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

(11) EP 2 088 003 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
12.08.2009 Bulletin 2009/33

(21) Application number: **08101159.5**

(22) Date of filing: **31.01.2008**

(51) Int Cl.:
B41M 3/14 *(2006.01)* ***B42D 15/00*** *(2006.01)*
B42D 15/10 *(2006.01)*

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MT NL NO PL PT RO SE SI SK TR
Designated Extension States:
AL BA MK RS

(71) Applicant: **National Bank of Belgium**
1000 Brussels (BE)

(72) Inventors:
- **Golaire, Monique**
  1630 Linkebeek (BE)
- **Degryse, Maryke**
  8310 Assebroek (BE)
- **Paquot, Nathalie**
  5080 Emines (BE)
- **Van Braeckel, Paul**
  9800 Meigem (BE)
- **Haeyaert, Beni**
  8310 Assebroek (BE)

(74) Representative: **Ostyn, Frans**
K.O.B. NV
Kennedypark 31 c
8500 Kortrijk (BE)

(54) Colour switching

(57) The invention relates to a method for printing one or more security items (10) on a substrate of which at least a part is made of a transparent material, wherein the method comprises the steps of
- printing a first pattern of indicia (1) in at least two colours (Y, M, C) on one side of the said transparent material, this first pattern of indicia (1) being provided such that a partitive mixing of colours occurs between the colours (Y, M, C) of these indicia of the first pattern (1);
- printing a second pattern of indicia (2) on the opposite side of the said transparent material, such that particular indicia of the first pattern (1) are at least partially overlapped by the indicia of the second pattern (2);
- the overlapping indicia of the second pattern (2) having a filtering or masking function with relation to the overlapped indicia of the first pattern (1) such that, because of the parallax effect due to the thickness of the substrate, the partitive colour mixing of the indicia of the first pattern (1) changes with a changing angle of view resulting in a change of the overall colour of the indicia.

The invention furthermore relates to a security item (10) printed on a security document according to such a method.

EP 2 088 003 A1

Description

[0001] The present invention relates to a method for printing one or more security items on a substrate of which at least a part is made of a transparent material, and in particular to a method for printing one or more security items on security documents, on a part of a security document or on a substrate that can be transferred to a security document. Security documents are in particular: banknotes, postage stamps, identity cards, passports, checks, certificates, certificates of authenticity, ... The present invention relates also to a printed security item manufactured according to such a method.

[0002] Printing security items, so called security printing is an application or combination of printing technologies such as offset, intaglio, silkscreen and letterpress. Security printing encompasses the printing of banknotes, postage stamps, stamps, stock certificates, identity cards, passports, checks, deeds, plane tickets, diploma's and other documents needing a protection against counterfeiting.

[0003] Security papers, such as banknotes circulate in a world where the threat of the counterfeiter is ever present. With the development of new printing processes and the introduction of new technologies, more methods of reproduction are available to the counterfeiter than ever before. It is therefore essential that security documents, such as banknotes should be practically forgery proof. This is achieved not only by the way in which the printing technologies and their combinations are used, but also through the nature of the substrate and the ink, and the use of special additional elements such as security threads, holograms, and so on.

[0004] Banknotes are generally printed on a substrate made of 100 % cotton and are further protected by a watermark, a security thread, fluorescent fibres of different colours and length, optical variable inks or other visual or machine detectable characteristics.

[0005] However, a disadvantage of such banknotes is their restricted lifespan. Banknotes in a synthetic material do not have this drawback, as they can last about four times as long as the conventional cotton notes. The plastic note technology uses a polymer plastic substrate instead of paper. Compared to paper, plastic banknotes are stronger and non-porous.

[0006] However, plastic banknotes have the disadvantage that a number of safety features such as real multitone watermarks, windowed security threads which are successfully used in paper notes, can not be used or are less effective when used in plastic notes.

[0007] Therefore it is an object of the present invention to provide a new method for printing one or more security items on a substrate, in particular, a method for printing one or more security items on a banknote, with which the above mentioned drawbacks are overcome and which results in a security item with a much higher security level against counterfeiting than the known methods.

[0008] The above mentioned object is achieved by providing a method for printing one or more security items on a substrate of which at least a part is made of a transparent material, wherein the method comprises the steps of

- printing a first pattern of indicia in at least two colours on one side of the said transparent material, this first pattern of indicia being provided such that a partitive mixing of colours occurs between the colours of these indicia of the first pattern;
- printing a second pattern of indicia on the opposite side of the said transparent material, such that particular indicia of the first pattern are at least partially overlapped by the indicia of the second pattern;
- the overlapping indicia of the second pattern having a filtering or masking function with relation to the overlapped indicia of the first pattern such that, because of the parallax effect due to the thickness of the substrate, the partitive colour mixing of the indicia of the first pattern changes with a changing angle of view resulting in a change of the overall colour of the indicia.

[0009] The expression "indicia" as used in this text refers to any pattern consisting of lines, dots, etc. which may be applied in visible form on a document or which can be visualised under specific light circumstances, for example use of an invisible fluorescent ink which becomes visible under black light, etc.

[0010] As this invention is meant to be printed on a transparent substrate, it is clear that beyond the traditional printing technique all possible techniques to transfer images to the transparent substrate or to generate an image on such a substrate can be used, such as inkjet printing, thermal transfer printing, sublimation printing, etc.

[0011] This invention enables the printer of security documents to improve the security level of security documents, through an optimal use of the technical possibilities of existing banknote presses and/or other high tech machinery.

[0012] In an advantageous method according to the invention, the thickness of the substrate is of the same order of magnitude as the width of the indicia constituting the first and second pattern.

[0013] In a more advantageous method according to the invention, the thickness of the substrate and the width of the indicia of the first and second pattern are situated between 5 and 1200 μm.

[0014] The indicia preferably consist of lines and/or dots, more preferably being a line pattern.

[0015] In a favourable method according to the invention, the first and second pattern are printed in register. This seriously hampers the counterfeiting, because the slightest shift of the images with respect to one another results in a situation wherein another colour pattern of the indicia is obtained than originally is intended.

[0016] In an advantageous method according to the

invention, the overlapping indicia of the second pattern having a masking function with relation to the overlapped indicia of the first pattern are printed in an opaque ink or in a transparent ink printed in a high density such that, at least part of the first pattern is not visible because it is masked by the second pattern.

[0017] In a preferred method according to the invention, the overlapping indicia of the second pattern having a filtering function with relation to the overlapped indicia of the first pattern are printed in a transparent ink such that when the observer looks at the security item (10), at least part of the first pattern (1) has an altered colour because it is filtered by the second pattern.

[0018] It is a further object of the present invention to provide a new security item printed on a security document consisting of a substrate of which at least a part is made of a transparent material, in particular, a security item that is printed on a banknote, with which the above mentioned drawbacks are overcome and which results in a security item with a much higher security level against counterfeiting than the known security items.

[0019] This further object of the invention is solved by providing a security item printed on a security document consisting of a substrate of which at least a part is made of a transparent material, wherein the security item consists of

- a first pattern of indicia in at least two colours that is printed on one side of the said transparent material, this first pattern of indicia being such that a partitive mixing of colours occurs between two neighbouring colours of these indicia of the first pattern;
- a second pattern of indicia that is printed on the opposite side of the said transparent material, such that particular indicia of the first pattern are at least partially overlapped by the indicia of the second pattern;
- the overlapping indicia of the second pattern having a filtering or masking function with relation to the overlapped indicia of the first pattern such that, because of the parallax effect due to the thickness of the substrate, the partitive colour mixing of the indicia of the first pattern changes with a changing angle of view resulting in a change of the overall colour of the indicia.

[0020] In a preferred embodiment of a security item according to the invention, the transparent material is a transparent synthetic material.

[0021] The transparent material preferably has a thickness of between 5 and 1200 μm.

[0022] In an advantageous embodiment of a security item according to the invention, the security item is printed by a method according to the invention as described above.

[0023] Additional features and advantages of the invention will be further explained on the basis of non-restricting exemplifying embodiments represented in the attached drawings and in the following detailed description. In this description reference is made to the following drawings wherein

- *figure 1a* is a representation of a star that is provided with a line pattern that is printed in three colours being yellow, cyan and magenta on one side of a transparent substrate;
- *figure 1b* is a representation of detail A as shown in figure 1a;
- *figure* 2 is a representation of a line pattern that is printed on the opposite side of the transparent substrate and that is intended to overlap the line pattern as shown in figure 1a;
- *figure 3a* is a representation of what is viewed when an observer looks perpendicularly to the security item;
- figure 3b is a representation of detail S as shown in figure 3a;
- *figure 4a* is a representation of what is viewed when the visual angle with which the observer looks at the security item changes by tilting the security item in one direction around an imaginary axis that is parallel to the lines of the line patterns as shown in figures 1a and 2;
- *figure* 4b is a representation of detail T as shown in figure 4a;
- *figure 5a* is a representation of what is viewed when the visual angle with which the observer looks at the security item changes by tilting the security item in opposite direction around an imaginary axis that is parallel to the lines of the line patterns as shown in figures 1a and 2;
- *figure 5b* is a representation of detail U as shown in figure 5a;
- *figure* 6a is a representation of what is viewed when the security item is reproduced by a counterfeiter by copying the security item;
- *figure 6b* is a representation of detail X as shown in figure 6a;
- *figure* 7a is a representation of what is viewed when the security item is reproduced by a counterfeiter when the lines of the different line patterns at each side of the transparent substrate are not printed in perfect register;
- *figure* 7b is a representation of detail Z as shown in figure 7a.

[0024] According to the method of the invention, security documents, such as banknotes, credit cards, drivers' licenses, etc. printed on a substrate of which at least a part is made of a transparent material, for example a synthetic material such as polypropylene or polyester, can be provided with a new security item via known banknote presses. Another possibility is transferring a transparent substrate, comprising a security item according to the invention, to a document.

[0025] According to this invention, a first pattern of indicia is printed on one side of said transparent material,

wherein this pattern of indicia is provided in such a way that a partitive mixing of colours occurs between the colours of these indicia, partitive mixing of colours being defined as the mixing of small colour patches that are placed next to one another. On the opposite side of the transparent substrate, a second pattern of indicia is printed in such a way that particular indicia of the first pattern are at least partially overlapped by the indicia of the second pattern. The overlapped indicia of the second pattern can therewith have a filtering or a masking function with relation to the overlapped indicia of the first pattern such that, because of the parallax effect due to the thickness of the substrate, the partitive colour mixing of the indicia of the first pattern changes with a changing angle of view.

[0026] It is furthermore possible to provide at least part of the side of the substrate where the second indicia are situated with a reflective layer, for instance a white layer printed in an opaque ink, over the second indicia (such that the second indicia are situated between this reflective layer and the substrate).

[0027] The thickness of the substrate is preferably of the same order of magnitude as the width of the indicia constituting first and second pattern. The thickness of the substrate and the width of the indicia are preferably situated in between 5 and 1200 μm. The thickness of the substrate therewith depends from the type of security document and also from the design of the security document ("graphism").

[0028] The indicia of the first and second pattern preferably consist of lines and dots, more preferably being a line pattern.

[0029] In order to hamper the counterfeit, the indicia of the first and second pattern are preferably printed in perfect register.

[0030] When the overlapping indicia of the second pattern have a masking function with relation to the overlapped indicia of the first pattern, than these overlapping indicia are preferably printed in an opaque ink or in an ink that is darker coloured than the ink in which the indicia of the first pattern are printed, the best result being obtained when the second pattern of indicia is printed in a black colour. When the overlapping indicia of the second pattern however have a filtering function with relation to the overlapped indicia of the first pattern, than these overlapping indicia are preferably printed in a transparent ink that not having a masking effect.

[0031] In an exemplary security item (10) printed by a method according to the invention, on one side of a transparent substrate having a thickness of 150 μm, a star (1) (as can be seen in figure 1a) is printed on one side of the transparent substrate, wherein this star (1) is provided with a line pattern that is printed in three colours being yellow (Y), cyan (C) and magenta (M) (as can be seen in figure 1b). The width of the lines of the line pattern is such that a partitive mixing of the colours yellow (Y), cyan (C) and magenta (M) is obtained, as can be seen in figure 1a, for instance 150 μm for the cyan (C) and the magenta (M) coloured lines, and 300 μm for the yellow (Y) coloured line. On the other side of the transparent substrate, a line pattern (2) consisting of black opaque lines (B) having a width of 300 μm is printed in register with the line pattern of the star (1), the black lines (B) thus having a masking function with relation to the lines (Y, C, M) of the line pattern of the star (1). This black line pattern (2) is printed such that, when an observer looks perpendicularly at the side onto which this black line pattern (2) is printed, only the yellow lines (Y) are visible, as can be seen in figures 3a and 3b, thus masking the cyan and magenta coloured lines (C, M).

[0032] When now the visual angle with which the observer looks at the security item (10) changes by tilting the security item in one direction (here clockwise) around an imaginary axis that is parallel to the lines of the line patterns (1, 2) as shown in figures 1a and 2, because of the parallax effect due to the thickness of the substrate, half of the yellow lines (Y) and the cyan coloured lines (C) becomes visible, as can be seen in figure 4b, giving a partitive colour mixing into the colour green (G) (see figure 4a).

[0033] When the visual angle with which the observer looks at the security item (10) changes by tilting the security item in opposite direction (here counterclockwise) around an imaginary axis that is parallel to the lines of the line patterns (1, 2) as shown in figures 1a and 2, because of the parallax effect due to the thickness of the substrate, half of the yellow lines (Y) and the magenta coloured lines (M) becomes visible, as can be seen in figure 5b, giving a partitive colour mixing into red (R) (see figure 5a).

[0034] When this security item (10) is reproduced by a counterfeiter by simply copying the security item (10), then the magenta and cyan coloured lines (M, C) get lost because they are masked by the black line pattern (2). Then, only the yellow and black lines (Y, B) are visible as a whole, resulting in a counterfeited security item (11) as can be seen in figures 6a and 6b. The counterfeiter then has to reproduce himself the magenta and cyan coloured lines (M, C), and adding these by the yellow lines that have to be separated from the black lines (B) in order to become the colour pattern of the star (1). When the counterfeiter succeeds to also reproduce the black masking lines (B), then he has to apply the coloured and black lines (Y, M, C and B), with the same accuracy as the original, on the correct side of the transparent substrate. When he doesn't succeed to do this, or in other words the line patterns (1,2) are not printed in perfect register, when the observer looks perpendicularly at the reproduced security item (11), then not only a star (1) in a yellow colour (Y) with black lines (B) occur, but also a line pattern in another colour or other colours occur, this depending on the displacement of the black lines (B) with relation to the coloured lines (Y, C, M). When for instance the yellow lines are masked, then the cyan and magenta coloured lines (C, M) become visible, as can be seen in figure 7a, and, due to the partitive mixing, a star (1) in a blue colour (BL) occurs (as can be seen in figures 7a and

7b).

Claims

1. Method for printing one or more security items (10) on a substrate of which at least a part is made of a transparent material, **characterised in that** the method comprises the steps of

   - printing a first pattern of indicia (1) in at least two colours (Y, M, C) on one side of the said transparent material, this first pattern of indicia (1) being provided such that a partitive mixing of colours occurs between the colours (Y, M, C) of these indicia of the first pattern (1);
   - printing a second pattern of indicia (2) on the opposite side of the said transparent material, such that particular indicia of the first pattern (1) are at least partially overlapped by the indicia of the second pattern (2);
   - the overlapping indicia of the second pattern (2) having a filtering or masking function with relation to the overlapped indicia of the first pattern (1) such that, because of the parallax effect due to the thickness of the substrate, the partitive colour mixing of the indicia of the first pattern (1) changes with a changing angle of view resulting in a change of the overall colour of the indicia.

2. Method according to claim 2, **characterised in that** the thickness of the substrate is of the same order of magnitude as the width of the indicia constituting the first and second pattern (1, 2).

3. Method according to claim 2, **characterised in that** the thickness of the substrate and the width of the indicia of the first and second pattern (1, 2) are situated between 5 and 1200 μm.

4. Method according to any one of claims 1 to 3, **characterised in that** the indicia of the first and second pattern (1, 2) consist of lines and/or dots.

5. Method according to claim 4, **characterised in that** the first and second pattern (1, 2) are a line pattern.

6. Method according to any one of claims 1 to 5, **characterised in that** the first and second pattern (1, 2) are printed in register.

7. Method according to any one of claims 1 to 6, **characterised in that** the overlapping indicia of the second pattern (2) having a masking function with relation to the overlapped indicia of the first pattern (1) are printed in an opaque ink or a transparent ink printed in a high density such that when the observer looks at the security item (10), at least part of the first pattern (1) is not visible because it is masked by the second pattern (2).

8. Method according to any one of claims 1 to 7, **characterised in that** the overlapping indicia of the second pattern (2) having a filtering function with relation to the overlapped indicia of the first pattern (1) are printed in a transparent ink such that when the observer looks at the security item (10), at least part of the first pattern (1) has an altered colour because it is filtered by the second pattern.

9. Security item printed on a security document consisting of a substrate of which at least a part is made of a transparent material provided with one or more security items, **characterised in that** the security item consists of

   - a first pattern (1) of indicia in at least two colours (Y, M, C) that is printed on one side of the said transparent material, this first pattern (1) of indicia being such that a partitive mixing of colours occurs between two neighbouring colours of these indicia of the first pattern (1) ;
   - a second pattern (2) of indicia that is printed on the opposite side of the said transparent material, such that particular indicia of the first pattern (1) are at least partially overlapped by the indicia of the second pattern (2);
   - the overlapping indicia of the second pattern (2) having a filtering or masking function with relation to the overlapped indicia of the first pattern (1) such that, because of the parallax effect due to the thickness of the substrate, the partitive colour mixing of the indicia of the first pattern (1) changes with a changing angle of view resulting in a change of the overall colour of the indicia.

10. Security item according to claim 9, **characterised in that** the transparent material is a transparent synthetic material.

11. Security item according to claim 9 or 10, **characterised in that** the transparent material has a thickness of between 5 and 1200 μm.

12. Security item according to any one of claims 9 to 11, **characterised in that** the security item is printed by a method according to any one of claims 1 to 9.

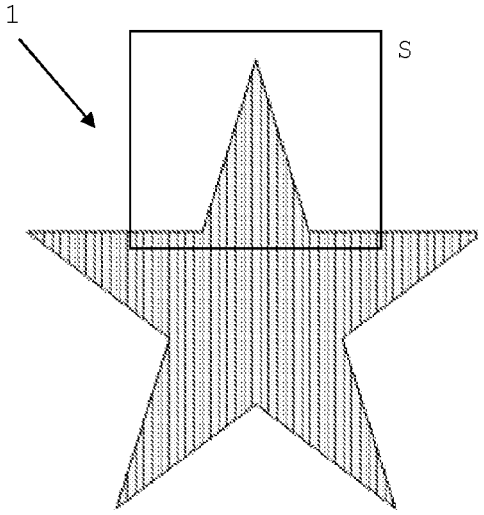

FIG. 1a

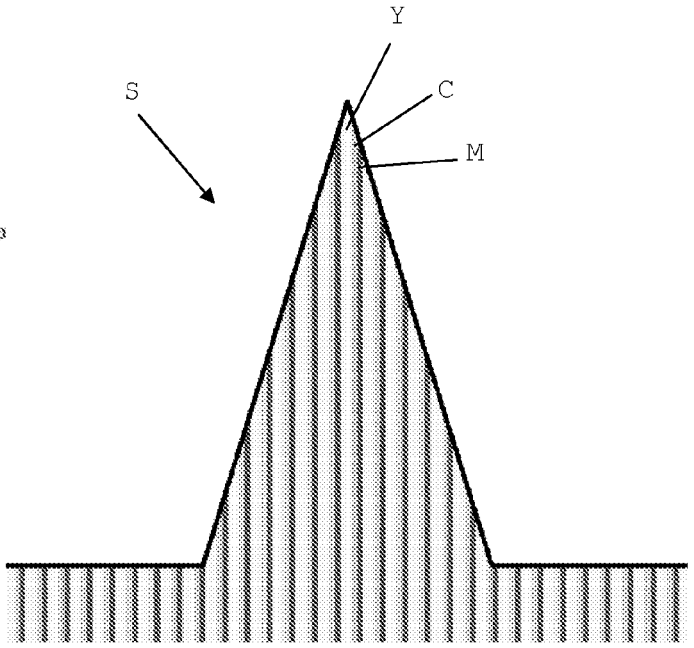

FIG. 1b

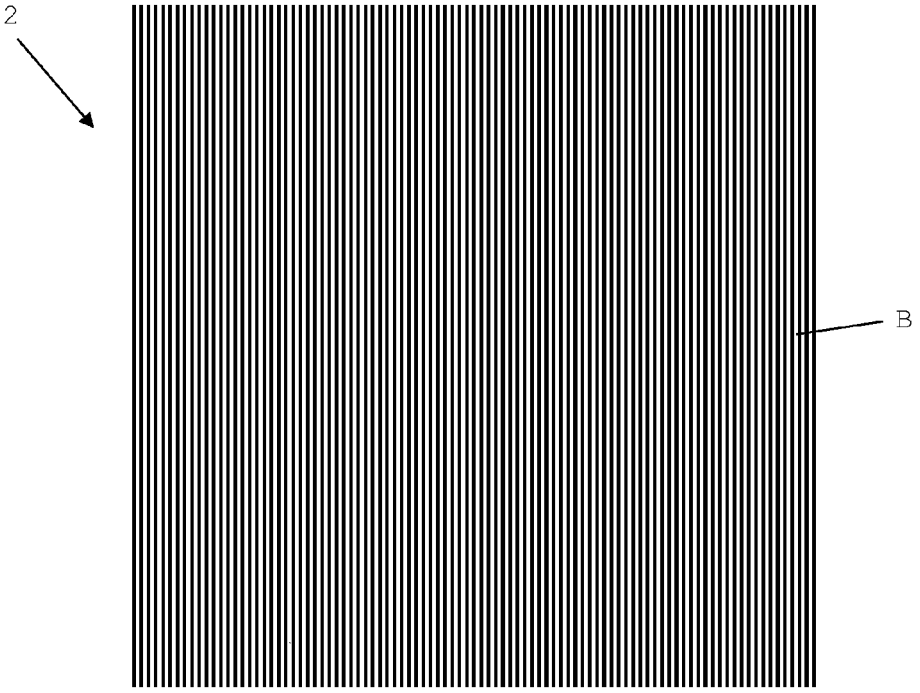

FIG. 2

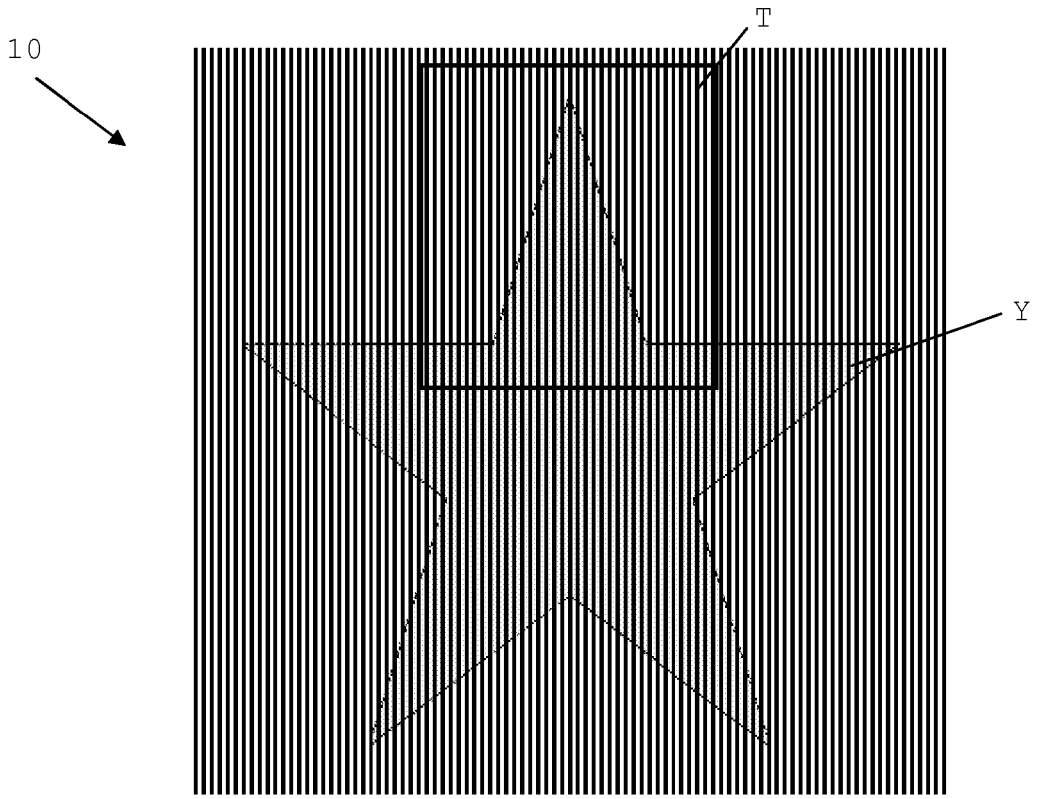

FIG. 3a

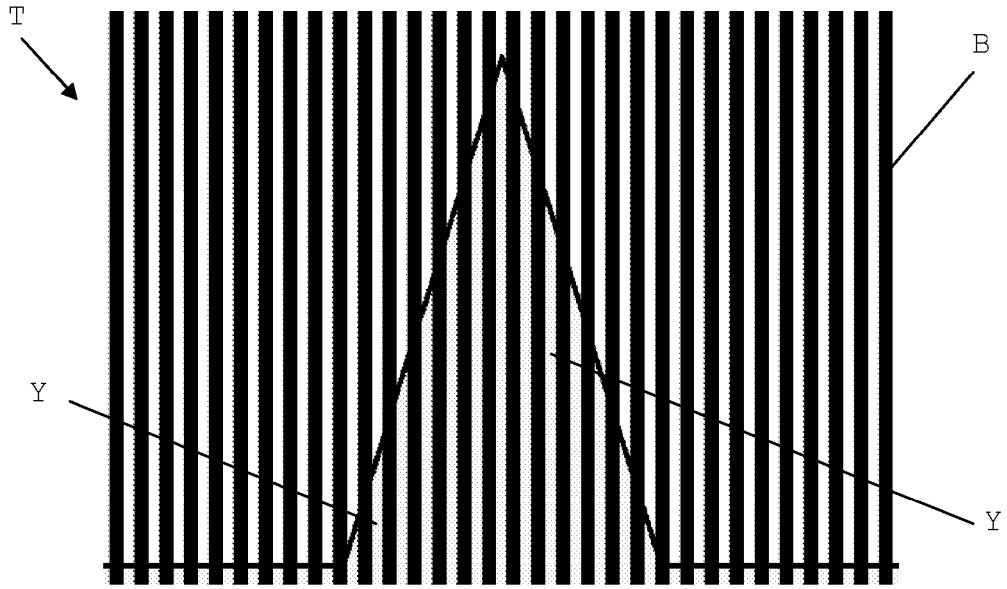

FIG. 3b

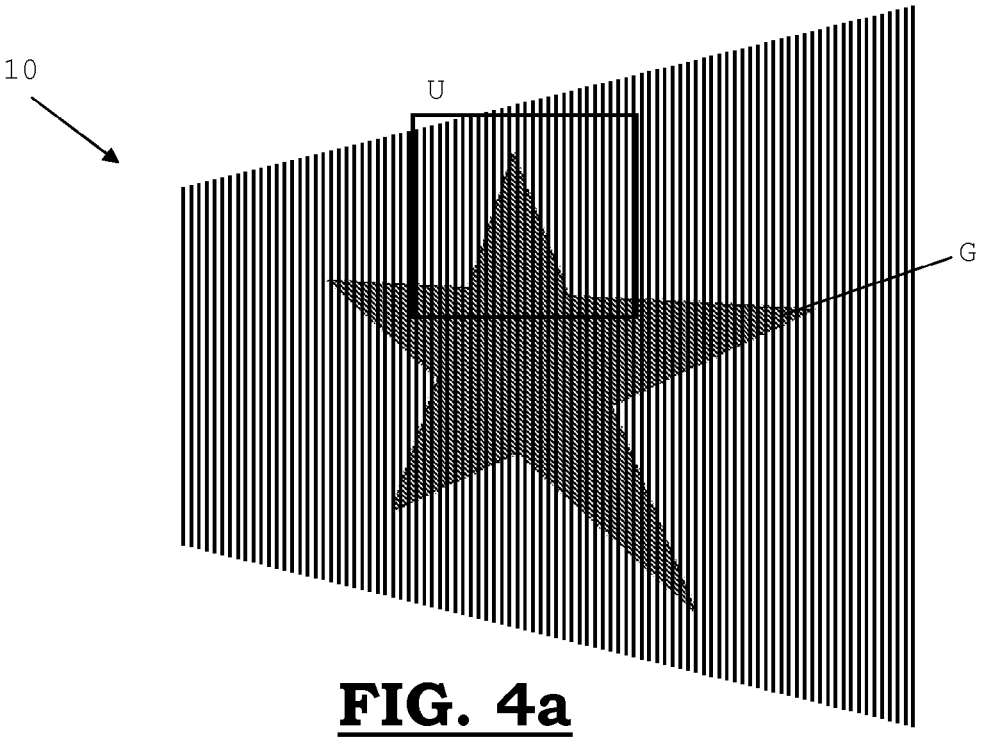

FIG. 4a

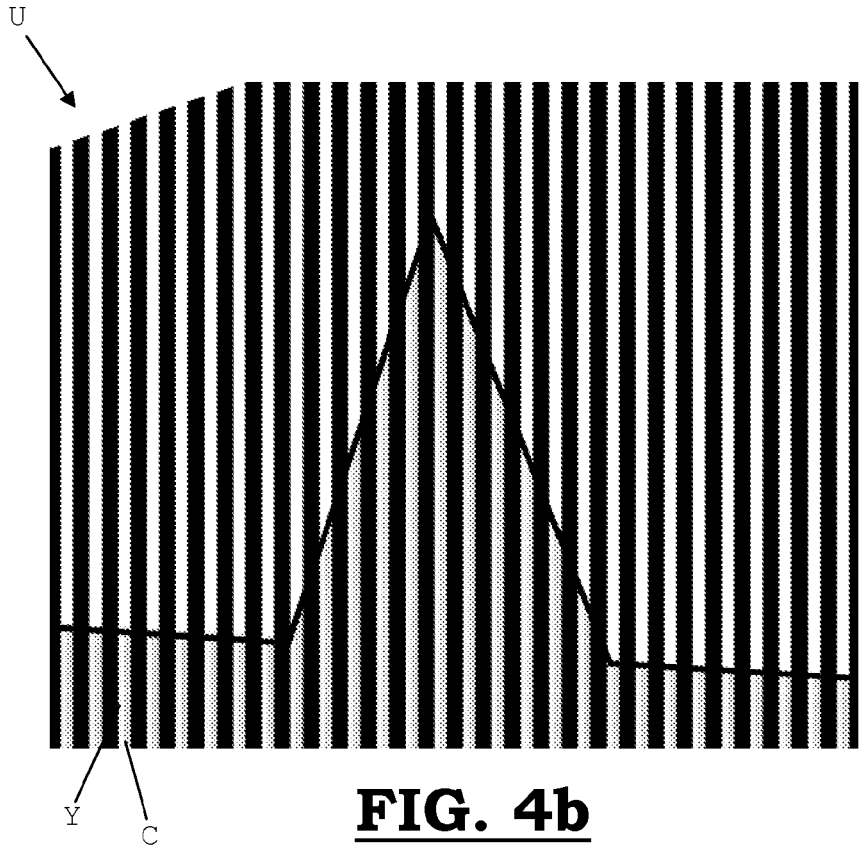

FIG. 4b

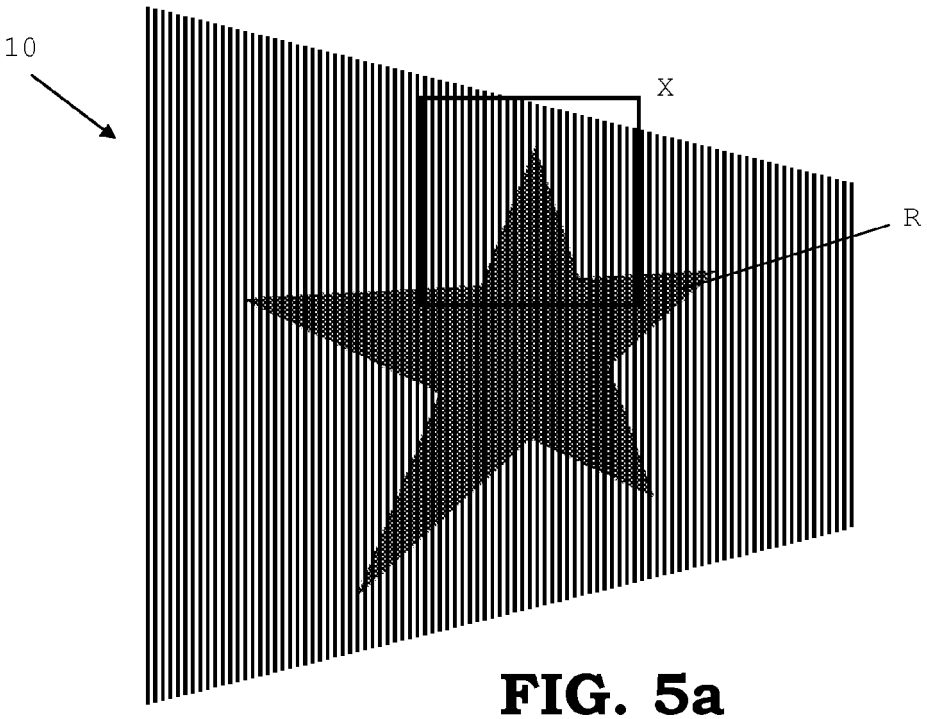

FIG. 5a

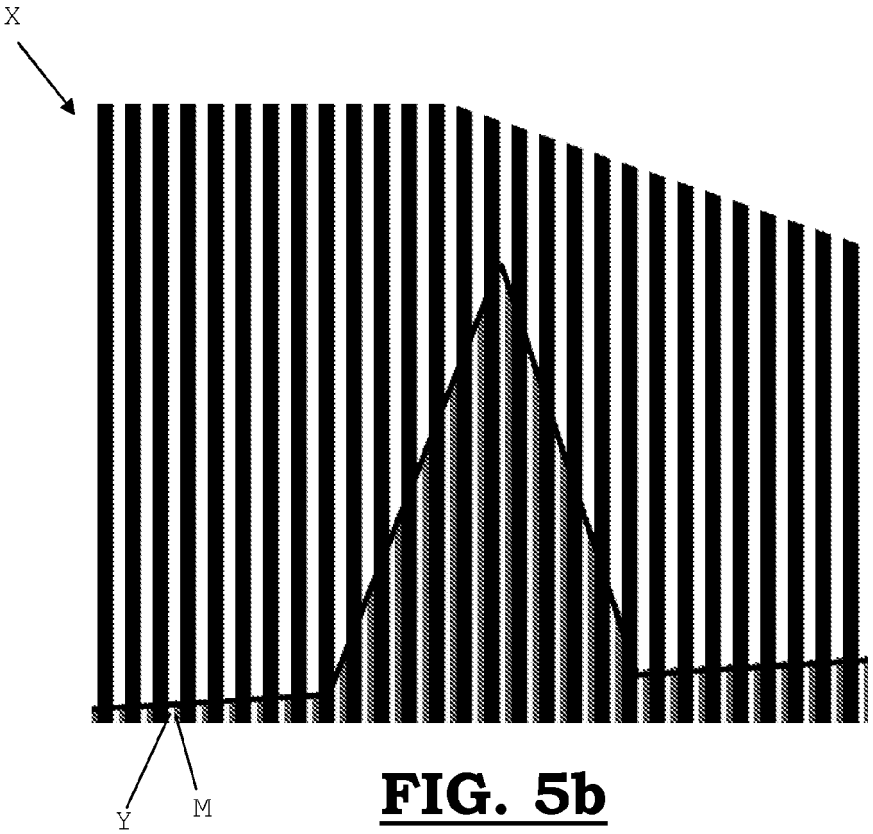

FIG. 5b

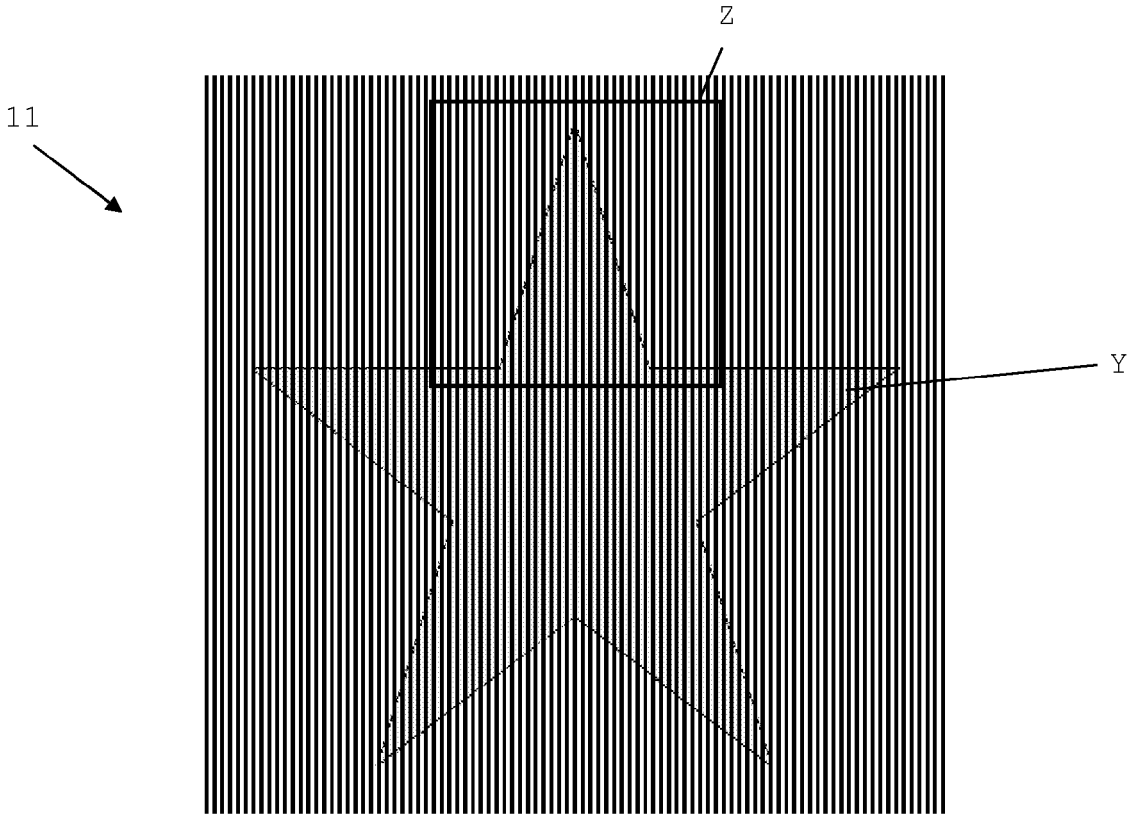

FIG. 6a

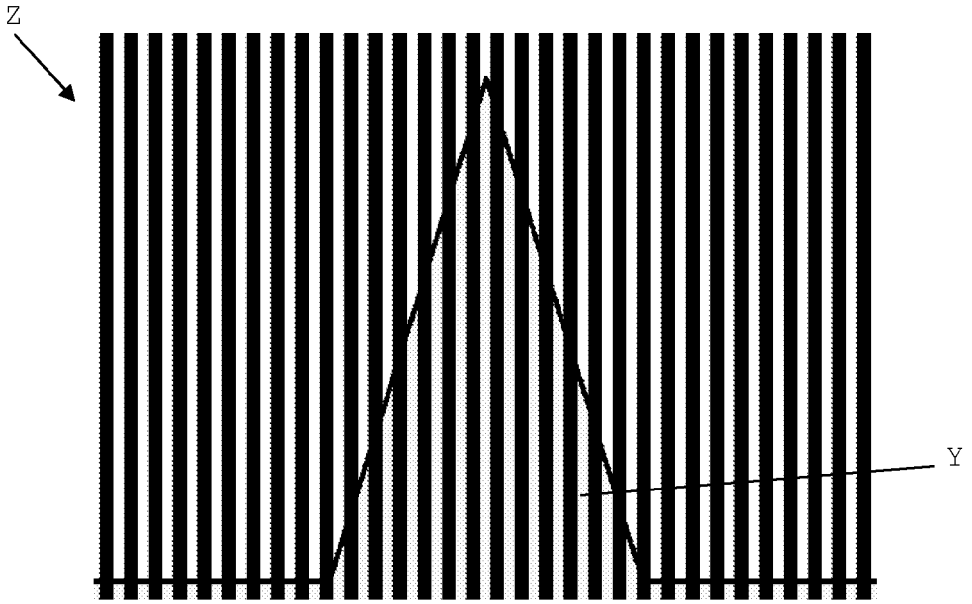

FIG. 6b

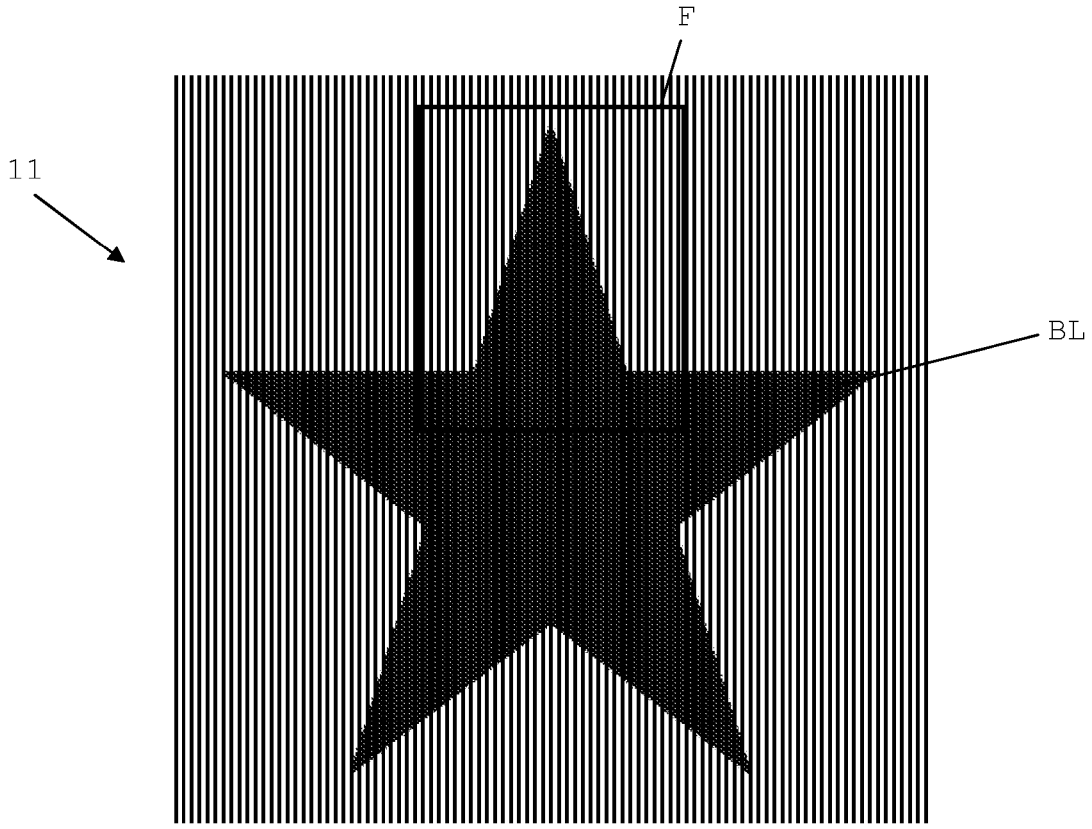

FIG. 7a

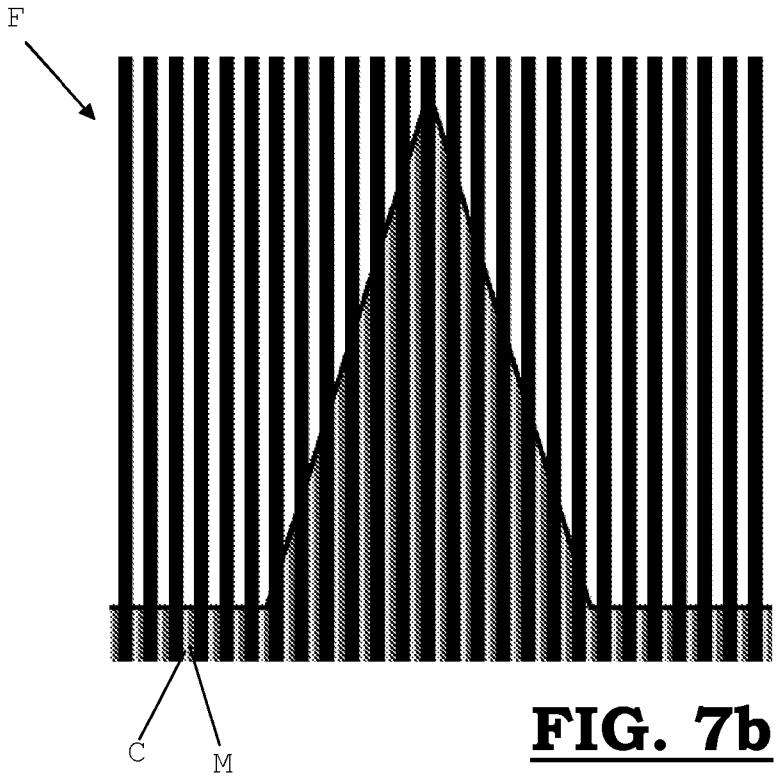

FIG. 7b

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 08 10 1159

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 97/47478 A (THOMAS DE LA RUE INTERNATIONAL [GB]; HOWLAND PAUL [GB]; DRINKWATER KEN) 18 December 1997 (1997-12-18) * page 3, line 13 - page 6, line 29 * * page 8, line 1 - page 10, line 4 * * page 10, line 30 - page 11, line 8 * * page 16, lines 18-34 * * page 17, lines 4-32 * * page 19, line 5 - page 21, line 2 * * claims 1,8-34; figures 1-15 *	1-12	INV. B41M3/14 B42D15/00 B42D15/10
X	GB 2 350 319 A (RUE DE INT LTD [GB]) 29 November 2000 (2000-11-29) * page 5, line 23 - page 6, line 14 * * page 7, lines 15-26 * * page 9, line 15 - page 13, line 32 * * claims 1-19; figures 1-7 *	1-12	
A	US 5 795 643 A (STEININGER HELMUT [DE] ET AL) 18 August 1998 (1998-08-18) * column 4, lines 34-57 * * figures 4a,4b *	1-12	TECHNICAL FIELDS SEARCHED (IPC) B41M B42D
A	WO 00/00356 A (ALUSUISSE LONZA SERVICES AG [CH]; ZEITER PATRIK [CH]; LUETHI MARKUS [C) 6 January 2000 (2000-01-06) * page 3, line 15 - page 4, line 12 * * page 9, lines 7-21 * * figure 1 *	1-12	
A	DE 42 26 906 A1 (BASF MAGNETICS GMBH [DE]) 17 February 1994 (1994-02-17) * figure 8 *	1-12	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	2 July 2008	Patosuo, Susanna

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)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 08 10 1159

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

02-07-2008

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9747478 A	18-12-1997	AU 723787 B2	07-09-2000
		AU 3100097 A	07-01-1998
		CA 2258251 A1	18-12-1997
		DE 19781815 T0	17-06-1999
		GB 2330111 A	14-04-1999
		US 6089614 A	18-07-2000
GB 2350319 A	29-11-2000	NONE	
US 5795643 A	18-08-1998	AT 149121 T	15-03-1997
		BR 9307341 A	01-06-1999
		CN 1087730 A	08-06-1994
		DE 4236563 A1	05-05-1994
		DK 670786 T3	05-05-1997
		WO 9409990 A1	11-05-1994
		EP 0670786 A1	13-09-1995
		ES 2098789 T3	01-05-1997
		GR 3023340 T3	29-08-1997
		JP 3386076 B2	10-03-2003
		JP 8505821 T	25-06-1996
		RU 2101187 C1	10-01-1998
		ZA 9308043 A	28-04-1995
WO 0000356 A	06-01-2000	AU 4028499 A	17-01-2000
		CA 2335239 A1	06-01-2000
		DE 59903555 D1	09-01-2003
		EP 0967091 A1	29-12-1999
		ES 2184453 T3	01-04-2003
		US 6494491 B1	17-12-2002
DE 4226906 A1	17-02-1994	AT 143870 T	15-10-1996
		BR 9306906 A	08-12-1998
		CN 1086479 A	11-05-1994
		DK 655032 T3	18-11-1996
		WO 9404367 A1	03-03-1994
		EP 0655032 A1	31-05-1995
		ES 2094554 T3	16-01-1997
		GR 3022252 T3	30-04-1997
		JP 8503788 T	23-04-1996
		JP 3309318 B2	29-07-2002
		RU 2102244 C1	20-01-1998
		US 5728449 A	17-03-1998
		ZA 9305912 A	13-02-1995

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82