

(19)



(11)

EP 3 408 441 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:

19.07.2023 Bulletin 2023/29

(21) Application number: **16717484.6**

(22) Date of filing: **26.01.2016**

(51) International Patent Classification (IPC):

D06B 3/12 (2006.01) **D06B 15/04** (2006.01)
D06L 1/00 (2017.01) **D06C 7/00** (2006.01)
D06B 3/10 (2006.01) **D06B 19/00** (2006.01)

(52) Cooperative Patent Classification (CPC):

**D06C 7/00; D06B 3/10; D06B 3/12; D06B 15/04;
D06B 19/00; D06L 1/00**

(86) International application number:

PCT/IT2016/000017

(87) International publication number:

WO 2017/130225 (03.08.2017 Gazette 2017/31)

(54) **THERMAL TREATMENT OF TEXTILE MATERIAL AND APPARATUS FOR REMOVING OILY IMPURITIES FROM A TEXTILE**

WÄRMEBEHANDLUNG VON TEXTILMATERIAL UND VORRICHTUNG ZUM ENTFERNEN ÖLIGER VERUNREINIGUNGEN AUS EINEM TEXTILMATERIAL

TRAITEMENT THERMIQUE DE MATIÈRES TEXTILES ET APPAREIL POUR ELIMINATION DES IMPURETÉS HUILEUSES D'UN TEXTILE

(84) Designated Contracting States:

**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**

(43) Date of publication of application:

05.12.2018 Bulletin 2018/49

(73) Proprietor: **Jersey Mode S.p.A.**

59100 Prato (IT)

(72) Inventor: **TEMPESTINI, Lorenzo**

I-59100 Prato (IT)

(74) Representative: **Nesti, Antonio et al**

Studio Ferrario S.r.l.

Via Arnolfo, 27

50121 Firenze (IT)

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DescriptionSector of the invention

[0001] The present invention relates to a thermal treatment for textile material, designed in particular for removal from the textile material of impurities or oily residue that might remain trapped in the textile material following upon the spinning and weaving processes and/or due to increase in colour fastness in the case of coloured fabrics.

Prior art

[0002] It is known in fact that the process of production of textile material currently in use envisages, during the step of preparation of the yarn and subsequent weaving, application of lubricant oils on the material to be spun or woven. Application of these substances enables a reduction in the friction due to rubbing of the thread, thus enabling an increase in the processing rate.

[0003] At the end of the weaving process a product is thus obtained that is more or less rich in these oils.

[0004] Before passing on to the next steps of the cycle of textile production, dyeing and finishing, it becomes necessary, both for reasons linked to quality and for environmental reasons, to proceed to the so-called "scouring", i.e., a process of washing of the textile material aimed at eliminating these oils.

[0005] The oils present on the raw textile material would cause in fact a non-uniform dyeing of the textile material, and passage into the stenter dryer would lead to evaporation of the oils, with consequent production of smoke, pollution, and unpleasant smells.

[0006] Washing or cleaning of the raw textile material, with continuous or piece feed, is today performed principally in two ways: either by passage of the textile material into kiers filled with a solution made up of water and detergent products (soaps) or via so-called dry cleaning, i.e., a process that envisages the use of perchloroethylene for removal of the oils.

[0007] Both of the processes described above involve critical aspects linked to environmental factors.

[0008] The washing process in fact entails the use of large amounts of water and the use of soaps necessary for rendering the oils soluble, which, once removed from the textile material, are found to be present in the wastewater.

[0009] The dry-cleaning process is certainly less burdensome from the standpoint of consumption of water, but introduces the use of a substance, perchloroethylene, that, if not properly handled, may prove altogether dangerous, both from the environmental standpoint and from that of health hazards.

[0010] In particular, the treatment of oily impurities present in the textile material itself is one of the main problems linked to the cycle of processing of fabric in the step commonly referred to as "finishing".

[0011] The impurities may be classified in the two categories:

egories:

- Primary impurities. These are substances that are generated in the fibre and add to the fibre during the natural phase of formation of the fibre itself. These impurities are present in significant amounts in natural fibres, and their amount is proportional to the nature and origin of the fibre itself. They are absent, instead, or present in negligible amounts, in artificial and synthetic fibres except for the oligomers present in some types of polyester in amounts of up to 1.5%.
- Secondary impurities. These are substances added to the fibre in the various steps of the textile-production cycle, such as spinning and weaving, to improve flow thereof through lubrication and reduce, at the same time, the negative effects resulting from abrasion due to contact with the mechanical members of the machines. They are present on the various types of fibres in amounts that vary from fibre to fibre.

[0012] The chemical nature of the secondary impurities may in turn be distinguished into the two types:

- Paraffins. These are aliphatic hydrocarbons and hence substances insoluble in water, which, however, can be eliminated from the fibre by emulsion by using surfactants in the baths of water.
- Spinning oils. These are mineral-oil-based products of emulsion, added with emulsifiers that enable stability of the emulsion, antistatic products that reduce electrostatic charges, and hygroscopic products that provide humidity to reduce the electrostatic effect. The property of spinning oils is that they are emulsifiable in water, for some cases in cold conditions (20° - 25°C), for others at a temperature of 60° - 80°C, once again in the presence of surfactants, which favour removal thereof from the fibre. If the spinning oils present on synthetic fibres, and in particular polyesters and polyamides, are subjected to thermofixing treatment, they create serious environmental problems. In fact, when these oils are subjected to temperatures higher than 180°C, they volatilize, producing considerable amounts of smoke that, if it is not drawn off totally by the abatement system installed on the stenter, produces pollution of the working environment. For these reasons, it currently becomes necessary, before thermofixing, to carry out the treatment of scouring in water or even better a washing in solvent so as to treat the fibre already free from spinning oils. However, even though thermofixing bestows dimensional stability and constancy of mass per unit area on the finished textile material, in addition to reducing the possibility of formation of creases and streaks in the dyeing process, it also reduces the dyeing affinity and in part the elasticity of the textile material.
- Weaving oils. These are products of emulsion with a base of mineral oils and vegetable oils, which exert

their specific action of lubricants in the movement of the mechanical members of knitting machines. They are declared as being emulsifiable because their physical state of emulsion resists throughout the entire period of conservation of the product; however, very frequently they are not easy to remove by emulsification from the textile substrate on which they are deposited.

[0013] As regards raw fabrics, primary impurities and above all secondary impurities are frequently the cause of dyeing defects, which may present in the form of oily stains, generally due to weaving oil, which may be colourless, or else assume whitish/opaque, yellowish, and even grey/blackish colours, or else bestow on the fibre a markedly hydrophobic nature, in the case of spinning oils, since, being greasy substances, they permeate the fibre, subtract hydrophilicity and wettability, and create the basis for a problematical and irregular distribution of the dye on the fabric and hence generate a lack of uniformity of dyeing. Furthermore, given that the impurities constitute a surface substrate on the outside of the fibre that absorbs dye during the dyeing process, without an appropriate preparation, they may cause reduction of the values of colour fastness, i.e., resistance to colour running and to rubbing.

[0014] From US4411051 a treatment process of a textile material is disclosed, in which in order to selectively protect heat sensitive regions of textile material webs from damage during thermo-treatment, such regions are preliminarily subjected to a cooling step so that the thermal elevation caused by the subsequent thermo-treatment will not bring damage to the heat sensitive regions.

[0015] From WO2006046265 a process for treating a textile article is disclosed, including the steps of cooling the textile article by a cryogenic fluid and subsequently wetting the article with a product at low condensation temperature in liquid state and making the liquid product act on the fibers of the article. There is thus felt the need for a treatment of the textile material that will enable removal of the impurities, in particular oily impurities, with a reduced environmental impact and limiting both the consumption of water and the consumption of energy necessary for removal of the impurities themselves. According to a second advantageous aspect of the invention, a process is proposed capable moreover of increasing colour fastness of textile materials.

[0016] It is known that colour fastness of a textile material is the stability to chromatic variations in tone and intensity, i.e., the resistance that it manifests in regard to aggressive agents.

[0017] The problem of colour fastness has always played a very important role in the field of textile processes since it concurs in definition of the qualitative level of the material. Low colour fastness leads to fading of the fabric during washing of the garment, with consequent risks of staining of the other garments washed together, or else of the garment itself (for example, in the

case of a garment made with two different colours, where one is "contaminated" by the other during washing). Another case where colour fastness is a factor of considerable importance regards clothing for new-born babies. Here the fabric can come repeatedly into contact with saliva, and poor colour fastness could cause the dye to pass from the garment to the mouth of the baby.

[0018] Colour fastness can be marred by various agents, each of which acts on the colour with different mechanisms, causing different forms of degradation.

[0019] The agents that may weaken the bond between the dye and the fibre may be water, sweat, saliva, light radiation, friction/rubbing, etc. For this reason, there exist various types of tests for testing the various degrees of colour fastness, for example:

Light fastness (EN ISO 105-B02);

Colour fastness to dry rubbing (EN ISO 105-X12);

Colour fastness to wet rubbing (EN ISO 105-X12);

Colour fastness to water (EN ISO 105-E01); and

Colour fastness to perspiration (EN ISO 105-E04).

[0020] Colour fastness hence depends upon various factors, such as the chemical nature of the dye, the chemical nature of the fibre, the type of bonds between dye and fibre, and the intensity of the dye. For this reason, according to the type of result that it is desired to obtain, different types of dyes are used and as many types of materials. Higher levels of colour fastness entail dyeing processes that are more laborious and consequently more costly. In general, to be able to obtain higher levels of fastness, it is necessary to resort to so-called "reactive" dyes, whereas, when no stringent specifications are set in this connection, recourse is had to "direct" dyes. In general, reactive dyeing requires twice the time necessary for carrying out direct dyeing, with consequent doubling of the amount of raw materials and energy necessary for the process (water, heat).

[0021] There is hence felt the need for a treatment that will enable production of fabrics with a high degree of colour fastness and with a reduced environmental and economic impact as compared to current production techniques.

Summary of the invention

[0022] The above and further purposes have been achieved with a treatment according to one or more of the annexed claims that envisages the use of low temperatures for treatment of textile material.

[0023] In various examples of embodiment, the temperature of the textile material is brought to a value much lower than 0°C by means of various refrigerating systems that can operate with transmission of heat by conduction, or convection, or radiation.

[0024] In the first case (conduction), the textile material is set in contact with a cold substance (temperature much lower than 0°C), for example by dipping it in liquid nitro-

gen.

[0025] In the second case (convection), the cold substance is injected into a chamber that is cooled (oven). The textile material, by passing through this environment, is cooled by the mixture of gases at low temperature.

[0026] In the third case (radiation), transmission of heat takes place by exposure of the textile material to previously cooled surfaces.

[0027] The reduction of temperature of the textile material leads, as a consequence, to the transition of state of the particles of oil, waxes, and lubricants present on the textile material, which pass from a liquid state to a solid state and will be the brittle, the lower their temperature. The same applies to the bonds that are created between these substances and the fibre or fibres used for making up the yarn. For the process to be effective, the textile material will have to reach a temperature lower than -60°C . The time necessary for this to occur obviously depends upon different factors, amongst which:

- the mass of the textile material to be treated;
- the specific weight of the textile material;
- the initial temperature of the textile material to be treated; and
- the cooling system used (direct dipping in cryogenic fluid, passage through the refrigerating tunnel, etc.).

[0028] The particles are then subsequently removed from the textile material by means of exclusively physical operations (shaking, vibrations, ultrasound, suction, etc.) and recovered when they are brought back to room temperature. A first advantage of the invention lies in the fact that the treatment according to the invention does not make use of polluting substances and/or substances dangerous for health and the environment.

[0029] A further advantage lies in the fact that the textile material subjected to the treatment at low temperature is cleaned from oily substances and can be used directly for subsequent operations of textile dyeing and finishing.

[0030] A further advantage lies in the fact that the considerable reduction in temperature, followed by the step of return to room temperature, strengthens the bond between dye and fabric bringing dyeing processes carried out with direct dyes to values of colour fastness comparable to those obtained with reactive dyes. The advantages afforded by this process are hence a greater colour fastness, with time saving (to treat 450 m of fabric at a rate of 25 m/min, keeping the fabric immersed for 20 s, 18 min are required as against the 300 min of difference between dyeing using a reactive process and dyeing using a direct process), and without any need to use raw materials, such as water, steam, and auxiliary textiles, a fact that leads this process to have an extremely reduced impact on the environment as compared to the classic process used as reference.

List of the drawings

[0031] The above and further advantages will be better understood by any person skilled in the branch from the ensuing description and from the annexed drawings, which are provided by way of non-limiting example and in which:

- Figure 1 shows a diagram of a system for carrying out the treatment of the invention;
- Figure 2 shows a table exemplifying the results obtained with the treatment of the invention;
- Figure 3 shows a second diagram of a system according to the invention;
- Figure 4 is a table of comparative results on colour fastness prior to and after treatment;
- Figures 5 and 6 show, respectively, the result of the dry-rubbing test (EN ISO 105-X12) on a specimen dyed but not treated and the result of the dry-rubbing test (EN ISO 105-X12) on a dyed and treated specimen;
- Figure 7 shows by way of example durations of the cooling step;
- Figure 8 shows a table of symbols representing the affinity of the treatment of the invention for different types of textile material; and
- Figure 9 shows a table of symbols representing the effectiveness and efficiency of the treatment process according to the invention as the cooling technology varies.

Detailed description

[0032] With reference to the drawings, there now follows a description of a treatment according to the invention for removing oily impurities from a textile material.

[0033] In the embodiment described, the treatment basically comprises a step of feed of an amount of textile material, preferably a continuously fed fabric, which is subjected in succession to a cooling step at a temperature lower than the temperature of solidification of said impurities, preferably lower than -130°C , and a step of removal of the solidified oily impurities from the fabric.

[0034] Removal is obtained by means of an action of a physical or physico-mechanical type, for example by vibration, shaking, or suction.

[0035] According to the invention, as represented in Figure 1, the cooling step is performed by dipping the fabric in liquid nitrogen, and subsequent suction of the sublimation fumes.

[0036] The cooling step and/or the step of removal of the solidified impurities are executed repeatedly and in succession.

[0037] Illustrated schematically in Figure 1 is an apparatus suited to carry out the treatment according to the invention for removing oily impurities from a fabric, comprising a feed 1 with continuous advance of a fabric 2, which is made to pass below the level of filling of a tank

of liquid nitrogen 3 set downstream of said feed 1.

[0038] After cooling, the fabric 2 is made to pass along-side a suction plate or mat 4, downstream of the aforesaid tank, for removal of the sublimation fumes from the fabric and with them the impurities.

[0039] In the diagram illustrated, the apparatus comprises an array of deflecting rollers 5 arranged for bringing about a repeated dipping of the fabric in the tank 3 and corresponding repeated passes of the fabric against a suction plate or mat. Appearing in the table of Figure 2 are the results of treatments according to the invention carried out on various types of fabric.

Test 1:

[0040]

- step of cooling by dipping in N₂;
- step of removal by treatment with jets of solid CO₂, and subsequent suction.

Test 2:

[0041]

- step of cooling by dipping in N₂;
- step of removal by suction of the sublimation fumes.

Test 3:

[0042]

- step of cooling by passage through a tunnel at a temperature of -100°C;
- step of removal by treatment with jets of solid CO₂, and subsequent suction. The stay times in the tank or in the tunnel in the three tests were the following:

Test 1: 15 s

[0043]

Test 2: 15 s

Test 3: 15 min

[0044] The suction pressure applied was 60 kPa.

[0045] The tests were carried out in compliance with the standard UNI 9273:1988 to highlight the values of impurities in the fabric prior to and after treatment.

[0046] The values are given in weight percentages of the extracted substances.

[0047] The tests conducted enabled verification of whether the treatment, and in particular the succession of the steps of cooling in liquid nitrogen and suction of the sublimation fumes, manages to reduce significantly the percentage of impurities present in the fabric and achieve the desired advantages.

[0048] With reference to Figures 3-6, there is now de-

scribed a treatment according to the invention for increasing colour fastness of a fabric.

[0049] In the embodiment described, the treatment basically comprises a step of feed of an amount of fabric, preferably a continuously fed fabric, which is subjected to one or more steps of cooling at low temperatures, for example lower than -130°C.

[0050] The colour, by remaining at this temperature for some seconds, increases its own bond with the fabric, thus increasing its fastness.

[0051] Illustrated schematically in Figure 3 is an apparatus suited to carrying out the process according to what has been described in the present disclosure in order to increase colour fastness of the fabric, the apparatus comprising a feed with continuous advance of a fabric 7, which is made to pass below the level of filling of a tank 9 of liquid nitrogen 10. In the diagram illustrated, the apparatus comprises an array of deflecting and entraining rollers 8 connected to which is a chain is with pins to which the fabric 7 is fixed. The rolls thus arranged enable repeated dipping of the fabric in the nitrogen 10, thus enabling increase of the processing rate.

[0052] The process proves all the more effective, the lower the temperature of the fluid through which the fabric is made to pass.

[0053] Appearing in Figure 7 is the table with the values of comparison between the stay time of the fabric in the tunnel and the time necessary for dipping. As emerges clearly from the data, on account of the different principles of transmission of heat, dipping of the fabric in liquid nitrogen at a temperature close on -190°C enables processing times to be obtained shorter than the time for passage through the tunnel cooled at -130°C.

[0054] Appearing in the table of Figure 4 are the results of the colour-fastness tests conducted on two specimens of one and the same type of fabric subjected to the same dyeing treatment, one of which, however, has undergone the subsequent treatment according to the invention described herein.

[0055] Figures 5 and 6, instead, present visually the difference between the two cloths used for the test of colour fastness to dry rubbing. The cloth of Figure 6 used for the fabric subjected to the treatment according to the invention is much lighter than that of Figure 5 used on non-treated fabric, thus indicating a greater colour fastness.

Claims

1. Treatment of a textile material (2) with oily impurities, comprising the following steps:

feeding (1) an amount of textile material (2); and cooling said amount of textile material at a temperature lower than -130°C;

said treatment being **characterized in that** said textile material (2) is a coloured fabric and **in**

- that** said cooling step is carried out at a temperature lower than the temperature of solidification of said impurities, and sufficiently low as to allow weakening of the bond between fibre and impurities, the treatment comprising subsequent removal, by means of physical action, of the solidified impurities from the textile material, and suction of the sublimation fumes from the textile material, wherein said cooling step is carried out by repeated dipping of the textile material in liquid nitrogen.
2. The treatment according to Claim 1, wherein said feeding step is carried out with continuous feeding of piece textile material.
 3. The treatment according to Claim 2, wherein said cooling step and said suction step are executed repeatedly and in succession.
 4. The treatment according to either Claim 2 or Claim 3, wherein said suction step is performed by means of a suction plate or mat brought up to the cooled fabric.
 5. An apparatus for removing oily impurities from a textile material, comprising:
 - at least one feed (1) with continuous advance of a textile material (2);
 - at least one tank containing liquid nitrogen (3) downstream of said feed (1) **characterized in that**
 - said tank containing liquid nitrogen (3) is provided for carrying out a treatment of cooling at a temperature lower than the temperature of solidification of said impurities; and
 - suction means (4), set downstream of said tank, for drawing in the sublimation fumes from the textile material, and
 - means for removal by physical action of solidified impurities from the textile material.
 6. The apparatus according to Claim 5, comprising means for repeatedly subjecting said textile material to passage through the tank containing liquid nitrogen and subsequent suction.
 7. The apparatus according to Claim 5 or Claim 6, wherein said suction means comprise at least one suction plate or mat brought up to said textile material (2).

Patentansprüche

1. Behandlung eines Textilmaterials (2) mit öligen

Fremdstoffen, die folgenden Schritte umfassend:

Zuführen (1) einer Menge des Textilmaterials (2) und Kühlen der Menge des Textilmaterials auf eine Temperatur unter 130 °C, wobei die Behandlung **dadurch gekennzeichnet ist, dass** das Textilmaterial (2) ein farbiges Flächengebilde ist und dass der Kühlungsschritt bei einer Temperatur ausgeführt wird, die niedriger als die Verfestigungstemperatur der Fremdstoffe und ausreichend niedrig ist, um eine Schwächung der Bindung zwischen Faser und Fremdstoffen zu ermöglichen, wobei die Behandlung das nachfolgende Entfernen der verfestigten Fremdstoffe von dem Textilmaterial mittels physikalischer Wirkung und das Absaugen der Sublimierungsdämpfe von dem Textilmaterial umfasst, wobei der Kühlungsschritt durch wiederholtes Eintauchen des Textilmaterials in flüssigen Stickstoff ausgeführt wird.

2. Behandlung nach Anspruch 1, wobei der Zuführungsschritt mit kontinuierlichem Zuführen von Stücken des Textilmaterials ausgeführt wird.
3. Behandlung nach Anspruch 2, wobei der Kühlungsschritt und der Absaugschritt wiederholt und nacheinander ausgeführt werden.
4. Behandlung entweder nach Anspruch 2 oder nach Anspruch 3, wobei der Absaugschritt mittels einer Saugplatte oder -matte durchgeführt wird, die an das gekühlte Gewebe herangebracht wird.
5. Vorrichtung zum Entfernen öliger Fremdstoffe von einem Textilmaterial, Folgendes umfassend:
 - mindestens eine Zufuhr (1) mit kontinuierlichem Vorschub eines Textilmaterials (2),
 - mindestens einen Tank, der flüssigen Stickstoff (3) enthält, prozessaufwärts von der Zufuhr (1), **dadurch gekennzeichnet, dass**
 - der Tank, der flüssigen Stickstoff (3) enthält, zum Ausführen einer Kühlungsbehandlung bei einer Temperatur bereitgestellt ist, die niedriger als die Verfestigungstemperatur der Fremdstoffe ist, und
 - Absaugmittel (4), die prozessabwärts des Tanks angeordnet sind, um die Sublimierungsdämpfe von dem Textilmaterial einzusaugen, und
 - Mittel zum Entfernen verfestigter Fremdstoffe von dem Textilmaterial mittels physikalischer Wirkung.
6. Vorrichtung nach Anspruch 5, Mittel zum wiederholten Veranlassen des Durchlaufs des Textilmaterials durch den Tank, der flüssigen Stickstoff enthält, und

des nachfolgenden Absaugens umfassend.

7. Vorrichtung nach Anspruch 5 oder 6, wobei die Absaugmittel mindestens eine Saugplatte oder -matte umfassen, die an das Textilmaterial (2) herangebracht wird. 5

Revendications

1. Traitement d'une matière textile (2) avec des impuretés huileuses, comprenant les étapes suivantes :
- introduire (1) une quantité de matière textile (2) ;
et refroidir ladite quantité de matière textile à une température inférieure à 130 °C ;
ledit traitement étant **caractérisé en ce que** ladite matière textile (2) est un tissu coloré et **en ce que** ladite étape de refroidissement est effectuée à une température inférieure à la température de solidification desdites impuretés, et qui est suffisamment basse pour permettre l'affaiblissement de la liaison entre la fibre et les impuretés, le traitement comprenant l'élimination ultérieure, au moyen d'une action physique, des impuretés solidifiées de la matière textile, et l'aspiration des fumées de sublimation de la matière textile, dans lequel ladite étape de refroidissement est effectuée par immersion répétée de la matière textile dans de l'azote liquide. 15 20 25 30
2. Traitement selon la revendication 1, dans lequel ladite étape d'introduction est effectuée par une introduction continue d'une pièce de matière textile. 35
3. Traitement selon la revendication 2, dans lequel ladite étape de refroidissement et ladite étape d'aspiration sont exécutées de manière répétée et successive. 40
4. Traitement selon l'une ou l'autre des revendications 2 ou 3, dans lequel ladite étape d'aspiration est réalisée au moyen d'une plaque ou natte d'aspiration amenée jusqu'au tissu refroidi. 45
5. Appareil pour éliminer des impuretés huileuses d'une matière textile, comprenant :
- au moins un dispositif d'introduction (1) à avance continue d'une matière textile (2) ;
au moins un réservoir contenant de l'azote liquide (3) en aval dudit dispositif d'introduction (1), **caractérisé en ce que** ledit réservoir contenant de l'azote liquide (3) est prévu pour effectuer un traitement de refroidissement à une température inférieure à la température de solidification desdites impuretés ; et 50 55

des moyens d'aspiration (4), placés en aval dudit réservoir, pour tirer les fumées de sublimation de la matière textile, et des moyens pour éliminer, par une action physique, les impuretés solidifiées de la matière textile.

6. Appareil selon la revendication 5, comprenant des moyens pour soumettre, de manière répétée, ladite matière textile au passage par le réservoir contenant de l'azote liquide et à une aspiration ultérieure. 10
7. Appareil selon la revendication 5 ou 6, dans lequel lesdits moyens d'aspiration comprennent au moins une plaque ou natte d'aspiration amenée jusqu'à ladite matière textile (2). 15

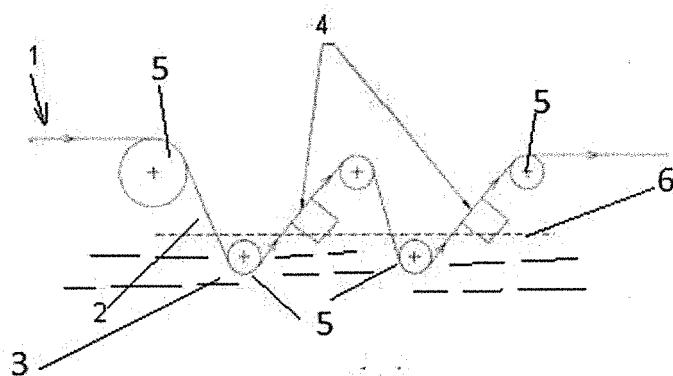


FIG. 1

COMPOSITION	% SUBSTANCES ON RAW MATERIAL	% SUBSTANCES AFTER TEST 1	% SUBSTANCES AFTER TEST 2	% SUBSTANCES AFTER TEST 3
80% Polyester 20% Linen	0.21	0.17	0.08	-
30% Wool 70% Viscose	0.86	0.47	0.4	-
53% Viscose 38% Nylon 9% Spandex	1.44	1.53	1.31	-
94% Viscose 6% Spandex	1.59	1.04	-	-
70% Viscose 25% Nylon 5% Spandex	1.71	2.11	-	-
72% Viscose 23% Nylon 5% Spandex	0.49	-	-	0.45

FIG. 2

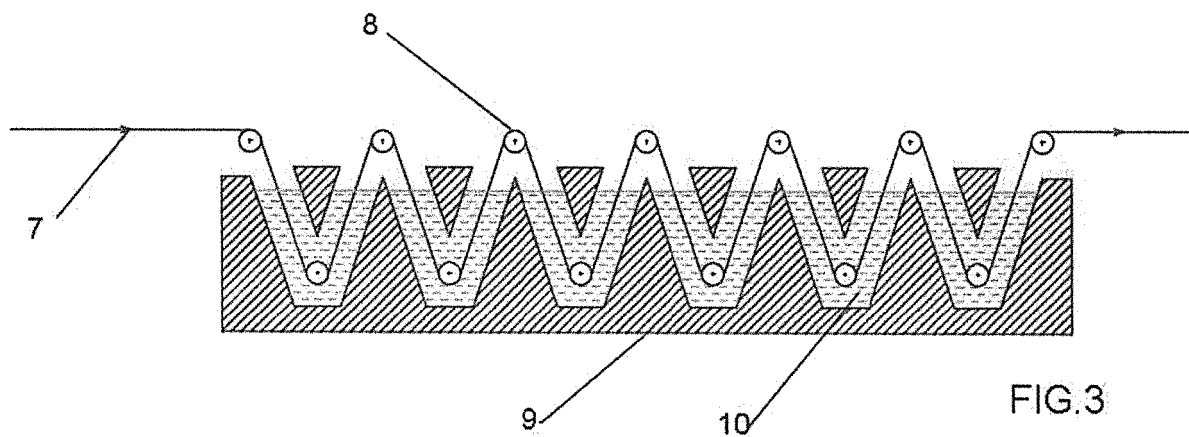


FIG. 3

TYPE OF TEST	VALUE BEFORE TREATMENT	VALUE AFTER TREATMENT
Dry rubbing	2	3/4
Wet rubbing	2	3
Alkaline perspiration	3	3
Water fastness	4	4

FIG. 4

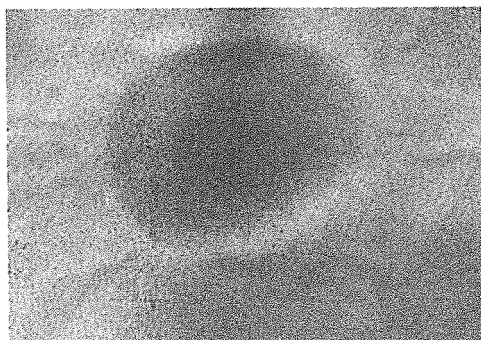


FIG.5

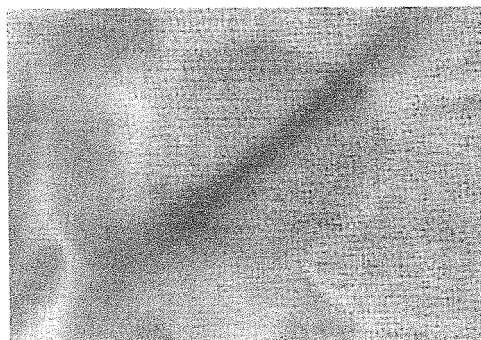


FIG.6

<u>TREATMENT TIME OF FABRIC</u> <u>(seconds)</u>	
DIPPING IN LIQUID NITROGEN -195°C	PASSAGE IN TUNNEL -130°C
15	1080

FIG.7

AFFINITY OF TREATMENT OF DIFFERENT FIBRES			
<u>VEGETABLE FIBRES</u>	<u>ANIMAL FIBRES</u>	<u>ARTIFICIAL FIBRES</u>	<u>SYNTHETIC FIBRES</u>
			
			Treatment with lower performance on nylon fibres

FIG. 8

<u>PROCESS EFFECTIVENESS</u>		<u>PROCESS EFFICIENCY</u>	
Passage in tunnel	Dipping in nitrogen	Passage in tunnel	Dipping in nitrogen
			

FIG. 9

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 4411051 A [0014]
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