

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
13 August 2009 (13.08.2009)

PCT

(10) International Publication Number
WO 2009/098435 A2

(51) International Patent Classification:
B41M 3/14 (2006.01) *B42D 15/10* (2006.01)
B42D 15/00 (2006.01)

(21) International Application Number:
PCT/GB2009/000242

(22) International Filing Date:
29 January 2009 (29.01.2009)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0802421.8 8 February 2008 (08.02.2008) GB

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— without international search report and to be republished upon receipt of that report (Rule 48.2(g))

(54) Title: SUBSTRATE FOR SECURITY DOCUMENT

(57) Abstract: A polymer substrate (1) for a security document, the substrate having at least one elongate transparent region (3) extending through a more opaque area of the substrate and completely or almost completely between spaced locations on the boundary of the substrate. The width of the transparent region (3) is at least 2mm and the transparent region has an optical density not exceeding 0.3.



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SUBSTRATE FOR SECURITY DOCUMENT

The invention relates to a security document and a substrate for a security document.

5 A variety of security devices have been proposed in the past to prevent security documents from being counterfeited or fraudulently produced. A particularly useful security device is one which is readily verifiable by a user but which is difficult to produce. One example of such a security device is an enclosed clear transparent region in an otherwise opaque substrate.

10 For example WO8300659 describes a polymer banknote formed from a transparent substrate comprising an opacifying coating on both sides of the substrate. The opacifying coating is omitted in localised regions on both sides of the substrate to form a transparent window region. Other examples of a security documents with a transparent window are described in WO-A-2008/003949 and
15 WO-A-2006/133512.

WO0039391 describes a method of making a transparent aperture in a paper substrate. This is achieved by blinding one or more selected areas of a porous support surface, depositing a first layer of paper fibres onto the porous support surface around the blinded areas, bringing an impermeable elongate security thread
20 to lie in contact with the blinded areas of the support surface such that at least the edges of the elongate security thread overlie the deposited layer, and depositing a further layer of paper fibres over the first layer and the impermeable strip to securely embed the edges of the elongate security thread within the paper. The blinded areas are impermeable, which substantially prevents the deposition of fibres thereon
25 before the elongate security thread is laid thereover. Thus, substantially no paper fibres are deposited on one side of the elongate security thread in a central region between edges of the elongate security thread to thereby expose a continuous area of the elongate security thread at a first surface of the paper. Additionally a plurality of discrete translucent or transparent windows is formed in a second surface of the
30 paper in which the elongate security thread is exposed.

An alternative method for forming a transparent region in a paper document is to apply a transparent film in the form of a patch or a strip over a hole formed in the document either during or post manufacture of the substrate. Such approaches have been described within the prior art for example EP723501, EP724519 and

WO03054297.

The use of an enclosed transparent region prevents the generation of a “simple” counterfeit arising from the increasing popularity of colour photocopiers and other imaging systems and the improving technical quality of colour photocopies. In addition the clear transparent region provides a feature that is easily verifiable by the general public.

The presence of an enclosed transparent region in an opaque document should be identifiable by the use of transmitted light detectors in secure document handling machines. However the fact that the position of the enclosed window varies, for example in different denominations of banknotes, increases the cost and expense of modifying the detector such that it is compatible with all design variants.

US-A-5,783,275 describes the incorporation of security threads into security documents such as banknotes. These security threads are provided with holographic or other optically variable effects or alternatively with structures having a metallic lustre or with a security print. These are relatively complex structures.

An example of a transparent security thread is described in US-A-2003/0082348. This is formed by taking an opaque, paper document and transparentising a thin line extending across the document so as to form a thin, thread like feature. This simulated security thread has a width typically in the range of 0.38-1.58mm and a transparency such that when the document is held to the light, the thread can be seen.

EP-A-0930174 describes a security document incorporating a plastic thread or strip which is translucent, the translucent part possessing visually and/or mechanically readable signs or patterns.

EP-A-0536855 describes a security paper incorporating a plastic strip which is embedded within the paper and which is not readily visible under reflective illumination to the unaided eye.

GB-A-1357489 describes a banknote or other paper sheet including an opaque thread or strip.

These security documents have the advantage of providing actual or simulated threads which enable them to be authenticated upon manual inspection. However, they are not ideally suited for machine authentication.

In accordance with the present invention, a polymer substrate for a security document has at least one elongate transparent region extending through a more

opaque area of the substrate and completely or almost completely between spaced locations on the boundary of the substrate, , wherein the width of the transparent region is at least 2mm and the transparent region has an optical density not exceeding 0.3.

5 A transparent region or strip of this type enables the transparent region to be easily detected by transmitted light detectors on cash handling equipment. The fact that the transparent strip traverses completely or almost completely across the substrate, for example the full document height, or alternatively the full document width, means that the position of the detector is not critical. Also, the transmitted
10 light detector can be set up such that the document is only deemed authentic when the width of the transmitted light area corresponds to either the full width or full height of the transparent region.

Furthermore, setting the width of the elongate region to be at least 2mm while requiring that it extends through a more opaque area of the substrate means
15 that an authentication machine will detect a distinct flash of light when the substrate passes across a light source. This is further enhanced by the high degree of transparency required.

This should be contrasted with conventional threads which will have too narrow a width and typically too low a transparency for the required "flash" to be
20 observed and detected reliably and on high speed sorting machines.

By "almost completely" we mean that the transparent region may be spaced from the boundaries by up to 10mm.

Another problem with the known use of transparent regions is that an enclosed clear transparent region in an opaque substrate is susceptible to
25 counterfeiting, for example by punching a hole in an opaque substrate and then placing a clear transparent polymeric film over the hole.

Preferably, therefore, the at least one transparent region extends completely between the spaced locations on the boundary of the substrate.

This minimises the counterfeiting risk since this is not possible with a
30 continuous transparent strip as the document must be split into two sections and then reassembled such that there is a transparent strip between the two sections. It is very difficult to achieve this without damaging the document to an extent that would be recognised by the authenticator.

A particularly preferred form of transparent region is rectilinear, such a region

extending between opposite edges of the document. However, other forms of transparent region are envisaged including stepped, curved, spiral and the like.

By "polymer" we mean a synthetic plastics material including a co-extrusion or lamination of such materials.

5 For the purpose of the current invention a transparent region of the document is defined as one whose optical density when measured on a transmission densitometer, with an aperture area equivalent to that of a circle with a 1mm diameter, is preferably less than 0.3, more preferably less than 0.2 and even more preferably less than 0.1 as measured for example on a MacBeth TD932.

10 By a "more opaque area" we mean that the area of the substrate on either side of the transparent region has an optical density which is at least 0.15 units greater than the optical density of the transparent region and preferably 0.3 units greater than the transparent region and even more preferably 0.5 units greater than the transparent region. Thus, for example, if the transparent region has an optical
15 density of 0.1 units then the more opaque area may have an optical density of 0.25, preferably 0.4 and more preferably 0.6.

In many cases, a single transparent region is provided. However, more than one transparent region could be provided and this allows additional information to be defined by the transparent regions. For example, spacing between regions and/or
20 their widths could be used to form a code. Where there is more than one transparent region present the transparency of the individual regions may be different. Alternatively the transparency across an individual region may be varied.

Some examples of substrates, security documents and methods according to the invention will now be described with reference to the accompanying drawings,
25 in which:-

Figure 1 is a plan view of a first example;

Figure 2 is a schematic cross-section of the example shown in Figure 1;

Figures 3-9 and 11 are plan views similar to Figure 1 but of further examples;

and,

30 Figure 10 is a schematic diagram of an example of apparatus for carrying out the method.

Figures 1 and 2 show an example of a security document of the current invention in plan-view and cross-section respectively. In this example the security document comprises a transparent polymeric substrate 1 onto which is applied a

pigmented coating 2 which may be opaque. The pigmented coating 2 can be applied by any conventional printing process, but typically this is a gravure printing process. The pigmented coating may comprise a single layer applied to one side of the transparent substrate or, as shown, one or more layers 2 applied to both sides of the transparent substrate. The pigmented coating is omitted in one region of the document, on both sides, to provide a continuous transparent strip 3 which traverses the full height of the secure document orthogonal to the opposite, parallel edges.

The pigmented coating(s) 2 of the secure document, such as a banknote, then undergoes further standard security printing processes including one or more of the following; wet or dry lithographic printing, intaglio printing, letterpress printing, flexographic printing, screen-printing, and/or gravure printing as well as being provided with identifying indicia etc as is conventional. The resulting print is not shown in Figure 1.

As mentioned above, the transparent strip 3 enables the transparent region to be easily detected by transmitted light detectors on cash handling equipment. An example in schematic form of suitable cash handling equipment is shown in Figure 10. In this apparatus, a radiation source 30, such as an optical source, is located above a document feed path indicated by an arrow 32 in Figure 10. Below the feed path 32 is located a radiation sensor 34 such as a CCD array and both the source 30 and sensor 34 are connected to a processor 36. As a document 38 similar to the document shown in Figures 1 and 2 is fed in a conventional manner between the source 30 and sensor 34, initially the pigmented coating 2 will substantially attenuate the intensity of the light passing through the document. However, when the transparent strip 3 is located between the source and the sensor, the intensity of received radiation will suddenly increase and this increase will be detected by the processor 36. Typically, the length of the sensor 34 in a direction perpendicular to the direction of movement along the transport path 32 will be at least equal to the length of the transparent region 3. Thus, when the document 38 passes along the path 32 short edge first, a "flash" of transmitted light will be detected by the sensor 34 equivalent to the width of the transparent strip 3. The length of time the "flash" of transmitted light is detected for will correspond to the width of the continuous transparent region 3. The width of the transparent strip 3 can be varied between families of secure documents to provide a method of coding. A more complex coding system can be introduced into the document by providing multiple continuous

transparent strips which can either be of the same width or different widths (as described below).

Figures 3 and 4 show alternative configurations for the continuous transparent region. In Figure 3 a continuous transparent strip 5 traverses the full width of the secure document 6 orthogonally to the opposite, short parallel edges. The continuous transparent strip does not have to be linear and a stepped transparent region 7 which traverses the full height of the secure document is illustrated in Figure 4. Alternatively the continuous strip can be curved.

Figure 5a shows a further alternative configuration for the continuous transparent region in which the transparent region extends between adjacent edges rather than parallel edges. In Figure 5a the document comprises one continuous transparent strip 20 extending between adjacent edges. In Figure 5b the document comprises two continuous transparent strips 20,21 between adjacent edges positioned in opposite corners of the note. The advantage of the configuration in Figure 5b is that there will always be at least one "flash" of transmitted light irrespective of the position of the detectors in relation to the height of the note.

Figure 5c shows a further design alternative where a continuous transparent strip runs diagonally between opposed corners. The advantage of this design is that a flash will be seen by a detector mounted in any position on either/both short edge and long edge feed machines.

Figure 6 shows a further design alternative where a continuous transparent strip 8 is integrated into the design of the secure document 10. Figure 6 illustrates an example where the transparent strip 8 comprises a first continuous transparent region 9 formed by omitting the pigmented coating on a transparent polymeric substrate as referred with reference to Figures 1 and 2. The strip extends completely between the opposite long edges of the document 10. The optical density in this region will be less than 0.1. Immediately adjacent to this region is a region 11 of increased transparency compared to the rest of the pigmented substrate and this is achieved by removing one of the pigmented coatings or reducing the thickness of the pigmented coatings. This region will typically have an optical density of between 0.1 and 0.3. In this example the optical density of region 11 is 0.25.

The use of variable transparent regions of different optical densities increases the complexity of the device and provides an advantage in machine readability. For example if the document in Figure 6 is passed through a transmitted light detector short edge first then a first "flash" of transmitted light will be detected of

a particular intensity associated with region 11 with an optical density of 0.25. The length of time for which this first "flash" of transmitted light is detected will correspond to the width of the transparent region 11. If the note continues to pass through the detector a second flash of transmitted light is detected corresponding to the width of the transparent region 9 with a optical density of 0.1. The intensity of the transmitted light will be greater for region 9 compared to region 11 due to region 9 having a lower optical density. If the note continues to pass through the detector a third "flash" of transmitted light is detected associated with a further part of region 11. In more complex examples more than two regions of varying optical density may be present within the strip 8. In Figure 6 the secure document also comprises a fully enclosed transparent region 12, as well as continuous transparent region 8 which extends across the full height of the document.

In a further example, illustrated in cross-section in Figure 7, a single transparent region 25 is formed by reducing the number of pigmented coatings in that region rather than fully exposing the transparent polymeric substrate 1. In the example in Figure 7 the transparent region 25 only has one layer of pigmented coating 2A while the remainder of the document has four layers 2A-2D. The coating in the transparent regions must be sufficiently light transmitting that the optical density of the region does not exceed 0.3.

Figure 8 illustrates an example where the security document comprises multiple transparent strips 40-42 which can be used to form a code. The strips 40-42 are shown as dark lines for ease of understanding the drawing. In this case, the code is formed firstly by the fact that there are three strips 40-42 and secondly because the distance between adjacent strips 40;41 and 41;42 is different. Figure 9 illustrates a further example where multiple strips 43-45 are provided of different widths (as well as with different spacings) and again illustrated as dark lines. A series of banknotes can comprise different numbers of strips to indicate denomination. As the document in Figure 8 is passed by the transmitted light detector 34 the number of "flashes" of transmitted light which are of full note width will determine its denomination. In the example in Figure 9 both the number of "flashes" and the duration of each "flash" will determine the denomination. Of course, other variations are possible such as varying widths and same spacing.

In some detector systems it may be difficult to differentiate between the edge of the document and the continuous transparent strip and the detector may inaccurately interpret the continuous strip as the edge of a document having an incorrect length. This

problem may simply be overcome by programming the detector to recognise the duration of the "flash" of light associated with the continuous strip which may be shorter or longer than that associated with the edge of the note. Alternatively, unlike a void, the polymeric substrate forming the transparent strip will reflect a fraction of the incident light and this reflected light could be detected by a second detector to confirm that this is part of the document and not an edge. This method for determining the presence of enclosed transparent regions in polymer banknotes is described in US20030043365.

In a further embodiment, to avoid confusion with the edge of the note, the transparent continuous strip, can be provided with an optical structure which provides a scattering or diffusing screen. This will reduce the level of transmitted light below that observed for a fully transparent substrate or a void, but the level of transmitted light will still be such that a significant portion of light can pass through the screen and activate the detectors.

The continuous transparent strip can be of any width but preferably the width of the strip is in the range 2mm to 30mm and even more preferably in the range 2mm to 20mm.

As mentioned above, the invention is applicable to substrates for security documents prior to applying the security printing processes.

It will also be understood that in all the examples described with reference to the drawings, the transparent regions extend fully between the sides or boundaries of the substrate. This has two particular advantages as explained in the introduction, namely ensuring that the document can be detected optically and increasing the difficulty of fraudulently reproducing the document. However, in some examples of the invention, the transparent region need not extend fully between edges of the document and could terminate a short distance before reaching the boundary, for example up to about 10mm. An example of such a document is illustrated in Figure 11 where a transparent region or strip terminates short of the edges or boundary of the document by a distance D.

The current invention is most applicable to banknotes but can also be used in other secure documents such as a fiscal stamp, cheque, postal stamp, certificate of authenticity, brand protection article, bond or payment voucher.

CLAIMS

1. A polymer substrate for a security document, the substrate having at least one elongate transparent region extending through a more opaque area of the substrate and completely or almost completely between spaced locations on the boundary of the substrate, wherein the width of the transparent region is at least 2mm and the transparent region has an optical density not exceeding 0.3.
2. A substrate according to claim 1, wherein the at least one transparent region extends completely between the spaced locations on the boundary of the substrate.
3. A substrate according to claim 1 or claim 2, wherein the boundary of the substrate includes opposite, parallel edges, the transparent region(s) extending between the parallel edges.
4. A substrate according to claim 3, wherein the substrate is rectangular, the transparent region(s) extending substantially completely between either the short or the long edges of the rectangle.
5. A substrate according to any of the preceding claims, wherein the or each transparent region is rectilinear.
6. A substrate according to claim 5, when dependent on claim 3 or claim 4, wherein the transparent region(s) extends orthogonally to the parallel edges.
7. A substrate according to any of claims 1 to 4, wherein the transparent region(s) has a stepped or curved form.
8. A substrate according to any of the preceding claims, wherein the transparent region extends through the thickness of the substrate.
9. A substrate according to any of the preceding claims, the substrate being provided with a plurality of said transparent regions.
10. A substrate according to claim 9, wherein the transparent regions are spaced apart by different distances.
11. A substrate according to claim 9 or claim 10, wherein the transparent regions have different widths.
12. A substrate according to any of the preceding claims, wherein the transparency of the or at least one transparent region varies across its width.
13. A substrate according to any of the preceding claims, wherein the or at least one transparent region has an optical density no greater than 0.2, preferably no greater than 0.1.

14. A substrate according to claim 12 and claim 13, wherein the or at least one transparent region has a central elongate area with an optical density no greater than 0.1 and one or more edge areas with an optical density greater than 0.1.
15. A substrate according to any of the preceding claims, wherein the or each transparent region has a width no greater than 30mm, preferably no greater than 20mm.
16. A substrate according to any of the preceding claims, wherein the or at least one transparent region includes an optical structure such as a scattering or diffusion screen.
- 10 17. A substrate according to any of the preceding claims, wherein the more opaque areas of the substrate are provided by one or more pigmented coatings on one or both surfaces of the substrate.
18. A substrate according to claim 17, wherein the pigmented coatings have been provided by printing such as by gravure printing.
- 15 19. A security document comprising a substrate according to any of the preceding claims.
20. A document according to claim 19, the substrate being provided with identifying indicia.
21. A document according to claim 19 or claim 20, wherein the transparent region(s) forms part of the document design.
- 20 22. A document according to any of claims 19 to 21, the document comprising one of a banknote, fiscal stamp, cheque, postal stamp, certificate of authenticity, brand protection article, bond or payment voucher.
23. A series of banknotes according to claim 22, wherein the arrangement or form of the transparent region(s) on each banknote differs between denominations in the series.
- 25 24. A method of monitoring security documents according to any of claims 19 to 23, the method comprising causing relative movement between the security document and a source of radiation; and detecting the passage of radiation through the at least one transparent region.
- 30 25. A method according to claim 24, when dependent on at least claim 9, further comprising monitoring the times at which radiation is transmitted through each transparent region during the relative movement.

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Fig.1.

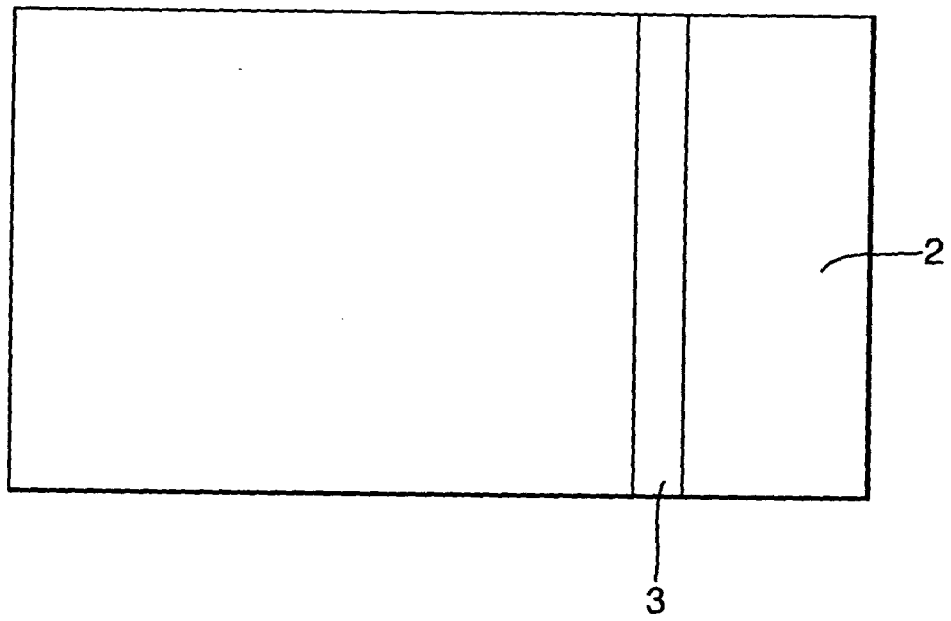


Fig.2.

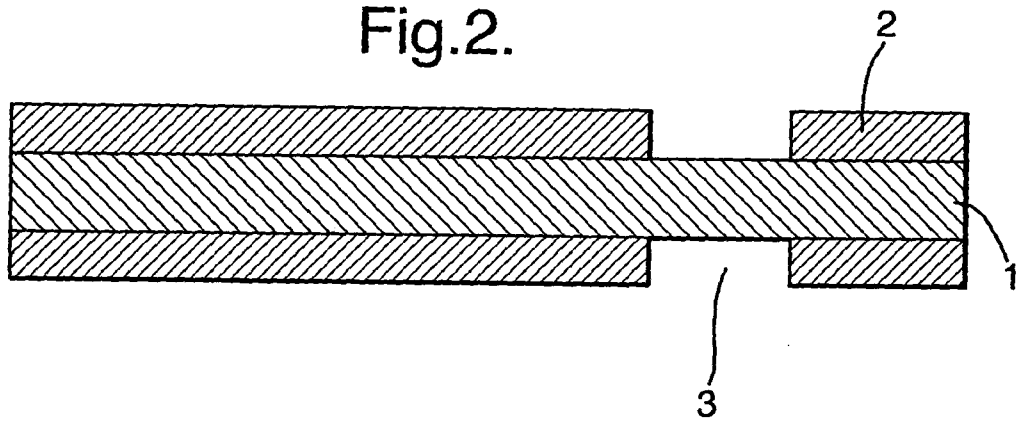


Fig.3.

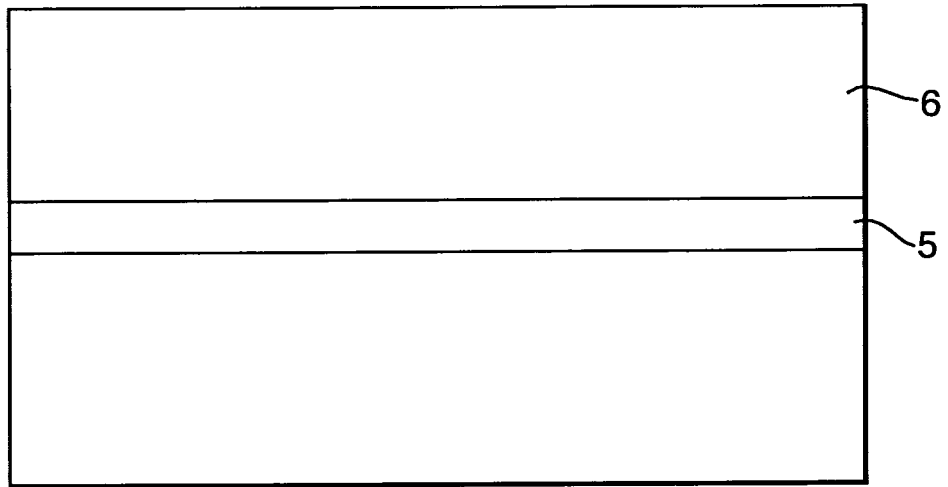


Fig.4.

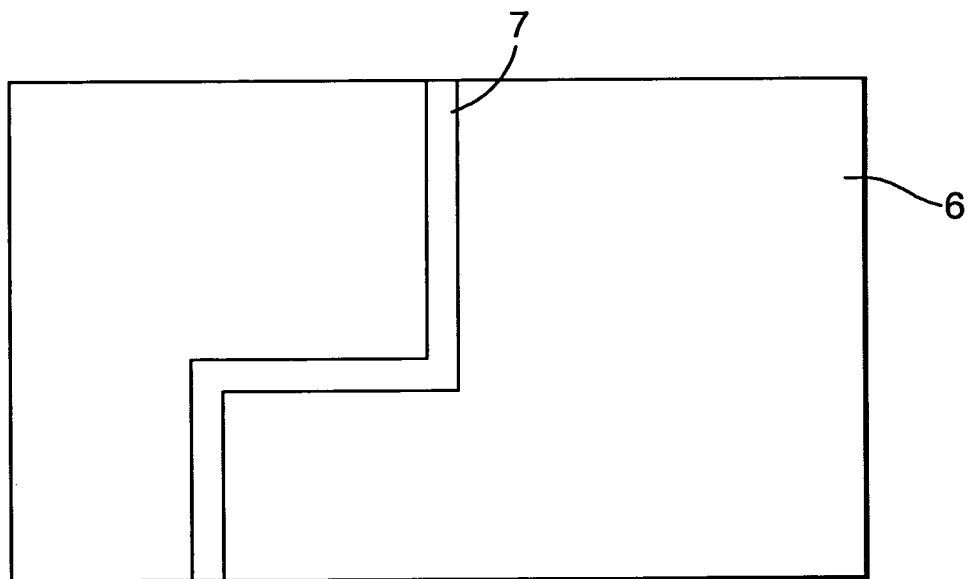


Fig.5a. 3/8

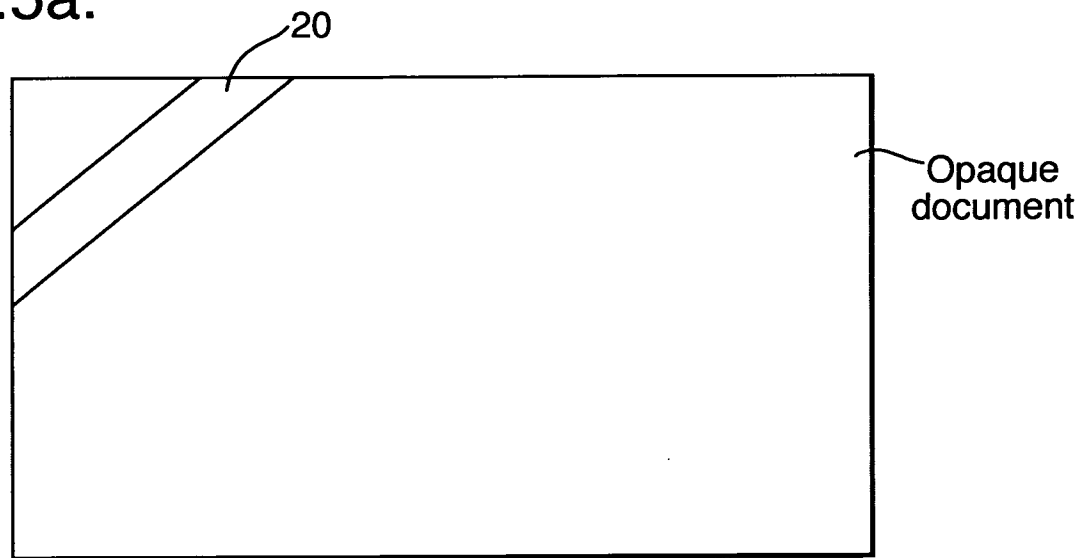


Fig.5b.

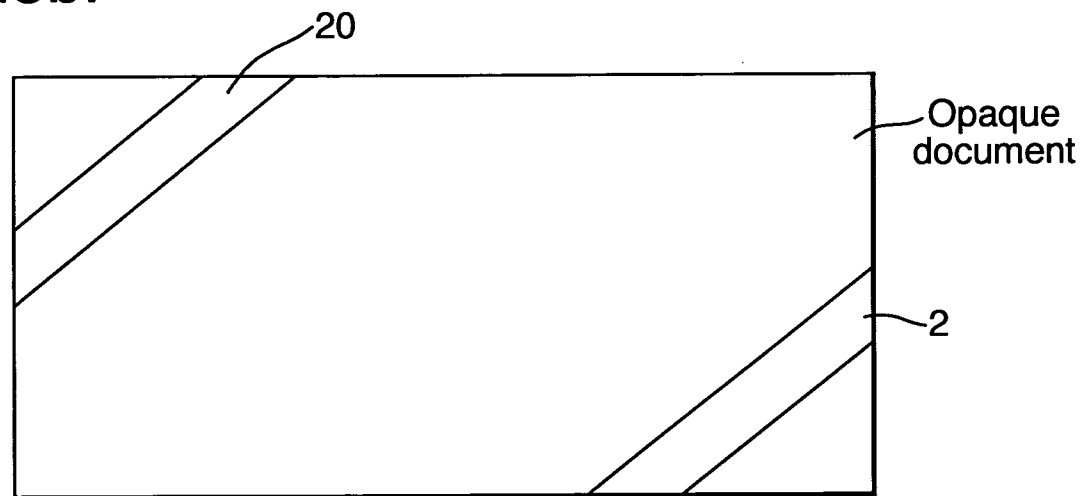
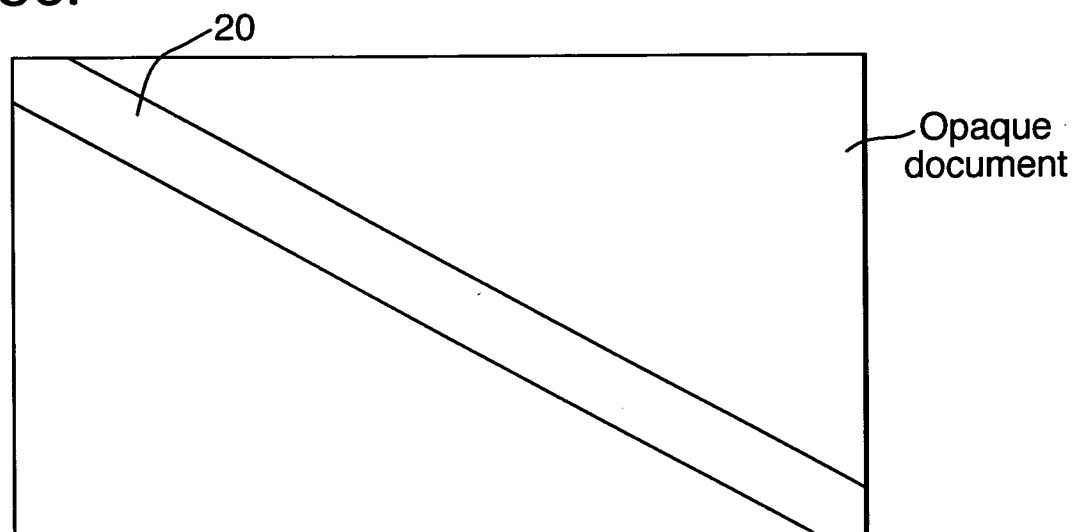
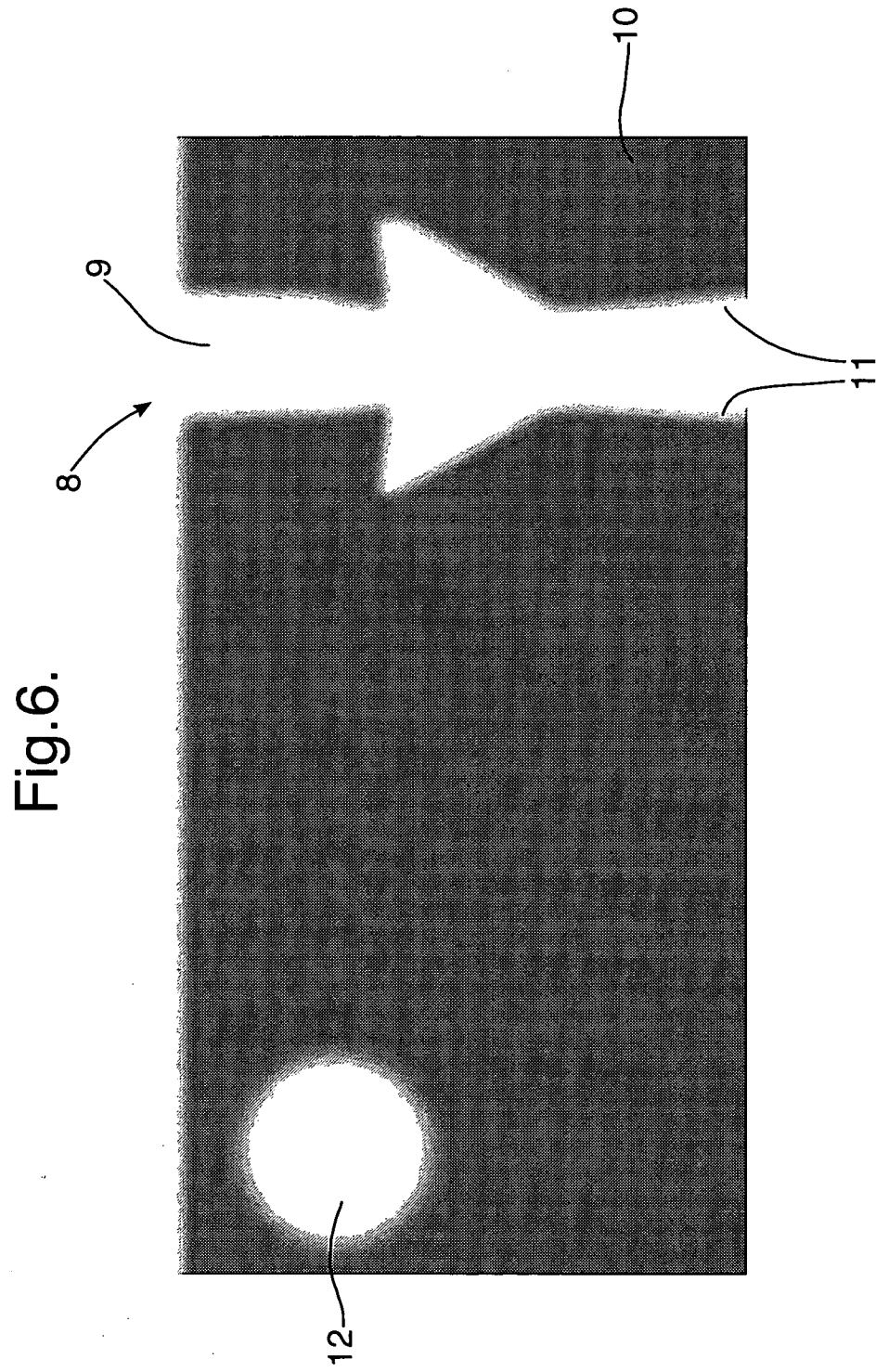
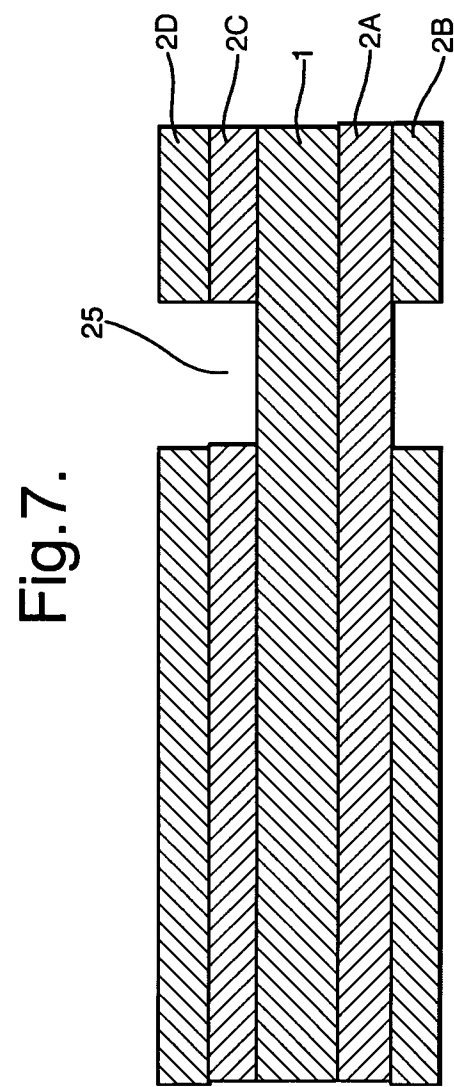


Fig.5c.



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Fig.8.

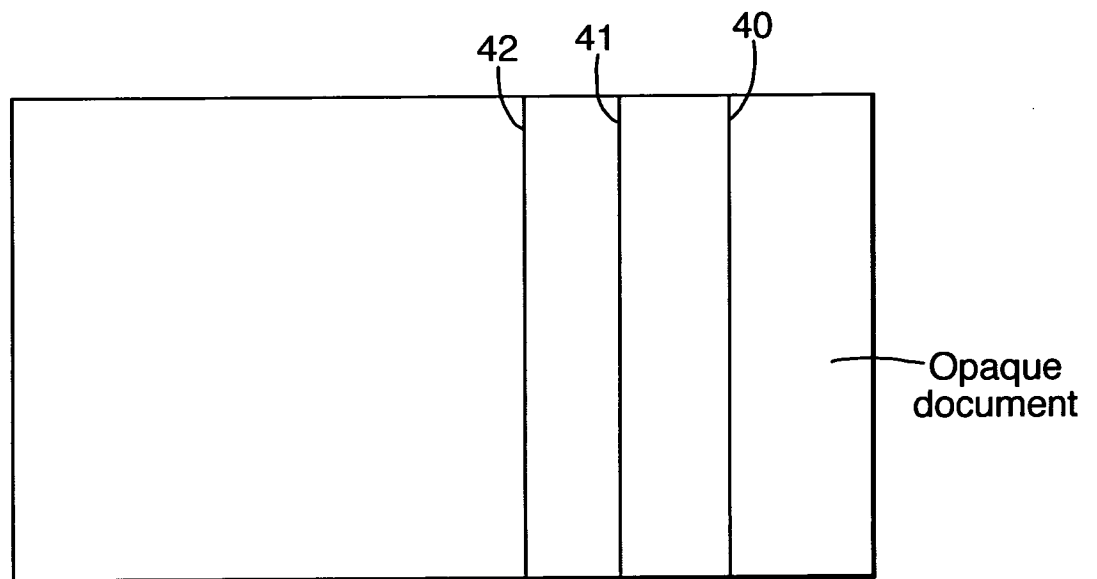


Fig.9.

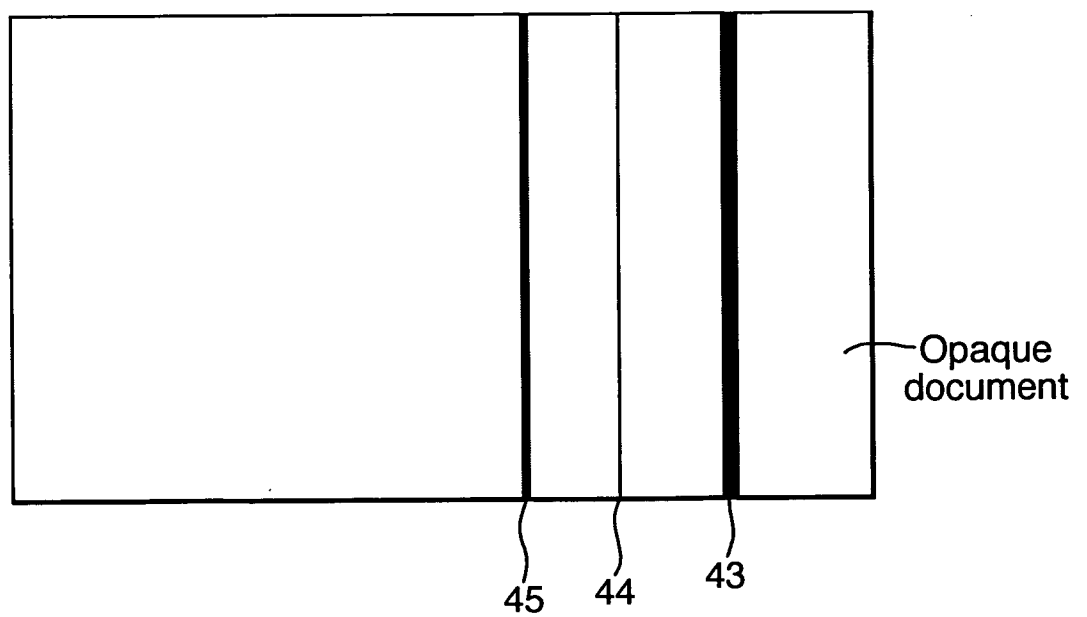


Fig.10.

