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(54) **Process for making surface designs on woolen textile substrates and textile products thus obtained**

(57) The process according to the invention consists in applying printing pastes containing high concentrations of anti-felting polyurethane resins, possibly colored via pigments or other dyeing substances of different dyeing nature (acid, premetallized, reactive, direct, basic and disperse dyes), in combination with traditional printing pastes, colored or not. It is also possible to combine printed design patterns with anti-felting characteristics and

printed design patterns obtained with resist printing and/or corrosion printing, as well as to obtain the superimposition of two or more design patterns, of which at least one defined by the shape of unfelted areas. The effect deriving by the contrast of differently felted areas is activated further to the milling step carried out after the printing step.

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Description

[0001] The present invention concerns the field of textile production. More specifically, it concerns a new process for obtaining peculiar surface designs through printing on woolen or wool-mixed textile materials.

[0002] Textile printing, in general terms, consists of applying printing pastes - containing dyes or pigments - to manufactured textile products. This step is followed by one or more stabilization steps, comprising physical and/or chemical treatments having the purpose of stably and locally fixing the dyeing substances. A more precise, though brief, consideration of the various kinds of known printing systems, can be found in the introductory part of the description of European Patent Publication n. EP1591582, in the name of the same applicant, herein incorporated for reference.

[0003] It is also known the phenomenon of the felting, typical of wool and of other keratin-based animal fibers. This phenomenon can be defined as a progressive entangling of the fibers and is made possible by the external morphology of the wool fibers. In fact, in particular conditions of humidity (bath ratio), temperature and mechanical stress, the external cuticular cells (scales) of different wool fibers gradually engage with each other.

[0004] The felting is sometimes exploited to confer to the fabric or manufactured garment a desired degree of compactness, by means of a controlled felting, wet finishing step named "milling".

[0005] More specifically, the different aims of the above mentioned wool finishing step can be summarized as follows:

- increase of mass per unity of surface area of the fabric; this is due to the reduction in the transversal and longitudinal size of the fabric, with consequent increase in the specific weight;
- obtaining a fabric with particular feel effects and surface appearance; namely, a soft and swollen feel and an increase in thickness are obtained in comparison with a fabric that has not undergone the treatment;
- in woven and knitted wool fabrics the milling is carried out as the first step of the wet finishing, and is therefore the very preparation to subsequent finishing steps, such as the raising and the cutting;
- when dyeing woolen manufactured garments, the milling step is associated to the bating step, preliminary to the actual dyeing step. The bating has the aim of getting rid of the auxiliary and oiling substances used in the spinning and sometimes in the weaving steps, whereas the milling, carried out contemporarily to the bating step, makes the fabric more compact and with a more hairy, tight and napped feel and surface appearance.

[0006] On the other hand, it is clear that the felting is in other cases a phenomenon that one wishes to avoid, or at least to control, to the very purpose that the woolen fabric will preserve its features of distension, smoothness and clearness of the weave design. Typically, the maintenance of woolen garments, involving a number of subsequent machine washing treatments, due to the previously mentioned conditions of humidity, temperature and mechanical friction, may easily cause an uncontrolled felting of the garment, with the consequent impossibility of using the article any longer, because of an excessive shrink and/or compacting, as well as of an irregular increase of the surface hairiness. In order to let the woolen fabrics undergo maintenance cycles in aqueous conditions, but also to permit the carrying out of garment dye operations that will not induce the felting, finishing techniques have been successfully developed for preserving the woolen fabrics from these drawbacks, by applying appropriate felting prevention substances with decaying, additive or mixed properties.

[0007] The decaying methods consist in an oxidation attack of the wool cuticle, so as to diminish the surface friction properties. The decaying action is obtained by using chlorine gas dissolved in water, hypochlorites, or organic products that are capable of liberating chlorine in gradual manner (e.g. dichloroisocyanuric acid - Basolan®).

[0008] The additive methods consist in treatments with preformed polymers, generally applied to the fabric via immersion in a *foulard* machine and subsequently reticulated by means of the chemical action of catalysts and/o heat. The commonly used polymers are polyurethanes, polyethers, polyacrilates, and silicon-derived agents. The application of the polymers brings about a lining of the wool fibers and scales with a film that, also in this case, decreases the surface friction between the fibers and thus prevents and/or reduces the felting of woolen articles undergoing aqueous treatments in heat conditions.

[0009] The mixed methods are sometimes used by associating the decaying action of oxidating products (e.g. Basolan®) with the scale protective action performed by the above mentioned film-developing resins.

[0010] The applicant has now surprisingly identified a new process that, with a non obvious combination of the aforementioned prior art elements, allows to obtain on the textile material, in a very simple manner, aesthetical effects which are either new or comparable with effects that can presently be achieved only with much longer operative times and higher costs.

[0011] Such a result is achieved, according to the present invention, with a printing process that can be used on a textile substrate, the essential features of which are defined in the first of the appended claims.

[0012] In practice, the process according to the invention consists in applying printing pastes containing high concentrations of anti-felting polyurethane resins, possibly colored via pigments or other dyeing substances of different dyeing nature (acid, premetallized, reactive, direct, basic and disperse dyes), in combination with traditional printing pastes,

colored or not. It is also possible to combine printed design patterns with anti-felting characteristics and printed design patterns obtained with resist printing and/or corrosion printing, as well as to obtain the superimposition of two or more design patterns, of which at least one defined by the shape of unfelted areas. The effect deriving by the contrast of differently felted areas is activated further to the milling step carried out after the printing step.

[0013] The features and advantages of the printing process on woolen or wool-mixed textile materials for obtaining designs defined by areas having different milling characteristics, and of the articles so obtained will be apparent from the following description of embodiments thereof, given purely as a non-limiting example, with reference to the annexed drawings wherein:

- figures 1 and 2 represent respective examples of printed fabrics obtained with a first embodiment of the process;
- figures 3 and 4 are respective examples of fabrics obtained with a second embodiment of the process; and
- figure 5 is an example of fabric obtained with a third embodiment of the process.

[0014] According to the invention, the process can be applied on textile substrates consisting of woven or knitted fabrics or of manufactured garments, of a woolen nature, that is to say made of wool or wool-mixed. These substrates can be in a raw condition, or bated or even partially milled and dyed.

[0015] The sequence of the processing steps can be considered, *per se*, analogous to a conventional direct printing process. Therefore, first of all there is a preparation step of the printing paste or pastes, and the carrying out of one or more printing runs (application, corrosion and/or resist printing), as will be clarified further hereafter. At least one of the printing pastes contains an anti-felting resin, so as the areas of the fabric interested by the print with such paste react in a different manner, with respect to the other areas, to a subsequent milling treatment.

[0016] After the printing step carried out with the above mentioned paste or pastes by means of any known application technique (screen printing, hollow cylinder printing, cylinder printing or roller printing), the following steps may follow: a steaming step to fix the dyeing substances (basic, acid, reactive, disperse dyes); a thermofixing step, to cause the reticulation of the anti-felting resin in the areas interested by the relevant pastes (dry with high speed ventilation at a temperature comprised between about 120°C and 160°C, for a time of about 2-3 minutes), and also to fix the pigments used in the printing paste; a washing step to wash the residuals of paste, unfixed dyeing substances and/or pigments; and finally a milling step that will produce the controlled felting of the material, in a different way depending on the fact that a specific area was or was not interested by the action of the anti-felting pastes.

[0017] All these steps are carried out with apparatus and operative conditions known or obvious to a person skilled in the art, and in any case variable according to the techniques that are applied on a case by case basis, and to the effect one wishes to obtain.

[0018] Turning back to the core of the process, that is to the say to the print runs, in a first embodiment of the process according to the invention two or more printing pastes are simply used in a combined manner to create a design pattern in two or more colors, at least one paste containing an anti-felting agent, and at least one (not necessarily the same containing the anti-felting agent) having coloring properties. In practice, the printing of a design pattern defined by the regions treated with the anti-felting agent will be intrinsically combined with an actual surface design obtained as an effect of the pigments or dyeing substances contained in the paste or pastes.

[0019] Therefore, with reference to figures 1 and 2, a printed design in two or more colors will be obtained, in which the anti-felting properties are selectively conferred - even to a variable extent - to one or more pastes associated to respective colors, while the remaining colors are printed concurrently with traditional pastes. Then, when the milling step is carried out on the fabric, the various colors (more precisely, the various regions in respectively different colors) become shrunk in a different manner, creating a pattern that, intrinsically, associates the color effects to those of a varied volume and of the wrinkles and displacements determined by the tensions between the felted and the non-felted regions.

[0020] The example of figure 1 refers to a flowery design, in which the darker color is associated with an anti-felting effect, while the lighter color is in areas where the fabric is felted or "milled". In an analogous manner, in the geometrical pattern of figure 2, the clustered lines in various colors are printed with normal colored printing pastes, and the final milling has therefore conferred to them the predictable felting effect. To the contrary, the wider stripes between the clusters of lines are printed with an anti-felting printing paste, which prevented the milling.

[0021] It can be clearly noticed that with this solution, above and beyond the difference of feel between the two type of effects, there is obtained a particular result of creasing and three-dimensional displacement of the fabric: the different extent of shrinkage associated respectively to the line clusters (felted) and to the stripes in between (non-felted) causes internal tensions and consequent wrinkles that in this case emulate the use of embroideries or stretch yarns.

[0022] As far as the printing paste is specifically concerned, a preferred preparation of an anti-felting paste is expressed by the following recipe.

Chronological order	Products	Amount (/kg)
1	Purified water	as needed
2	Sodium carbonate	0,5 - 15 g
3	Wetting agent (e.g. sodium alkane sulfonates with alkyldiols) INVADINE MR®(Ciba Specialty Chemicals S.p.A.)	10 - 15 g
4	Anti-felting resin (e. g. Polyurethane-derived and dimethylpolysiloxane-derived substances) DICRYLAN VSR® (Ciba Specialty Chemicals S.p.A.)	5 - 500 g

[0023] The use of the wetting agent ensures a correct and homogeneous penetration of the printing paste in the textile substrate. The composition thus obtained is slowly agitated and then is added to with a thickening agent, according to the following specifications, so that the paste acquires the suitable thickness in view of the subsequent use.

Chronological order	products	Amount (/kg)
5	Thickening agent (e.g. dispersion of acrylic copolymers in light mineral oil) - ALCOLPRINT DT-CS® (Ciba Specialty Chemicals S.p.A.)	35 - 65 g

[0024] Finally, as will be explained further hereinafter, the paste may be colored by adding appropriate agents.

Chronological order	products	Amount (/kg)
6	Dyes (acid, premetallized, reactive, direct, basic and disperse dyes) Pigments	as needed

[0025] The mixture is then quickly agitated until the desired viscosity is obtained. In the above recipe, as mentioned, the coloring agents represent an optional presence; all the other components, except the anti-felting resin (the variability range of which is related to the higher or lower extent of anti-felting effect one wishes to obtain), are normally used in traditional printing pastes. These traditional pastes, when used in combination with the anti-felting paste, will therefore follow a recipe analogous to the one mentioned above, save for the omission of the anti-felting resin.

[0026] In the first embodiment, the printing steps already described can be applied to a raw fabric, piece dyed or yarn dyed correspondingly changing the range of effects that can be obtained. On the other hand, these steps may be combined with further printing treatments - resist printing or corrosion printing - so as to create further new and peculiar aesthetic effects. With reference to figures 3 and 4, in a second embodiment the resist or corrosion printing interacts with the pattern defined by the contrast between the felted and the non felted regions, modifying the color of the fabric - otherwise determined by the sole print with the anti-felting agent - adding further design effects typical of the traditional print.

[0027] In figure 3 there is shown an example of a result obtainable by combining the anti-felting print, in this case on a raw fabric, with a traditional resist print. The color motifs of the resist print (determined by the defective fixing of the colorant, in the subsequent dye, due to the resist) are combined with the pattern of the felted/non felted areas.

[0028] In an analogous manner, in the exemplifying sample of figure 4, a print with a corrosion paste is shown, in which, in a number of flowery motifs, the paste has attacked in selective way a pre-existing color, whereas other flowery motifs are simply the result of unfelted areas, due to the effect of the print with the anti-felting agent.

[0029] In both cases, the print with anti-felting agent, producing evident areas with mutually different milling, is then combined with a coloring effect achieved with traditional corrosion or resist techniques, with an even more peculiar aesthetical effect.

[0030] In a third embodiment of the invention, represented by the example of figure 5, two or more entirely different design patterns are superimposed, at least one of which being defined by a print with an anti-felting agent, while the other (or others) are defined by a traditional direct print in two or more colors. The different patterns mutually intersect accomplishing a new and fanciful interweave effect. Namely, the sample in the depicted example exhibits a flowery pattern defined by milled/non milled areas, combined and intersected with a multicolor line pattern.

[0031] It will be readily understood from the foregoing that with the process according to the invention, controlled effects of wrinkling, undulation and displacement of pre-determined areas in contrast with other areas (as a function of

the pattern of the printing matrix) can be obtained on fabrics or manufactured garments, in various possible combinations with traditional coloring effects, all the above with simple printing runs, thanks to the different felting characteristics conferred to the various areas of the fabric by the printing pastes which are used.

[0032] For obtaining effects to some extent (but not closely) comparable to those achievable with the invention, one should apply on the fabrics or garments some kind of embroideries or ribbons of different nature (as to stretch and felting capability) with respect to the basic woolen fabric, this obviously involving longer productive times and higher costs when compared with the process according to the invention.

[0033] As mentioned, the specific techniques and operative conditions of the various steps of the process may undergo various adjustments, being it clear for instance that a higher concentration of anti-felting resin in the relevant paste will involve, the other conditions remaining unchanged, a more significant effect of creasing and waving of the fabric. Generally speaking, the specifications of the example just described, although they should be considered advantageous in order to obtain an optimal result, must not be considered as a limitation.

[0034] In fact, variants and/or modifications can be brought to the printing process for obtaining surface designs defined by areas having different milling characteristics, and to the textile products thus obtained according to the present invention, without for this reason departing from the scope of protection of the invention itself as defined by the appended claims.

Claims

1. A process to be used on a woolen textile substrate, the process comprising a printing step in which at least one first printing paste is directly applied on said substrate by means of a printing matrix on which there is formed a pattern to be reproduced, and a subsequent milling step, said first printing paste comprising an anti-felting agent, whereby further to said milling step the superficial areas interested by the application of said paste have a different felting behavior with respect to the remaining parts of said substrate, the process being **characterized by** the fact that said first anti-felting printing paste, or at least one possible further printing paste used concurrently with said first paste, has colorant, corrosive, or resist properties, whereby areas with different milling characteristics, and consequent controlled effects of creasing and/or undulation, are defined on said substrate in accordance with said pattern of said matrix, concurrently with traditional color effects.
2. The process according to claim 1, wherein a number of colorant printing pastes are used in order to create a printed pattern in respective colors, one or more of said printing pastes comprising said anti-felting agent.
3. The process according to claim 2, wherein two or more of said colorant printing pastes comprise said anti-felting agent, possibly in mutually different concentrations.
4. The process according to any of the previous claims, wherein said printing step realizes the combination of motifs determined by said anti-felting paste and motifs defined by at least one further printing paste with resist or corrosion properties.
5. The process according to claim 4, wherein said at least one further paste is a resist printing paste, inhibiting the fixing of a dye in a dyeing step carried out subsequently to said printing step.
6. The process according to claim 4, wherein said at least one further paste is a corrosion printing paste, attacking a dye fixed to the substrate in a dyeing step carried out previously to said printing step.
7. The process according to any of the previous claims, wherein said printing step further comprises a direct print in two or more colors with a second matrix on which there is formed a different pattern than the first matrix, whereby at least two patterns become intersected on the substrate, a first one defined by said areas with different milling characteristics, the other by the color motifs defined by said direct print.
8. The process according to any of the previous claims, wherein said anti-felting agent is a polyurethane-based resin.
9. The process according to claim 8, wherein in said at least one anti-felting paste said anti-felting agent has a concentration of between about 5 and 500 g per kg of printing paste.
10. The process according to claim 8 or 9, wherein said paste also comprises a wetting agent in a concentration of between about 10 and 15 g per kg of paste.

11. The process according to any of the claims 8 to 10, wherein said paste also comprises a thickening agent in a concentration of between about 35 and 65 g per kg of paste.
- 5 12. The process according to any of the previous claims, wherein between said printing step and said milling step said textile substrate undergoes a thermofixing step for inducing the reticulation of said anti-felting agent in the areas interested by the relevant pastes, said thermofixing step comprising a drying with high speed ventilation at a temperature of between about 120° and 160°C, for a time of about 2-3 minutes.
- 10 13. The process according to any of the previous claims, wherein between said printing step and said milling step said textile substrate undergoes a steaming step for fixing possible dying substances and/or pigments used in the print; and a washing step to eliminate the residuals of paste, unfixed dyeing substances and/or pigments

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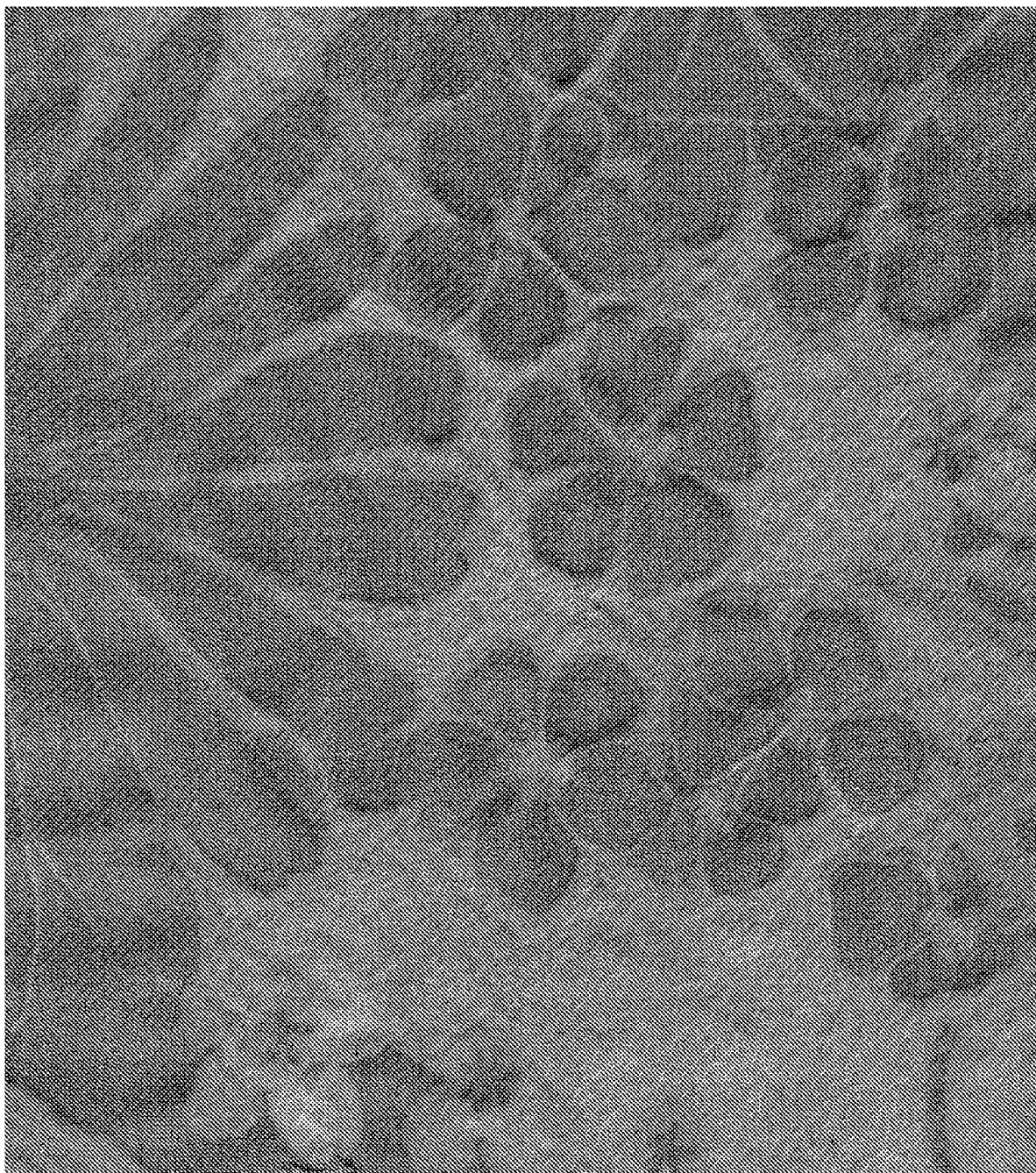


Fig. 1

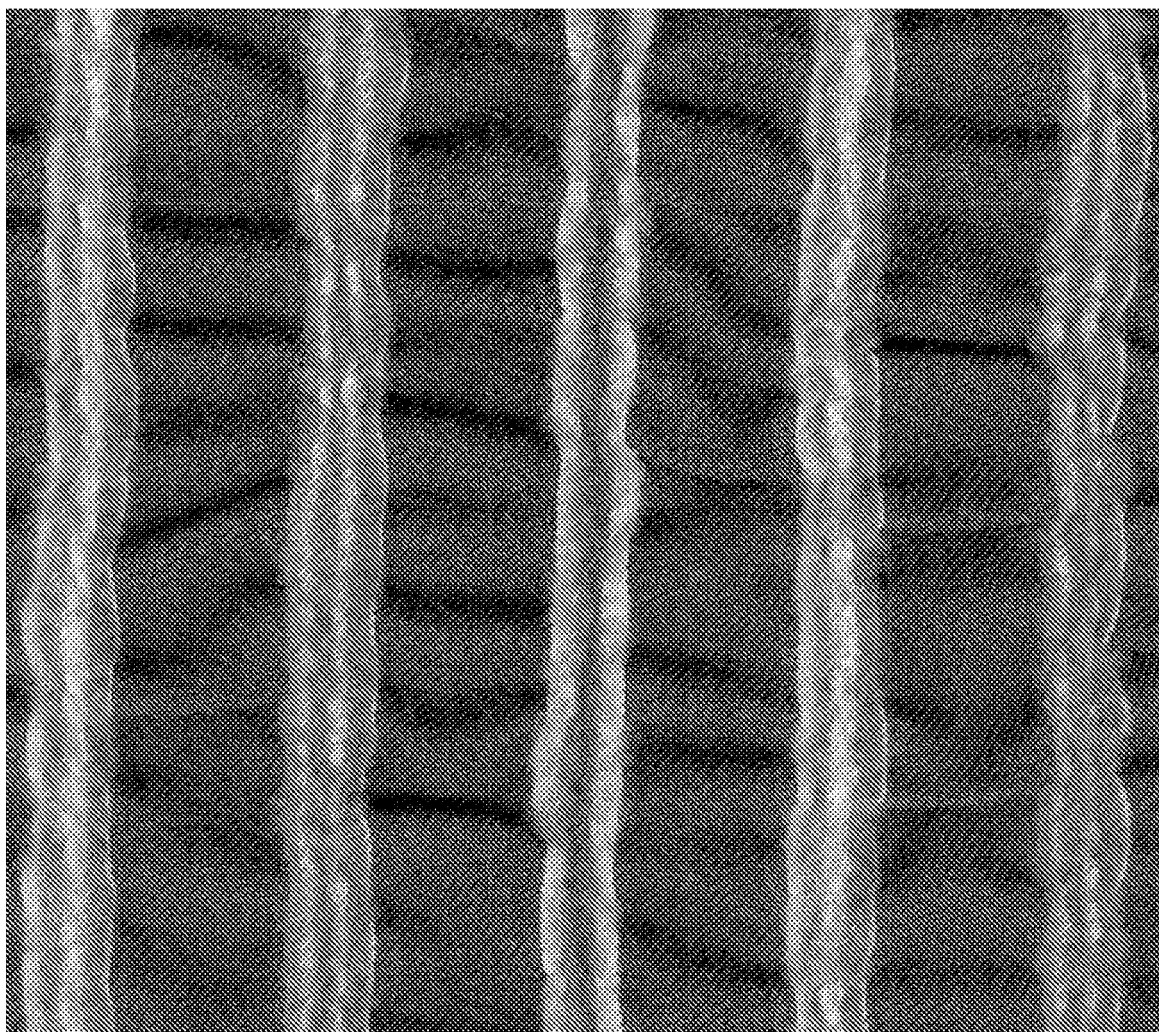


Fig. 2



Fig. 3

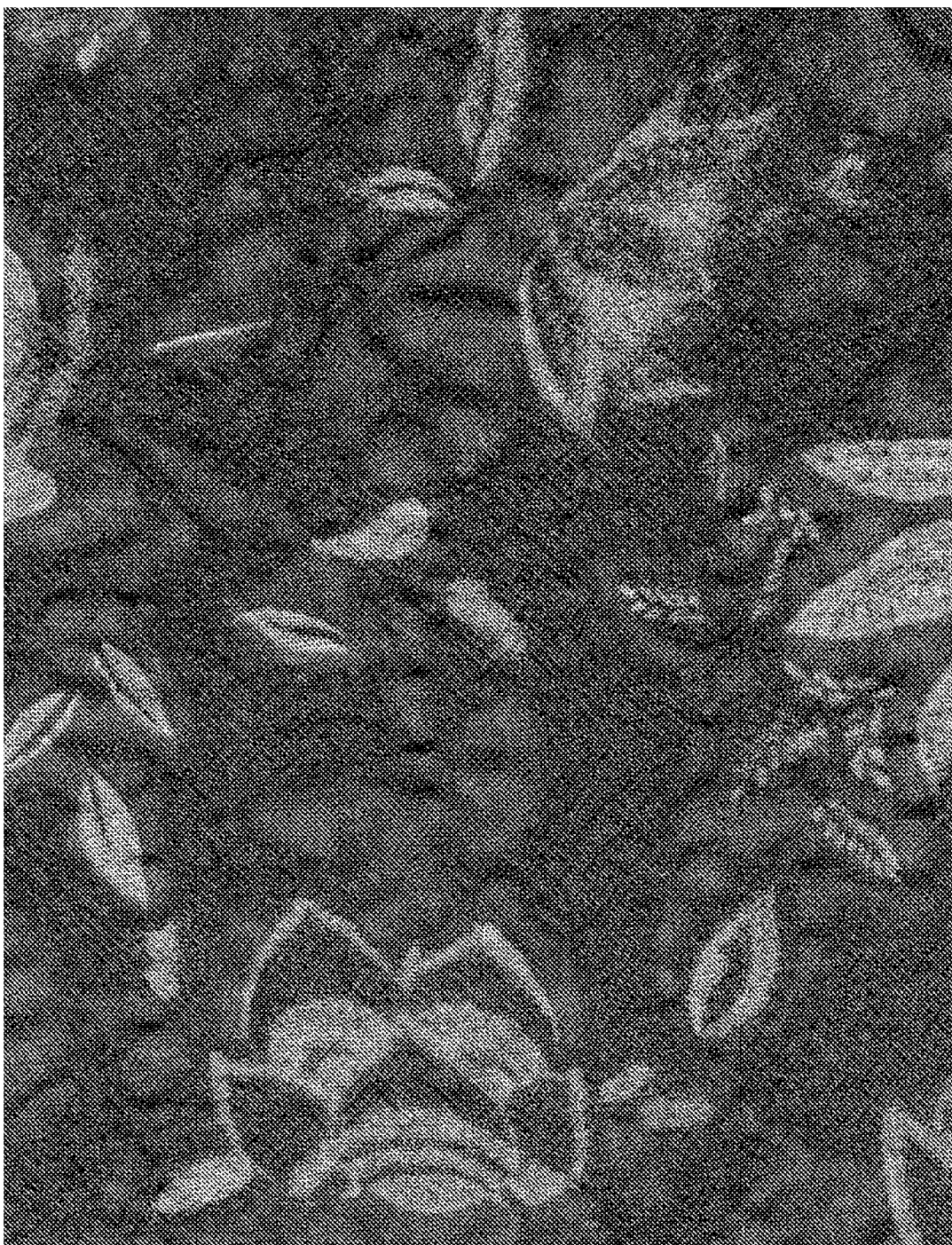


Fig. 4

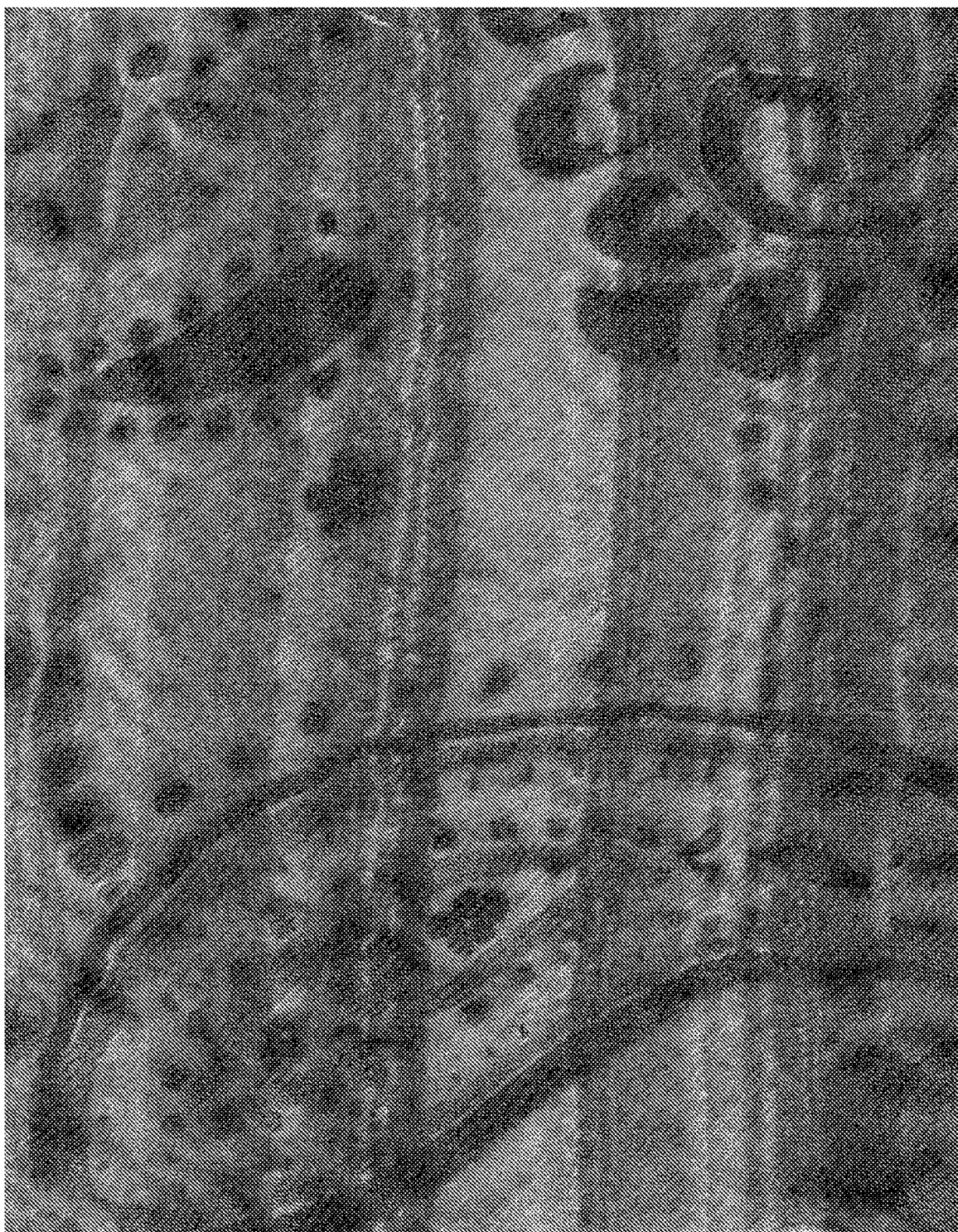


Fig. 5

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 1591582 A [0002]