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[54] **INK-JET PRINTING CLOTH, INK-JET PRINTING PROCESS AND PRODUCTION PROCESS OF PRINT**

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[52] **U.S. Cl.** **347/106**; 347/100; 347/103; 427/288; 428/224

[58] **Field of Search** ..... 347/106; 346/11; 427/288; 106/22 R, 22; 524/805; 428/224

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[57] **ABSTRACT**

Disclosed herein is an ink-jet printing cloth on which textile printing is conducted using an ink-jet system, wherein the cloth contains a water repellent and a hydrophilic agent so as to have a predetermined water repellency.

32 Claims, 4 Drawing Sheets

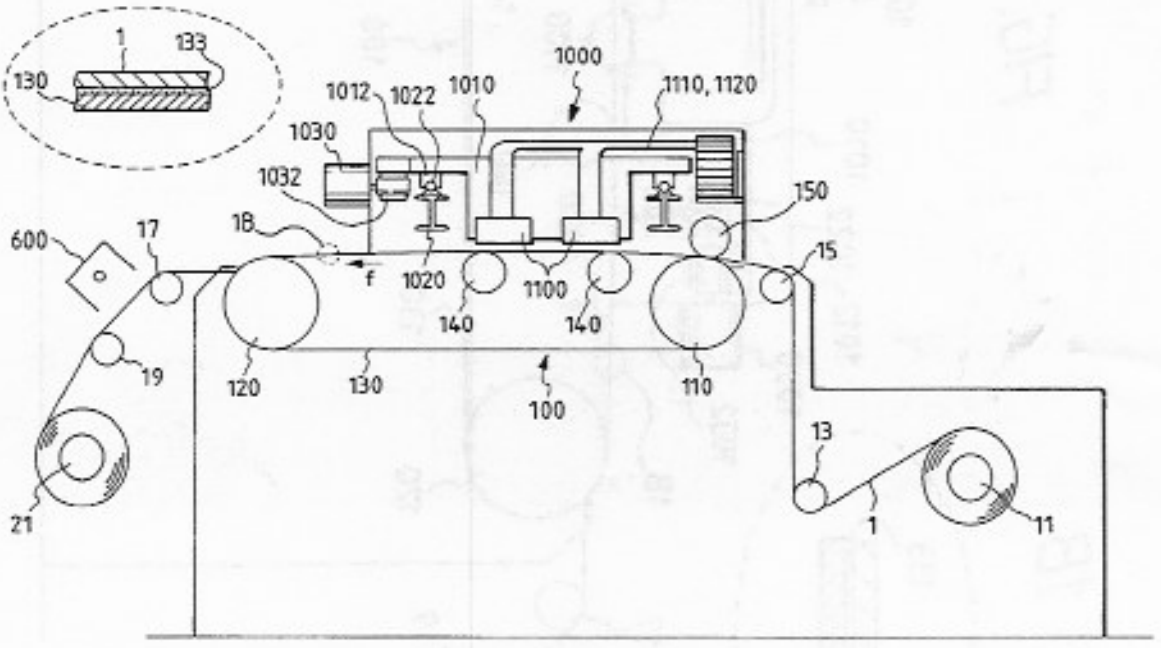


FIG. 2

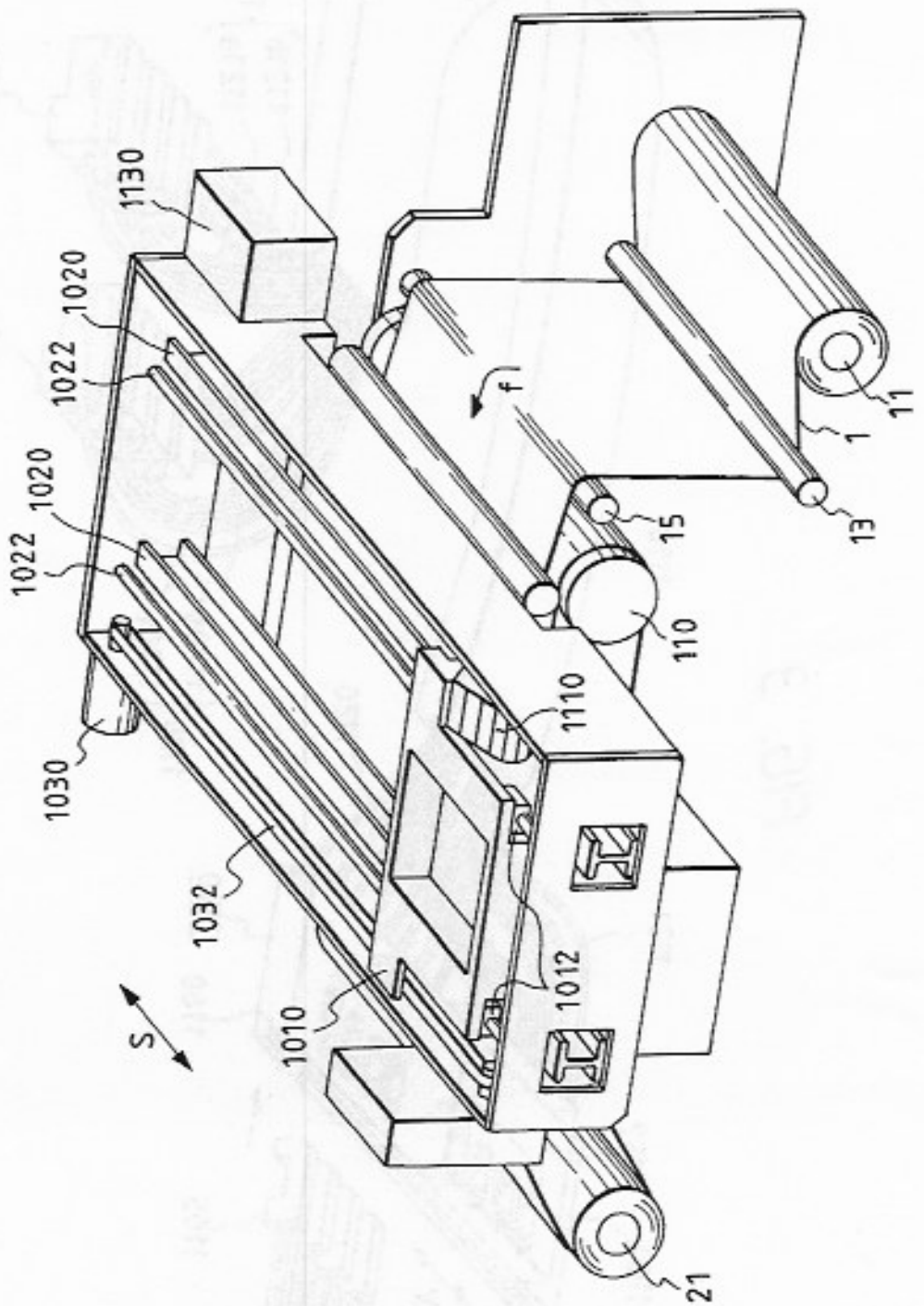
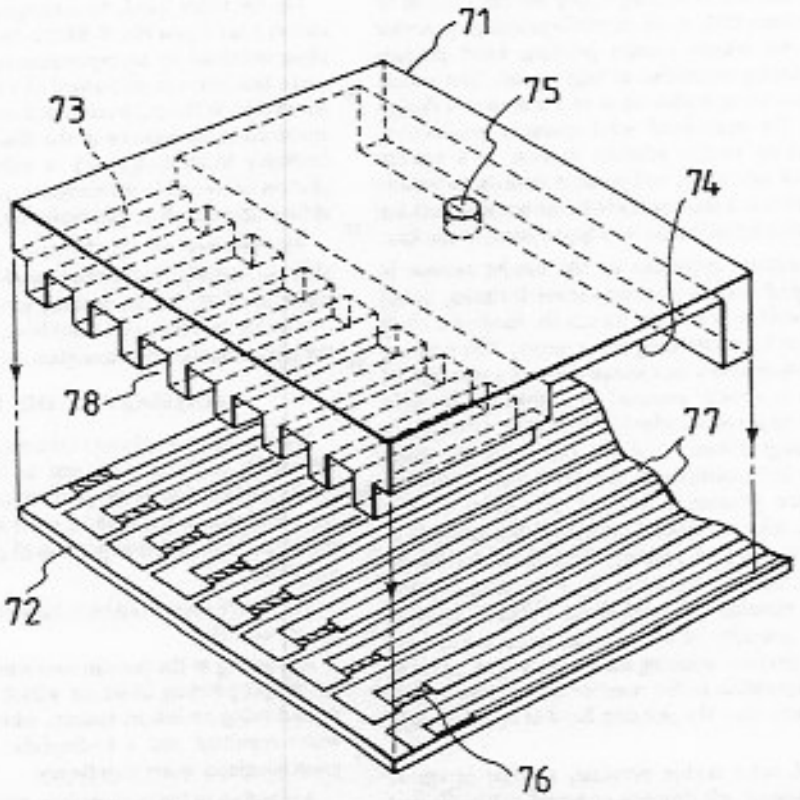

1130
1020
1022
1020
1022
1030
1032
1010
1012
1110
110
15
13
11
1
f
S
21

FIG. 4



applying inks to a cloth containing a water repellent and a hydrophilic agent and having a predetermined water repellency;

fixing dyes in the inks to the cloth; and

washing the thus-treated cloth.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1A is a typical sectional side elevation schematically illustrating the constitution of an ink-jet printing apparatus to which the present invention is applied.

FIG. 1B is an enlarged view of a portion of a conveyor belt in FIG. 1A.

FIG. 2 is a perspective view typically illustrating a printer section and a feed section in the apparatus shown in FIG. 1A.

FIG. 3 is a typical perspective view of an ink-feeding system in the apparatus shown in FIG. 1A.

FIG. 4 is a perspective view schematically illustrating the constitution of a printing head to be mounted on the apparatus shown in FIG. 1A.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

According to the ink-jet printing cloth and printing process based on the present invention, prints excellent in drying property, coloring ability and resistance to bleeding can be provided.

According to the ink-jet printing cloth according to the present invention, inks do not penetrate very far into the interior of fiber owing to the water repellent contained therein, and so dyes do not diffuse, resulting in improvement in coloring. The hydrophilic agent simultaneously contained in the cloth moderately prevents the inks from being repelled by the water repellent. More specifically, the inks used have affinity for the hydrophilic agent, and are hence absorbed in the cloth to some extent and are also laterally spread.

Therefore, since the cloth according to the present invention also becomes excellent in drying property and great in area factor, it is also excellent in coloring ability. The term "area factor" means a proportion of dots occupied in a unit area. When the permeability (water repellency) of the cloth is preset to a value less than 50 points by uniformly containing the water repellent and the hydrophilic agent in a certain proportion in the cloth, scattering of hydrophilicity of fiber itself due to density, directional property, irregularities, impurities and the like can be lessened, and so uneven spread (bleeding) of inks can be prevented.

The preferred embodiments of the present invention will now be described to explain the present invention in more detail.

No particular limitation is imposed on the fiber material for the ink-jet printing cloth according to the present invention. Examples thereof include various fiber materials such as cotton, silk, wool, nylon, polyester, rayon and acrylic fibers. The cloth used may be a blended fabric or union cloth thereof.

The water repellency in the present invention has been measured by using, as a measuring means, the water repellency test (spray method) described in JIS L 1092.

No particular limitation is imposed on the water repellent useful in the practice of the present invention so far as it has the ability to repel water which is a main component of inks. However, examples thereof include paraffins, fluorine-containing compounds, pyridinium salts, N-methylolalkylamides, alkylethyleneureas, oxazoline derivatives, silicone compounds, triazine compounds, zirconium compounds and mixtures thereof. Of these, paraffinic and fluorine-containing type water repellents are particularly preferred from the viewpoints of easy adjustment of water repellency, prevention of bleeding and concentration.

The amount of the water repellent to be applied is 0.05 to 40% by weight based on the cloth. If the amount is less than 0.05% by weight, the effect of preventing excessive penetration of ink becomes insufficient. On the other hand, if the water repellent is contained in an amount exceeding 40% by weight, a great change in performance can no longer be brought about.

Any water-soluble polymer having a water-repellent function may also be used as the water repellent. Examples of such water-soluble polymers include starch, cellulosic substances such as carboxymethylcellulose, methylcellulose and hydroxyethylcellulose, sodium alginate, gum arabic, guar gum, gelatin, tannin and derivatives thereof, polyvinyl alcohol and derivatives thereof, polyethylene oxide and derivatives thereof, water-soluble acrylic polymers, and water-soluble maleic anhydride polymers.

The amount of the water-soluble polymer is 0.1 to 20% by weight based on the cloth. Any amount of the water-soluble polymer exceeding 20% by weight results in a cloth markedly deteriorated in desizing ability. It is also not preferred from the viewpoint of economy to use the water-soluble polymer in such a great amount. On the other hand, if the amount is less than 0.1% by weight, the effect of such an agent is not sufficiently exhibited.

The hydrophilic agent useful in the practice of the present invention is a substance capable of improving the ink-absorbing ability of a cloth when added in a predetermined amount or more to the cloth as compared with the cloth before its addition. An increase in the absorbing ability can be determined by whether the water repellency is reduced or not, and the degree of the reduction. As specific examples of a method of applying the hydrophilic agent, there are considered various methods such as a method of containing a surfactant and a method of containing a water-soluble substance having a hydrophilic group. Any of these methods may be used.

As the surfactant used for enhancing the absorbing ability, anionic, nonionic and amphoteric surfactants are preferred. As examples of the anionic surfactant, may be mentioned surfactants of the sulfonic acid, carboxylic acid, sulfuric acid ester and phosphoric acid ester types. As the nonionic surfactant, there may be used ether types such as polyoxyethylene alkyl ethers, polyoxyethylene alkyl allyl ethers and acetylene glycol, the ester types such as polyoxyethylene alkyl esters and sorbitan fatty acid esters, aminoether types such as polyoxyethylene alkylamines, ether ester types such as polyoxyethylene sorbitan fatty acid esters, and the like. As the amphoteric surfactant, there may be used betaine types and the like.

The surfactant is preferably applied in an amount of 0.01 to 50% by weight based on the cloth. If the amount exceeds 50% by weight, a change in absorbing ability can no longer be brought about, and such a great amount is hence not preferred from the viewpoint of economy. On the other hand, if the amount is less than 0.01% by weight, the effect of such an agent is not sufficiently exhibited.

As the water-soluble substance having a hydrophilic group used for improving the absorbing ability, those like water-soluble solvents generally incorporated into ink-jet inks are preferred. Examples of usable solvents include

propyl or butyl) ether; polyalkylene glycols such as polyethylene glycol and polypropylene glycol and products obtained by modifying one or two hydroxyl groups thereof, typified by mono- or dialkyl ethers thereof; glycerol; thiodiglycol; sulfolane; N-methyl-2-pyrrolidone; 2-pyrrolidone; and 1,3-dimethyl-2-imidazolidinone. The preferable content of these water-soluble solvents is generally within a range of from 0 to 50% by weight based on the total weight of the ink.

In the case of a water-based ink, the content of water as a principal component is preferably within a range of from 30 to 95% by weight based on the total weight of the ink.

Besides the above components, anti-clogging agents such as urea and derivatives thereof, dispersants, surfactants, viscosity modifiers such as polyvinyl alcohol, cellulosic compounds and sodium alginate, pH adjustors, optical whitening agents, mildewproofing agents, and the like may be added as other ingredients for inks as needed.

As an ink-jet recording method and apparatus used, there may be used any method and apparatus conventionally known. Examples thereof include a method and an apparatus in which thermal energy corresponding to recording signals is applied to an ink within a recording head, and ink droplets are generated by this thermal energy.

The inks applied onto the ink-jet printing cloth of this invention in accordance with the process of the present invention in the above-described manner only adhere to the cloth in this state. Accordingly, it is preferable to subsequently subject the cloth to a process for fixing the dyes in the inks to fiber and a process for removing unfixed dyes. Such a fixing process may be conducted in accordance with any conventionally-known method. Examples thereof include a steaming process, an HT steaming process and a thermofix process. The removal of the unreacted dyes may be performed by any washing process conventionally known.

After conducting the ink-jet printing and the post-treatment of the cloth in the above-described manner, the cloth is dried to provide a print according to the present invention.

An exemplary constitution of an ink-jet printing apparatus used in the present invention will hereinafter be roughly described. It goes without saying that the apparatus to which the present invention can be applied is not limited to the construction as described below. It is therefore possible to make any change in construction and add any structural element, which are easily conceived by those skilled in the art.

FIG. 1A is a typical sectional side elevation schematically illustrating the construction of a printing apparatus. Reference numeral **1** designates a cloth as a printing medium. The cloth **1** is unwound according to the rotation of a rewind roller **11**, fed in a substantially horizontal direction by a conveyance section **100**, which is provided at a position opposite to a printer section **1000**, through intermediate rollers **13** and **15**, and then wound up on a take-up roller **21** through a feed roller **17** and an intermediate roller **19**.

The conveyance section **100** roughly includes conveyance rollers **110** and **120** respectively provided on the upstream and downstream sides of the printer section **1000** viewing from the feeding direction of the cloth **1**, a conveyor belt **130** in the form of an endless belt, which is extended between and around these rollers, and a pair of platen rollers **140** provided so as to extend the conveyor belt **130** under an appropriate tension in a predetermined range to enhance its evenness, thereby evenly regulating the surface of the cloth **1** to be printed upon by the printer section **1000**. In the illustrated apparatus, the conveyor belt **130** is made of a metal as disclosed in Japanese Patent Application Laid-Open No. 5-212851. As illustrated in FIG. 1B with partial enlargement, an adhesive layer (sheet) **133** is provided on its surface. The cloth **1** is adhered to the conveyor belt **130** through the adhesive layer **133** by an attaching roller **150**, thereby ensuring the evenness of the cloth **1** upon the printing.

To the cloth **1**, fed in a state such that the evenness has been ensured as described above, is applied a printing agent in the region between the platen rollers **140** by the printer section **1000**. The thus-printed cloth **1** is separated from the conveyor belt **130**, or the adhesive layer **133** at the position of the conveyance roller **120** and wound up on the take-up roller **21**. In the course of the winding, the cloth is subjected to a drying treatment by a drying heater **600**. In particular, this drying heater **600** is effective when a liquid agent is used as the printing agent. The form of the drying heater **600** may be suitably selected from a heater by which hot air is blown on the cloth **1**, a heater by which infrared rays are applied to the cloth **1**, and the like.

FIG. **2** is a perspective view typically illustrating the printer section **1000** and the feed system of the cloth **1**. The constitution of the printer section **1000** will be described with reference to this drawing and FIG. 1A.

In FIGS. **1A** and **2**, the printer section **1000** includes a carriage **1010** which scans in a direction different from the conveying direction (a secondary scanning direction) f of the cloth **1**, for example, the width direction S of the cloth **1** perpendicular to the conveying direction f. Reference numeral **1020** designates a support rail extending in the S direction (a main scanning direction) and supporting a slide rail **1022** which supports and guides a slider **1012** fixed to the carriage **1010**. Reference numeral **1030** indicates a motor as a drive source for conducting the main scanning of the carriage **1010**. The driving power thereof is transmitted to the carriage **1010** through a belt **1032** to which the carriage **1010** has been fixed, or another suitable drive mechanism.

On the carriage **1010**, are mounted sets of printing heads **1100** each having many printing agent-applying elements arranged in a predetermined direction (in this case, the conveying direction f), said sets each being composed of a plurality of the printing heads **1100** arranged in a direction (in this case, the main scanning direction S) different from said predetermined direction. In this embodiment, two sets of the printing heads **1100** are held in the conveying direction. In each set, the printing heads **1100** are provided in a number corresponding to the number of printing agents of different colors, thereby permitting color printing. Colors of the printing agents and the number of the printing heads in each set may be suitably selected according to an image intended to be formed on the cloth **1**, and the like. For example, yellow (Y), magenta (M) and cyan (C), or the three primary colors for printing, or black (Bk) in addition to these colors may make one set. Alternatively, special colors (metallic colors such as gold and silver, and bright red, blue, etc.), which are impossible or difficult to be expressed by the three primary colors, may be used in place of or in addition to the above color set. Further, a plurality of printing agents may be used according to their color depth even if they have the same colors as each other.

In this embodiment, as illustrated in FIG. 1A, two sets of the printing heads **1100**, which each are composed of plural printing heads arranged in the main scanning direction S, are provided one by one in the conveying direction f. The colors, arranging number, arranging order and the like of the

enhancement in reliability, can be fully applied thereto, high-density mounting can be achieved with ease, and production costs are also low.

The present invention will hereinafter be described more specifically by the following examples and comparative examples. Incidentally, all designations of "part" or "parts" and "%" as will be used in the following examples mean part or parts by weight and % by weight unless expressly noted.

EXAMPLES 1 to 12

(A) Production of ink-jet printing cloth

Using a 100% cotton satin fabric (mercerized product), a 100% nylon taffeta fabric and a 100% polyester tropical fabric, pretreatments using their corresponding pretreatment agents shown in Table 1 were conducted by the padding process. The thus-pretreated fabrics were then squeezed to a pickup of 70% by a mangle and dried at a drying temperature of 120° C. for 2 minutes.

(B) Preparation of ink-jet printing ink

Reactive dye inks, acid dye inks and disperse dye inks were prepared in the following manner. The total amounts of the inks are all 100 parts.

(1) Reactive dye inks:

Reactive dye 10 parts

Thiodiglycol 40 parts

Water 50 parts.

Dyes used were C.I. Reactive Yellow 95, C.I. Reactive Red 226, C.I. Reactive Blue 15 and C.I. Reactive Black 39.

(2) Acid dye inks

Acid dye 10 parts

Diethylene glycol 40 parts

Water 50 parts.

Dyes used were C.I. Acid Yellow 110, C.I. Acid Red 266, C.I. Acid Blue 90 and C.I. Acid Black 26.

(3) Disperse dye inks:

Disperse dye 10 parts

Thiodiglycol 40 parts

Water 50 parts.

Dyes used were C.I. Disperse Yellow 42, Teraprint Red 3GN Liquid (trade name, product of Ciba-Geigy AG), C.I. Disperse Blue 56 and Teraprint Black 2R (trade name, product of Ciba-Geigy AG).

(C) Ink-jet printing

Using a Bubble Jet Printer BJC-820J (trade name, manufactured by Canon Inc.) as an ink-jet printing apparatus, sets of the above-prepared printing inks were separately charged in this printer. The fabrics were separately mounted on base paper webs to permit the conveying of the fabrics, thereby printing the fabrics. Any printing apparatus may be used without limitation to the above printer.

(D) Post-treatment

The printed fabrics were subjected to a steaming treatment at 100° C. for 8 minutes for the reactive dye inks, at 100° C. for 30 minutes for the acid dye inks, and at 180° C. for 10 minutes for the disperse dye inks. The thus-treated cloths were washed and then dried.

(E) Evaluation of prints

The thus-obtained print samples and the fabrics used were evaluated in the following manner. The results are shown in Table 1.

(1) Bleeding:

The linearity of fine-line portions in each print sample was visually observed to rank resistance to bleeding in accordance with the following standard:

A: Good;

B: Somewhat poor;

C: Poor.

(2) Color depth (K/S) of print:

A minimum spectral reflectance of a 20×20 mm square printed portion in each print sample was measured by a Minolta Spectrocolorimeter CM-2022 (trade name). A K/S value was found from this reflectance. The color depth of each print sample was ranked in terms of this K/S value in accordance with the following standard:

A: Greater than 13;

B: 10 to 13;

C: Smaller than 10.

(3) Drying property:

Printing was conducted by the BJC-820J printer, and the printed area was rubbed with a cloth upon elapsed time of 30 seconds after the printing. The drying property was evaluated by whether ink smearing occurred or not and ranked in accordance with the following standard:

A: No ink smearing occurred;

C: Ink smearing occurred.

(4) Water repellency:

Each fabric sample was sprayed with 250 ml of water by a Spray Tester (trade name, manufactured by Daiei Kagaku Seiki Seisakusho) in accordance with the water repellency test (spray method) described in JIS L 1092. The water repellency was ranked in terms of 0 to 100 points according to the wet state of the sample after the test.

Comparative Examples 1 to 11

Ink-jet printing and evaluation were conducted in the same manner as in Examples 1 to 12 except that the cloths and the textile printing inks were changed to those shown in Table 2. The results are shown in Table 2.

TABLE 1

	Cloth	Pretreatment Agent [conc. in aq. solution (%)]	Ink	Water repellency	Resistance to bleeding	Color depth	Drying property
Ex. 1	Cotton	Water repellent 1 [3], Surfactant 1 [1], Na_2CO_3 [2]	Reactive	0	A	A	A
Ex. 2	Cotton	Water repellent 2 [1], Surfactant 2 [1], Na_2CO_3 [2]	Reactive	0	A	A	A
Ex. 3	Cotton	Water repellent 1 [3], Surfactant 1 [1], Na_2SO_4 [4], Na_2CO_3 [2]	Reactive	0	A	A	A
Ex. 4	Cotton	Water repellent 1 [3], Surfactant 1 [1], urea [4], Na_2CO_3 [2]	Reactive	0	A	A	A
Ex. 5	Cotton	Water repellent 1 [3], Surfactant 1 [1],	Reactive	0	A	A	A

parative examples, which are outside the scope of the present invention, are shown in Table 5.

Evaluation of prints:

The thus-obtained print samples and the fabrics used were evaluated in the following manner. The results are shown in Tables 3 to 5.

(1) Bleeding

The linearity of fine-line portions in each print sample was visually observed to rank resistance to bleeding in accordance with the following standard:

A: Good;

B: Somewhat poor;

C: Poor.

(2) Optical density (OD)

The optical density of a solid printed area was measured by a Macbeth densitometer RD918, thereby ranking it in accordance with the following standard:

A: OD value not lower then 1.3;

B: OD value ranging from 0.8 to 1.2;

C: OD value lower than 0.8.

(3) Tendency to strike-through

The optical densities of the front and back surfaces of a solid printed area were measured by a Macbeth densitometer RD918. The tendency to strike-through was ranked in terms of a ratio (OD of the back surface to OD of the front surface) between the OD values in accordance with the following standard:

(Cotton)

A: Not lower than 0.7;

B: 0.60 to 0.69;

C: Lower than 0.60.

(Nylon and polyester)

A: Not lower than 0.9;

B: 0.80 to 0.89;

C: Lower than 0.80.

(4) Drying property

An ink in an amount of 0.03 g was dropped on a cloth to be tested to rank the drying property in terms of time required to absorb the ink in accordance with the following standard:

A: Not longer than 10 seconds;

B: 11 to 30 seconds;

C: Longer than 30 seconds.

(5) Permeability or wetting property (contact angle)

An ink in an amount of 0.03 g was dropped on a cloth to be tested to measure its contact angle with the cloth (the cloth is easier to wet as the contact angle is narrower, i.e., the wetting property is greater).

(Contact angle)

S: Narrower than 90° (unmeasurable due to strike-through);

I: 90 to 110°;

G: Wider then 110°.

(6) Dye distribution

An ink-jet print to be tested was cut so as to permit the observation of its fiber section. The section was observed through a microscope to determine a difference in the concentration of a fixed dye between the peripheral surface and the interior of the fiber. The print was ranked as A where the color was deep in a wide range of the peripheral surface of the fiber because its OD value was also high.

A: The color was deep in a wide range of the peripheral surface of the fiber, but the color was thin in the interior of the fiber;

B: The color was deep only in a part of the peripheral surface of the fiber;

C: The color was even and thin as a whole in both peripheral surface and interior of the fiber.

TABLE 3

		Pretreatment 1		Pretreatment 2								
	Cloth	Agent/conc. in aq. soln. (%)	Cont. angle	Agent/conc. in aq. soln. (%)	Cont. Angle	Ink	Blooding	OD	Strike-through	Drying prop.	Dye Distr.	Water repell.
Ex. 13	Cotton	Water repell. 1/1, Na_2CO_3/2	G	Surfactant 1/1, Na_2CO_3/2	S	Reactive	A	A	A	A	A	0
Ex. 14	Cotton	Water repell. 2/1, Na_2CO_3/2	G	Surfactant 2/1, Na_2CO_3/2	S	Reactive	A	A	A	A	A	0
Ex. 15	Cotton	Water repell. 3/1, Na_2CO_3/2	G	Surfactant 3/1, Na_2CO_3/2	S	Reactive	A	A	A	A	A	0
Ex. 16	Cotton	Water repell. 2/1, Na_2CO_3/2	G	Surfactant 1/1, Na_2CO_3/2	S	Reactive	A	A	A	A	A	0
Ex. 17	Cotton	Water-soluble polymer 1/3, Na_2CO_3/2	G	Surfactant 1/1, Na_2CO_3/2	S	Acid	A	A	A	A	A	0
Ex. 18	Nylon	Water repell. 1/1	G	Surfactant 1/1	S	Acid	A	A	A	A	A	0
Ex. 19	Nylon	Water repell. 2/1	G	Surfactant 2/1	S	Acid	A	A	A	A	A	0
Ex. 20	Nylon	Water repell. 3/1	G	Surfactant 3/1	S	Acid	A	A	A	A	A	0

TABLE 4

		Pretreatment 1		Pretreatment 2								
	Cloth	Agent/conc. in aq. soln. (%)	Cont. angle	Agent/conc. in aq. soln. (%)	Cont. Angle	Ink	Bleeding	OD	Strike-through	Drying prop.	Dye Distr.	Water repell.
Ex. 21	Nylon	Water repell. 2/1	G	Surfactant 1/1	S	Acid	A	A	A	A	A	0
Ex. 22	Nylon	Water-soluble polymer 1/3	G	Surfactant 1/1	S	Acid	A	A	A	A	A	0
Ex. 23	Polyester	Cationic substance 1/1	G	Surfactant 1/1	S	Disperse	A	A	A	A	A	0
Ex. 24	Polyester	Water repell. 1/1	G	Surfactant 2/1	S	Disperse	A	A	A	A	A	0
Ex. 25	Polyester	Water repell. 2/1	G	Surfactant 3/1	S	Disperse	A	A	A	A	A	0

art technique can improve the tendency to strike-through, but does not achieve effective absorption of light by dyes because the dyes penetrate into the interior of the fiber, and hence can provide only a cloth poor in coloring ability. To the contrary, according to the present invention, no ink is absorbed in the interior of the fiber, and so coloring ability is improved.

As described above, the ink-jet printing cloths and printing processes according to the present invention permit the provision of bright prints excellent in drying property, free of bleeding and high in color depth and image quality.

Besides, the cloths obtained by containing the water repellent and the hydrophilic agent by at least two cloth-treating steps can provide bright prints free of bleeding, high in color depth, good in tendency to strike-through and high in image quality and grade, and are excellent in ink-drying property upon printing, and hence permit textile printing free from ink smearing.

While the present invention has been described with respect to what is presently considered to be the preferred embodiments, it is to be understood that the invention is not limited to the disclosed embodiments. To the contrary, the invention is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structures and functions.

What is claimed is:

1. An ink-jet printing cloth on which textile printing is conducted using an ink-jet system, wherein the cloth contains a water repellent and a hydrophilic agent so as to have a predetermined water repellency.

2. The ink-jet printing cloth according to claim **1**, wherein the water repellency is less than 50 marks in terms of the water repellency prescribed by the water repellency test with a spray method described in JIS L 1092.

3. The ink-jet printing cloth according to claim **1**, wherein the water repellent is any of paraffinic and fluorine-containing type water repellents.

4. The ink-jet printing cloth according to claim **1**, wherein the water repellent is applied in an amount of 0.05 to 40% by weight based on the cloth.

5. The ink-jet printing cloth according to claim **1**, wherein the hydrophilic agent is applied in an amount of 0.01 to 50% by weight based on the cloth.

6. The ink-jet printing cloth according to claim **1**, further comprising at least one of a water-soluble inorganic salt and urea.

7. The ink-jet printing cloth according to claim **1**, wherein the wetting property to inks of the peripheral surface of fiber constituting the cloth is higher than that of the interior of the fiber.

8. A process for producing an ink-jet printing cloth on which textile printing is conducted using an ink-jet system, which comprises the steps of:

applying a water repellent to a cloth;

drying the cloth; and

further applying a hydrophilic agent to the dry cloth.

9. The production process according to claim **8**, wherein a predetermined water repellency is given to the cloth through the steps according to claim **8**.

10. The production process according to claim **9**, wherein the water repellency is less than 50 marks in terms of the water repellency prescribed by the water repellency test with a spray method described in JIS L 1092.

11. The production process according to claim **8**, wherein the water repellent is any of paraffinic and fluorine-containing type water repellents.

12. The production process according to claim **8**, wherein the water repellent is applied in an amount of 0.05 to 40% by weight based on the cloth.

13. The production process according to claim **8**, wherein the hydrophilic agent is applied in an amount of 0.01 to 50% by weight based on the cloth.

14. The production process according to claim **8**, wherein at least one of a water-soluble inorganic salt and urea is applied to the cloth.

15. The production process according to claim **8**, wherein the wetting property to inks of the peripheral surface of fiber constituting the cloth is made higher than that of the interior of the fiber through the steps according to claim **8**.

16. An ink-jet printing process comprising the steps of:

preparing a cloth containing a water repellent and a hydrophilic agent and having a predetermined water repellency;

applying an ink containing a dye by an ink-jet system to said cloth;

fixing the dye in said ink to the cloth; and

washing the cloth.

17. The ink-jet printing process according to claim **16**, wherein a cloth having a water repellency less than 50 marks in terms of the water repellency prescribed by the water repellency test with a spray method described in JIS L 1092 is used.

18. The ink-jet printing process according to claim **16**, wherein the water repellent is any of paraffinic and fluorine-containing type water repellents.

19. The ink-jet printing process according to claim **16**, wherein the water repellent is applied in an amount of 0.05 to 40% by weight based on the cloth.

20. The ink-jet printing process according to claim **16**, wherein the hydrophilic agent is applied in an amount of 0.01 to 50% by weight based on the cloth.

21. The ink-jet printing process according to claim **16**, wherein the cloth contains at least one of a water-soluble inorganic salt and urea.

22. The ink-jet printing process according to claim **16**, wherein an electrothermal converter which generates thermal energy causing film boiling of ink is used as an energy-generating means for ejecting the ink.

23. The ink-jet printing process according to claim **16**, wherein the wetting property to inks of the peripheral surface of fiber constituting the cloth is higher than that of the interior of the fiber.

24. A process for producing a print by applying inks to a cloth using an ink-jet system to print the cloth, which comprises the steps of:

applying inks to a cloth containing a water repellent and a hydrophilic agent and having a predetermined water repellency;

fixing dyes in the inks to the cloth; and

washing the thus-treated cloth.

25. The process for producing a print according to claim **24**, wherein a concentration of a fixed dye at the peripheral surface of fiber constituting the print is higher than that at the interior of the fiber through the steps according to claim **24**.

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 5,867,197

DATED : February 2, 1999

INVENTOR(S) : MAKOTO AOKI

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

ON THE COVER PAGE:

Item [56] FOREIGN PATENT DOCUMENTS

"0459282" should read --4-59282--.

COLUMN 2:

Line 42, "in" should be deleted.

COLUMN 9:

Line 48, "not illustrated." should read --(not illustrated).--.

COLUMN 10:

Line 16, "the" (first occurrence) should read -- the construction--.