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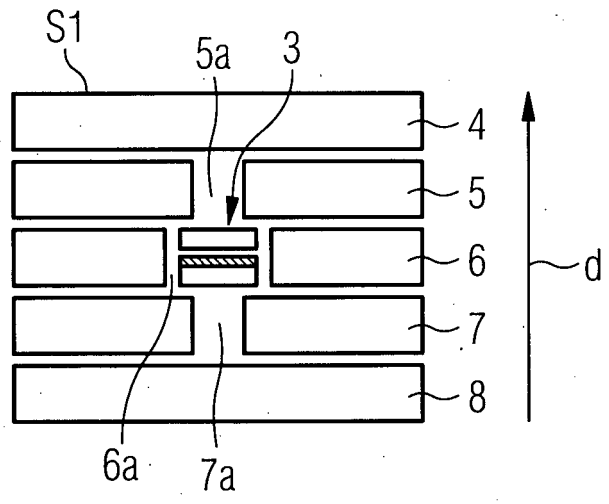
(54) **PERSONALIZABLE SECURITY DOCUMENT AND METHOD OF MANUFACTURING THE SAME**

(57) A personalizable security document (10) includes a security feature (3) embedded inside a body of said document (10). The security feature (3) includes a laser-sensitive material (3c) on a substrate (3b), which can be irradiated with laser light to form a color feature that is visible from one or both sides of the document (10). In order to achieve a high image quality, a protective material (3a) is provided over the laser-sensitive material. This prevents the pigments of the laser-sensitive material to come into direct contact with the material forming the document (10), such as polycarbonate. Instead, the activated pigments are transferred to the layer of protective material, which may ensure the desired image quality. The subtrate (3b) and/or the protective layer (3a) can be made of glass. The protective layer (3a) can be a titanium dioxide layer, a silica layer or a metallic layer.

FIG 3



EP 4 155 093 A1

Description

Technical Field

[0001] The present disclosure generally relates to security features for security documents, in particular, personalizable security documents such as identification documents, driver's licenses and the like.

Background

[0002] Generally, physical identification documents contain a variety of different security features to aid in authenticating a document. In some applications, a laser engraved image is considered vital, as the image features are obtained inside a polycarbonate substrate rather than on the surface of the substrate. A laser engraved feature in a polycarbonate substrate may include a black and white (in particular, grayscale) image, a color image, a combination of grayscale and color, or special features like the Mirage technology of the present applicant.

[0003] In case of a color image, producing color inside a polycarbonate substrate using a laser is advantageous over the use of other technologies such as inkjet printing, which produces color images on top of the document. Some technologies use inks applied onto a polycarbonate layer, which is then laminated in order to protect the inks. Subsequently, a laser is used to activate the inks/pigments in order to display colors.

[0004] EP 0 972 632 A1 discloses a security card comprising a laminate of a flexible glass layer and a support. The glass layer has sufficient flexibility to allow substantial bending of the card without causing breakage of the glass. Further, the glass layer acts as a security feature, because delamination in order to falsify information stored in the card is difficult without breaking the glass.

[0005] The present disclosure is directed, at least in part, to improving or overcoming one or more aspects of prior systems, without being limited to a particular type of security document.

Summary of the Disclosure

[0006] According to one aspect of the present disclosure, a personalizable security document comprises a laminated body formed by a plurality of layers of at least one first material arranged on top of each other in a thickness direction. The body has a first side and a second side opposite to the first side in the thickness direction. The document further comprises a security feature embedded in the body. The security feature includes a laser-sensitive material provided on a substrate, and a protective material provided over the laser-sensitive material to separate the laser-sensitive material from a first layer of the plurality of layers arranged on top of the security feature. The protective material is formed by a. material that is different from the at least one first material of the plurality of layers. At least portions of the layers arranged on top of the laser-sensitive material are transparent to visible light such that a color feature produced upon irradiation of the laser-sensitive material with laser light is visible from the first side.

[0007] According to another aspect, the present disclosure relates to a method of manufacturing a personalizable security document. The method comprises providing a laser-sensitive material on a substrate, providing a protective material over the laser-sensitive material, and arranging a structure formed by the substrate, the laser-sensitive material and the protective material between at least two layers of at least one first material that is different from the protective material. For example, the at least one first material includes polycarbonate (PC), polyvinyl chloride (PVC) and/or thermoplastic polyurethane (TPU). The method further comprises laminating the at least two layers to form a body of the personalizable security document. At least portions of one or more layers arranged on top of the laser-sensitive material are transparent to visible light such that a color feature produced upon irradiation of the laser-sensitive material with laser light is visible from a first side of the body.

[0008] Other features and aspects of the present disclosure will be apparent from the following description and the accompanying drawings.

Brief Description of the Drawings

[0009]

Fig. 1 shows a top view of an exemplary security document in accordance with the present disclosure;
Fig. 2 shows a bottom view of the security document in accordance with the present disclosure;
Fig. 3 is a schematic side sectional view illustrating a layer configuration of the security document in accordance with the present disclosure;
Fig. 4 is an enlarged view showing a configuration of a security feature in accordance with the present disclosure;
Fig. 5 is a schematic side sectional view illustrating a process of irradiating laser light onto the security feature in accordance with the present disclosure; and
Fig. 6 is a schematic side sectional view showing the security document in accordance with the present disclosure after lamination.

Detailed Description

[0010] The following is a detailed description of exemplary embodiments of the present disclosure. The exemplary embodiments described herein are intended to teach the principles of the present disclosure, enabling those of ordinary skill in the art to implement and use the present disclosure in many different environments and for many different applications. Therefore, the exemplary embodiments are not intended to be, and should not be

considered as, a limiting description of the scope of protection. Rather, the scope of protection shall be defined by the appended claims.

[0011] The present disclosure is based at least in part on the realization that, in case of color, laser personalization, adding an additional feature to the system may enhance the security of a document. This additional feature can be a flexible layer made of material that is different from the material of the other layers of the documents, such as polycarbonate. For example, a flexible glass substrate or a flexible metallic plate can be used. This provides an additional layer of security.

[0012] In addition, it has been realized that adding a protection on top of the color feature, such as a coating, enhances the optical response of the engraved color. In case layers such as polycarbonate layers are provided directly on top of the coating/inks which are used for producing color using a laser, this can result in an image that has a poor quality in terms of color gamut or image resolution. Therefore, it has been realized that the color gamut, for example, inside the polycarbonate body can be protected with a protective layer in order to increase the image quality.

[0013] More particularly, it has been realized that, when laser-sensitive pigments/inks or solutions are coated inside a laminated polycarbonate structure, the colors generated by the laser (or any other source activating the pigments/inks) do not appear well, because the colors are transferred directly to the polycarbonate layer adjacent to the pigments/inks. This is also the case for layers other than polycarbonate, for example, PVC layers, TPU layers, PET layers and the like. Therefore, to enhance the overall optical response of the engraved colors, a protective layer can be used on top of the coating and below the adjacent polycarbonate layer to protect the color from getting transferred to the polycarbonate when the laser and the ink interact. In this manner, the optical response for engraving a security feature, which can be a personalized color image, can be increased.

[0014] In addition, it has been realized that any layer on the top (or bottom) of the laser-sensitive material can provide an additional security feature. This is because, when a counterfeiter tries to alter the document, the protective layer is broken.

[0015] Fig. 1 shows a plan view of an exemplary security document 10 in accordance with the present disclosure. As shown in Fig. 1, security document 10 comprises a laminated body 1 formed by a plurality of layers 4, 5, 6, 7, 8 of at least one first material arranged on top of each other in a thickness direction d (see, for example, Fig. 3). Body 1 has a first side S1 and second side S2 opposite to first side S1 in thickness direction d. Second side S2 of document 10 is shown in Fig. 2. Each of the plurality of layers 4, 5, 6, 7, 8 is configured as a plastic layer, such as a polycarbonate layer, a PVC layer, a TPU layer or a PET layer. It will be appreciated that in some embodiments all layers are formed from the same material, whereas in other embodiments one or more layers may be formed from different plastic materials.

[0016] As shown in Figs. 1 and 2, document 10 is a personalizable security document, which comprises a security feature 3 embedded in body 1. In the embodiment shown in Figs. 1 and 2, security feature 3 is visible from both sides S1 and S2 after personalization. For example, personalization of security document 10 results in a color feature 2, such as a portrait image, which is visible from both the first side S1 and the second side S2. Here, it will be readily appreciated that color feature 2 will appear mirrored when viewed from second side S2. Security feature 3 and the personalization of security document 10 will be described in more detail below.

[0017] Figs. 3 and 4 show a first exemplary embodiment of security feature 3. In the exemplary embodiment, security feature 3 includes a laser-sensitive (laser-activated, laser-reactive) material 3c, such as an ink or pigments which, upon irradiation with laser light, produce a color feature (for example, thermocromic dyes, metallic nanoparticles, dielectric nanoparticles, dyes with nanoparticles, or any combination of the same, for example, provided in several layers). In other words, before irradiation with laser light, laser-sensitive material 3c may be transparent or have a first color, and the laser light activates laser-sensitive material 3c to change its color to a (second) color which can be observed. In this respect, the contrast/intensity of the resulting color may depend on the laser parameters (intensity, speed, laser focus, laser spacing, repetition rate, laser polarization, laser wavelength, pulse duration and the like). The generation of a color feature using laser-sensitive inks or pigments is well-known, such that the details will be omitted herein. However, it will be appreciated that, using appropriate laser parameters and scanning of the laser beam, color images can be engraved in security feature 3. In this respect, a plurality of different laser-sensitive pigments and/or different laser wavelengths can also be used in combination to produce multicolor images.

[0018] Laser-sensitive material 3c is provided on a substrate 3b. In an exemplary embodiment, substrate 3b is a glass substrate, in particular, a flexible glass substrate. Further, laser-sensitive material 3c is formed as a coating on substrate 3b. It will be appreciated, however, that in other embodiments laser-sensitive material 3c may be applied onto substrate 3b by a different process (e.g., as a film layer that is bonded to substrate 3b using an adhesive, and the like). Laser-sensitive material 3c includes an ink or pigments that change their color upon irradiation with laser light. For example, said ink or pigments may include solutions of nanoparticles and/or thermochromic pigments. Such laser-sensitive materials are known to a skilled person, and a detailed description will be omitted herein.

[0019] As shown in Fig. 4, security feature 3 further includes a protective material 3a provided over laser-sensitive material 3c. Protective material 3a is provided to separate laser-sensitive material 3c from a first layer 5 of the plurality of layers arranged on top of security fea-

ture 3 (see, for example, Fig. 3). Protective material 3a is formed by a material that is different from the at least one first material of the plurality of layers 4, 5, 6, 7, 8 disposed on top of and below security feature 3. In the exemplary embodiment shown in Figs. 3 and 4, protective material 3a is configured as a glass barrier, for example, a flexible glass barrier, having a thickness between 30 μm and 100 μm, preferably around 70 μm. In some embodiments, the configuration of the glass barrier may be the same as that of substrate 3b on which laser-sensitive material 3c is provided (perhaps with different thickness).

[0020] As schematically shown in Fig. 3, a structure formed by substrate 3b, laser-sensitive material 3c and protective material 3a is provided in a second layer 6 of the plurality of layers adjacent to first layer 5. For example, said structure may be accommodated in a recess 6a formed in second layer 6. Accordingly, as shown in Fig. 3, it follows that an area of said structure, in particular, substrate 3b, laser-sensitive material 3c and protective material 3a is smaller than an area of each of the plurality of layers 4, 5, 6, 7, 8. Of course, it is also contemplated that substrate 3b, laser-sensitive material 3c and protective material 3a have different areas, as long as protective material 3a covers at least the portion of laser-sensitive material 3c that will form color feature 2. Here, cross-sections of substrate 3b, laser-sensitive material 3c and protective material 3a in a plane perpendicular to thickness direction d do not need to be the same, and can have any desired shape such as a circular shape, a rectangular shape, a polygonal shape and the like.

[0021] In the example shown in Fig. 3, a thickness of the structure formed by substrate 3b, laser-sensitive material 3c and protective material 3a is substantially the same as the thickness of second layer 6, for example, between 50 μm and 200 μm, preferably between 70 μm and 150 μm. In the example shown in Fig. 3, two layers 4, 5 are provided on top of second layer 6, and two layers 7, 8 are provided below second layer 6. Of course, it will be appreciated that in other embodiments different numbers of layers may be provided on top of and below second layer 6, as long as at least one layer is provided on top of second layer 6, and one layer is provided below second layer 6.

[0022] One or more of the layers provided on top of second layer 6 may have a recess that conforms with recess 6a. For example, first layer 5 may have a recess 5a which has essentially the same size as recess 6a. Likewise, a third layer 7 arranged below second layer 6 may have a recess 7a with a size that is substantially the same as the size of recess 6a. Here, it will be appreciated that Fig. 3 shows a state of document 10 before lamination of layers 4, 5, 6, 7, 8. After lamination, any recesses in the layers, such as recesses 5a and 7a will be filled with the material of the respective layers. Of course, it will also be appreciated that, in some embodiments, no recesses 5a, 7a (or only one of the recesses) may be present before lamination.

[0023] Fig. 5 shows a schematic illustration of a process for personalizing document 10, in particular, security feature 3 of the same. Here, for the sake of illustration, Fig. 5 again shows the state of document 10 before lamination. Of course, it will be appreciated that, in a practical implementation, the personalization will generally be performed after lamination of document 10. In other words, a personalizable security document 10 in accordance with the present disclosure is generally produced and supplied to customers prior to personalization, and personalization will usually be performed by the customers. Of course, there also may be cases where the personalized document is supplied to customers. In such a case, the personalization can be performed before lamination, as illustrated in Fig. 5.

[0024] Fig. 6 shows security document 10 after lamination of the plurality of layers 4, 5, 6, 7, 8. As shown in Fig. 6, security feature 3 is securely embedded inside body 1 of security document 10. Here, it will be appreciated that at least portions of the layers 4, 5 arranged on top of laser-sensitive material 3c (security feature 3) are transparent to visible light such that color feature 2 is visible from first side S1. In some embodiments, the same applies to the layers 7, 8 arranged below the laser-sensitive material. This results in that color feature 2 can also be seen from second side S2. In some embodiments, laser-sensitive material 3c and/or the laser used to activate the same is configured such that, when laser-sensitive material 3c is irradiated with laser light 9, color feature 2 is formed such that it has different appearances when viewed in transmission and in reflection, respectively.

[0025] In case security feature 3 is visible from both sides S1 and S2, a transparent window 11 extending through body 1 of security document 10 is formed by the transparent portions of the layers arranged above and below security feature 3. Here, as previously mentioned, it will be appreciated that in some embodiments the area (size) of security feature 3 (substrate 3b, laser-sensitive material 3c and protective material 3a) is smaller than the area of the layers 4, 5, 6, 7, 8 forming body 1. In this case, a plurality of security features may be included in document 10. In other embodiments, however; it is also contemplated that security feature 3 (substrate 3b, laser-sensitive material 3c and/or protective material 3a) has the same size as each of the layers. In other words, security feature 3 is not provided in a recess formed in second layer 6, but instead replaces second layer 6 and is sandwiched between first layer 5 and third layer 7.

[0026] In other embodiments, it is also contemplated to sandwich security feature 3 having a size that is smaller than a size of layers 4, 5, 7, 8 of security document 10 between two layers 5, 7. In other words, second layer 6 may be omitted. Also in this case, security feature 3 will be securely embedded inside body 1 after lamination. However, the resulting thickness of body 1 may be less uniform due to the absence of the material of second layer 6 surrounding security feature 3.

[0027] In yet other embodiments, laser-sensitive material 3c may be provided directly on a top surface of third layer 7. In other words, third layer 7 forms the substrate on which laser-sensitive material 3c is provided, and no separate member is provided to form said substrate. Also in this case, however, protective material 3a will be provided over laser-sensitive material 3c to separate the same from adjacent layer 5. Second layer 6 surrounding protective material 3a may be provided, or may be omitted in other embodiments. In the latter case, protective material 3a may be formed as a layer having the same size as the remaining layers of document 10.

[0028] While protective material 3a has been described above as a glass barrier such as a flexible glass barrier with a thickness between 30 μm and 100 μm, in other embodiments, protective material 3a may be formed as a material layer deposited on top of laser-sensitive material 3c, for example, a silica layer or another glass-like layer, a titanium dioxide layer, or a metallic layer. In this case, protective material 3a may have a significantly reduced thickness, for example, between 20 nm and 1000 nm, preferably between 50 nm and 500 nm. It will be appreciated that the thickness of surrounding second layer 6, if present, can be adapted accordingly to the resulting total thickness of security feature 3 in this case.

Industrial applicability

[0029] With the above-described personalizable security document, security can be enhanced, because the flexible layer of protective material such as glass acts as an additional security feature. In case of tampering, not only will the colors be destroyed, but, in some cases, also the protective layer. Accordingly, with the present disclosure, any kind of laser-reactive coatings can be protected inside a laminated polycarbonate body, by being sandwiched between two physical layers such as two flexible glass layers, or by being provided on a flexible glass layer and being covered by a vapour-deposited or chemically-deposited layer such as silica. The colors produced by the laser light are of high quality compared to other technologies, and the present disclosure can be used to produce high-quality color images using a single laser or, in other cases, multiple lasers.

[0030] An exemplary method of manufacturing a personalizable security document as described above comprises the following steps:

In a first step, a laser-sensitive material 3c is provided on a substrate 3b or layer 7. Next, a protective material 3a is provided over laser-sensitive material 3c. A structure formed by substrate 3b or layer 7, laser-sensitive material 3c and protective material 3a is arranged between at least two layers 4, 5, 6, 7, 8 of at least one first material that is different from the protective material, such as polycarbonate, PVC and TPU. The at least two layers 4, 5, 6, 7, 8 are laminated to form a body 1 of personalizable security document 10. At least portions of one or more layers arranged on top of laser-sensitive material 3c are transparent to visible light such that a color feature produced upon irradiation of laser-sensitive material 3 with laser light 9 is visible from a first side S1 of body 1.

[0031] Here, it will be appreciated that, generally, the personalization of security feature 3 is performed after the step of laminating the plurality of layers. Of course, as previously mentioned, in some embodiments, the personalization may also be performed prior to laminating the layers.

[0032] As also explained above, in some embodiments, the method includes providing a structure or module formed by substrate 3b, laser-sensitive material 3c and protective material 3a in a recess formed in second layer 6 either prior to arranging the plurality of layers on top of each other, or while doing so. For example, said structure or module may be arranged on top of third layer 7, and second layer 6 with the corresponding recess 6a may then be arranged around said structure, before subsequent first layer 5 is arranged on top of second layer 6. As mentioned above, in some embodiments, second layer 6 may be omitted. In other words, said structure is embedded between first layer 5 and third layer 7 arranged directly below first layer 5.

[0033] In other embodiments, laser-sensitive material 3c may be applied directly on top of third layer 7. In other words, a step of applying laser-sensitive material 3c onto third layer 7 may be present. In a next step, protective material 3a is then provided over laser-sensitive material 3c to protect the same. In some embodiments, this may include bonding a barrier such as a flexible glass barrier to substrate 3b with laser-sensitive material 3c, or to third layer 7 with laser-sensitive material 3c. In other embodiments, a step of depositing protective material 3a on laser-sensitive material 3c may be included to form a silica layer or another glass-like layer. In some embodiments, a material may be deposited on laser-sensitive material 3c in a first step, and oxidized or treated in another appropriate manner in a subsequent step to form the protective layer. It is also contemplated to form the protective layer by appropriate treatment of laser-sensitive material 3c, such as oxidizing the top portion of a metallic layer or the like.

[0034] It will be appreciated that the foregoing description provides examples of the disclosed systems and methods. However, it is contemplated that other implementations of the disclosure may differ in detail from the foregoing examples. All references to the disclosure or examples thereof are intended to reference the particular example being discussed at that point and are not intended to imply any limitation as to the general disclosure.

[0035] Recitation of ranges of values herein are merely intended to serve as a shorthand method for referring individually to each separate value falling within the range, unless otherwise indicated herein, and each separate value is incorporated into the specification as if it were individually recited herein. All method steps described herein can be performed in any suitable order,

unless otherwise indicated or clearly contradicted by the context.

[0036] Although the preferred embodiments of the present disclosure have been described herein, improvements and modifications may be incorporated without departing from the scope of the following claims.

Claims

1. A personalizable security document (10) comprising:

a laminated body (1) formed by a plurality of layers (4, 5, 6, 7, 8) of at least one first material arranged on top of each other in a thickness direction (d), the body (1) having a first side (S1) and a second side (S2) opposite to the first side (S1) in the thickness direction; and
a security feature (3) embedded in the body (1), wherein the security feature (3) includes:

a laser-sensitive material (3c) provided on a substrate (3b); and
a protective material (3a) provided over the laser-sensitive material (3c) to separate the laser-sensitive material from a first layer (5) of the plurality of layers arranged on top of the security feature, the protective material (3a) being a formed by a material that is different from the at least one first material of the plurality of layers (4, 5, 6, 7, 8),
wherein at least portions of the layers (4, 5) arranged on top of the laser-sensitive material are transparent to visible light such that a color feature (2) produced upon irradiation of the laser-sensitive material (3c) with laser light (9) is visible from the first side (S1).

2. The security document of claim 1, wherein a structure formed by the substrate (3b), the laser-sensitive material (3c) and the protective material (3a) is provided in a second layer (6) of the plurality of layers adjacent to the first layer (5).

3. The security document of claim 2, wherein a thickness of the structure is substantially the same as the thickness of the second layer (6), for example, between 50 μm and 200 μm, preferably between 70 μm and 150 μm.

4. The security document of claim 1, wherein a structure formed by the substrate (3b), the laser-sensitive material (3c) and the protective material (3a) is embedded between the first layer (5) and a third layer (7) arranged directly below the first layer.

5. The security document of any one of claims 2 to 4, wherein the substrate (3b) is a glass substrate, preferably a flexible glass substrate.

6. The security document of claim 1, wherein the substrate (3b) is formed by a third layer (7) arranged directly below the first layer (5).

7. The security document of any one of claims 1 to 6, wherein the laser-sensitive material (3c) is formed as a coating on the substrate (3a).

8. The security document of any one of claims 1 to 7, wherein the laser-sensitive material (3c) includes an ink or pigments that change their color upon irradiation with the laser light (9), said ink or pigments including, for example, solutions of nanoparticles and/or thermochromic pigments.

9. The security document of any one of claims 1 to 8, wherein the protective material (3a) is configured as a glass barrier, for example, a flexible glass barrier, having a thickness between 30 μm and 100 μm, preferably around 70 μm.

10. The security document of claim 9, wherein the glass barrier has the same configuration as the substrate (3b).

11. The security document of any one of claims 1 to 8, wherein the protective material (3a) is configured as material layer deposited on the laser-sensitive material (3c), for example, a silica layer or another glass-like layer, the material layer having a thickness between 20 nm and 1000 nm, preferably between 50 nm and 500 nm.

12. The security document of any one of claims 1 to 11, wherein at least portions of one or more layers (7; 8) arranged below the laser-sensitive material are transparent to visible light such that the color feature (2) produced upon irradiation of the laser-sensitive material (3c) with the laser light (9) is visible from both the first side (S1) and the second side (S2).

13. The security document of any one of claims 1 to 12, wherein each of the plurality of layers (4, 5, 6, 7, 8) is configured as a polycarbonate layer, a PVC layer or a TPU layer.

14. The security document of any one of claims 1 to 13, wherein the laser-sensitive material, when irradiated with appropriate laser light, is configured such that the color feature has different appearances when viewed in transmission and in reflection, respectively.

15. A method of manufacturing a personalizable security document (10), the method comprising:

providing a laser-sensitive material (3c) on a substrate (3b);
providing a protective material (3a) over the laser-sensitive material (3c);
arranging a structure formed by the substrate (3b), the laser-sensitive material (3c) and the protective material (3a) between at least two layers (4, 5, 6, 7, 8) of at least one first material that is different from the protective material, such as polycarbonate, PVC and TPU; and
laminating the at least two layers (4, 5, 6, 7, 8) to form a body (1) of the personalizable security document (10),
wherein at least portions of one or more layers (4, 5) arranged on top of the laser-sensitive material are transparent to visible light such that a color feature produced upon irradiation of the laser-sensitive material (3c) with laser light is visible from a first side (SI) of the body (1).

FIG 1

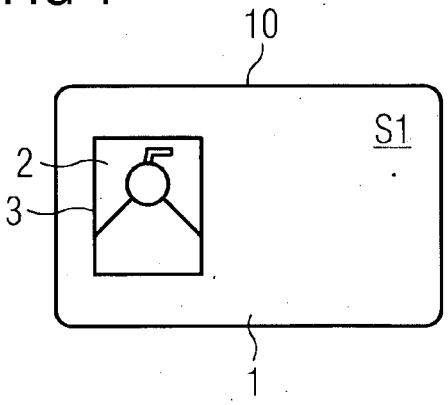


FIG 2

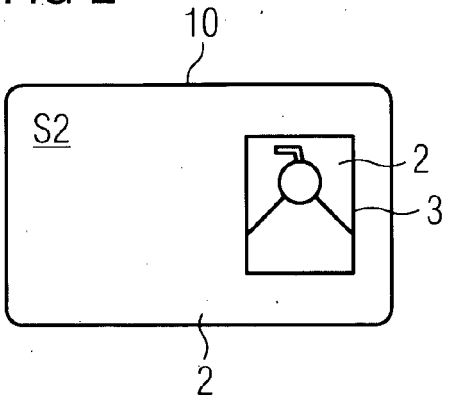


FIG 3

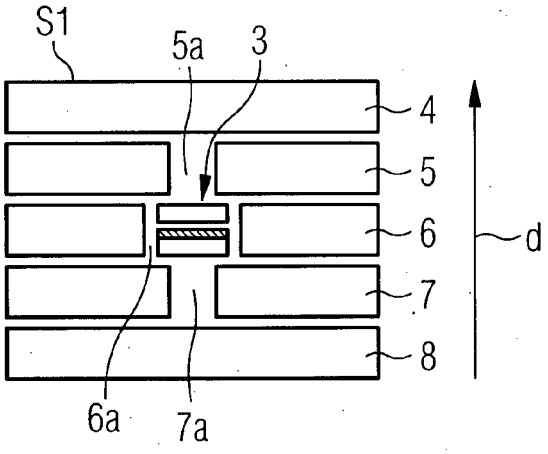


FIG 4

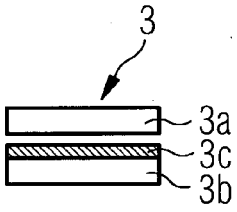


FIG 5

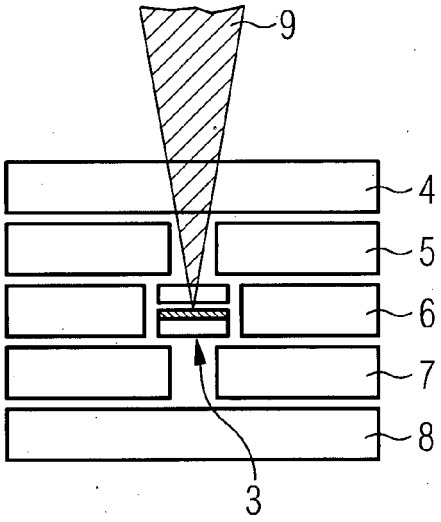
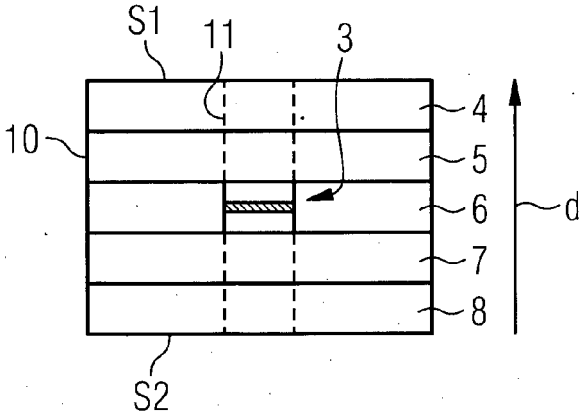


FIG 6



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EUROPEAN SEARCH REPORT

Application Number
EP 21 31 5188

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	EP 3 034 318 A1 (GEMALTO SA [FR]) 22 June 2016 (2016-06-22)	1,2,4, 6-8, 11-15	INV. B42D25/351 B42D25/36 B42D25/373 B42D25/378 B42D25/41 B42D25/45 B42D25/47
A	* paragraphs [0083] - [0091]; figure 3 *	3,5,9,10	

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Place of search	Date of completion of the search	Examiner
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