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(12) # EUROPEAN PATENT APPLICATION

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(71) Applicant: **COLOUR ACTIVATED TRANSILLUMINATION SYSTEMS LTD.**
2 Samuel Ogden Street
Manchester, M1 7BP(GB)

(72) Inventor: **Hooper, Keith Gifford Harlan**
Orchard Cottage
Broadhempston Devon TQ9 6BD(GB)

(74) Representative: **Austin, Hedley William et al,**
A.A. THORNTON & CO. Northumberland House 303-306
High Holborn
London WC1V 7LE(GB)

(54) **Printing process.**

(57) A coloured design is printed onto a polymer surface (preferably by a four-colour printing process) such that the design penetrates into the polymer surface and cannot be erased by solvent action or mechanical abrasion without destruction of the surface. The polymer is preferably in the form of a sheet, film or coating and the non-printed surface is subjected to elevated temperature before or during application of the printed design.

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Printing Process

The present invention is concerned with a method of printing the surfaces of synthetic polymer materials. There are many known ways of printing the surfaces of synthetic polymer materials, such as lithographic processes, silk screen processes, transfer processes, ink jet printing processes and intaglio (gravure) processes.

Conventional methods of applying multi-coloured designs to polymer surfaces include silk screen printing and transfer printing. Silk screen printing has the disadvantages that it is difficult to obtain accurate registration and fine definition, and transfer printing has the disadvantage that a different pigment is required for each colour required in the final printed design: for a multi-coloured design, many pigments, for example, up to 16 different pigments, may be required. For each different pigment, a separate printing roller is required and the use of such a large number of printing rollers causes severe difficulties in obtaining colour registration.

According to the present invention, there is provided a method of printing a coloured printed design on a polymer body, in which the printed

design penetrates into the surface of said polymer body such that it cannot be erased by solvent action or mechanical abrasion without destruction of said surface.

The method according to the invention may be a four-colour printing process, which involves making four colour-separation negatives from the desired design by means of colour filters (the four colours being, for example, magenta, yellow, cyan and black), preparing corresponding printing plates from each of the colour-separation negatives and printing on the polymer surface using each of the resulting printing plates, in succession and in register, using an appropriate ink for each printing plate. (The term "printing plate" as used herein includes other printing surfaces, such as printing rollers.)

This corresponds generally to a known four-colour process and enables designs to be obtained with any desired colours, by suitable choice of coloured inks and overlap of printed dot areas, as appropriate. The four-colour process has, until now, only been used for printing on the surfaces of paper, paper articles, and the like. In order to adapt the process known for four-colour printing of paper for printing of polymer surfaces, we ensure that the inks penetrate the polymer surface. In addition, we generally prefer to employ colour separation obtained by electronic scanning; this enables optimised colour separation to be obtained, relevant to the substrate being printed. If colour separation is carried out as if for the known four-colour printing of paper, it is generally necessary to modify the colour and/or composition of the inks used; an appropriate combination of inks can generally be arrived at empirically, but this is generally less satisfactory than preparing colour separation negatives specific to the surface to be printed.

The or each printing plate used in the method according to the invention is preferably gravure, lithographic or flexographic; the or each printing plate may be prepared

by a generally conventional process, such as screening.

The polymer which is printed according to the invention may be in any suitable physical form, such as in the form of a 3-dimensional moulded article or in laminar form (such as a film, sheet, coating or textile fabric).

By way of example, when the polymer is in the form of a film, sheet or moulded article, it may be made of a thermoplastic polymer, such as a polyester, nylon, polypropylene, polystyrene (including high impact polystyrene), an acrylic polymer, a polycarbonate, polyvinyl chloride, a cellulosic polymer, or a thermoset polymer such as

an alkyd, an unsaturated polyester, an epoxy resin, a phenoplast or an aminoplast. The polymer may, when in the form of a moulded article, contain conventional reinforcement, such as, for example, glass fibres.

Such polymers may also be used in the method according to the invention in the form of a coating on, for example, wood, hardboard, chipboard, laminated plastics, metals (such as etched metals or anodised aluminium) or ceramics.

When the polymer is in the form of a coating, it may have been applied, for example, by spraying (e.g. electrostatic spraying) or curtain coating; the coating may be a stoved coating. When the substrate is a ceramic article (such as a ceramic tile),curtain coating is preferred, whereas when the substrate is a metal, electrostatic spraying is preferred.

When the polymer printed according to the present invention is a textile, it may be, for example, of polyamide, polyester, and acrylic polymer, or polypropylene. In a modification of the process according to the invention, when the article being printed is a textile, then the polymer may comprise a natural polymer, in addition to, or instead of, a synthetic polymer. Examples of such natural polymers include wool and cotton textiles.

Such textiles may, for example, be in the form of woven fabric, knitted fabric, or even open mesh net.

The coloured inks used in the method according to the invention preferably comprise dyes or pigments in an oil or resin base; solvent free inks are sometimes preferred. Examples of suitable inks are available commercially from Coates Brothers under the designation Lithotex 137 17/220. Such inks have good colourfastness and are resistant to washing, perspiration, dry cleaning, rubbing and gas-fading.

When the polymer body to be printed is in laminar form and the printed design is applied to one surface thereof, in a particularly preferred embodiment, the other surface thereof is subjected to elevated temperature and pressure before or during application of the printed design (for example, by means of a heated press plate). The elevated temperature employed is preferably from 100 to 220°, more preferably 110 to 180°C. Higher temperatures in the above ranges can be employed when the polymer is relatively thermally stable (such as a polyurethane) or in the form of a coating on a thermally stable backing (such as PVC or a polyurethane on a thermally stable fabric backing).

The pressure employed may be from 1 to 400 psi, preferably from 50 to 200 psi. Lower pressures are generally employed for thinner polymer substrates and higher pressures for thicker substrates. For example, a pressure as low as 1 psi can be used when printing a very thin PVC film, such as one having a thickness as low as 12, or where low gloss is wanted.

In some cases, the polymer substrate can be laminated to another polymer layer at the same time as the printing process according to the invention is carried out. When the polymer is subjected (on its non-printed surface) to elevated temperature and pressure, the printing may be carried out by a transfer process as an alternative to the four-colour process described above.

A glossy finish can be applied to the print by the use of a glossy transfer paper and/or by the use of glazing rollers.

When the polymer substrate is plasticised, the plasticiser should not be such as to allow too much migration of dye away from areas to be printed. Accordingly, when the polymer is PVC, it desirably is not plasticised by means of styrene-butadiene copolymer.

A polymer body which is printed according to the invention may act as a support for the printed design, the

printed body being bonded to an article it is wished to decorate, either with the printed design on the polymer surface facing the article to be decorated (in which case the polymer would, of course, be transparent) or with another surface adhered to the final substrate.

It should be emphasised that the method according to the invention results in printing, not just on the surface, but penetration of dyes into the layer adjacent the surface, making the resulting printed designs more permanent than those obtained in prior processes (that is, the printed design cannot be erased by solvent action or mechanical abrasion without destruction of the polymer surface).

In order that the present invention may be more fully understood, the following Examples are given by way of illustration only.

Example 1

One surface of unsupported PVC film was heated by a heated press plate at 110°C for a dwell time of 80 seconds and a pressure of 200 psi, and the other surface thereof was printed by a four-colour printing process. Excellent colour reproduction and print clarity was obtained.

Example 2

Example 1 was repeated using a dwell time of 50 seconds and a pressure of 100 psi, the printing being lithographic using two colours. Good colour reproduction and print clarity was obtained.

Example 3

One surface of unsupported PVC film was heated by a heated press plate at 110°C for a dwell time of 40 seconds and a pressure of 100 psi, and the other surface thereof was gravure printed in three colours to form a checked pattern. Excellent colour reproduction and print clarity was obtained.

Example 4

One surface of unsupported PVC film was heated by a heated press plate at 150°C for a dwell time of 30 seconds

and a pressure of 100 psi. The other surface was screen printed in multiple colours; excellent colour reproduction and print clarity were obtained.

Example 5

Example 1 was repeated. using a temperature of 160°C and a dwell time of 40 seconds; similar results were obtained.

Example 6

One surface of rigid PVC (of the type and thickness used for credit cards) was pressed by means of a press plate at 140°C for a dwell time of 30 seconds under a pressure of 1 psi and then the other surface was printed as in Example 1;similar results were obtained.

Examples 7 and 8

PVC coated cotton fabric was pressed on the cotton surface by means of a press plate at110°C for 50 seconds and 40 seconds, respectively, using a pressure of 100 psi. The other surface was then printed as in Example 1; similar results were obtained.

CLAIMS

1. A method of printing a coloured design on a polymer body, in which the printed design penetrates into the surface of said polymer body such that it cannot be erased by solvent action or mechanical abrasion without destruction of said surface.

2. A method according to claim 1, which is a four-colour printing process.

3. A method according to claim 1 or 2 wherein the polymer body is in laminar form and the printed design is applied to one surface thereof, in which the other surface thereof is subjected to elevated temperature and pressure before or during application of said printed design.

4. A method according to claim 3, in which said elevated temperature is 100 to 220°C

5. A method according to claim 3 or 4, in which said pressure is from 50 to 200 psig.

6. A method according to any of claims1 to 5, in which said polymer is polyvinyl chloride.

7. A method according to claim 6, in which the polyvinyl chloride is in the form of a sheet or film, or a coating on a fabric.

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EUROPEAN SEARCH REPORT

0121323
Application number

EP 84 30 1290

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. ³)
X,Y	FR-A-2 318 193 (OZALID) * Page 1, lines 6-10; page 3, line 15 - page 4, line 4; page 5, lines 9-14 *	1-7	B 41 M 1/30 B 41 M 1/18
X,Y	GB-A-1 047 619 (NATIONAL DISTILLERS AND CHEMICAL) * Claims; page 2, lines 20-53 *	1-7	
X,Y	DE-A-3 021 022 (CP-COMPONENTS KUNSTSTOFFBAUTEILE) * Figure; page 8, lines 13-15; page 9, line 27 - page 10, line 7; page 11, lines 16-18 *	1-7	
Y	US-A-2 236 754 (I. GURWICK) * Page 1, right-hand column, lines 5-11; figure *	1,3	
X	FR-A-2 279 559 (ATO CHIMIE) * Claims *	1-7	B 41 M 1/30 B 41 M 1/18
X	US-A-3 519 466 (AKIYUKI AKAMATSU) * Claim 7; column 1, lines 50-54; column 6, lines 8-45 *	1-7	
X	DE-A-2 315 873 (DÄTWYLER AG) * Claims 1,2 *	1-7	

TECHNICAL FIELDS SEARCHED (Int. Cl. ³)

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	29-05-1984	RASSCHAERT A.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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D : document cited in the application
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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. ³)
X	FR-A-1 365 679 (PIRELLI PLAST) * Abstract *	1-7	
A	GB-A- 600 999 (W.E.F. GATES) * Claims *	1	
A	WO-A-8 103 462 (CUSTOR) * Figures *	1-7	
			TECHNICAL FIELDS SEARCHED (Int. Cl. ³)

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THE HAGUE	29-05-1984	RASSCHAERT A.

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