



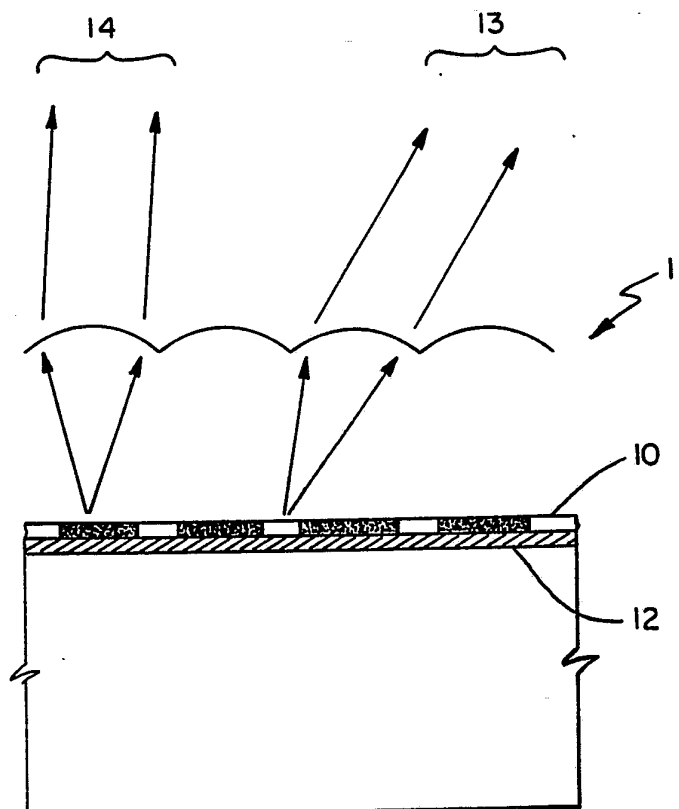
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<p>(21) International Application Number: PCT/US92/08311 (22) International Filing Date: 29 September 1992 (29.09.92) (30) Priority data: 778,680 18 October 1991 (18.10.91) US (71) Applicant: INNOVATIVE IMAGING SYSTEMS, INC. [US/US]; 19 Sterling Road, North Billerica, MA 01862 (US). (72) Inventors: SEWARD, George, H. ; 1702 Stearns Hill Road, Waltham, MA 02154 (US). MUELLER, Peter, F. ; 7 Preservation Way, Westford, MA 01886 (US). (74) Agents: SOLOWAY, Norman, P. et al.; Hayes, Soloway, Hennessey & Hage, 175 Canal Street, Manchester, NH 03101-2335 (US).</p>		<p>(81) Designated States: CA, JP, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, SE). Published <i>With international search report.</i></p>

(54) Title: METHOD OF PRODUCING ANTI-REPRODUCTION COATINGS FOR DOCUMENTS

(57) Abstract

This invention relates to a photocopy prevention film applied to a document to be protected that comprises a microlens array (11) in combination with a semi-transparent mask (10) located in the back focal plane of the array. The document so produced favors the visual response of the human eye at specific view angles over the physical response of a copying machine in its normal mode.



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1 METHOD OF PRODUCING ANTI-REPRODUCTION COATINGS
2 FOR DOCUMENTS

3
4 BACKGROUND OF THE INVENTION

5 The present invention is directed to document security
6 systems, and more particularly to a photocopy prevention
7 system, i.e. method and product.

8 Copying machines have become increasingly popular in
9 recent years and can be found in most business offices and
10 in public areas, such as shopping centers, hotel lobbies
11 and the like. Because of the widespread availability of
12 various types of copying machines, the ease with which
13 they can be operated, and the low cost of each copy,
14 virtually all documents are susceptible to being copied by
15 anyone without the consent of the originator or owner.
16 While the development of these copying machines certainly
17 represents progress in the graphical communication field,
18 they are often used to copy documents which may be abusive
19 to the originator or owner. For example, the unauthorized
20 and indiscriminate copying of materials such as news
21 letters, poems, sheet music, drawings etc. may violate the
22 legal rights of the publishers and/or authors denying to
23 them the compensation to which they are entitled. Also,
24 security can be flagrantly breached by copying material of
25 a sensitive nature such as classified government
26 information, industrial and commercial data, and personal
27 correspondence of a confidential nature.

28 The foregoing discussion of the prior art derives from
29 Reinnagel U.S. Patent No. 4,025,673, in which a copy
30 resistant document is described which comprises a sheet of
31 material having an upper irregular surface comprised of a
32 multiplicity of fibers extending upwardly from said sheet
33 at angles less than 90° relative to the plane of said
34 sheet. The fibers contain a coating of a colored material
35 thereon applied by spraying at an angle corresponding to

1 the angle at which the document would normally be viewed
2 for reading by the human eye. Graphical information is
3 then imprinted on the irregular surface to produce a
4 document easily readable at the normal human eye viewing
5 angle but unreadable when viewed perpendicular to the
6 plane of the document to create a useless image for
7 reproduction by a copying machine. In U.S. Patent No.
8 4,522,429, confidential information is first printed,
9 typed, or otherwise applied to paper with a color having a
10 reflection spectral response of less than about 10% for
11 light with a wavelength below about 600 NM. The color is
12 sufficiently contrasting with the information to enable
13 the information to be read by the human eye when the
14 document is viewed under white light, but the document can
15 not be successfully photocopied. In U.S. Patent No.
16 4,786,084, there is a report of a photocopy prevention
17 film which is applied to a document to be protected that
18 comprises either a volume holographic refraction grating
19 or a surface holographic refraction grating. The
20 refraction grating is bonded to a document and either
21 causes normally scattered light to be focused towards the
22 photoreceptors of a photocopy machine or causes light
23 normally reflected off the document toward the receptors
24 to be scattered away from the receptors.

25 While the above patents disclose proposals to render
26 documents resistant to photocopying, for one reason or
27 another, none of these proposals provide a satisfactory
28 solution to the problem of rendering documents resistant
29 to photocopying, and none contemplate the advantages of
30 the present invention.

31 SUMMARY OF THE INVENTION

32 Accordingly, it is a primary object of the present
33 invention to provide copy resistant documents and methods
34 for producing or treating original documents so as to
35 inhibit, if not prevent, the reproduction thereof by
36 conventional copying machines and processes.

1 It is another object of this invention to provide a
2 method of producing obliterating patterns in the viewing
3 path of the original document that are related to the
4 angle of viewing.

5 It is an additional object of the present invention to
6 decrease the amount of document image light reaching the
7 photo receptors of a photocopying machine so that no copy
8 can be produced.

9 It is a further object of the present invention to
10 provide protection from photocopying and facsimile
11 machines having an acceptance field angle as great as 70°.

12 It is still a further object of the present invention
13 to prevent unauthorized copying of a document while
14 preserving high contrast and brightness for reading of the
15 document.

16 It is another object to provide protection from
17 copying by photocopy machines using all visible
18 wavelengths of light.

19 The present invention is directed to an electrostatic
20 copy prevention film applied to a document to be protected
21 that comprises a micro lens array in combination with a
22 semi-transparent mask located in the back focal plane of
23 the array.

24 The foregoing and other objects, advantages, and
25 characterizing features of the present invention will
26 become clearly apparent in the ensuing detailed
27 description thereof, taken together with the accompanying
28 drawings wherein like reference characters denote like
29 parts through the various views.

30 BRIEF DESCRIPTION OF THE DRAWINGS

31 Figure 1 is a diagrammatic view of the over laminate
32 sheet which when applied to a document renders the
33 document non-reproducible by an electrostatic copier
34 operated in its normal mode.

1 DETAILED DESCRIPTION OF ILLUSTRATED EMBODIMENTS

2 By specifying a microlens array in combination with a
3 semi-transparent mask located in the back focal plane of
4 the array, an overlamine sheet was fabricated which when
5 applied to a document rendered the document non-
6 reproducible by an electrostatic copier operated in its
7 normal mode.

8 The first requirement of the microlens array is that
9 it have a sufficiently small spatial period to adequately
10 sample the document under treatment. In theory, the
11 smallest the period would ever have to be for the average
12 reader using the unaided eye would be 0.05mm or a
13 fundamental array spatial frequency of 20 cycles/mm. This
14 estimate of the upper limit is based on the Nyquist
15 sampling theorem and the commonly held rule of thumb in
16 visual optics that the highest spatial frequency
17 discernible to the standard observer under normal viewing
18 conditions is 10 cycles/mm. The sampling theorem holds
19 that to preserve a signal with no loss of information, the
20 sampling frequency must equal or exceed twice the maximum
21 frequency of the signal.

22 In practice, type pitch of 10 characters per inch
23 (cpi) is adequately sampled with an array of 4 cycles/mm,
24 i.e. with individual microlens diameters of 0.25mm
25 (approximately 0.01").

26 The second requirement of the microlens array is that
27 its back focal plane coincide with the back surface of the
28 substrate in which it is formed. Thus, light sources,
29 that subtend a small angle as viewed from the lens array,
30 are brought to a sharp point image (or line image if the
31 microlenses are cylindrical) on the back surface of the
32 substrate.

33 The third requirement of the microlens elements is
34 that their focal length be extremely short, i.e.
35 preferably 1X to 1.5X of their diameter. The short focal
36 length is necessary in order to keep the overlamine

1 sheet as thin and flexible as possible. Specifically, to
2 produce an overlaminating film of 1 mil to 1.5 mil
3 thickness, requires that the microlenses also have
4 diameters of 1 mil to 1.5 mil which results in spatial
5 frequencies of 30 cycles/mm to 40 cycles/mm, an order of
6 magnitude greater than demanded by character sampling
7 considerations. The short focal length is also necessary
8 in order to achieve wide acceptance angle operation. The
9 need for wide acceptance angle operation will be clear
10 when the function of the semi-transparent mask is
11 described. Finally, the short focal length implies a
12 large numerical aperture which in turn permits efficient
13 optical coupling.

14 One function of the mask layer, which is applied to
15 the back surface of the microlens array, is to present a
16 controlled image to any optical system (including a human
17 observer) whose optical axis is set normal to the array
18 surface. Within the mask layer the controlled image may
19 either be continuous or sampled and may consist of a
20 random noise pattern, a decorative pattern, a warning
21 notice that the treated document is not to be copied, or
22 virtually any preselected image a user might choose. If
23 the controlled image is sampled, then each sample element
24 must be registered on the optical axis of its
25 corresponding microlens element. A more detailed
26 description of the sampled image requirements will be
27 given later. Since the optical axis of commercial
28 electrostatic copy machines and facsimile machines are set
29 normal to the surface of the document being copied, such
30 machines will only copy the controlled image of the
31 overlamine sheet and not the protected document.

32 The second function of the semi-transparent mask layer
33 is to permit reading of the protected document at specific
34 view angles. This is accomplished by establishing clear
35 windows in the mask pattern; one window for each
36 corresponding microlens element. In the case of a

1 lenticular array (i.e. cylindrical microlenses), the
2 windows take the form of slits whose width is preferably
3 between about 20% and about 30% of the microlens width and
4 whose length is limited only by the size of the
5 overlamine sheet. In the case of a two dimensional
6 array (e.g. hexagonal), the windows take the form
7 approximately of an annulus whose outer diameter
8 approximates the microlens diameter and whose inner
9 diameter preferably is between about 84% and about 90% of
10 the microlens diameter. The window does not have to
11 occupy the entire annulus area but must be restricted to
12 the annulus region. The view angle is controlled by the
13 distance the windows are displaced from the optical axis
14 in the back focal plane of the microlenses.

15 In addition to the microlens array on the top surface
16 and the mask pattern with windows on the bottom surface,
17 the overlamine sheet must also have an adhesive layer on
18 the very bottom surface. The adhesive can be either
19 pressure sensitive or thermally activated. The latter is
20 the preferred approach because it will lead to a thinner
21 finished product and one that is most like existing
22 commercial office laminating systems. In fact, by
23 packaging the overlamine material described in this
24 disclosure in roll form of appropriate widths, General
25 Binding Corporation (GBC) laminators could be used to
26 prepare protected documents. The only laminate
27 modification that might be required would be in the
28 thermostatic control setting. Since the microlens
29 structure is replicated in a thermoplastic film under
30 controlled heat and pressure, care must be taken not to
31 exceed the thermoplastic flow temperature of the array,
32 otherwise the microlens structure could be erased. The
33 strategy is to use a high flow temperature thermoplastic
34 for the array and a low temperature thermally activated
35 adhesive.

1 Turning now to the Figures, Figure 1 illustrates a
2 cross-section of a laminated document in accordance with
3 the present invention. The microlens array with the
4 windowed (10) mask pattern is permanently applied over the
5 printed surface (12) of the document. Accordingly, the
6 mask pattern with the windows in combination with the
7 microlens array (11) restricts the document viewing angle
8 to the region as defined at (13). The mask pattern, which
9 is applied to the back surface of the microlens array, can
10 be seen at (14), which appears at or near normal incidence
11 to the document.

12 From the foregoing, it is apparent that the present
13 invention fully accomplishes its intended objects and
14 provides methods for both treating existing documents and
15 producing original documents in such a manner as to at
16 least inhibit production of intelligible copies therefrom
17 by conventional copying machines.

18 Preferred forms of this invention having been
19 disclosed in detail, it is to be understood that
20 modifications thereof can be made without departing from
21 the broad spirit and scope of this invention.

1 WHAT IS CLAIMED:

- 2 1. An electrostatic copy prevention film laminate
3 for application to a document comprising:
4 a transparent film having an integral microlens
5 array (11) in combination with a semi-transparent mask
6 (10) located in the back focal plane of the array,
7 said array having a sufficiently small spatial
8 period to adequately sample the document to be protected
9 and wherein the back focal plane of the array coincides
10 with the back surface of the document to which it may be
11 applied, and the microlens elements have a substantially
12 short focal length to permit optical coupling with the
13 document; and
14 wherein the semi-transparent mask layer is
15 patterned with windows and presents a controlled image to
16 any optical system whose optical axis is set normal to the
17 array surface and permits reading of the protected
18 document at specific view angles.
- 19 2. The electrostatic copy prevention film of claim 1
20 wherein the spatial period is about 0.05mm.
- 21 3. The electrostatic copy prevention film of claim 1
22 wherein the focal length of the microlens (11) elements
23 are about 1-1.5 times the diameter of said elements.
- 24 4. The electrostatic copy prevention film of claim 1
25 wherein the controlled image within the mask layer (10)
26 consists of a random noise pattern, a decorative pattern,
27 or a warning notice.
- 28 5. The electrostatic copy prevention film of claim 1
29 wherein the mask pattern (10) contains one clear
30 transparent window for each microlens element.
- 31 6. The electrostatic copy prevention film of claim 1
32 wherein the internal microlens array (11) comprising a
33 lenticular array and the mask layer contains windows (10)
34 in the form of slits whose width is about 20-30% of the
35 lenticular microlens diameter.

1 7. The electrostatic copy prevention film of claim 1
2 wherein the internal microlens array comprises (11) a two
3 dimensional array and the mask layers contains windows
4 which take the form approximately of an annulus whose
5 outer diameter equals the microlens diameter and whose
6 inner diameter is about 84-90% of the microlens diameter.

7 8. The electrostatic copy prevention film of claim 1
8 wherein the view angle is controlled by the distance the
9 windows are displaced from the optical axis in the back
10 focal plane of the microlenses.

11 9. The electrostatic copy prevention film of claim 1
12 wherein the laminate contains an adhesive layer which is
13 selected from those adhesives that are pressure sensitive
14 or thermally activated.

15 10. The electrostatic copy prevention film of claim 9
16 wherein the temperature at which the thermally activated
17 adhesive becomes active for lamination is at a temperature
18 below that of the film's thermal flow temperature.

19 11. A method of protecting a document against
20 reproduction by copying machines comprising attaching to
21 the document the photocopy prevention film laminate of
22 claim 1.

23 12. A method according to claim 11, wherein the film
24 laminate is adhesively attached to the document.

25 13. The method of claim 12, and including the step of
26 applying an adhesive layer to the bottom surface of the
27 film laminate, and activating the adhesive by heat and/or
28 pressure.

29 14. The method of claim 11 and including the step of
30 applying adhesive layer to the surface of the document,
31 and overlaying the laminate film in contact with the
32 adhesive layer.

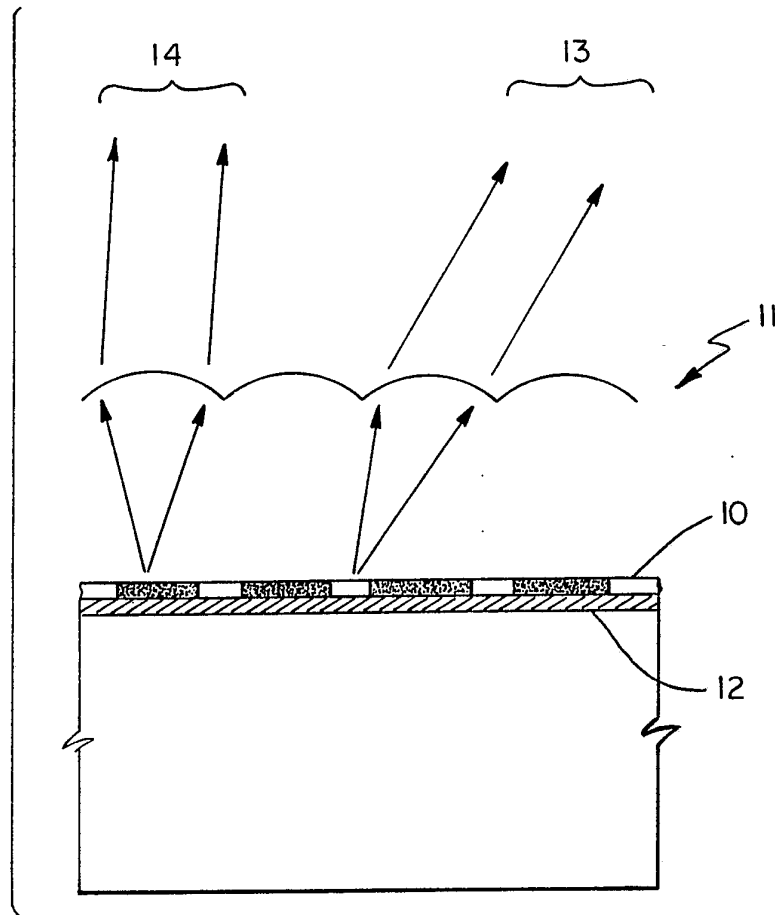


FIG. 1

INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 92/08311

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶		
According to International Patent Classification (IPC) or to both National Classification and IPC Int.Cl. 5 G03G21/00; G03C5/08		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
Int.Cl. 5	G03G ; G03C ; B41M	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸		
III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹		
Category ¹⁰	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
A	US,A,4 025 673 (REINNAGEL) 24 May 1977 cited in the application see column 6, line 29 - column 11, line 24; figures 2-11 ---	1, 4, 11, 12
A	PATENT ABSTRACTS OF JAPAN vol. 9, no. 199 (P-380)(1922) 16 August 1985 & JP,A,60 063 578 (MINOLTA CAMERA K.K.) 11 April 1985 see abstract ---	1
A	EP,A,0 281 350 (NOCOPI INTERNATIONAL INC.) 7 September 1988 see column 1, line 62 - column 3, line 16; figure 2 ---	1, 2, 4
	-/--	
<p>¹⁰ Special categories of cited documents :</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&" document member of the same patent family</p>		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search <p align="center">21 JANUARY 1993</p>	Date of Mailing of this International Search Report <p align="center">26 JAN 1993</p>	
International Searching Authority <p align="center">EUROPEAN PATENT OFFICE</p>	Signature of Authorized Officer <p align="center">CIGOJ P.M.</p>	

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		Relevant to Claim No.
Category °	Citation of Document, with indication, where appropriate, of the relevant passages	
A	XEROX DISCLOSURE JOURNAL. vol. 5, no. 6, November 1980, STAMFORD, CONN US page 581 VANCE J. CARPENTER ET AL. 'MEANS FOR PREVENTING COPYING AND CASUAL VIEWING OF SECURE DOCUMENTS' see the whole document ---	1,11
A	NL,A,8 601 250 (AVERY INTERNATIONAL CORPORATION) 16 December 1987 see page 1, line 8 - page 2, line 8; figures 1A-2 ---	1,11
A	DE,A,4 000 786 (KISOKASEISANGYOU CO.,LTD.) 16 May 1991 see abstract; figures 1,2 ---	1
A	US,A,4 869 946 (CLAY) 26 September 1989 see abstract; figures 1-5 -----	1

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

US 9208311
SA 65963

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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NL-A-8601250	16-12-87	None	
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