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(54) **Method for preventing color copying of documents.**

(57) A method of producing a certificate on a substrate which is difficult to reproduce using color copiers including the steps of printing a first portion of the certificate in a first color and printing the second portion of the certificate in a second color, wherein the first and second portions have substantial color contrast in the original and, when reproduced using conventional color copiers, have substantially the same color. Preferably, the step of printing the second portion includes printing with a fluorescent ink.

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FIELD OF THE INVENTION

The present invention relates to ways of preventing the effective color copying of printed materials and, more particularly, to a method of printing which results in particularly low contrast between the printed area and the background when such color copying is attempted.

BACKGROUND OF THE INVENTION

Much of what is important to people is represented by printed pieces of paper or plastic. A short list of such important pieces of printed materials includes paper money, corporate stock certificates, car registrations, identity cards and theater or transportation tickets or passes.

In each case the issuer has an interest in ensuring that it remain the sole source for the printed paper, i.e. that others be prevented from producing accurate copies of the originals without authorization. To this end, a very large number of important documents of the type described above, which documents or related materials will hereinafter be referred to as "certificates," bear at least one color other than black. The use of color makes it more difficult and costly for a counterfeiter to accurately reproduce the certificate.

Unfortunately, the relatively recent advent of color photocopying has made it considerably easier to reproduce even color certificates. The result has been an upsurge in forged certificates and considerable losses, both monetary and otherwise, incurred by the issuing authorities.

For illustrative purposes only, and without in any way limiting the scope of the present invention, discussion is largely confined to bus passes, particularly those bus passes of the type purchased each month by the passenger which allows the passenger to use the various buses of the issuing authority throughout the month at no additional cost.

The monthly bus passes typically include certain written information, printed on a piece of thick paper approximately 10 cm by 5 cm and generally bear two or more colors. All the rider need do in using the pass is to present the pass to the inspection of the bus driver whenever the passenger boards a bus. The inspection is typically quite cursory, usually consisting of the passenger flashing the pass momentarily in the direction of the bus driver as the passenger boards the bus.

The typical distance between the pass and the driver's eyes is commonly on the order of one meter. At such a large distance, given the brevity of the presentation, in view of the imperfections in the lighting conditions, and in light of the many other distractions with which the driver must typi-

cally contend, the driver is unable to read the printed matter on the pass and is barely able to note and verify the general color scheme of the pass. All this makes it relatively easy to counterfeit such passes. All the counterfeiter need do is obtain possession of a single legitimate card long enough to photocopy the pass using standard color photocopying equipment.

A number of methods have been developed in an attempt to reduce or eliminate the counterfeiting problem. Unfortunately, most involve elaborate and expensive measures which are inappropriate for many applications. For example, many currencies feature watermarks or raised engraving, or other anti-counterfeit measures. Similarly, some passes, usually made of plastic, feature a magnetic strip which can be read by a decoding machine which determines whether the card is genuine.

All of these methods, which are effective to a certain extent when used with documents which can be verified or which are given to a clerk or bank teller, and which are economical when used to protect against counterfeiting of credit cards or other certificates which have a life of several years, are relatively expensive and/or ineffective when used in conjunction with printed cards or passes which are to be used once or for a short period of time or which are not inspected closely, for example, bus passes, theater or sports tickets.

There is thus a widely recognized need for a way to prevent counterfeiting of certificates, which is both effective and relatively inexpensive, preferably not adding to the cost of producing the certificate or only adding a negligible amount to the cost. Further there is a need for adding such protection even to certificates of high value, such as currency, which already are protected by other methods.

It would be desirable to have a way of producing certificates in the same ways as are already commonly used and at the same costs, using standard printing procedures, but which will result in an item which will be hard or even impossible to produce.

There have been many attempts made to render documents uncopyable. The problem of copying has existed since the invention of photocopiers and has, as indicated above, become more critical with the advent of high resolution color copiers. Previous attempts to prevent copying include the following:

U.S. Patent 4,277,514 describes a system in which a certificate is printed in a particular pattern with an ink having a high reflectivity at wavelengths above or below the visible range, but within the sensitivity of copiers. Such patterns will then be printed on any counterfeit.

U.S. Patent 4,175,776 describes a system in which one of a background and non-overlapping indicia are printed in a pale blue color and the other is printed in a pale pink color. These colors do not absorb light to which the Xerox Type 6500 copier is sensitive and thus the entire surface, when copied by such a printer, appears white.

U.S. Patents 4,118,122 and 3,887,742 describe processes for defeating black and white copying which appear to employ materials to which the eye is sensitive and the photocopier is not, or vice-versa, such that information can be made to either drop-out or be obliterated depending on the copying system used. U.S. Patent 3,852,088 describes a system for reducing the reproducibility of a document in a variety of types of black and white copiers. The information is printed on a masking background on an opaque background. The background absorbs energy for the wavelengths used in all classes of copiers. The ink has a high reflectance over the range used in one class of copier and is somewhat absorptive over the range used in another class of copier.

U.S. Patent 3,713,861 describes a system in which a document is spray coated with a fluorescent material which fluoresces during copying and renders the document uncopiable.

U.S. Patent 4,066,280 describes a system for the prevention of copying a document which is printed using an ink containing specularly reflecting materials such as powdered aluminum. Such spectral reflection is said to avoid the faithful copying of the document.

U.S. Patent 4,168,088 describes a system in which a warning word or phrase is printed in a coarse mesh on a background of the same color in a finer mesh. If the transition between the two meshes is smooth, the word or phrase will not be visible to the naked eye, but will be visible when the document is copied. U.S. Patents 4,265,469 and 4,579,370 to the same assignee describe similar systems which utilizes the resolution of the copier to render a hidden word or phrase visible.

SUMMARY OF THE INVENTION

According to the present invention one region of a certificate is printed in a first color which is substantially faithfully reproduced by color copiers. A second region of the certificate, which is preferably adjacent to the first region, is printed with a second color which is perceived by the eye of an observer as having a different color but is perceived and copied by the copier as having the same or very similar color to the first color.

Thus in accordance with one aspect of the invention there is provided a certificate which is hard to reproduce using color photocopying, com-

prising: a writing surface featuring a first marking of a first color and a second marking of a second color, wherein the first and second colors are selected so that, when the certificate is copied using conventional color photocopying equipment and the resulting photocopy exhibits little contrast between said first and second markings.

In a second aspect of the invention, the second region of the certificate is printed with a fluorescent ink.

Preferably, the second portion is also printed with a pattern, preferably a pattern of crossed lines. Preferably, this ink used to print this pattern is the same as that used to print the first region of the certificate.

While not wishing to be bound by any theory, it is believed that when the fluorescing ink is illuminated by the color copier during the copying process, the light which is absorbed by the ink and emitted by the fluorescence is such that the overall color of the second region is actually the same as that of the other region or is at least reproduced as such by the photocopier. An additional feature of at least some embodiments of the invention is that while a certificate printed in accordance with the invention cannot be copied by a color copier to produce a faithful rendition of the certificate, black and white copiers do reproduce the contrast between the first and second regions.

More specifically, the system according to a preferred embodiment of the present invention, comprises using a carefully selected combination of colors (or inks) which will produce very low contrast when photocopied using color photocopying equipment.

The present invention successfully addresses the shortcomings of the presently known configurations by providing an inexpensive certificate which is hard or impossible to reproduce using color photocopying with presently known color photocopying technology.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be better understood from the following description of the preferred embodiments taken together with the drawings in which Figs. 1A-1G, 2A-2G and 3A to 3G are originals prepared in accordance with invention and copies of the originals made with various copying machines.

DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

The present invention allows for the production of a certificate which has the property that when an attempt is made to reproduce it, using color pho-

tocopying techniques, certain markings, which are distinct against a color background, are reproduced with substantially the same color as the background.

According to one embodiment of the present invention, a certificate is produced using a combination of at least two carefully selected colors which cover adjoining areas of the certificate. The pair of colors has the property that when the certificate is photocopied the contrast between the two colored areas is greatly reduced so as to make the boundary between the two areas indistinct and so render the copied certificate readily identifiable as not being an original printed certificate. This makes it easier to identify and seize counterfeit certificates and thus serves to deter and discourage counterfeiting attempts

Further, in an especially preferred embodiment of the invention, one of the inks used to color one of the areas is a fluorescent ink which absorbs light at one wavelength (or band of wavelengths) and emits light at a second wavelength (or band of wavelengths). When a document is printed with a carefully selected pair of colors one of which is printed with a fluorescent ink, the color change which results during printing is such that the color of the fluorescent area is perceived as the same as that of the other color.

For this combination, a double change takes place during copying. Firstly, the fluorescent portion of the card is no longer fluorescent. Secondly, in a preferred embodiment of the invention, the color contrast of the fluorescent portion is reduced with respect to the other portion such that any indicia printed in the fluorescent portion substantially disappear. Both of these changes are especially useful when used in bus passes and the like for which verification at a distance is required.

In order to reach full color saturation with the fluorescent colors printed on white background it is generally necessary to print the color twice. It has been found that when one of the colors, particularly the fluorescent color, is under-printed with a partial printing, such as a grid of lines or dots, preferably of the other color, it is easier to match the fluorescent color to the background, even if it is printed only once. This reduces the cost of printing the certificates.

The following non-limiting examples describe certain preferred embodiments of the invention. The colors used according to the present invention are herein described according to their Pantone designations as they appear in the Pantone Color Formula Guide 747XR, 2nd Edition, 1990-1991. As described therein, certain of the colors are fluorescent. It is to be understood that any other colors which are equivalents of the respective Pantone designations used herein are also within

the scope of the present invention.

While it is generally necessary that the fluorescent colors be printed twice to match the color standard, in the following examples, in order to reduce printing costs, the inks are printed only once. Thus, some experimentation may be required to achieve the color matching of the invention, depending on the press used and on the printing conditions. The inks used were manufactured by K+E BASF Company of Germany. Other manufacturers inks are also suitable.

The certificates of the following examples were printed on a GTO 52 press, manufactured by the Heidelberg Company of Germany.

EXAMPLE 1

A certificate was printed on glossy paper. One area of the certificate (the background) was printed using a mixture of 62 weight percent Pantone Yellow C, 24.5 weight percent Warm Red C, 0.5 weight percent Pantone Process Black C and 13 weight percent Pantone Transparent White. Indicia were printed in areas surrounded by the background printing but not overlapping therewith using Pantone 804 U, which is a fluorescent ink. The indicia were printed once.

EXAMPLE 2

A certificate was printed on glossy paper. One area of the certificate (the background) was printed using a mixture of 53 weight percent Pantone Yellow C, 15.5 weight percent Warm Red C, 0.8 weight percent Pantone Process Black C and 30.7 weight percent Pantone Transparent White. Indicia were printed in areas surrounded by the background printing but not overlapping therewith using Pantone 804 U, which is a fluorescent ink. The indicia were printed once.

The certificates described in Examples 1 and 2 were photocopied using RICOH NC 100, CANNON 100, Cannon 200, Cannon 500 and Brother Cycolor 5500 color photocopying machines using various contrast settings. In each case the color contrast between the writing and the background was greatly reduced from what it was in the original printed certificate.

Even after adjusting the contrast setting the appearance of the copy was vastly different from that of the original with the writing being legible only on careful inspection from very close range, in sharp contrast with the original which was easily visible and legible from over a meter away.

In a broad aspect of the first two examples, the background is made of a mixture of colors including at least two main colors. The first main color is Pantone Yellow C or Pantone Yellow 012 C. The

second main color is Pantone Rubine Red C, Pantone Orange 021 C or Pantone Warm Red 032 C. The weight ratio of the first main color to the second main color in the mixture is preferably between about 2:1 and about 4:1. Most preferably the two main colors are Pantone Yellow C and Pantone Warm Red C. It is preferable to add to the two main colors a third color, namely Pantone Process Black C, or Pantone Transparent White, preferably both.

The most preferred systems according to the embodiment of the invention of Examples 1 and 2 would thus include an area printed using Pantone 804 U with background printed with a color composed of Pantone Yellow C, Pantone Warm Red C, Pantone Process Black C and Pantone Transparent White.

The precise composition of the second color, preferably used for the background, may be varied within certain ranges while still providing the desired effect. Preferably, that color may be composed of from about 30 to 80 weight percent Pantone Yellow C, from about 5 to about 40 weight percent Pantone Warm Red C, from about 0.1 to about 5 weight percent Pantone Process Black C and from about 1 to about 50 weight percent Pantone Transparent White.

In the following Examples one area was completely printed in the background color indicated and the second area was printed with screen pattern of 150 lines per inch at a coverage of approximately 40 percent. The use of a grid of this type was found useful in attaining good copier color match between the areas. Changing the area of coverage of the grid provides an additional degree of freedom in matching the two areas. Grids having 20–60% coverage are especially useful in the present invention, with 40% giving, generally, the best results. This second area was then overprinted once with the indicated fluorescent ink. Each of the colors was printed only once.

EXAMPLE 3

The background and grid was printed using ink having a designation Pantone 239 C (13 parts Pantone Rhod. Red, 3 parts Pantone Purple) and the overprint was printed using Pantone 806 U fluorescent ink. An example of the original is shown in Fig. 1A. A copy of the original made on a Cannon 100 copier is shown in Fig. 1B. A copy of the original made on a Cannon 200 copier is shown in Fig. 1C. A copy of the original made on a Cannon 500 copier is shown in Fig. 1D. A copy of the original made on a Ricoh NC 100 copier is shown in Fig. 1E. A copy of the original made on a Brother Cycolor 5500 copier is shown in Fig. 1F. A copy of the original made on a Ricoh FT 5590

black and white copier is shown in Fig. 1G.

EXAMPLE 4

The background and grid was printed using ink which is a mixture of 42% Pantone Warm Red, 17% Pantone Rubine Red, 39% Transparent White and 2% Pantone Reflex Blue C. The overprint was printed using Pantone 805 U fluorescent ink. An example of the original is shown in Fig. 2A. A copy of the original made on a Cannon 100 copier is shown in Fig. 2B. A copy of the original made on a Cannon 200 copier is shown in Fig. 2C. A copy of the original made on a Cannon 500 copier is shown in Fig. 2D. A copy of the original made on a Ricoh NC 100 copier is shown in Fig. 2E. A copy of the original made on a Brother Cycolor 5500 copier is shown in Fig. 2F. A copy of the original made on a Ricoh FT 5590 black and white copier is shown in Fig. 2G.

EXAMPLE 5

The background and grid was printed using the same background ink as in Example 1 and the overprint was printed using Pantone 804 U ink. An example of the original is shown in Fig. 3A. A copy of the original made on a Cannon 100 copier is shown in Fig. 3B. A copy of the original made on a Cannon 200 copier is shown in Fig. 3C. A copy of the original made on a Cannon 500 copier is shown in Fig. 3D. A copy of the original made on a Ricoh NC 100 copier is shown in Fig. 3E. A copy of the original made on a Brother Cycolor 5500 copier is shown in Fig. 3F. A copy of the original made on a Ricoh FT 5590 black and white copier is shown in Fig. 3G.

Use of a grid printed under the fluorescent ink results in more exact cancellation in color copiers than when the grid is omitted as in Example 1.

In one preferred embodiment of the invention the background can be matched with the fluorescent printing by the following method. First the fluorescent ink is printed on the actual substrate to be used in the manner in which the certificates are to be printed. Then the printed fluorescent ink is copied on one or more copiers to produce a color copy in which as described above the color is different from that of the original. This color copy is matched to a standard (non-fluorescent) ink which is then used as the background, preferably with no underprinting. In general color copying is not exact even for standard colors and the results of printing do not match, exactly, that on the color cards so that some adjustment of the background ink will be necessary in order to get a perfect match and hence complete blending of the fluorescent ink.

While the invention has been described in embodiments in which the background and indicia are printed on white, otherwise unprinted background, the invention is also applicable to printing on already printed certificates. If the earlier printing consists of text, the invention may be practiced as described above. If the indicia and background of the invention must be printed on colored stock, then the colors used for printing are adjusted to take account of the color of the stock.

While the invention has been described with respect to certain preferred embodiments, it will be appreciated that many variations, modifications and other applications of the invention may be made and that other colors, color combinations and modes of under-printing may be used in the method of the invention.

Claims

1. A method of producing a certificate on a substrate which is difficult to reproduce using color copiers comprising the steps of:
printing a first portion of the certificate in a first color; and
printing the second portion of the certificate in a second color,
wherein the first and second portions have substantial color contrast in the original and, when reproduced using conventional color copiers, are reproduced in colors having substantially reduced color contrast.
2. A method of producing a certificate on a substrate which is difficult to reproduce using color copiers comprising the steps of:
printing a first portion of the certificate in a first color; and
printing the second portion of the certificate in a second, color including the step of printing with a fluorescent ink.
3. A method according to claim 2 wherein the first and second portions have substantial color contrast in the original and, when reproduced using conventional color copiers, have substantially reduced color contrast.
4. A method according to claim 2 or claim 3 wherein the second portion is under-printed before printing with the fluorescent ink.
5. A method according to claim 4 wherein the under-printing is printed using the same ink as used to print the first portion.
6. A method according to claim 4 or claim 5 wherein the under-printing is printed in a

pattern or crossed lines.

7. A method according to any of claims 4-6 wherein the coverage of the under-printing is between 20 and 60 percent.
8. A method according to claim 7 wherein the coverage of the under-printing is between 35 and 45 percent.
9. A method according to any of the preceding claims wherein when reproduced on a color copier such first and second areas are reproduced at substantially the same color.
10. A method according to any of the preceding claims wherein one of the colors is printed using an ink designated by Pantone 804 U.
11. A method according to any of the preceding claims wherein one of the colors is printed using an ink which is a mixture of 62 weight percent Pantone Yellow C, 24.5 weight percent Warm Red C, 0.5 weight percent Pantone Process Black C and 13 weight percent Pantone Transparent White.
12. A method according to any of claims 1-10 wherein one of the colors is printed using an ink which is a mixture of 53 weight percent Pantone Yellow C, 15.5 weight percent Warm Red C, 0.8 weight percent Pantone Process Black C and 30.7 weight percent Pantone Transparent White.
13. A method according to any of claims 1-9 wherein one of the colors is printed using an ink designated by Pantone 805 U.
14. A method according to any of claims 1-9 or 13 wherein one of the colors is printed using an ink which is a mixture of 42% Pantone Warm Red, 17% Pantone Rubine Red, 39% Transparent White and 2% Pantone Reflex Blue C.
15. A method according to any of claims 1-9 wherein one of the colors is printed using an ink designated by Pantone 806 U.
16. A method according to any of claims 1-9 or 15 wherein one of the colors is printed using an ink having a designation Pantone 239 C.
17. A certificate at least a portion of which is produced according to any of the preceding claims.

Fig. 1A



Fig. 1B



Fig. 1C



Fig. 1D



Fig. 1E



Fig. 1F



Fig. 1G

"EGGED BUS"

"EGGED BUS"

Fig. 2A

Fig. 2B



Fig. 2C



Fig. 2D



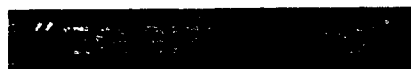
Fig. 2E



Fig. 2F



Fig. 2G



"EGGED BUS"

Fig. 3A

Fig. 3B



Fig. 3C



Fig. 3D



Fig. 3E



Fig. 3F



Fig. 3G





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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.5)
X	PATENT ABSTRACTS OF JAPAN vol. 4, no. 70 (P-12)(552) 23 May 1980 & JP-A-55 036 873 (DAINIPPON INSATSU K.K.) 14 March 1980 * abstract *	1,9,17	G03G21/00
X	--- PATENT ABSTRACTS OF JAPAN vol. 4, no. 70 (P-12)(552) 23 May 1980 & JP-A-55 036 872 (DAINIPPON INSATSU K.K.) 14 March 1980 * abstract *	1,9,17	
X	--- EP-A-0 428 828 (BAYROPA JUNG GMBH) * claims 1,2 *	2,17	
A	--- US-A-4 325 981 (SUGIURA ET AL.) * abstract; figures 1-6 *	1-3,9,17	
D,A	& US-A-4 277 514		
D,A	--- US-A-4 118 122 (REES ET AL.) * abstract *	1-3,9,17	
A	--- US-A-4 281 921 (VAN AUKEN) * column 2, line 31 - line 58; figure 1 *	1-3,9,17	
A	--- PATENT ABSTRACTS OF JAPAN vol. 5, no. 17 (P-47)(689) 31 January 1981 & JP-A-55 146 471 (FUJI XEROX K.K.) 14 November 1980 * abstract *	2-6,17	G03G G03C
A	--- PATENT ABSTRACTS OF JAPAN vol. 1, no. 165 (E-079)26 December 1977 & JP-A-52 110 636 (CANON K.K.) 16 September 1977 * abstract *	2,4,17	
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The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 25 JANUARY 1993	Examiner CIGOJ P.M.
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	



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A	GB-A-2 139 955 (THE GENERAL ELECTRIC COMPANY) * abstract *	2,17	

D,A	US-A-3 713 861 (J.H. SHARP) * column 5, line 3 - column 6, line 12; figures 1-3 *	2-4,9,17	

			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 25 JANUARY 1993	Examiner CIGOJ P.M.
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	