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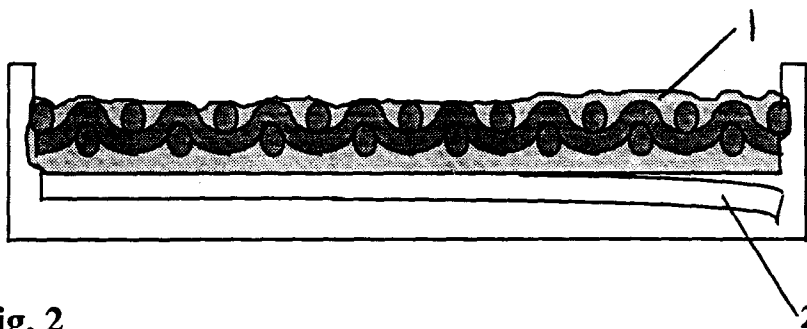
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**(54) Screen printing stencil production**

(57) A screen printing stencil is produced chemically by application of a chemical agent 5 to a screen mesh 3 having a stencil-forming layer. The chemical agent 5 is applied dropwise using computer-controlled apparatus. The chemical agent reacts with the stencil-forming agent to harden the stencil in areas which remain upon subsequent wash-out. The stencil so produced can be

used for screen printing in the usual way. The method avoids the use of safe lights and actinic radiation. The apparatus used can be a commercially-available apparatus designed for direct application of liquids dropwise to screens mounted in their frames. The stencil-forming layer can be provided using a commercially-available emulsion-coated film or a commercially-available emulsion applied directly to the screen mesh.

**Fig. 2****EP 0 909 642 A1**

## Description

### BACKGROUND TO THE INVENTION

#### Field of the Invention

**[0001]** The present invention relates to the production of stencils for screen printing.

#### Related Background Art

**[0002]** The production of screen printing stencils is generally well known to those skilled in the art.

**[0003]** One method, referred to as the "direct method" of producing screen printing stencils involves the coating of a liquid light-sensitive emulsion directly onto a screen mesh. After drying, the entire screen is exposed to actinic light through a film positive held in contact with the coated mesh in a vacuum frame. The black portions of the positive do not allow light to penetrate to the emulsion which remains soft in those areas. In the areas which are exposed to light, the emulsion hardens and becomes insoluble, so that, after washing out with a suitable solvent, the unexposed areas allow ink to pass through onto a substrate surface during a subsequent printing process.

**[0004]** Another method, referred to as the "direct/indirect method" involves contacting a film, consisting of a pre-coated unsensitised emulsion on a base support, with the screen mesh by placing the screen on top of the flat film. A sensitised emulsion is then forced across the mesh from the opposite side, thus laminating the film to the screen and at the same time sensitising its emulsion. After drying, the base support is peeled off and the screen is then processed and used in the same way as in the direct method.

**[0005]** In the "indirect method" a film base is pre-coated with a pre-sensitised emulsion. The film is exposed to actinic light through a positive held in contact with the coated film. After chemical hardening of the exposed emulsion, the unexposed emulsion is washed away. The stencil produced is then mounted on the screen mesh and used for printing as described above for the direct method.

**[0006]** In the "capillary direct method" a pre-coated and pre-sensitised film base is adhered to one surface of the mesh by the capillary action of water applied to the opposite surface of the mesh. After drying, the film is peeled off and the screen then processed and used as described for the direct method.

**[0007]** In addition to the above methods, hand-cut stencils can be used. These are produced by cutting the required stencil design into an emulsion coating on a film base support. The cut areas are removed from the base before the film is applied to the mesh. The emulsion is then softened to cause it to adhere to the mesh. After drying, the base is peeled off. The screen is then ready for printing. This method is suitable only for simple

work.

**[0008]** One problem generally associated with all the prior art methods is that many steps are necessary to produce the screen, thus making screen production time-consuming and labour-intensive.

**[0009]** Another problem is that normal lighting cannot be used throughout the screen production process in any of the methods except hand cutting. This is because the stencil materials are light-sensitive. In addition, it is necessary to provide a source of actinic (usually UV) light for exposing the stencil. This usually incurs a penalty of initial cost, space utilisation and ongoing maintenance costs.

**[0010]** Other methods of preparing printing screens are available. CA-A-2088400 (Gerber Scientific Products, Inc.) describes a method and apparatus in which a blocking composition is ejected directly onto the screen mesh surface in a pre-programmed manner in accordance with data representative of the desired image. The blocking composition directly occludes areas of the screen mesh to define the desired stencil pattern.

**[0011]** EP-A-0492351 (Gerber Scientific Products, Inc.) describes a method and apparatus where an unexposed light-sensitive emulsion layer is applied to a screen mesh surface and a graphic is directly ink-jet printed on the emulsion layer by means of a printing mechanism, using a printing ink, to provide a mask through which the emulsion is exposed before the screen is further processed. The apparatus described has been commercialised under the name "Gerber ScreenJet", which is marketed as a screen imaging system for textile screen printing. The apparatus comprises a mechanism for mounting variously sized screen frames in a horizontal position and orientated with respect to the X, Y and Z printing axes of the apparatus, a control computer providing data defining the graphic, an ink-jet facility with one or more print heads which are movable in the X and Y directions and an ultraviolet lamp assembly for exposure of the light sensitive emulsion layer on the screen mesh surface. Several other similar ink-jet screen imaging systems are also available, including the "Luscher JetScreen", utilising a hot-melt ink-jet process, and a horizontal flat-bed ink-jet machine from Swiss company Mantel.

**[0012]** There is thus commercially available from several sources apparatus in which a screen printing screen can be received and onto which a liquid can be applied dropwise in preselected areas under control of data encoding information determining the areas of application and non-application. Such apparatus is referred to herein as being "of the kind described".

**[0013]** Dropwise liquid application apparatus such as ink-jet printers operate by ejecting a liquid onto a receiving substrate in controlled patterns of closely spaced liquid droplets. By selectively regulating the pattern of droplets, ink-jet printers can be used to produce a wide variety of printed materials, including text, graphics and images on a wide range of substrates. In many ink-jet

printing systems, ink is printed directly onto the surface of the final receiving substrate. An ink-jet printing system where an image is printed on an intermediate image transfer surface and subsequently transferred to the final receiving substrate is disclosed in US-A-4538156 (AT&T Teletype Corp.). Furthermore, US-A-5380769 (Tektronix Inc.) describes reactive ink compositions containing at least two reactive components, a base ink component and a curing component, that are applied to a receiving substrate separately. The base ink component is preferably applied to the receiving substrate using ink-jet printing techniques and, upon exposure of the base ink component to the curing component, a durable, crosslinked ink is produced.

**[0014]** EP-A-0635362 (Riso Kagaku Corp.) describes in example 5 a process which involves direct selective dissolution by a water-based solvent, which can be applied dropwise, of a resin layer coated on a polyester fibre cloth.

#### SUMMARY OF THE INVENTION

**[0015]** According to the present invention there is provided a method of producing a screen-printing stencil having open areas and blocked areas for respectively passage and blocking of a printing medium, the method comprising:

- providing a screen printing screen having a stencil-forming layer coated thereon;
- positioning the coated screen for application thereto dropwise of a chemical agent capable of reacting with the stencil-forming layer to produce areas thereof having lower and higher solubilities corresponding respectively to the blocked and the open stencil areas;
- applying dropwise to the coated screen the chemical agent under control of data encoding the respective lower and higher solubility areas; and
- washing away the stencil-forming layer in the areas of higher solubility, thereby to produce the screen-printing stencil.

**[0016]** In the method of the invention, the stencil is formed by chemical means without the need to use either special lighting conditions or actinic radiation.

**[0017]** Also, it is possible to carry out the method at reduced expenditure of time and labour, compared with the known processes.

**[0018]** The stencil-forming layer can be applied to the screen by any convenient means. One way is by means of a coated film comprising a support base on which the stencil-forming agent is coated. The coated film can be adhered to the screen by application of a liquid, for example water. This can be done by placing the coated film with its coated surface uppermost on a solid flat surface and placing the screen mesh on top such that there is close contact between the mesh and the coated film.

In another variant, the coated film can be rolled down a screen mesh which has been thoroughly wetted with a gentle spray of a liquid, for example water. After drying, the support base can be peeled away from the mesh to leave the stencil-forming layer. Alternatively, the stencil-forming layer may be coated directly onto the screen mesh, for example in the form of an emulsion applied by use of a coating trough or squeegee, preferably to both sides of the screen simultaneously.

**[0019]** The dropwise application of the chemical agent is conveniently carried out by means of an apparatus of the kind described, in which the coated screen is first positioned.

**[0020]** If desired, the chemical agent may be produced *in situ* by reaction between two or more precursor materials, separately applied to the stencil-forming layer, at least one of which is applied in the said areas corresponding to the blocked areas of the stencil to be produced. This may conveniently be achieved by use of a plurality of drop-ejection heads, in a suitable apparatus of the kind described.

**[0021]** The dropwise application is controlled according to data encoding the desired pattern of blocked and open areas of the stencil to be produced. This control may be by a computer, for example a personal computer. Thus, data representative of the desired output pattern is input to a controller as prerecorded digital signals which are used by the ejection head to deposit or not deposit the liquid containing the chemical agent as it scans the surface of the stencil forming layer.

**[0022]** The material of the stencil-forming layer is selected to react with the chemical agent to produce lower solubility areas corresponding to the said blocked areas.

#### DETAILED DESCRIPTION OF THE INVENTION

**[0023]** The invention will be described further by way of example with reference to the drawings of this specification, in which

Figures 1 to 4 show schematically the successive steps in the production of a printing screen in accordance with one method according to the invention, and

Figures 5 to 7 show schematically the successive steps in the production of a screen in accordance with a second method according to the invention. Referring to Figures 1 to 4, these show the formation of a screen printing stencil shown in Figure 4, starting with a coated film shown in Figure 1.

**[0024]** Figure 1 shows the coated film which consists of a stencil-forming layer 1 coated on a flexible support base 2, the film having been applied to a screen mesh 3, mounted in a suitable screen frame 4.

**[0025]** Figure 2 of the drawings shows the coated screen after the support base 2 has been peeled away.

**[0026]** Figure 3 shows a chemical agent 5 being ap-

plied to the stencil-forming layer 1 in droplets 5 which are ejected from an ejection head (not shown) of an apparatus of the kind described controlled by a computer. The chemical agent 5 is absorbed into the stencil-forming layer 1 to form areas 6 corresponding to the areas that have reacted with the chemical agent to produce areas of insoluble material.

**[0027]** Figure 4 of the drawings shows the final screen after the screen has been washed out so that the areas 6 of the stencil-forming layer to which the chemical agent was applied remains and the higher solubility areas have been washed away.

**[0028]** Figures 5 to 7 of the drawings correspond to figures 1 to 4 but show the production of a stencil by a method in which the stencil-forming layer is coated directly onto the screen without the use of a coated film. Here the stencil-forming layer is formed from a stencil-forming agent composed of a liquid unsensitised emulsion which is directly coated onto both sides of a screen mesh mounted in a frame.

**[0029]** Reference numerals increased by "10" are used in figures 5 to 7 to identify integers corresponding to integers of figures 1 to 4.

**[0030]** Figures 5 and 6 show operations corresponding to the operations of figures 1 and 3 and figure 7 corresponds to figure 4.

**[0031]** The key criterium in selecting a suitable combination of stencil-forming agent and chemical agent is that the chemical agent should form a good image on the layer formed from the stencil-forming agent; for example, a drop of the chemical agent should neither be so repelled by the layer as to produce a defective image nor it should not spread so far as to reduce the resolution of the image. Moreover, it should not spread so anisotropically (because of irregularities in the layer) as to deform the image.

**[0032]** The stencil-forming agent may comprise a polymer which reacts with the chemical agent and thus forms a part of the final screen stencil.

**[0033]** A typical example of such a polymer is polyvinyl alcohol which is preferably present in an amount of 5 to 100 wt.% of the stencil-forming layer with the balance comprising, for example, other suitable polymers and/or suitable fillers, binders and plasticisers. The polyvinyl alcohol preferably has a degree of hydrolysis of 20 to 99.9 mole % and, independently thereof, a degree of polymerisation of 100 to 3500.

**[0034]** Numerous other reactive polymers could alternatively be utilised in the present invention. Suitable polymers include those that change their solubility characteristics on treatment with a suitable chemical agent. Examples of such polymers are:

gelatin and its derivatives;  
cellulose derivatives that are water soluble, including starch and hydroxypropyl cellulose;  
epoxy resins; and  
amino resins, including urea-formaldehyde and

melamine-formaldehyde.

**[0035]** In methods according to the invention, the polymers and other components are chosen so that the chemical agent forms a good image when applied. Layers that are not compatible with any solvent used in the chemical agent (typically, water) will produce insufficient spread of the liquid and a poor-quality image will result. If the layer has too great an affinity with the chemical agent, the liquid will spread too far, giving a blurred, low resolution image.

**[0036]** When the stencil-forming layer is applied by use of a coated film, the stencil layer thickness is typically from 5 to 100  $\mu\text{m}$ .

**[0037]** The support base may comprise a non-reactive polymer, preferably an organic resin support, e.g. polyethylene terephthalate, polyethylene, polycarbonate, polyvinyl chloride or polystyrene. The organic resin support can optionally be coated with a subbing layer to give desired adhesion properties with the stencil-forming layer. The support base is removed as a coherent film in the screen production method, preferably prior to the application of the chemical agent to the stencil-forming layer.

**[0038]** The chemical agent is preferably applied dropwise to the stencil-forming layer by an apparatus of the kind described, for example a Gerber ScreenJet apparatus. The liquid applied should exhibit desirable stability, surface tension and viscosity characteristics and may therefore contain surfactants, viscosity modifiers, light stabilisers and/or anti-oxidants. When the active component(s) of the chemical agent is/are not liquids, the chemical agent may include a suitable carrier, for example a suitable solvent or dispersant for the active component(s).

**[0039]** Examples of suitable active components include

boron salts e.g. boric acid, Group I and Group II metal borates;  
aldehydes, e.g. formaldehyde;  
dialdehydes, e.g. glyoxal and glutaraldehyde, optionally activated by treatment with mineral acid;  
isocyanates and their derivatives, e.g. toluenediisocyanate; carbodiimides and their derivatives, e.g. 1,3-dicyclohexylcarbodiimide;  
transition metal compounds and complexes, e.g. pentahydroxy(tetradecanoate)dichromium and its derivatives;  
aziridine and its derivatives;  
amines;  
multifunctional silane compounds, e.g. silicon tetraacetate; N-methylol compounds, e.g. dimethylolurea and methyloldimethylhydantoin; and  
active vinyl compounds, e.g. 1,3,5-triacryloyl-hexahydro-s-triazine.

**[0040]** After application of the chemical agent to the

stencil-forming layer, the imaged screen is dried if necessary, then the resulting screen stencil can be developed by washing away the portion of higher solubility with a suitable solvent, for example water, thereby leaving behind areas of reduced solubility to occlude areas of the mesh.

[0041] Optionally, the stencil can be further toughened by a post-treatment, for example using extra chemicals, actinic radiation or heat. The extra chemicals (or precursors thereof) may be resident in the original stencil-forming agent, or may be supplied externally. Examples of chemical toughening agents are ones operating at pH 7 or higher and include dialdehydes particularly glyoxal, and aqueous bases, for example aqueous potassium carbonate. It is presently believed that these toughening agents will only work when a boron salt is used as the chemical agent.

[0042] The screen produced is then ready for use as a printing medium using techniques familiar to those skilled in the art. Where the chemicals used are those cited in the Examples 1 to 4 which follow, the broad physical properties, chemical resistances, washout solvent (water) and reclaim chemicals (typically periodate systems) will in many cases be those used routinely by screen printers. So, although the method of producing the stencil is new, the resulting product will often be familiar and highly acceptable to screen printers.

[0043] Surprisingly, we have found that when the active component of the chemical agent is a boron-containing salt, the stencil can be reclaimed with dilute acid without the use of the industry-standard periodate system. This low cost and environmentally-friendlier reclaim system is a distinct added advantage.

[0044] The advantages of the method of the present invention include: a screen stencil can be produced directly from digital information sources; it is not necessary to use safelights during the stencil making process; there is no requirement for an exposure step utilising an actinic radiation source; and a finished stencil can be produced in a shorter time than by conventional screen printing techniques.

[0045] The present invention is illustrated by the following examples without however being limited thereto. In these examples, various commercially-available materials are listed by their trade names; the following letters identifying the following companies:

- (a) 3M, UK
- (b) Autotype International, UK

#### EXAMPLE 1

[0046] A liquid containing a chemical agent was prepared according to the formula:

water - 87 wt.%;  
potassium tetraborate - 10 wt.%; and  
"Fluorad FC-93" (a) (1wt. % aqueous solution) - an-

ionic fluorinated surfactant - 1 wt.%.

[0047] The stencil-forming layer comprised a typical (but unsensitized) commercially available capillary screen film - "Autoline HD" (b) - consisting of a pigmented polyvinyl alcohol/polyvinyl acetate emulsion on a support base, with an approximate emulsion (stencil-forming agent) thickness of 15  $\mu$ m.

[0048] A degreased screen mesh of mesh count 120 threads per cm was mounted in a suitable frame, then the mesh was wetted thoroughly with a gentle spray of water and the receptor element was rolled down the mesh using light pressure. Slight pressure was applied to the print side of the receptor element by squeegee, then excess water was removed from the opposite side of the screen, followed by drying the screen using a fan with a maximum temperature of 40 °C. The support base was removed from the mesh.

[0049] The resulting screen was positioned in a Gerber ScreenJet apparatus to the manufacturer's instructions, then the prepared chemical agent was applied to the stencil-forming layer of the screen from a cartridge in a preprogrammed manner to form the desired image. The imaged screen was removed from the "ScreenJet" apparatus and dried by warm air fan (maximum 40 °C) to produce on the screen a stencil-forming layer having areas of lower and higher solubility. Any remaining unreacted part of the receptor element was removed and the screen was washed out using cold running water, until the portion of the assembly of higher solubility was washed away to waste.

[0050] The stencil was then placed in a standard screen printing machine and prints of an acceptable quality were obtained using standard solvent-based screen printing inks.

#### EXAMPLE 2

[0051] A liquid containing a chemical agent was prepared according to the formula:

water - 87 wt.%;  
potassium tetraborate - 10 wt.%; and  
"Fluorad FC-93" (a) (1wt. % aqueous solution) - an-  
ionic fluorinated surfactant - 1 wt.%.

[0052] The stencil-forming agent comprised a typical (but unsensitized) polyvinyl alcohol/polyvinyl acetate screen emulsion - "2000" (b). This was directly coated onto a suitably degreased screen mesh of 120 threads per cm., mounted in a suitable frame. Using a coating trough, two coats of this emulsion were applied, wet on wet, to the print side of the screen, followed by two coats, wet on wet, to the other side of the screen. The resulting screen was then dried horizontally, print side down using a warm air fan at a maximum temperature of 30 °C.

[0053] The resulting screen was positioned in the "ScreenJet" apparatus according to the manufacturer's

instructions, then the prepared chemical agent was applied to the stencil-forming layer of the screen from a cartridge in a preprogrammed manner to form the desired image. The imaged screen was removed from the "ScreenJet" apparatus and dried by warm air fan (maximum 40 °C) to produce on the screen a stencil-forming layer having areas of lower and higher solubility. Any remaining unreacted part of the receptor element was removed and the screen was washed out using cold running water, until the portion of the assembly of higher solubility was washed away to waste.

**[0054]** The stencil was then placed in a standard screen printing machine and prints of an acceptable quality were obtained using standard solvent-based screen printing inks.

#### EXAMPLE 3

**[0055]** The procedure of Example 1 above was repeated exactly to produce a screen stencil.

**[0056]** This stencil was then treated with a 10 wt.% aqueous solution of potassium carbonate, which was applied by brush so as to cover the entire stencil area, then finally allowed to dry. This produced a toughened stencil.

**[0057]** The stencil was then placed in a standard screen printing machine and prints of an acceptable quality were obtained using standard solvent-based screen printing inks.

#### EXAMPLE 4

**[0058]** The procedure of Example 1 above was repeated exactly to produce a screen stencil.

**[0059]** This stencil was then treated with a 2 wt.% solution of 35 wt.% hydrochloric acid, which was applied by brush so as to cover the entire stencil area. This treatment disrupted the screen stencil and allowed the resulting residue to be washed away to waste using a cold water spray, giving a reclaimed screen with no observable stain present.

#### Claims

1. A method of producing a screen-printing stencil having open areas and blocked areas for respectively passage and blocking of a printing medium, the method comprising:

providing a screen-printing screen having a stencil-forming layer coated thereon;  
positioning the coated screen for application thereto dropwise of a chemical agent capable of reacting with the stencil-forming layer to produce areas thereof having lower and higher solubilities corresponding respectively to the blocked and the open stencil areas;

applying dropwise to the coated screen the chemical agent under control of data encoding the respective lower and higher solubility areas; and

washing away the stencil-forming layer in the areas of higher solubility, thereby to produce the screen-printing stencil.

2. A method according to claim 1, wherein the stencil-forming layer is applied to the screen by means of a coated film comprising a support base and a layer of the stencil-forming material which is transferred to the screen in the application step.

3. A method according to claim 2, wherein the support base comprises polyethylene terephthalate, polyethylene, polycarbonate, polyvinyl chloride, polystyrene or a coated paper.

4. A method according to claim 2 or 3, wherein the layer of stencil-forming material on the support base has a thickness of from 5 to 100 µm.

5. A method according to claim 1, wherein the stencil-forming layer is applied to the screen as a liquid which is subsequently caused or allowed to dry to form the stencil-forming layer.

6. A method according to any preceding claim, wherein the chemical agent is produced *in situ* by reaction between two or more precursor materials, separately applied to the stencil-forming layer, at least one of which is applied dropwise in the said areas corresponding to the blocked areas of the stencil to be produced.

7. A method according to any preceding claim, wherein the stencil-forming layer comprises one or more of the following polymers:

polyvinylalcohol and its derivatives;  
gelatin and its derivatives;  
water-soluble cellulose derivatives, including starch and hydroxy propyl cellulose;  
epoxy resins; and  
amino resins, including urea-formaldehyde and melamine-formaldehyde.

8. A method according to claim 7, wherein the stencil-forming layer comprises polyvinyl alcohol with a degree of hydrolysis of from 20 to 99.9 mole % and/or a degree of polymerisation of from 100 to 3500.

9. A method according to claim 7 or 8, wherein the polymer(s) is/are present in the stencil-forming layer in a total amount of 5 to 100 wt % of the stencil-forming layer.

10. A method according to claim 9, wherein the stencil-forming layer contains one or more of: fillers, binders and plasticisers.
11. A method according to any preceding claim, wherein the active component(s) of the chemical agent comprises one or more of:
- boron salts, including boric acid, and Group I and Group II metal borates;
  - aldehydes, e.g. formaldehyde;
  - dialdehydes, e.g. glyoxal and glutaraldehyde, which may be activated by treatment with mineral acid;
  - isocyanates and their derivatives, including toluenediisocyanate;
  - carbodiimides and their derivatives, including pentahydroxy (tetradecanoate) dichromium and its derivatives; aziridine and its derivatives; amines;
  - multifunctional silane compounds, including silicon tetraacetate;
  - N-methylol compounds, including dimethylolurea and methyloldimethylhydantoin; and
  - active vinyl compounds, including 1,3,5-triacryloyl-hexahydro-s-triazine.
12. A method according to any preceding claim, wherein the active component(s) of the chemical agent constitutes from 0.5 to 100 wt.% of the chemical agent.
13. A method according to claim 6, wherein the chemical agent precursor applied in the areas corresponding to the blocked areas of the stencil to be produced comprises a reactive dialdehyde and a further chemical agent precursor is a dilute acid.
14. A method according to claim 13, wherein the reactive aldehyde is water-soluble, for example glyoxal and glutaraldehyde.
15. A method according to claim 13 or 14, wherein the dilute acid is an acid, for example hydrochloric acid or citric acid, which lowers the pH to 4 or less when mixed with the dialdehyde.
16. A method according to any preceding claim, wherein the stencil is further toughened by a post-treatment using one or more further chemical agents, actinic radiation or heat.
17. A method according to claim 16, wherein the further chemical agent(s) for the further toughening are resident in the original stencil-forming agent or layer.
18. A method according to claim 17, wherein the further chemical agents are applied dropwise.
19. A method according to any of claims 16 to 18, wherein the further chemical agent(s) include an aqueous base, for example, potassium carbonate.
20. A method according to any preceding claim, including a further, reclaim step.
21. A method according to claim 20, wherein the chemical agent which reacts with the stencil-forming layer comprises a borate and the reclaim is carried out at a pH of 4 or less.

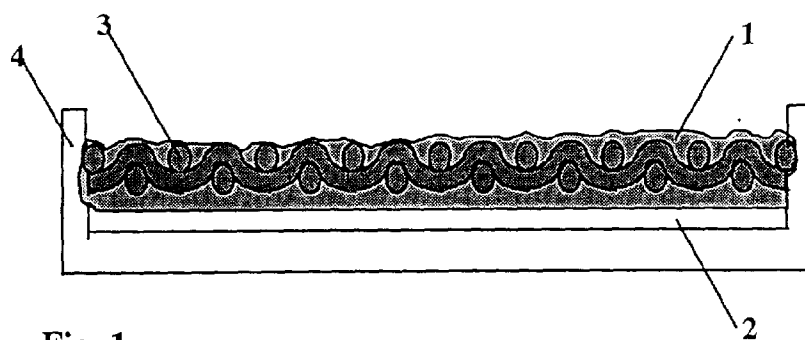


Fig. 1

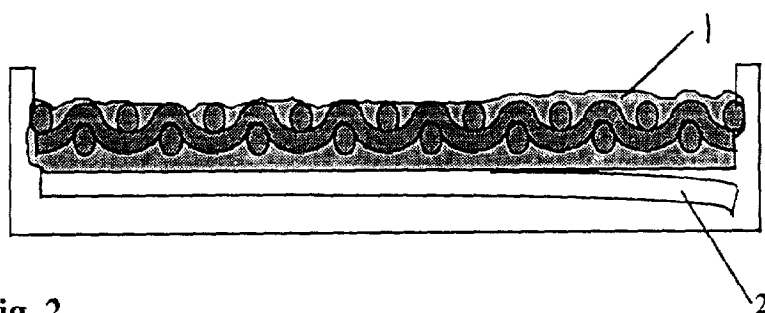


Fig. 2

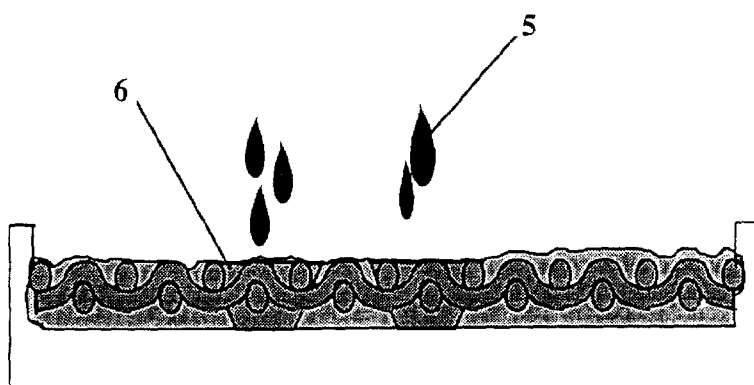


Fig. 3

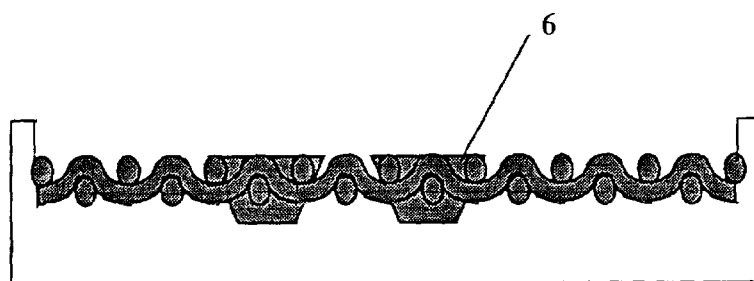


Fig. 4

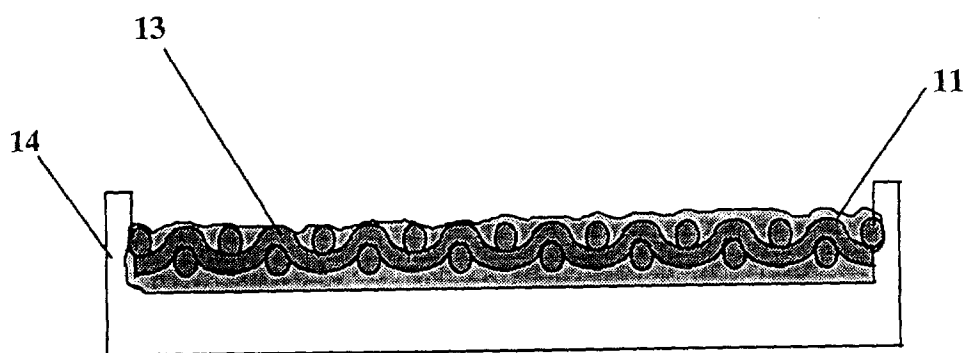


Fig. 5

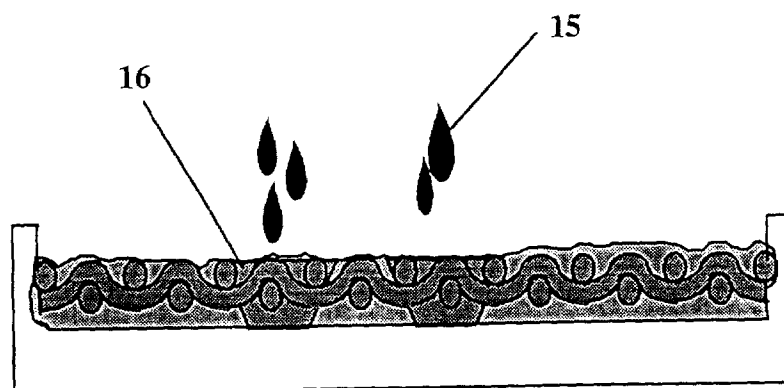


Fig. 6

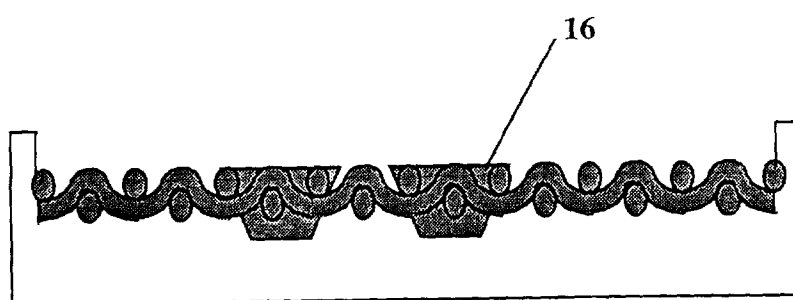


Fig. 7



European Patent  
Office

## EUROPEAN SEARCH REPORT

Application Number  
EP 98 30 7721

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
E	EP 0 883 026 A (EASTMAN KODAK CO) 9 December 1998 * the whole document *	1-21	B41C1/14
X	GB 1 431 462 A (AGFA GEVAERT AG) 7 April 1976	1-21	
Y	* the whole document *	16-21	
Y	US 5 654 032 A (GYBIN ALEXANDER S ET AL) 5 August 1997 * column 11, line 21 - line 28; claims *	16-21	
Y	EP 0 671 268 A (SONY CORP) 13 September 1995 * claim 8 *	18	
A	EP 0 588 399 A (DUCHOVNE YORAM) 23 March 1994 * the whole document *	1	
A	US 5 466 653 A (MA SHEAU-HWA ET AL) 14 November 1995 * the whole document *	1	TECHNICAL FIELDS SEARCHED (Int.Cl.6)
A	US 5 292 556 A (MATTHEWS ANDREW E ET AL) 8 March 1994 * the whole document *	1	B41C B41N B41M
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 26 February 1999	Examiner Rasschaert, A
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03 82 (P4/C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 98 30 7721

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
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