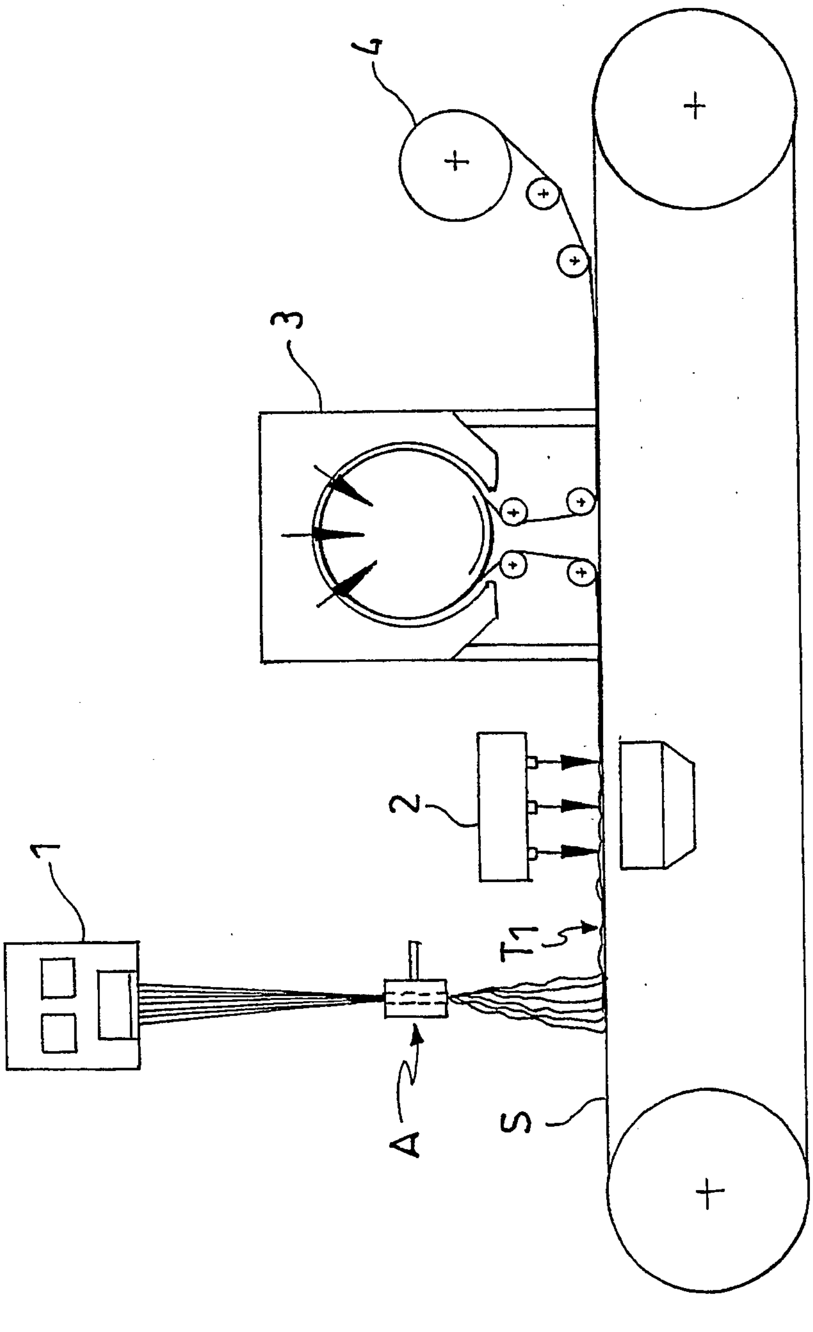


FIG.1a

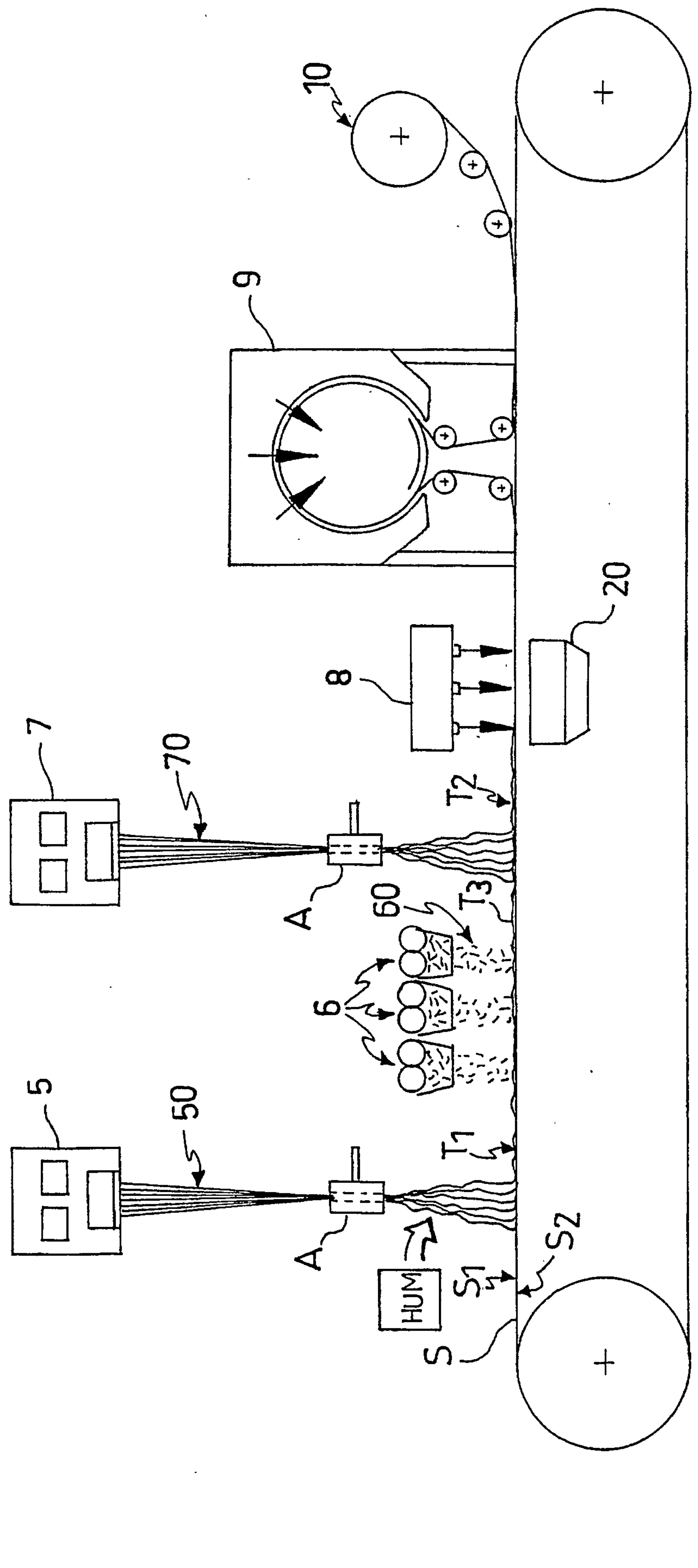


FIG. 1b

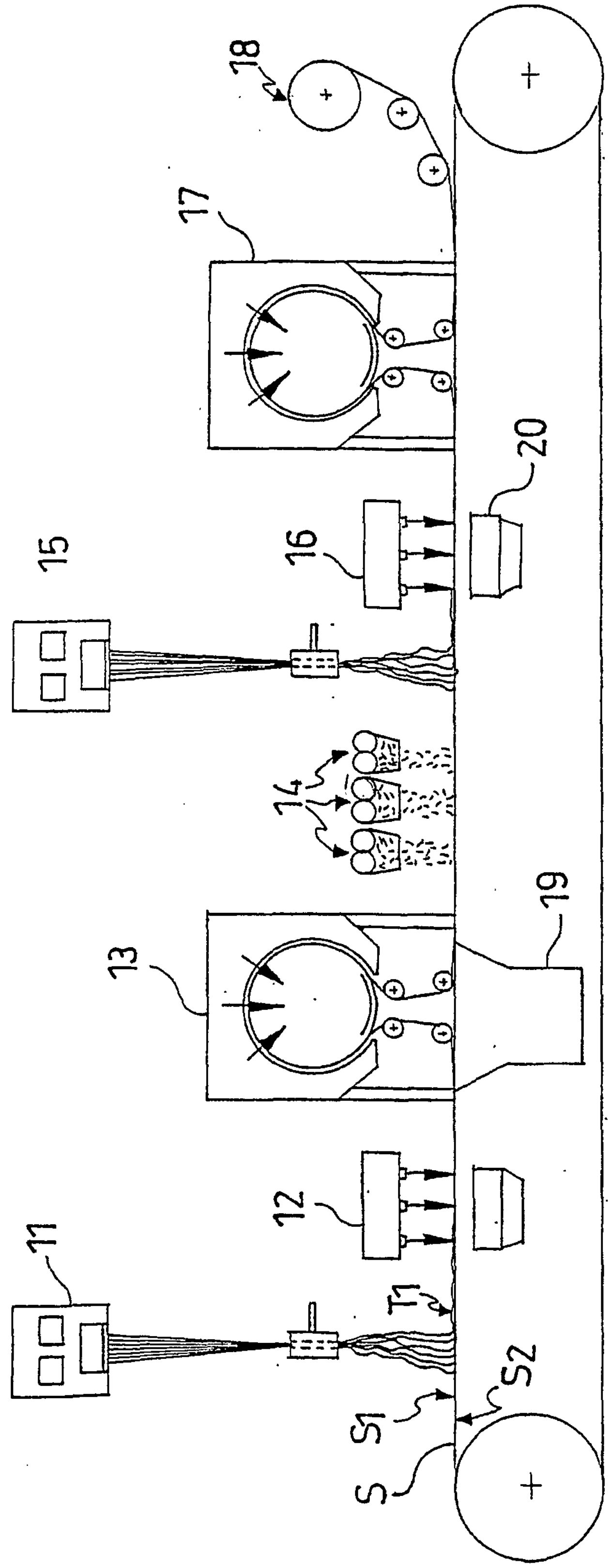


FIG.1c

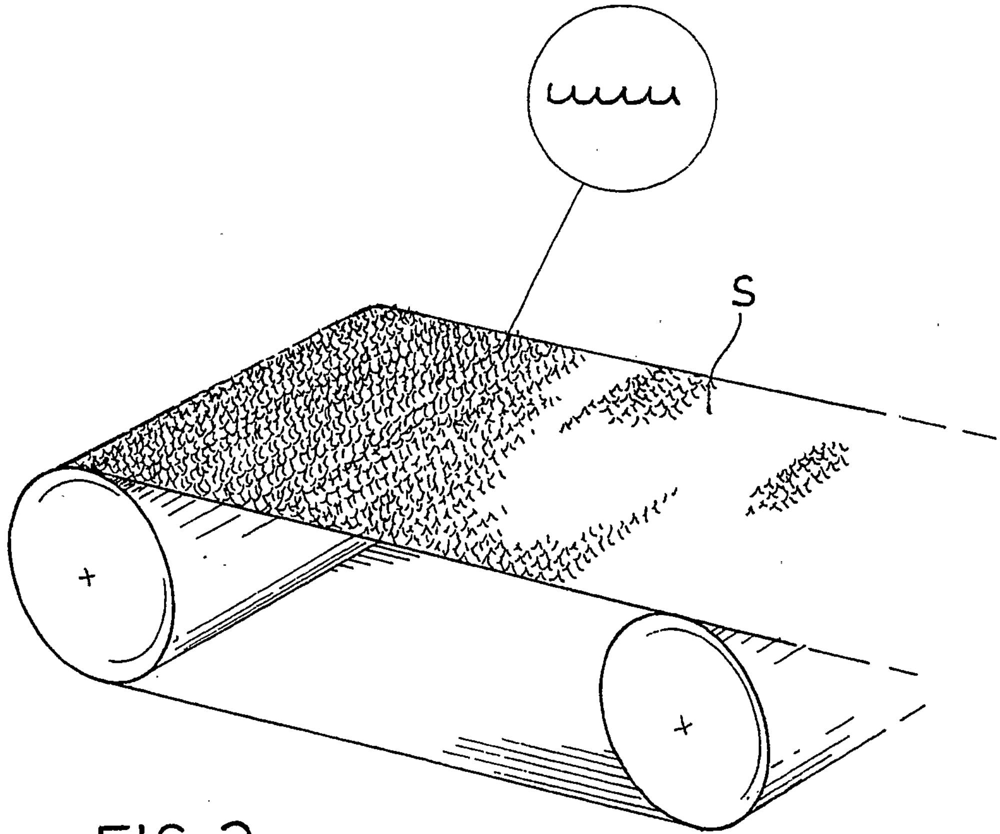


FIG. 2a

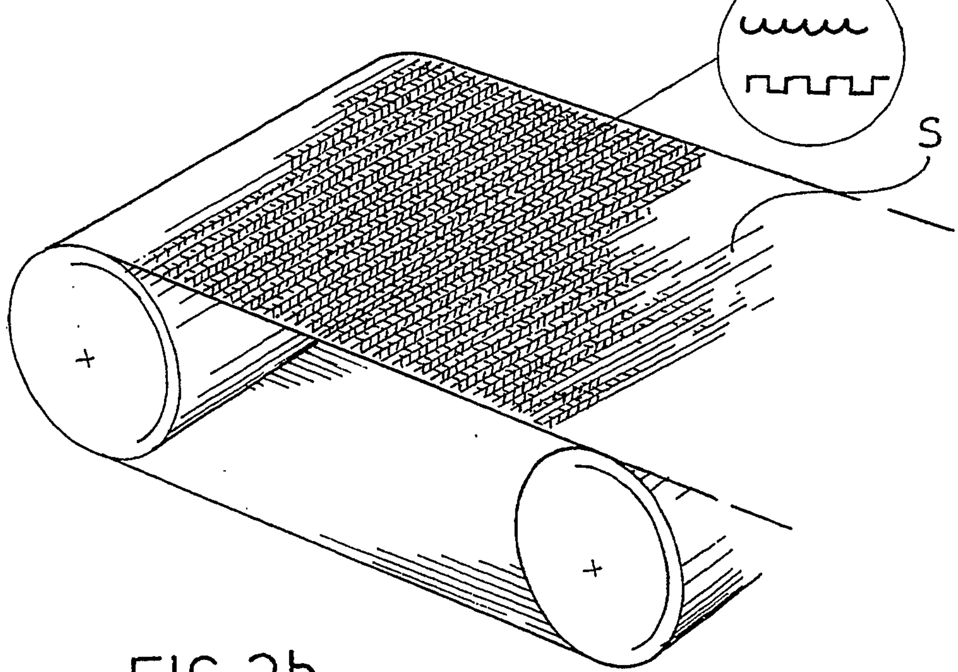
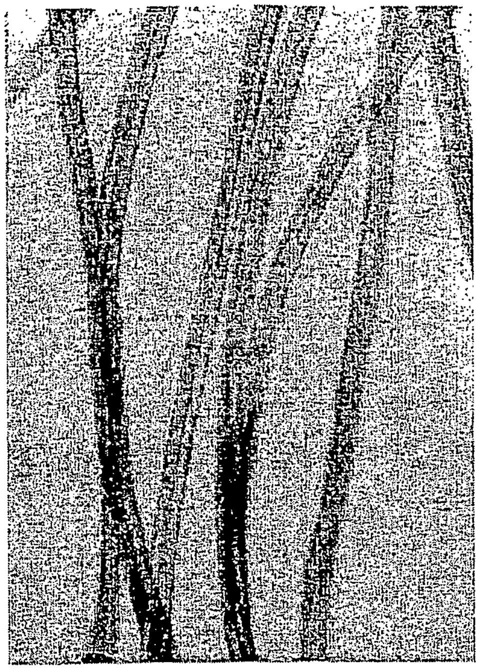


FIG. 2b

FIG. 3

A



B

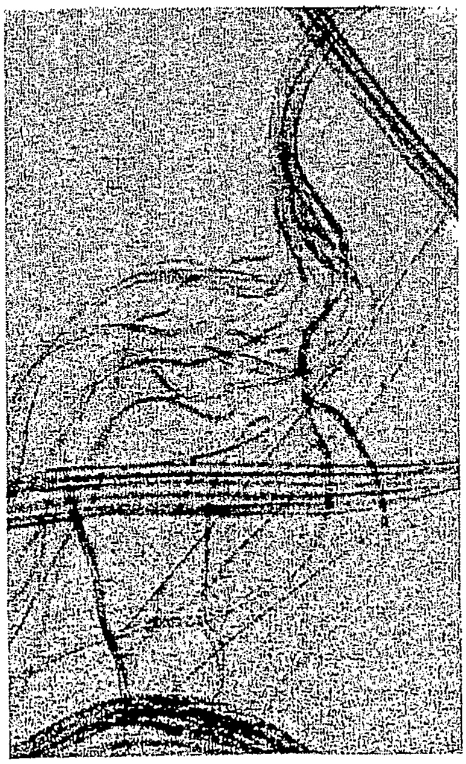
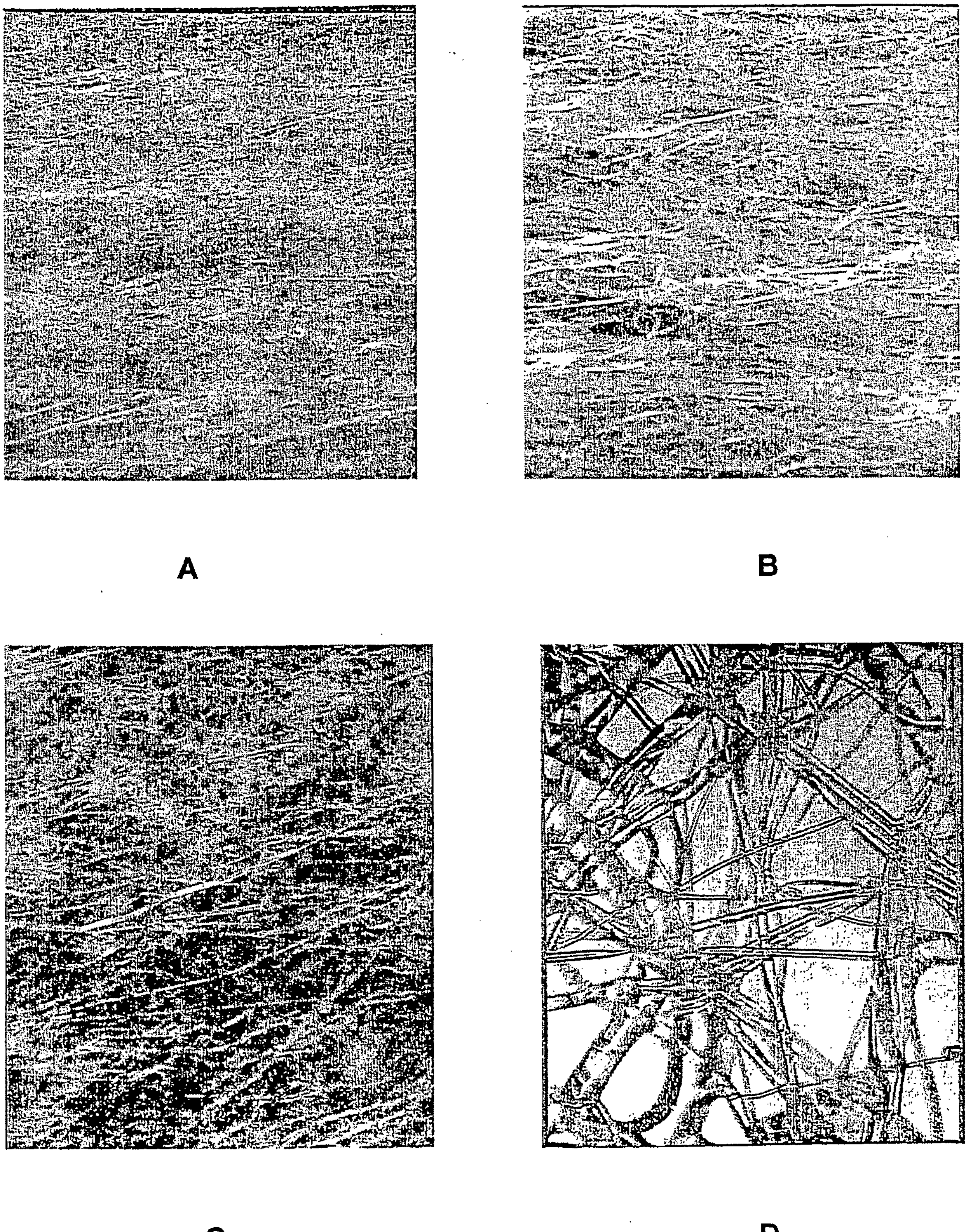


FIG. 4



A B C D

REFERENCES CITED IN THE DESCRIPTION

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