(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 734 880 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
02.10.1996 Bulletin 1996/40

(51) Int Cl.[6]: **B41M 1/28**, B41M 5/035

(21) Application number: **96302159.7**

(22) Date of filing: **28.03.1996**

(84) Designated Contracting States:
AT BE CH DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE

(30) Priority: **28.03.1995 US 412020**

(71) Applicant: **ZIPPO MANUFACTURUNG COMPANY**
Bradford, Pennsylvania 16701 (US)

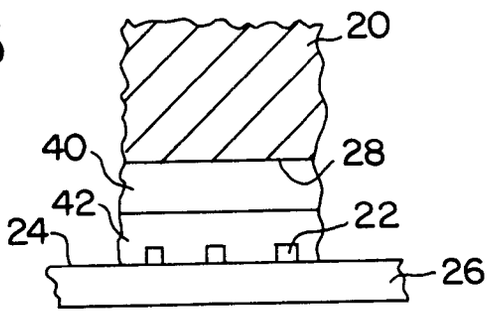
(72) Inventors:
- **Meister, Ronald J.**
  Bradford, Pennsylvania 16701 (US)
- **Songer, Lauren J.**
  Emporium, Pennsylvania 15834 (US)
- **Crumrine, Myron A.**
  Bradford, Pennsylvania 16701 (US)

(74) Representative: **Smaggasgale, Gillian Helen et al**
Mathys & Squire,
100 Grays Inn Road
London WC1X 8AL (GB)

(54) Method of thermally transferring printing onto a metal substrate and article manufactured thereby

(57) A method of thermally transferring printing onto a metal substrate surface and an article such as a cigarette lighter containing such printing. A white coating followed by a transparent coating are applied to the substrate surface, and printing is thermally transferred from a transfer media onto the substrate surface. The coatings are preferably electrostatically applied.

FIG. 3



EP 0 734 880 A1

Description

The present invention relates generally to thermal transfer printing, sometimes referred to as sublimation, thermostatic, or dye diffusion printing. More particularly, the present invention relates to thermally transferring printing onto a metal substrate such as, for example, thermally transferring a colored image onto a cigarette lighter.

In the dye diffusion printing process, color images are preprinted onto a transfer media in reverse using thermal transfer inks. The conventional process is illustrated in Fig. 1. The substrate 12 to be printed is placed on a block 16 of resilient heat resistant material. The printed media 10, commonly referred to as a transfer, is placed on the substrate 12 and subjected to heat and pressure, as illustrated at 14, by means of rigid heated platen 18. The transfer 10 is thus sandwiched between the platen 18 and the substrate 12 for thermal transfer of the printing from the transfer 10 onto the substrate 12. When the transition temperature of the printed dyes is reached, the dyes either gasify or liquify and migrate from the transfer 10 to the substrate 12 being printed and are absorbed into the substrate surface.

The dye diffusion printing process is commonly employed in the printing of wearables by garment manufacturers and specialty shops. Unlike other surface printing methods, the suitability of substrates for dye diffusion printing is limited by their absorption characteristics and receptivity to the dyes being used. As a result, the process historically has been limited to the transfer of printing onto cloth.

When the transfer is sandwiched between the platen 18 and substrate 12 for dye diffusion printing, as illustrated in Fig. 1, the transfer paper 10 undesirably acts as an insulative thermal barrier between the heat source (platen) and the part (substrate) being printed. See U. S. patents 5,260,127 to Umise et al and 5,322,751 to Chou et al, which are hereby incorporated herein by reference, relative to this thermal barrier effect.

U.S. patent 5,336,658 to Edwards, which is hereby incorporated herein by reference, discloses a thermal transfer printing receiver comprising a substrate containing particulate metal salts or metal oxides, a protective polymeric interlayer of an acidic polymer composition, and a receiver coat of dye-receptive polymer containing a crosslinked silicone release system and having a softening temperature below the temperature used during printing. The purpose of the interlayer is stated to be to alleviate problems with the effectiveness of the release system when the substrate contains particulate metal oxides or metal salts. None of the disclosed substrates are metallic. In one example, a substrate has a white coating of rutile titanium dioxide dispersed in a polyester urethane binder.

Since the dyes in the Edwards process penetrate the pigment-containing coating, any amount of pigment therein would be in competition with the dyes. As a result, color density may be sacrificed and results washed out.

The polyester urethane binder of Edwards would require a solvent system so that it could be applied in a liquid form. Solvents compatible with polyester urethane resins are generally considered to be very aggressive and hazardous.

Other art which may be of interest are U.S. patents 5,096,877; 5,262,231; and 5,314,862. The latter patent discloses a transparent layer and a white opacifying layer laminated on a thermal transfer sheet.

The absorption characteristics and receptivity to dyes of metals are such that they must first be coated with typically a transparent coating before they can be dye diffusion printed. The prints on such coated metals have undesirably been metallic in appearance and with limited color density and definition, and the full color range has been limited.

It is accordingly an object of the present invention to provide a high quality thermal transfer of printing onto a metallic object without resulting in the metallic appearance to the printing.

It is another object of the present invention to produce high resolution, high density, full color prints on metallic objects.

It is a further object of the present invention to eliminate or reduce the use of hazardous solvents during such a process.

It is yet another object of the present invention to provide such printing inexpensively.

In order to provide a high quality printed metal object without the metallic appearance to the printing, in accordance with the present invention, a white coating then a transparent coating is applied to the metal object after which the printing is thermally transferred onto the object. The white coating as well as the transparent coating are applied preferably electrostatically whereby a hazardous solvent is not required. Heat is transferred from the heat source through the metallic object to the transfer media whereby the metallic object may reach a suitable temperature before heat is supplied to the transfer sheet for effective and consistent results.

The above and other objects, features, and advantages of the present invention may be found in the following detailed description of the preferred embodiments thereof when read in conjunction with the accompanying drawings wherein the same reference numerals denote the same or similar parts throughout the several views.

In the Drawings:

Fig. 1 is a schematic sectional view illustrating a thermal transfer printing process in accordance with the prior art.

Fig. 2 is a schematic sectional view illustrating a thermal transfer printing process in accordance with the present invention.

Fig. 3 is a schematic enlarged partial sectional view of the metallic substrate to be printed and of the transfer

media.

Detailed Description of the Preferred Embodiments

Referring to Figs. 2 and 3, there is illustrated at 20 a metal substrate which is being dye diffusion printed in accordance with the present invention. The printed image, illustrated schematically at 22, is contained in reverse on a surface 24 of a transfer media 26 which surface 24 is brought into contact with the rigid substrate surface 28 to receive the printing 22. By "printing" is meant to not only include letters and numbers and other symbols but also other images such as provided by pictures. The substrate 20 and transfer 26 are placed between a rigid heated platen 30 and a resilient heat resistant block 32 and heat and pressure suitably applied, as illustrated at 34, for transferring the printing 22 onto the substrate 20. When the transition temperature of the printed dyes is reached, the dyes gasify (or may be such as to liquify) and migrate from the transfer 26 to the substrate surface 28 to be printed for absorption into the substrate surface 28.

The printability of substrates by the use of dye diffusion printing is limited by their absorption characteristics and receptivity to the dyes being used. This has historically resulted in the dye diffusion printing process being limited generally to the printing of cloth substrates. The application of transparent coatings to metals to allow absorption and receptivity of the dyes has still undesirably resulted in the prints on the metals being metallic in appearance with limited color density and definition and limited full color range. Referring to Fig. 3, in order to provide a higher quality printing onto the metal substrate 20 without the metallic appearance, in accordance with the present invention, a white opacifying base coat, illustrated at 40, is first applied to the substrate surface 28 to provide maximum adhesion and coverage over the metal, the white coating providing opaqueness to eliminate the metallic appearance and allowing a full range of color to be printed thereon with the coating serving as the color white. The pigment for the white base coat 40 may be titanium dioxide or other suitable pigment. A transparent finish coat, illustrated at 42, is then applied over the white coat 40 to provide maximum receptivity to the thermal transfer dyes with minimum color loss and bleed.

The transition temperature of the finish coat 42 is preferably close to the gasification temperature of the dyes in the transfer 26 so that the coatings may be softened during the transfer printing process to promote transfer and improve color density. For example, the finish coat 42 may be a polyester resin having a transition temperature of about 395°F which is close to the typical gasification temperature of about 400°F of the dyes.

A polyester urethane binder for the finish coat would require a solvent system so that it could be applied in a liquid form. The solvents typically compatible with polyester urethane resins are considered to be very aggressive and hazardous. In order to eliminate the safety and environmental problems inherent in applying conventional solvent based polyester urethane coatings as well as other solvent based coatings, in accordance with the present invention, the coating 42 as well as coating 40 is preferably electrostatically applied in accordance with principles commonly known to those of ordinary skill in the art to which this invention pertains, the metal substrate 20 being electrically conductive to allow such electrostatic application. The transparent coating 42 is preferably a transparent polyester resin which has been ground into a powder. The electrostatic application of the white base coating 40 has the added advantage of providing an even application over the substrate surface 28 so that a higher quality printed image may be achieved. The white base coating 40 may alternately, however, be applied as a water-based pigment.

It should be noted from Fig. 1 that the conventional dye diffusion printing process shown therein requires the thermal conductive path of the heat in the rigid heated platen to be through the transfer media then into the substrate being printed. This heating of the transfer sheet from the backside results in the paper of the transfer sheet disadvantageously acting as an insulative thermal barrier between the heat source and the part being printed. In addition, the rigid platen will not conform to an irregular substrate surface thereby inhibiting heat transfer and transfer of the printing. Referring to Fig. 2, in order that the metal substrate 20 may advantageously reach a suitable temperature before heat is supplied to the transfer sheet 26, in accordance with a preferred embodiment of the present invention, the heat source 30 is applied directly to the metal substrate 20, i.e., the substrate 20 is positioned between the heat source 30 and the transfer sheet 26 so that heat is transferred from the heat source 30 through the substrate 20 to the transfer media 26. This also advantageously positions the resilient heat resistant block 32 next to the transfer 26 so that it conforms to an irregular substrate surface 28 for improved heat transfer and transfer of the printing.

The use of the conventional silk screen process for providing the printing directly on the substrate using wet inks (no transfer sheet being involved) requires a screen for each color with the screens requiring registration which is difficult and results in rejects if the screens are not adequately registered. Such a process also does not allow shades or halftones and does not provide images which appear photographic. In order to achieve improved color densities and line screen definitions while eliminating such registration problems, in accordance with a preferred embodiment of the present invention, the transfer 26 is printed using four-color lithographic offset printing, which is a process commonly known to those of ordinary skill in the art to which this invention pertains. In this process, the image to be applied is scanned and then broken down into color dots through computerization. A printing plate is then generated for each of the three primary colors and the color black.

Each color is then printed in turn at respective stations. The printing plates are held captive so that there are no registration problems. The printing inks used may be the same as commercially available inks conventionally used for dye diffusion printing onto fabric. For example, such inks may be sublimation inks commercially available from Superior Printing Inks, Inc. of Cheektowaga, New York. The carrier media 26 is suitably a conventional paper material which maximizes the yield and eliminates sticking to the coated substrate surface 28. The resulting high receptivity of the coating and maximum yield characteristics of the carrier media are desired to allow transfers to be printed at improved color densities and line screen definitions.

In order to provide a finer grain so that a clearer and sharper image may be printed, in accordance with an alternative embodiment of the present invention, the transfer sheet 26 is printed by use of a process commonly known as a "continuous tone" process which prints dashes rather than dots. Such a process is commonly known to those of ordinary skill in the art to which this invention pertains. A full color continuous tone printer is commercially available from Eastman Kodak Company of Rochester, New York and identified as 1525+ copier/printer. Such a printer preferably includes digital imaging so that the printing cost may be reduced.

It should be understood that, while the invention has been described in detail herein, the invention can be embodied otherwise without departing from the principles thereof, and such other embodiments are indeed meant to come within the scope of the present invention as defined in the appended claims.

According to a second aspect of the present invention there is provided an article of manufacture comprising a metal substrate having a surface, a white coating on the substrate surface, a transparent coating over the white coating and printing on the coated substrate surface wherein the printing has been applied in accordance with the method of the above first aspect.

It will be understood that the metal substrate may be any suitable substrate including knives, jewellery, boxes and other containers of metal car body panels, body panels for scooters, motor bikes, mud guards, bicycle frames, handle bars, pedals, metallic accessories, cigar cutters, cigarette boxes, cigarette lighters, smokers' accessories, key rings, badges, bottle openers, hand tools, culinary utensils, metal table wear, metal cook wear, small domestic utensils and containers made of metal, sporting articles made of metal, and the like.

Claims

1. A method of applying printing onto a metal substrate surface comprising the steps of (a) applying a white coating to the substrate surface, (b) applying a transparent coating over the white coating, and (c) thermally transferring printing from a transfer media onto the coated substrate surface.

2. A method according to Claim 1 further comprising selecting a pigment for the white coating to be titanium dioxide.

3. A method according to Claim 1 or 2 comprising electrostatically applying the white coating, the transparent coating or both the white coating and the transparent coating.

4. A method according to any one of Claims 1 to 3 further comprising selecting the transparent coating to be composed of a polyester resin.

5. A method according to any one of Claims 1 to 4 further comprising selecting the transparent coating to have a transition temperature which is substantially equal to the gasification temperature of dyes in the transfer media.

6. A method according to any one of Claims 1 to 5 comprising thermally transferring colored printing from the transfer media onto the coated substrate surface.

7. A method according to any one of Claims 1 to 6 wherein the step of thermally transferring printing comprises transferring heat from a heat source through the substrate to the transfer media.

8. A method according to any one of Claims 1 to 7 wherein the step of thermally transferring printing comprises positioning the transfer media between the substrate surface and a resilient member for conforming of the resilient member to an irregular substrate surface.

9. A method according to any one of Claims 1 to 8 wherein the step of thermally transferring printing comprises applying the transfer media to the substrate surface, applying a resilient member to the transfer media for conforming of the resilient member to the substrate surface, and applying a heat source to an opposite surface of the substrate to transfer heat through the substrate to the transfer media.

10. A method according to any one of Claims 1 to 9 further comprising forming printing onto the transfer media by lithographic offset printing, by continuous tone printing or by continuous tone digital imaging printing.

11. An article of manufacture comprising a metal substrate having a surface, a white coating on said substrate surface, a transparent coating over said white

coating, and means defining printing on said coated substrate surface which has been thermally transferred thereon.

12. An article according to Claim 11 wherein said white coating comprises titanium dioxide.

13. An article according to Claim 11 or Claim 12 wherein said printing is colored printing.

14. An article according to any one of Claims 11 to 13 wherein said transparent coating is composed of polyester resin.

15. An article according to any one of Claims 11 to 14 wherein the metal substrate is the casing for a cigarette lighter.

FIG. 1 PRIOR ART

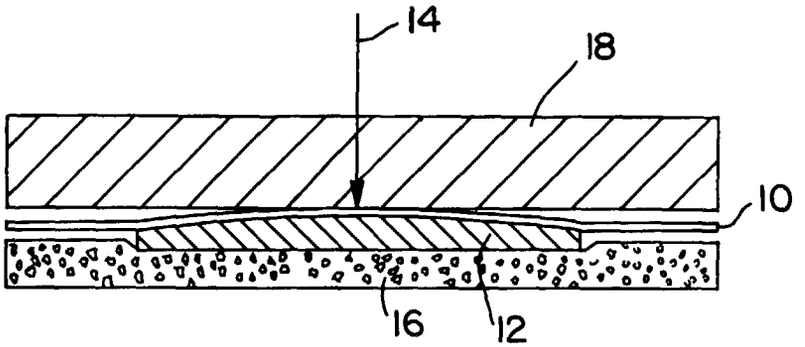


FIG. 2

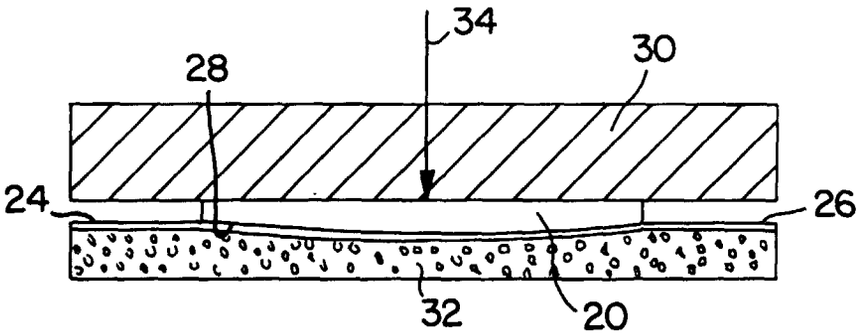
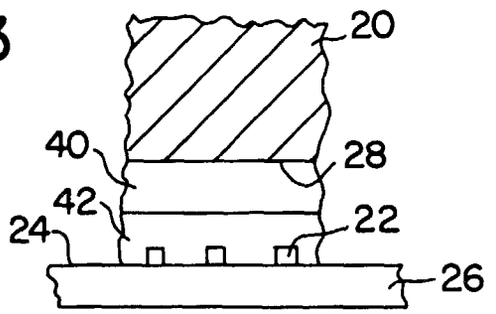


FIG. 3



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 96 30 2159

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.6)
X Y	DE-A-28 17 566 (DAVIS ROY ELBERT) 26 October 1978 * page 8, line 17 - line 25; claim 15 * * page 20, line 12 * ---	1-15 1-15	B41M1/28 B41M5/035
X Y	GB-A-2 101 529 (METAL BOX CO LTD) 19 January 1983 * page 2, line 69 - line 70; figures * ---	1-15 1-15	
X	WO-A-93 04872 (TRUCHAN GARY ;COMPTON JACK (US)) 18 March 1993 * page 9, line 14 - line 17; figure 2 * * page 12, line 11 * ---	1	
X	EP-A-0 014 901 (KOLLOID CHEMIE) 3 September 1980 * page 14, line 21 * * page 15, line 29-30 * ---	1	
Y	US-A-5 318 942 (LAUDY ROGER K) 7 June 1994 * the whole document * ---	8,9	TECHNICAL FIELDS SEARCHED (Int.Cl.6)
Y	FR-A-2 521 489 (SCHUHL JEAN) 19 August 1983 * page 2, line 24 * * page 2, line 38 * ---	4,8,9	B41M
Y	GB-A-2 049 554 (WOON WAI TSE) 31 December 1980 * the whole document * ---	7	
Y	US-A-4 758 952 (HARRIS JR CHARLES F ET AL) 19 July 1988 * the whole document * ---	10	
Y	FR-A-2 230 794 (SUBLISTATIC HOLDING SA) 20 December 1974 * page 7, line 1 - line 10 * ---	2,3	
	-/--		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	5 July 1996	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 (P04C01)

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 96 30 2159

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.6)
Y	FR-A-2 501 594 (MUSER PETER) 17 September 1982 * the whole document *	2,3	
Y	PATENT ABSTRACTS OF JAPAN vol. 017, no. 229 (M-1406), 11 May 1993 & JP-A-04 358877 (YAKA FUUDORU KK;OTHERS: 01), 11 December 1992, * abstract *	15	
A	DE-A-40 11 215 (LAVEZZARI S P A) 18 October 1990 * the whole document *	1	
A	CH-A-627 970 (TRANSFERTEX THERMODRUCK SYSTEM) 15 February 1982 * the whole document *	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	5 July 1996	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 (P04C01)