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(71) Applicant: **DE LA RUE INTERNATIONAL LIMITED** [GB/GB]; De La Rue House, Jays Close, Viables, Basingstoke, Hampshire RG22 4BS (GB).

(72) Inventors: **MESNAGE, Alice**; 47 Richmond Road, Southampton SO15 3FT (GB). **EASTGATE, Stephen**; 4 Rook Road, Wooburn Green, High Wycombe, Buckinghamshire HP10 0PY (GB).

(74) Agent: **GILL JENNINGS & EVERY LLP**; The Broadgate Tower, 20 Primrose Street, London EC2A 2ES (GB).

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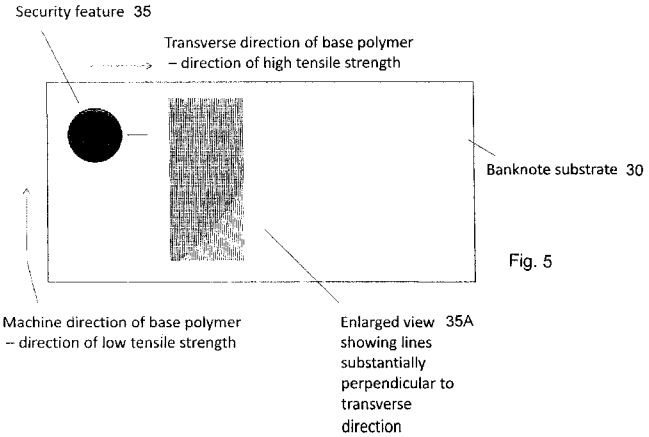

Fig. 5

(57) Abstract: A substrate (30) for a security document, the substrate being a substantially planar polymer sheet or laminate having a tensile strength which differs in at least two directions in the plane of the substrate. Part of the substrate (30) has an elongate deformation extending substantially orthogonally to the direction exhibiting the greater tensile strength.

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SUBSTRATE FOR A SECURITY DOCUMENT

The invention relates to a substrate for a security document, a security device comprising such a substrate and a method of manufacturing a substrate. In this case, the substrate can be used in the manufacture of security documents including articles of value such as banknotes, cheques, bonds, certificates, fiscal stamps, tax stamps, vouchers, passports and brand protection items.

The invention is particularly concerned with the use of polymer materials for such substrates. Optically variable security features, such as features exhibiting moiré effects, image switching effects or colourshifting effects which function because of a raised surface line structure are utilised commonly on paper based security documents but have not been widely exploited on polymer substrates due to the difficulties in retaining the raised structure in the polymer materials after embossing and the damage to the polymer material during the embossing process.

In accordance with a first aspect of the present invention, we provide a substrate for a security document, the substrate being a substantially planar polymer sheet or laminate having a tensile strength which differs in at least two directions in the plane of the substrate, and wherein part of the substrate has an elongate deformation extending substantially orthogonally to the direction exhibiting the greater tensile strength.

Preferably, the greater tensile strength is at least 100N/mm^2, preferably at least 150N/mm^2, and most preferably at least 200N/mm^2.

In accordance with a second aspect of the present invention, we provide a substrate for a security document, the substrate being a substantially planar polymer sheet or laminate exhibiting a tensile strength greater than 100N/mm^2 in at least one direction in the plane of the substrate, and wherein part of the substrate has an elongate deformation extending substantially orthogonally to the said direction exhibiting a tensile strength greater than 100N/mm^2. Preferably, said tensile strength exceeds 150N/mm^2, preferably 200N/mm^2.

The inventor has discovered that the mechanical properties, and in particular the tensile strength, of the polymer substrate have a significant impact on the performance of optically variable security features which function as a result of an embossed raised line structure.

The invention preferably applies to a substrate thickness in the range 30-100microns and more preferably in the range 50-90 microns and even more preferably in the range 60-80 microns.

The preferred substrate material for the current invention is polypropylene but other polymer materials are also suitable such as polyethylene terepthalate, nylon or polyethylene. In the case of polypropylene, the method of producing the film may lead to different tensile properties in different directions. For example bi-axially oriented polypropylene is typically produced using the well-known tenter frame process where an extruded film is stretched in both the machine direction and transverse direction. This process results in a film with a significantly higher tensile strength in the transverse direction compared to the machine direction. For example a 70 micron BOPP film may have a tensile strength of 250N/mm^2 in the transverse direction compared to a tensile strength of 90 N/mm^2 in the machine direction. Any degree of orientation of polymer chains in the polymeric film results in property variations within the thermoplastic polymer. The stretching of films will lead to decreasing strength and stiffness properties perpendicular to the orientation while increasing properties parallel to the direction of deformation. In the tenter process the polymer film is typically stretched more in the transverse direction compared to the machine direction for example in the transverse direction the film will be undergo a 10 fold stretch and in the machine direction it will undergo a 4 fold stretch.

BOPP film may also be manufactured by the alternative bubble process in which case the film is stretched evenly in both directions, typically 6.5 times in both directions, resulting in substantially the same tensile strength properties in both the machine and transverse direction which would typically fall between the two values for the film produced on the tenter process. In this case, the elongate

deformations would be arranged to extend substantially orthogonally to the direction exhibiting a tensile strength greater than 100 N/mm^2.

We have observed that when the tensile strength is less than 100 N/mm^2 in the direction substantially perpendicular to the long axis of the line structure the polymer material does not deform in a controlled manner and undergoes significant distortion when subjected to the pressure of the embossing plate.

The tensile strength is measured using the following ISO standard test method DIN EN ISO 527-1/-3. For example for a 75 micron BOPP film using the tenter method the following test conditions would be applied.

Tensile Strength in the transverse direction (TD) at 40% elongation.	DIN EN ISO 527-1/-3	Sample width	15mm
		Fixation length	100mm
		Speed	100mm/min
Tensile Strength in the machine direction (MD) at 100% elongation.	DIN EN ISO 527-1/-3	Sample width	15mm
		Fixation length	100mm
		Speed	100mm/min

The polymer substrate will typically comprise a base substrate polymer film, for example of BOPP, and then additional print receptive opacifying coatings applied on one or both sides of the polymer substrate to create a print receptive layer. Transparent window regions can be defined by a gap in at least one of the opacifying layer(s) in a conventional manner. The one or more opacifying layers can be provided on either side of the polymer substrate and the various window regions may also be defined on either or both sides. The window(s) can be provided with security devices. The elongate deformations can be formed by embossing directly the transparent substrate or by embossing through the opacifying coating(s).

The elongate deformation is typically rectilinear but could have other forms such as being curvilinear or part rectilinear and part curvilinear. Deformations which vary in amplitude along an elongate, typically rectilinear, datum line are envisaged, for example shaped as a sine wave

The elongate deformation typically defines a raised feature but could also define a depressed feature (concave) and will typically be embossed (with or without ink) into the substrate using a male or female embossing die although other means of deformation could also be used.

The elongate deformation is typically continuous but could be in the form of discontinuous set of dots or lines or mixed dots and lines.

In preferred examples, the elongate deformation forms part of an array of substantially parallel elongate deformations. The elongate deformation or array of such deformations can be used to define a latent image or other security effect in a conventional manner or could be used in combination with a printed feature such as a printed array of lines as will be described in more detail below.

The elongate deformation or array of deformations could define a security feature.

Substrates according to the invention can be used in the manufacture of a wide variety of security documents including articles of value such as banknotes, cheques, bonds, certificates, fiscal stamps, tax stamps, vouchers, passports and brand protection items.

We also provide a method of manufacturing a substrate for a security document according to a third aspect of the invention, the method comprising providing a substantially planar polymer sheet or laminate substrate having a tensile strength which differs in at least two directions in the plane of the substrate, and deforming part of the substrate so as to form an elongate deformation extending substantially orthogonally to the direction exhibiting the greater tensile strength.

Preferably, this method further comprises prior to the deforming step, measuring the tensile strength of the substrate in said at least two directions to determine which direction exhibits the greater tensile strength. This is particularly convenient when tensile strengths of a substrate are not known.

In accordance with a fourth aspect of the present invention, we provide a method of manufacturing a substrate for a security document, the method comprising providing a substantially planar polymer sheet or laminate substrate having a tensile strength in at least one direction that exceeds 100N/mm^2, and deforming part of the substrate so as to form an elongate deformation extending substantially orthogonally to the direction exhibiting a tensile strength greater than 100N/mm^2.

As with the first method, the method according to the fourth aspect preferably further comprises, prior to the deforming step, measuring the tensile strength of the substrate to determine in which direction it exhibits the tensile strength greater than 100N/mm^2.

In a particularly preferred application, we provide a security device comprising a substrate according to the first or second aspects of the invention; and a first array of lines printed or otherwise provided on the substrate, the lines comprising materials which appear different from each other (in the visible or non-visible wavelength range) whereby at least some of the lines in the first array appear different from other lines under a certain viewing condition; and a second, surface relief array of lines imposed on the first array, the surface relief array defined by a plurality of said elongate deformations, the orientation, line widths and spacings of the first and second arrays being such that the device exhibits a variable appearance as it is tilted.

The first array may be provided in a wide variety of different forms. In a simple example, the first array comprises an array of parallel lines and these could be rectilinear lines or curvilinear lines, for example wavy lines, and the like.

The lines of the first array are typically continuous and, for example, have a constant thickness, but can also be discontinuous. For example, the lines could be made up of spaced apart dots, alphanumeric symbols or other indicia providing yet a further security feature when the device is viewed under magnification. Further these dots or the like can be arranged in an orthogonal or other regular polygonal grid.

In a particularly preferred example, the materials providing the lines of the first array are chosen such that each line in the first array exhibits a different colour from its neighbouring lines. Typically, these colours will alternate across the array from line to line.

The lines of the first array can be provided preferably by printing but could also be coated, sprayed or the like onto the substrate. In the case of printing, the preferred methods include litho, offset letterpress, waterless lithography, direct letterpress, rotogravure, flexographic printing and screen printing.

When the lines of each array are parallel, the lines of the second array typically correspond to the lines of the first array with, for example, adjacent sides of the relief being provided with a respective line of the first array. However, adjacent sides of the second array could be provided with more than one line of the first array. It is preferable that the repeat distance (i.e. pitch) of the lines of the same colour of the first array is substantially the same as the repeat distance (i.e. pitch) of the second array. However, a difference in pitch of up to 15 or 30% is acceptable. It is not essential that the position of the different coloured lines is in accurate register with the relief of the second array. If the register can be controlled accurately then the colours observed and the angle at which the change is observed can be controlled. However if the required security feature is the simple presence of a colourshift on tilting the device then the accurate registration is not necessary.

The line widths of the surface relief structure of the second array are selected such that the structure is non-diffracting, i.e. greater than 10 microns. Preferably the pitch of the surface relief array will be chosen to be similar to that of the pitch

of the lines in the printed, first array i.e. preferably between 100-500 microns and even more preferably between 290-420 microns. Line width of the second array is preferably between 60-90% of the pitch of the second array.

In some examples, the lines of the second array have a similar form (curvilinear or rectilinear) to the lines of the first array but in other, preferred examples the lines of the second array could be different from those of the first array. For example, the second array could be formed with curvilinear lines such as wavy lines while the first array is formed of rectilinear lines.

Where the pitch or direction of the lines of the second array are not the same as the corresponding pitch or direction of the first array, it is possible to vary the dominant colour presented to the viewer when the image is tilted to create a moiré effect or patterning. This is preferably done by rotating the arrays or localized regions of the two arrays and the angle of rotation utilised between the two arrays depends on the nature of the optical effect required. The resultant moiré lines will be further apart the closer the angle of rotation is to zero while a rotation angle of approximately greater than 5° will lead to closely spaced moiré lines exhibiting a rapid colour change on tilting. In practice, a localized rotation is typically achieved by locally modulating the position of the lines of one of the arrays, for example the use of a wavy line in one of the arrays.

The pitch of the second array is typically constant but in some cases it can vary across the array and, for example, can increase in a regular manner. This leads to further patterning effects. For example, where the first array defines a simple arrangement of alternate lines presenting alternate colours under a combination of visible and non-visible illumination, varying the pitch of the second array having lines parallel to that of the first will cause a graduated colour shift effect to be observed when the device is tilted.

The second array is typically provided by means of embossing into the substrate, most conveniently achieved by blind intaglio embossing. Of course, other conventional embossing techniques could also be used. So far we have described a device having a single first array and a single second array. In

some examples, the device may further comprise a further second surface relief array of lines imposed on the first array, the lines of the further second array being laterally offset from the lines of the one second array. With this option, discrete areas of the first array are effectively defined by the second arrays and in a simple case will result in a dominant colour visible at any particular angle being different in the areas of the two second arrays.

Some examples of security devices according to the present invention will now be described with reference to the following drawings, in which:-

Figure 1 illustrates the printed array component of a security device according to an example of the invention (without superimposed surface relief);

Figure 2 is an enlarged view of part of Figure 1;

Figure 3 is an enlarged view of the security device formed by the printed array of Figure 1 superimposed with a surface relief structure when viewed perpendicularly, the moiré lines being a defect of the reproduction in this image;

Figure 4 illustrates the device of Figure 3 when viewed at a non-perpendicular angle;

Figure 5 shows the device of Figures 1 to 4 on a polymer substrate;

Figures 6A and 6B illustrate another example of a device when viewed at different tilt angles

Figure 6 is a schematic, enlarged view of the device of Figures 1-3 when viewed at a non-perpendicular angle;

Figure 7 is a view of the device shown schematically in Figure 6;

Figure 8 is a view of a second example of a security device according to the invention when viewed at a non-perpendicular angle;

Figure 9 is a considerably enlarged, diagrammatic view of part of the device shown in Figure 8;

Figure 10A illustrates one working of a printed array of a further example.;

Figure 10B illustrates a relief array to be imposed on the array of Figure 10A;

Figure 11A illustrates one working of a printed array of yet a further example;

Figure 11B illustrates a relief array to be imposed on the array of Figure 11A; and

Figures 12A and 12B illustrate one working of the printed array and the relief array respectively of yet another example.

Figure 1 illustrates a typical security device of the current invention comprising a printed circle made up of many rectilinear, equally spaced, parallel lines 1 which can be seen in more detail in Figure 2. The lines are printed on a polymer substrate 30 (Figure 5) such as BOPP. The lines 1 are each formed of one of two materials (each made up of one or more components), the two materials being used alternately, line by line, each material appearing a different visible colour. Without any further changes to the device structure, these colours will either combine when viewed by the naked eye to present an overall constant colour or appear as a multicoloured striped design depending on the resolution of the lines.

In order to bring out this difference in colours, the printed line array of Figures 1 and 2 is intaglio embossed to provide a surface relief second array 2 of lines 3 as can be seen in Figure 3. The lines 3 are rectilinear and parallel as can be seen in Figure 3 and are superimposed upon the printed line pattern 1. The pitch of the surface relief lines 3 is the same as that of the printed lines 1 but the array 2 is located at a non-parallel angle with the array 1 producing a moiré effect.

When the device is tilted along an angle in a plane generally perpendicular to the lines 3, alternate ones of the lines 1 will be partly or completely concealed with the result that the colour of the other lines will become more dominant, likewise when the device is tilted in the opposite direction but again along an angle in a plane generally perpendicular to the lines 3 the situation will reverse and the other colour will become dominant resulting in the device changing on tilting. The rotation of the two arrays results in different dominant colours being present at the same angle of tilt at different regions in the device and also a moiré effect will be seen as shown in Figure 4 resulting in the presence of coloured moiré fringes of different colours which appear as the device is tilted.

Figure 5 shows how the device in Figures 1-4, indicated at 35 and in enlarged form at 35A, is located on the polymer substrate 30 according to an example of the present invention. The polymer substrate 30 is BOPP and has a high tensile strength, in this example 250 N/mm^2, in the transverse direction (parallel to the long axis of the substrate in Figure 5) and a lower tensile strength in the machine direction (parallel to the short axis of the substrate in Figure 5). In order for the relief lines to be embossed without resulting in a significant macro distortion of the substrate the embossed second array of lines are embossed such that their long direction is perpendicular to the transverse direction of the base polymer substrate which is a direction that has a tensile strength of 250 N/mm^2 i.e. greater than 100 N/mm^2.

Figure 6 illustrates part of a banknote or other security document including a device of the type shown in Figures 1-4, when viewed in visible light. Figure 6A shows the device at 10 when viewed perpendicularly to the surface of the document while Figure 6B shows the device when viewed at an angle with the moiré pattern becoming very clear.

In order to understand the reason why this effect is being achieved we refer to Figure 7. It can be seen that one of the sets of lines 1 is a first colour in this case green (1A) while the other set of lines is a second colour in this case red (1B). It can then be understood that when the device is tilted while looking along

the direction 12 perpendicular to the direction of the embossed lines 3, different colours will be dominant and in different lateral positions (green to the left and red to the right) leading to a stripe effect.

In a simpler example, the sides or flanks of the surface relief lines 3 will be provided entirely with one or other of the lines 1, i.e. the two sets of the lines are parallel so that as the device is tilted and viewed along the direction 12, a gradual switch between one colour (the combination of colours) and the other (red or green) will be observed.

Figures 8 and 9 illustrate the principle of a second example. In this case, the printed array of lines shown in Figure 1 is embossed with two surface relief structures of similar form side by side but offset with respect to one another so that the peaks of the surface relief of one array correspond to the troughs of the other. In this case, the surface reliefs 14, 16 extend through circular regions (as seen in Figure 8) and because of the offsetting of the surface reliefs 14, 16, in one area of the device one of the resultant colours will be dominant (such as red) while in the other region the other colour will be dominant (such as green) when the device is viewed at a non- perpendicular angle. Again, the elongate direction of the surface reliefs 14,16 is chosen to be perpendicular to the direction of greater tensile strength and/or perpendicular to the direction exhibiting a tensile strength greater than 100 N/mm^2.

It will be appreciated that many different variations of effect can be achieved by varying the form, pitch and location of the different arrays.

In typical examples, the pitch of the lines 1 in the printed array will be between 290 microns and 420 microns, the closer the lines are together the flatter the resultant colour when viewed under visible illumination. Typically, a spacing between lines is allowed of up to 45 microns such that for a two colour design, i.e. alternating lines of different and a repeat of 290 microns, leads to a line width of about 100 microns.

The pitch of the surface relief will be chosen to be similar to that of the pitch of the printed lines.

Figure 10A shows an example of part of the printed array used to produce an optical effect suitable for use in the current invention. For simplicity only one of the printed workings is shown, however the printed array will comprise alternating lines of two different colours as described for Figure 1. The array of lines with the surface relief is shown in Figure 10B and has the same rectilinear profile as the printed arrays, with the lines extending perpendicularly to a direction in which the substrate exhibits a tensile strength greater than 100 N/mm^2. The array of lines with the surface relief has a region 20 in the shape of a numeral "5" which is offset from the background so that the peaks of the surface relief of the offset region correspond to the troughs of the background region. When viewed the lines 1 will exhibit a colour change as described above but because of the offsetting of the surface reliefs, the numeral "5" will have a different dominant colour compared to the background when the device is viewed at a non-perpendicular angle. In this example the relief lines have a repeat of 185µm and a 285µm line pitch (Centre to Centre). The two differing lines of the printed arrays have a line width of 125µm with a 25µm spacing between each line giving a line pitch for a line of each material of 300µm (Centre to Centre). In this example there is no angular rotation and the moiré effect is negligible.

Figure 11A shows a further example of part of the printed array used to produce the optical effect of the current invention. For simplicity only one of the printed workings is shown, however the arrays will comprise alternating lines of two different materials as described for Figure 1. The array of printed lines (Figure 11A) has a smooth wavy profile while the array of lines with surface relief (Figure 11B) has a background region 22 which broadly follows the profile of the printed array but in a second region 24 the array of lines with a surface relief has been rotated by 7 degrees to form a spiral pattern. A rotation of 7 degrees is still predominantly in the tensile strength direction. In practice, there could be a rotation of up to 20 degrees but more preferably less than 10 degrees. This

effectively results in a rotation of 7 degrees between the array of lines with surface relief and the array of printed lines in the region of the spiral with the result being that a moiré effect is observed with differently coloured moiré bands appearing along the spiral as the device is tilted and viewed under visible illumination. A colourshift effect will also be observed in both the spiral and background regions of the device when viewed. In this example the line widths and repeats are the same as the Figure 10 example.

Figure 12 shows a further example for the two arrays used to produce the optical effect of the current invention. For simplicity only one of the printed workings is shown (Figure 12A), however the arrays will comprise repeating lines of three different materials. The printed array is divided into three sections, in this example forming three stars. In Star (a) the lines of printed array repeat in the order red- green-blue, for Star (b) the repeat order is blue-red-green and for Star (c) the repeat order is green-blue red. In each Star the array of printed lines has a rectilinear pattern. The array of lines with surface relief (Figure 12B) has a similar rectilinear pattern which is uniform with no offset regions, the lines extending perpendicular to the direction of greater tensile strength and/or perpendicular to the direction exhibiting a tensile strength greater than 100 N/mm^2. The position of the differently coloured printed lines in relation to the peaks, troughs and flanks of the relief structure will vary for the different Stars and therefore a different colour will be seen in each Star as the device is tilted.

It is also possible to create a graduated colour shift instead of the patterns described above. This can be achieved by deliberately varying the pitch of the surface relief compared to that of the printed array using rectilinear lines and with the two sets of lines parallel. The degree of pitch variation affects how quickly the colours graduate.

Although the examples described have been formed as continuous, printed lines, for example litho printed, many other options are available as mentioned above. For example, the lines could be discontinuous and formed of dots, indicia and the like. In addition, the lines have been shown to change completely to a second colour under ultraviolet radiation while in other examples,

the lines could be divided into different portions which exhibit different colours under a combination of visible and UV illumination.

CLAIMS

1. A substrate for a security document, the substrate being a substantially planar polymer sheet or laminate having a tensile strength which differs in at least two directions in the plane of the substrate, and wherein part of the substrate has an elongate deformation extending substantially orthogonally to the direction exhibiting the greater tensile strength.

2. A substrate according to claim 1, wherein the greater tensile strength is at least 100N/mm^2, preferably at least 150N/mm^2, and most preferably at least 200N/mm^2.

3. A substrate for a security document, the substrate being a substantially planar polymer sheet or laminate exhibiting a tensile strength greater than 100N/mm^2 in at least one direction in the plane of the substrate, and wherein part of the substrate has an elongate deformation extending substantially orthogonally to the said direction exhibiting a tensile strength greater than 100N/mm^2.

4. A substrate according to claim 3, wherein said tensile strength exceeds 150N/mm^2, preferably 200N/mm^2.

5. A substrate according to any of the preceding claims, wherein the elongate deformation is rectilinear.

6. A substrate according to any of the preceding claims, wherein the elongate deformation defines a raised feature.

7. A substrate according to any of the preceding claims, wherein the elongate deformation is continuous.

8. A substrate according to any of the preceding claims, wherein the elongate deformation is embossed into the substrate.

9. A substrate according to claim 8, wherein the elongate deformation is an uninked emboss.

10. A substrate according to any of the preceding claims, wherein said elongate deformation forms part of an array of substantially parallel elongate deformations.

11. A substrate according to any of the preceding claims, wherein the polymer is one of polypropylene, polyethylene terephthalate, nylon or polyethylene.

12. A substrate according to any of the preceding claims, wherein one or both sides of the substrate is provided with a print receptive opacifying coating.

13. A substrate according to claim 12, wherein one or more window regions are provided in one or both of the opacifying coatings.

14. A substrate according to any of the preceding claims, wherein the elongate deformation or array of elongate deformations defines a security feature.

15. A security device comprising a substrate according to any of the preceding claims.

16. A security device comprising a substrate according to any of the preceding claims; a first array of lines printed or otherwise provided on the substrate, the lines comprising materials which appear different from each other whereby at least some of the lines in the first array appear different from other lines under a certain viewing condition; and a second, surface relief array of lines imposed on the first array, the surface relief array defined by a plurality of said elongate deformations, the orientation, line widths and spacings of the first and second arrays being such that the device exhibits a variable appearance as it is tilted.

17. A security device according to claim 15 or claim 16, provided as a transferable label on a carrier.

18. A document incorporating a security device according to any of claims 14 to 17 or on which such a security device has been affixed.

19. A method of manufacturing a substrate for a security document, the method comprising providing a substantially planar polymer sheet or laminate substrate having a tensile strength which differs in at least two directions in the plane of the substrate, and deforming part of the substrate so as to form an elongate deformation extending substantially orthogonally to the direction exhibiting the greater tensile strength.

20. A method according to at least claim 19, further comprising, prior to the deforming step, measuring the tensile strength of the substrate in said at least two directions to determine which direction exhibits the greater tensile strength.

21. A method of manufacturing a substrate for a security document, the method comprising providing a substantially planar polymer sheet or laminate substrate having a tensile strength in at least one direction that exceeds $100N/mm^2$, and deforming part of the substrate so as to form an elongate deformation extending substantially orthogonally to the direction exhibiting a tensile strength greater than $100N/mm^2$.

22. A method according to at least claim 21, further comprising, prior to the deforming step, measuring the tensile strength of the substrate to determine in which direction it exhibits the tensile strength greater than $100N/mm^2$.

23. A method according to any of claims 19 to 22, wherein the deforming step comprises embossing the substrate.

24. A method according to claim 23, wherein the embossing step comprises uninked embossing.

25. A method according to any of claims 19 to 24, wherein the polymer comprises one of polypropylene, polyethylene terephthalate, nylon or polyethylene.

26. A method according to any of claims 19 to 25 for manufacturing a substrate according to any of claims 1 to 13.

Fig. 1

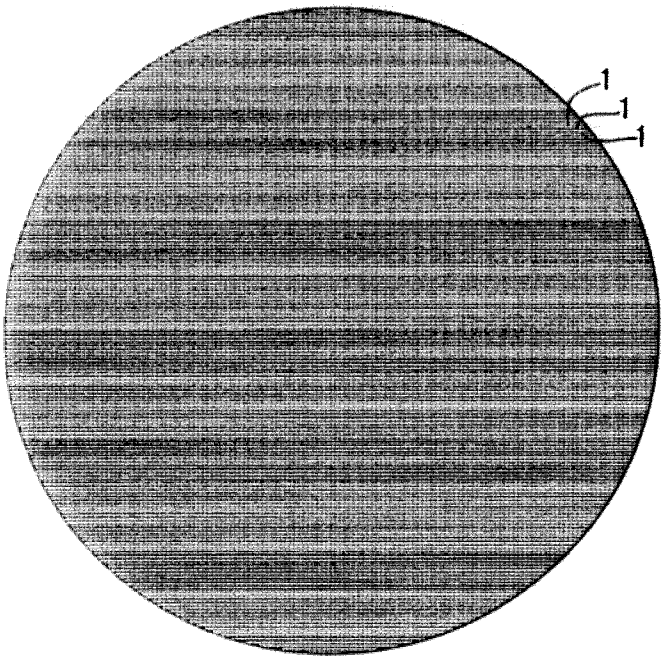


Fig. 2

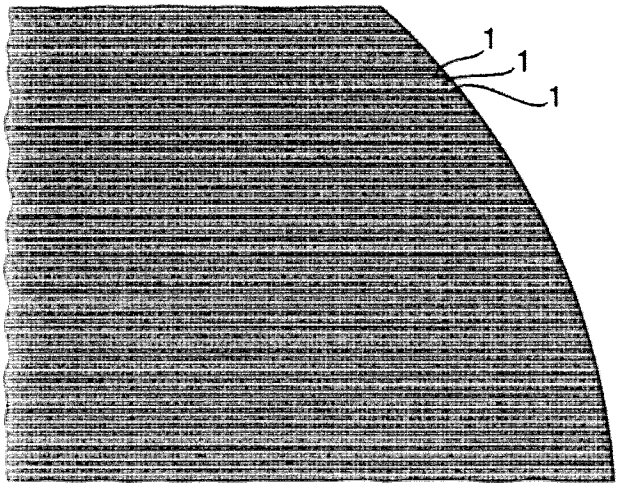


Fig. 3

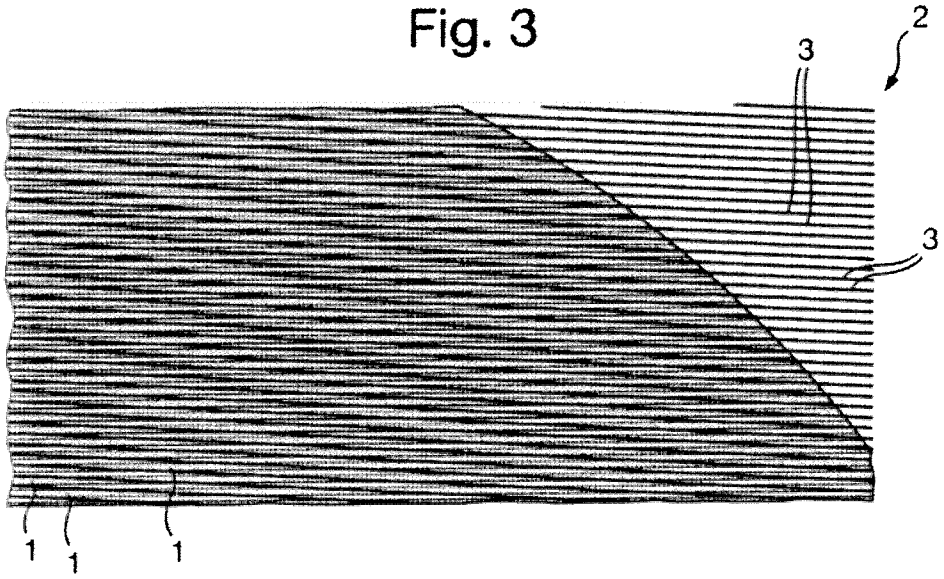
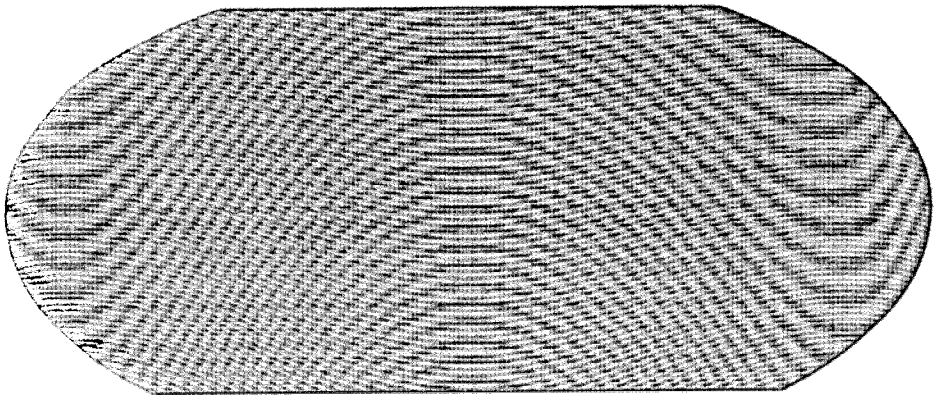


Fig. 4



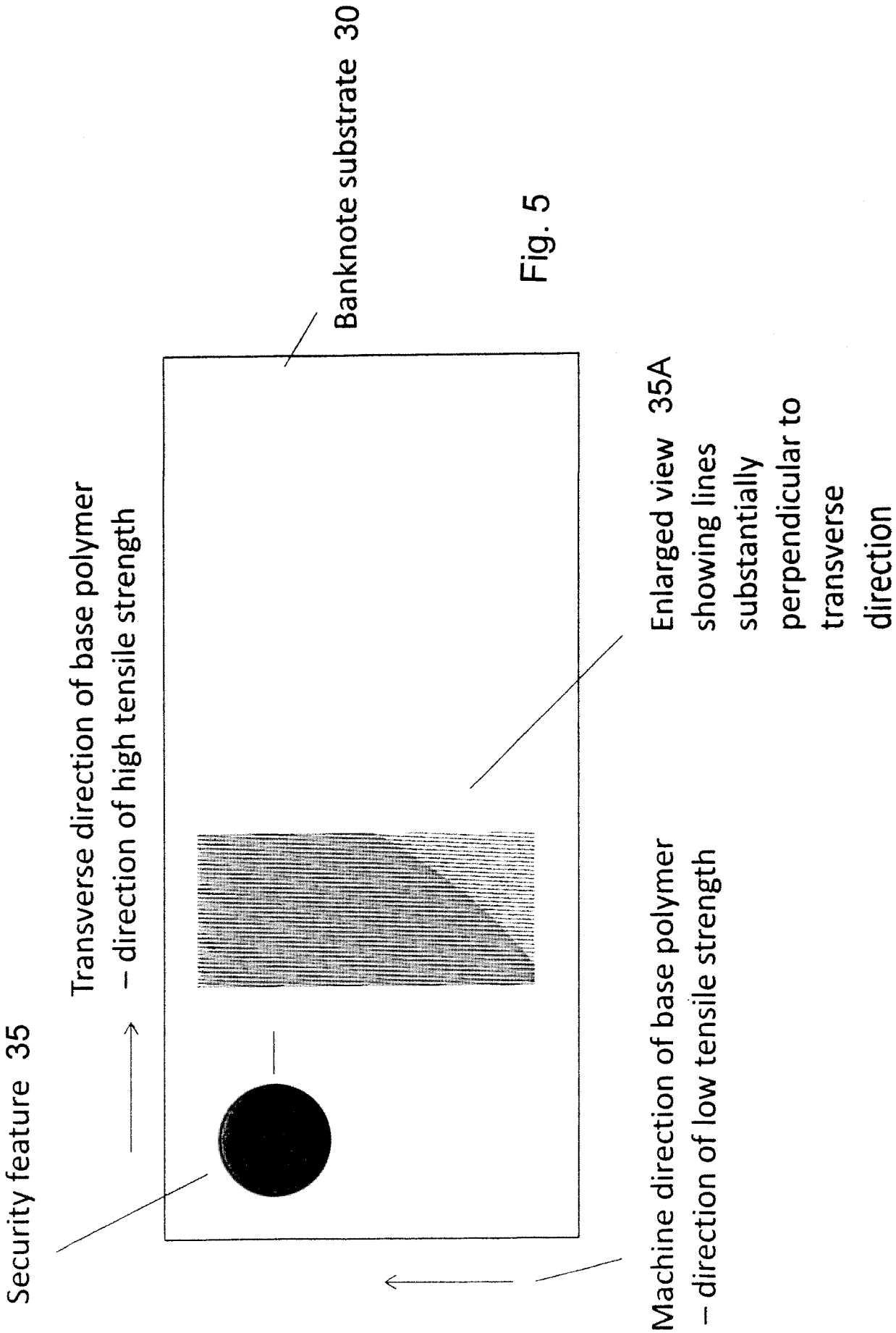

Banknote substrate 30
Security feature 35
Transverse direction of base polymer
– direction of high tensile strength
Enlarged view 35A
showing lines
substantially
perpendicular to
transverse
direction
Machine direction of base polymer
– direction of low tensile strength

Fig. 5

Fig. 6A

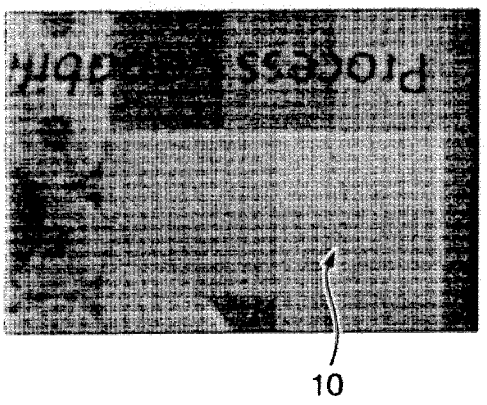


Fig. 6B

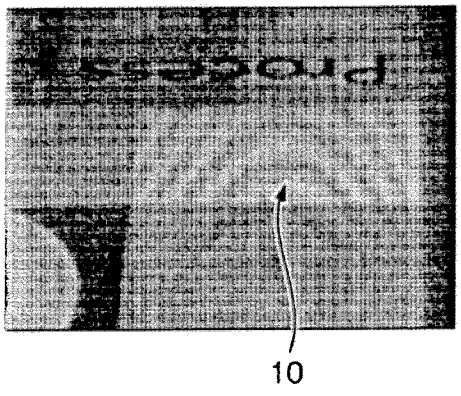


Fig. 7

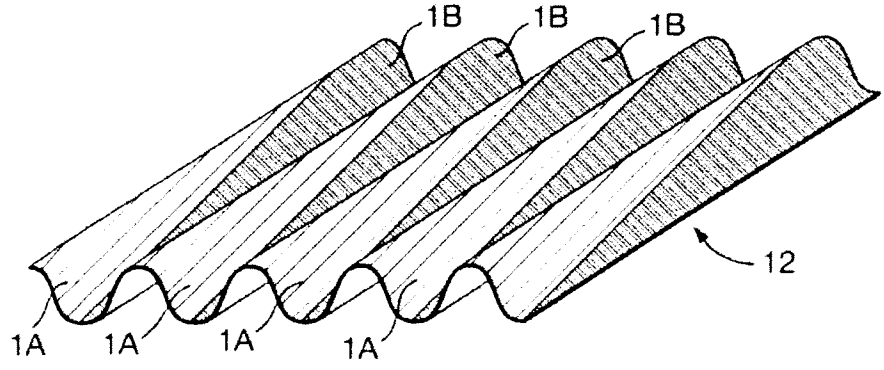


Fig. 8

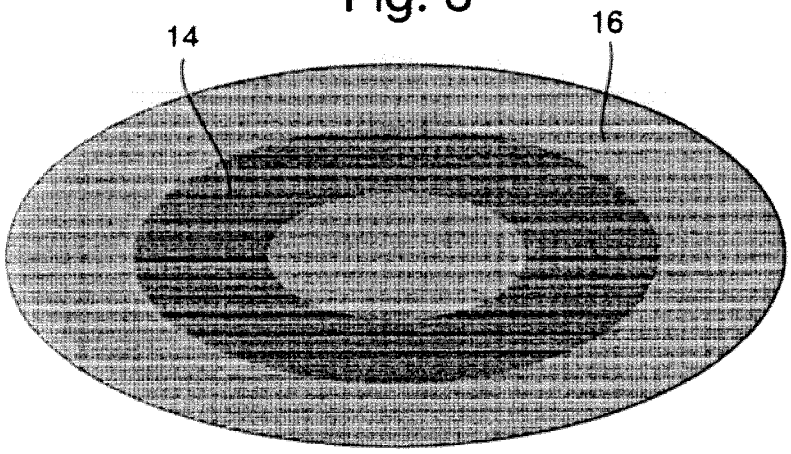


Fig. 9

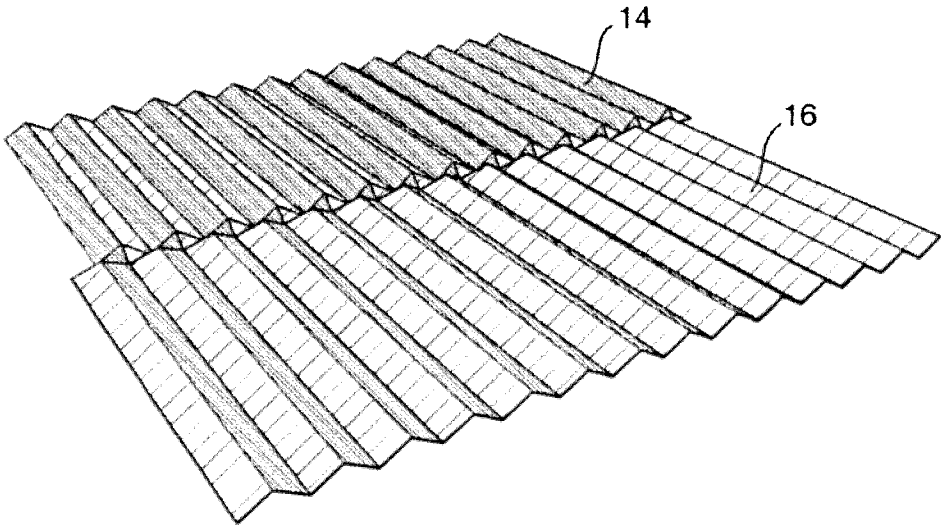


Fig. 10A

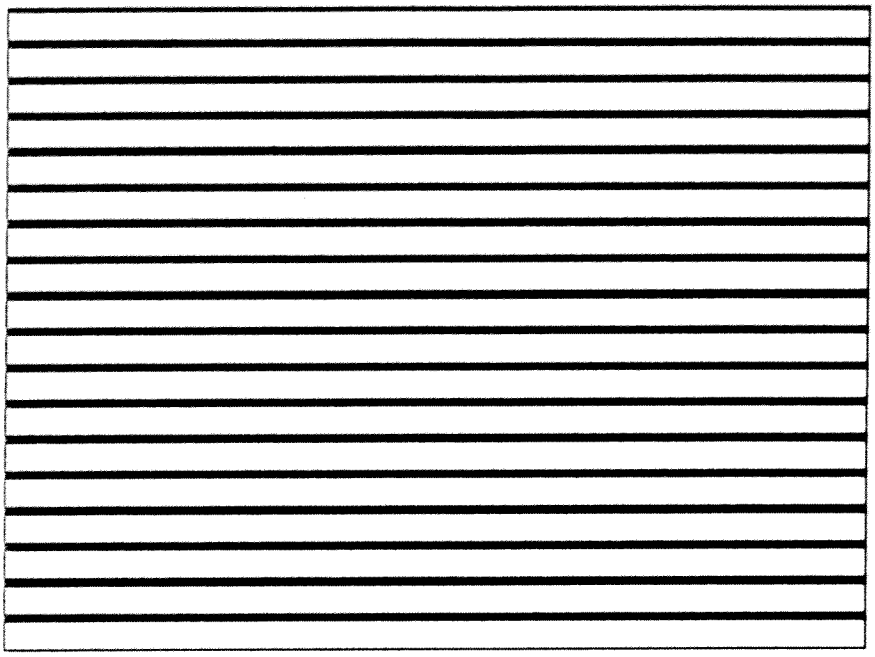


Fig. 10B

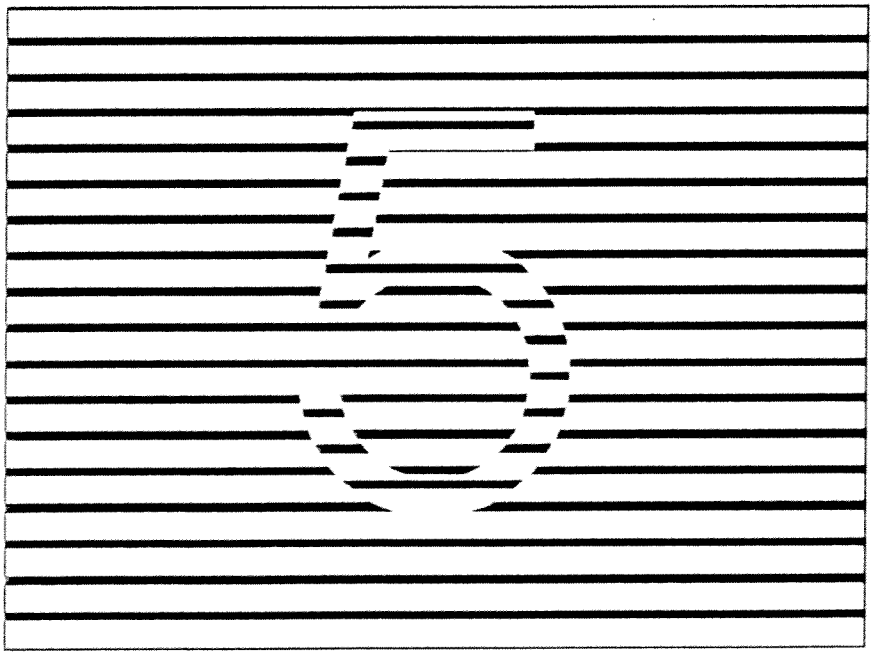


Fig. 11A

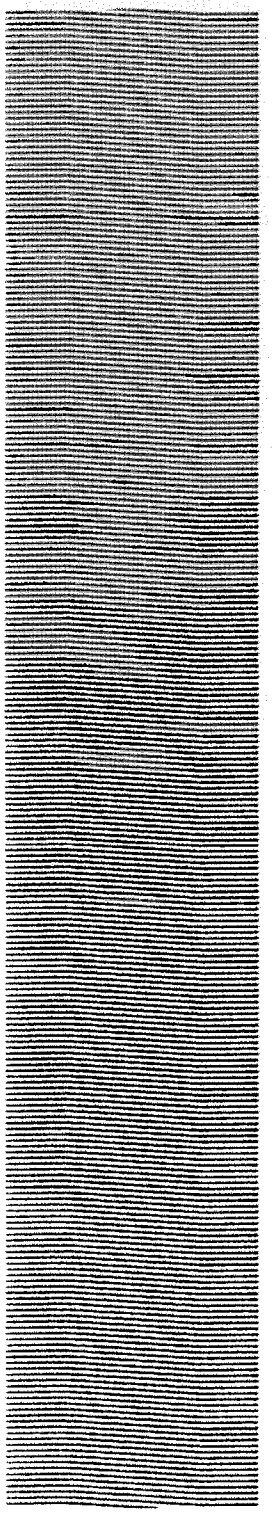


Fig. 11B

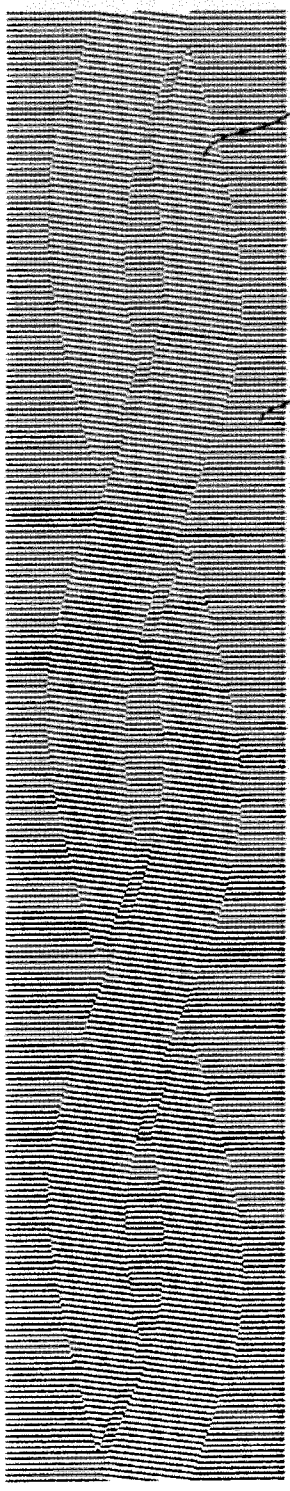


Fig. 12A

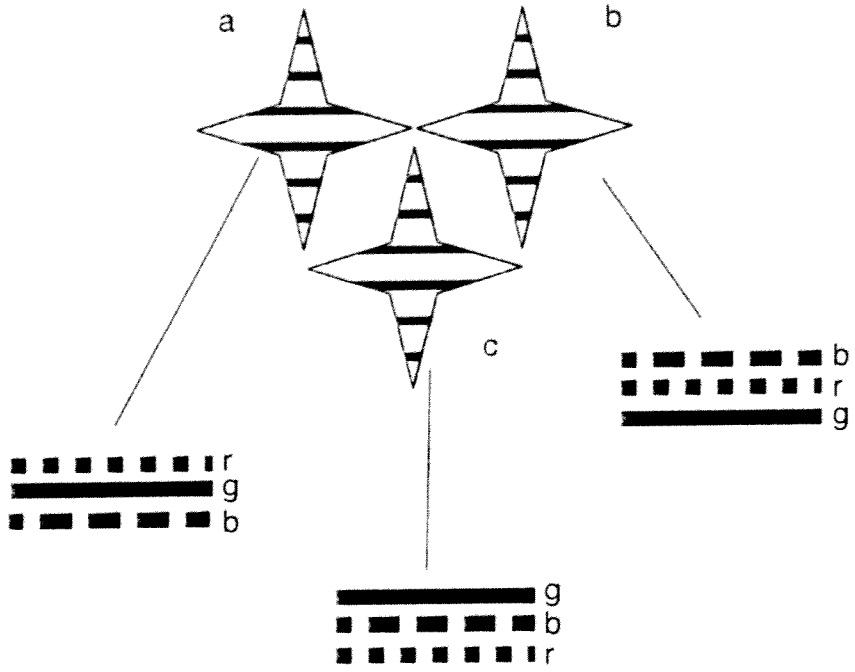
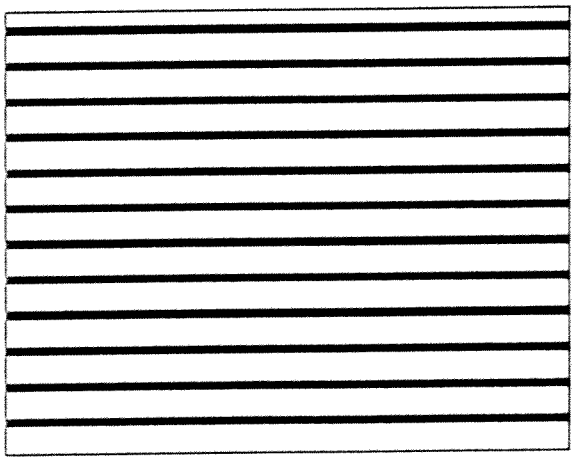


Fig. 12B



INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2016/051269

A. CLASSIFICATION OF SUBJECT MATTER
INV. B42D25/24 B42D25/29 B42D25/324 B42D25/425 B41M3/14
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B42D B41M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 6 270 610 B1 (BENOIT GORDON LEON [US] ET AL) 7 August 2001 (2001-08-07) column 4, line 66 - column 11, line 25; claims 1-9; examples 1-3; table 1	1-15, 17-26
Y	WO 94/29119 A1 (AUSTRALIA RESERVE BANK [AU]; JACKSON WAYNE KEVIN [AU]) 22 December 1994 (1994-12-22) page 6, line 14 - page 12, line 12; claims 1-27; figures 4-6	1-15, 17-26
Y	WO 00/18575 A1 (MOBIL OIL CORP [US]) 6 April 2000 (2000-04-06) page 5, line 31 - page 18, line 3; claims 1-22; example 1	1-15, 17-26

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
13 July 2016	26/07/2016

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Seiler, Reinhold

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INTERNATIONAL SEARCH REPORT

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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A	WO 2014/096794 A1 (RUE DE INT LTD [GB]) 26 June 2014 (2014-06-26) the whole document	1-26
A	EP 1 986 867 A2 (GIESECKE & DEVRIENT GMBH [DE]) 5 November 2008 (2008-11-05) the whole document	1-26

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