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(73) Patenthaver: **Bundesdruckerei GmbH, Kommandantenstrasse 18, 10969 Berlin, Tyskland**
Bundesrepublik Deutschland, Vertreten Durch Das Bundesministerium Des Innern, Vertreten Durch Das Bundeskriminalamt, Thaerstraße 11, 65193 Wiesbaden, Tyskland

(72) Opfinder: **BOSIEN, Andreas, Am Wukrosch 10, 15712 Königs Wusterhausen, Tyskland**
KNEBEL, Michael, Ringallee 57, 13086 Berlin, Tyskland
SEIDEL, Uwe, Am alten Steinbruch 1, 65388 Schlangenbad, Tyskland
ZERNICEK, Simone, Paul-Robeson-Straße 47, 10439 Berlin, Tyskland
LEOPOLD, André, Angermünder Straße 11, 10119 Berlin, Tyskland
SCHNEIDER, Ulrich, Ludwig-Hanson-Straße 17, 65232 Taunusstein, Tyskland

(74) Fuldmægtig i Danmark: **Plougmann Vingtoft A/S, Strandvejen 70, 2900 Hellerup, Danmark**

(54) Benævnelse: **SIKKERHEDSGENSTAND MED DYNAMISK OG STATISK VINDUESSIKKERHEDSKENDETEGN SAMT FREMGANGSMÅDE TIL FREMSTILLINGEN**

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SECURITY OBJECT WITH DYNAMIC AND STATIC WINDOW SECURITY FEATURE AND METHOD FOR THE MANUFACTURE THEREOF

The invention relates to a method for producing a security object, and to such a security object.

As a security object, a physical object is considered herein which preferably comprises a document body made of a plurality of materials, for example a composite article formed as a lamination body and which comprises at least one feature which makes forgery, imitation, duplication, or similar measures difficult or even impossible. Security objects are used, for example, for the production of security and/or value documents or directly as security or value documents. For example, modern passport or personal documents often include a security object in the form of a security document body made of plastic. Such a security object is usually made with several layers, such as films, made of the same or different plastic materials. Such an object having a security feature is a security object.

To protect against forgery, unauthorised replicas, duplications and the like, security composite articles or security documents have features known as 'security features'. One class of security features displays an optical effect which is dependent on the viewing angle. These viewing-angle-dependent effects can be generated, for example, by diffractive structures such as holograms or refractive structures.

One subgroup of the security features having an angle-dependent optical effect comprises a refractive structure, for example in the form of a lenticular lens which comprises a plurality of lens elements in a lens array, and for this purpose separates optically detectable information stored in the document body.

From WO 03/022598 A1 a recording medium is known, which has an upper layer having on its outer side a plurality of lenticular lenses and on its rear side a display element which appears to be movable about at least one axis when the recording medium is tilted. The lenticular lenses extend only over a part-region of the entire outside. The display element is a security element printed on an inner card layer. It is not stated how the lenticular lenses are inserted into the document body.

WO 2005/058610 A2 discloses a data carrier in which markings in the form of patterns, letters, numbers and/or images are introduced by a laser beam, which are visible because of local changes resulting from material transformation and caused by the laser beam, said changes being made to the optical properties of the data carrier. The data carrier comprises a laser-sensitive recording layer which is transparent in the visible spectral range and is provided with a surface relief in the form of a lenticular screen. The markings are introduced into the recording layer with the laser beam from different directions through the lenticular screen and can be recognised from the same directions when viewed later. The data carrier is transparent at least in the area of the introduced markings.

From WO 2011/051670 A2 a security device with a lens-like device is known, which comprises an arrangement of lens-shaped focussing elements formed via an arrangement of sets of image strips, so that from different viewing directions respectively a corresponding image strip of each set can be seen via a corresponding lens-shaped focussing element, wherein the image strips are at least partially formed as relief structures.

DE 10 2008 008 044 A1 discloses a cost-effective method for producing security and/or value documents which are suitable for producing flexible and forgery-proof structures with low thermal load, wherein the surface structure is embossed into the top side and/or bottom side of substrates used to make documents by means of an embossing device, which has at least one embossing tool respectively having a contact surface, using embossing pressure and ultrasonically, wherein the contact surface is equal to or greater than the top or bottom of the substrate. Embodiments of the manufacturing method are described, which impress microlenses into a document body.

WO 94/15319A1 describes an identity card with a viewing-direction-dependent visible authenticity feature.

WO 2013/139748 A1 also shows a security composite article with a viewing-direction-dependent security feature, which comprises an internal refractive structure.

WO 2006/087138 A1 describes a security element for securing valuables with a first and a second authenticity feature. The first authenticity feature comprises a first arrangement having a plurality of focussing elements which are present in a first grid, and a second arrangement having a plurality of microscopic structures which are present in a second grid. The first and second arrangements are arranged such that the microscopic structures of the second arrangement are magnified when viewed through the focussing elements of the first arrangement. The second authenticity feature can be tested by machine and/or visually and is not affected by the first arrangement of the first security feature.

WO 2016/011249 A2 describes a polymer layer material having a plurality of security elements for use in polymer-based security documents, such as banknotes.

WO 2007/133613 A2 describes a microoptical film structure which comprises a plane arrangement of focussing elements or lenses and is intended inter alia for use in a security document.

DE 10 2008 031 653 A1 discloses a method and a device for introducing a security feature into a value or security document. wherein the value or security document comprises a document body having at least one thermoplastic surface layer, the method comprising the steps of: providing the document body; providing and/or creating a structured sonotrode that is or will be coupled to a sound source; arranging the document body relative to the sonotrode; contacting the sonotrode and the surface layer of the document body and at the same time coupling in sound waves via the sonotrode into the value or security document so that a relief structure forms in the surface layer, wherein the sonotrode is provided and/or manufactured with a structuring which has a target penetration plane and the sonotrode is structured in such a way that there are regions projecting from the target penetration plane and recessed regions projecting into the target penetration plane, wherein the sonotrode is moved into the document body during the sound coupling by applying pressure until the target penetration plane coincides with a document body surface target level and the protruding areas create recessed relief structures and the recessed areas create projecting relief structures in the surface layer.

From EP 0 216 947 A1 a card-shaped data carrier with a substrate and at least one transparent cover film is known. The substrate is provided with information detectable through the cover film using a laser beam, wherein the transparent cover film carries a relief applied at least partially overlapping the information area prior to the recording of the information, which characteristically alters the information recording by virtue of its optical lens effect. Depending on the irradiation direction of the laser light, the information is stored at different locations in the substrate. Likewise, in a visual inspection, different information is perceived depending on a viewing angle.

From EP 0 219 012 B1, a data carrier is known in which information is introduced by means of a laser beam into an inner volume region, which is visible in the form of changes in the optical properties due to an irreversible change in the material caused by the laser beam. For example, data carriers in the form of cards, which have a lenticular screen on a surface, are described. The lenticular screen can be embossed during a laminating process by incorporating a negative of the lenticular screen into a corresponding laminating plate. Similarly, a thermostable embossing die can be used, which is inserted between the transparent cover layer and the laminating plate. It is further described that the card can be produced by means of a lamination process and the lenticular screen is subsequently introduced by means of an embossing punch or embossing roller. The information is introduced via a laser beam, which introduces information through the lenticular screen into the card body from different directions. This makes it easy to implement tilt images.

There is generally a need to always create novel security features, in particular those which are difficult to manufacture, and thus cannot be reproduced by counterfeiters, or if so only with considerable effort. Nevertheless, these features should allow simple and reliable verification of their presence and/or their authenticity and intactness, preferably without further aids.

The invention is therefore based on the technical object of providing a method for producing a novel security object and of providing a novel security object comprising a viewing-angle-dependent security feature, and which is more difficult to manufacture than security objects known from the prior art, in particular in the form of security document bodies in the form of composite articles.

The invention is based on the idea of producing a security object with a document body, which has a window section in which the document body is made of volume transparent material. In addition, the document body has a view section in which a view through the document body is prevented by a material layer which is volume translucent or opaque. This view section adjoins directly to the window section. Between the top side and the translucent or opaque material layer, the document body in the view section is volume transparent, so that graphic information formed on the translucent or opaque material layer or information stored in the volume between the translucent or opaque material layer and the top side is viewed through the top when examining. A novel security element comprises a lens array which extends both over at least a part of the window section and over at least a part of the view section and thereby spans a section boundary between the view section and the window section. In the document body, a laser-marked and detection-direction-dependent first information, which is stored in the document body via first irreversible material changes, is formed partly in the view section and partly in the window section. In addition, in the window section a laser-marked and static second information is stored in the document body via second irreversible material changes, wherein the second information is optically detectable as static information both through the lens array at or in the top side of the document body and through the bottom side of the document body. This means that the second information is detectable through the top side independently of the viewing direction relative to the top side of the document body, as well as correspondingly through the bottom side independently of the viewing direction relative to the bottom side of the document body. Since optical detectability is independent of the viewing direction, this second information is referred to as static information.

Such a security object is produced according to the invention by a method which comprises the steps: providing or producing a flat extended document body having a top side and an opposite bottom side, wherein a lens array is formed or will be formed on or in the top side, and storing a first laser-marked detection-direction-dependent information by irradiating spatially modulated light from one direction through the lens array and by causing first irreversible material changes in focal areas of the lenses of the first lens array. It is provided that the document body is prepared or produced with a view

section in which the document body has a material layer translucent or opaque in volume between the top side and bottom side of the document body, and with a window section adjoining the view section, in which the document body is formed from a volume transparent material between the top side and the bottom side of the document body, and with the lens array, wherein the lens array extends both over at least a part of the window section and over at least a part of the view section and thereby spans a section boundary between the view section and the window section, and storing the first information is carried out so that the laser-marked and detection-direction-dependent first information is partially formed in the view section and partially in the window section, and additionally in the window section further spatially modulated light is radiated through the bottom side of the document body and a static second information is laser marked and stored via second irreversible material changes in the document body, wherein the second information is optically detectable as static information both through the lens array on or in the top side of the document body and through the bottom side of the document body. The thus created security object having a document body or in the form of a security document body provides an easy-to-verify security feature. On the one hand, there is a first information which can be detected or cannot be detected depending on the viewing direction and, in addition, a second information which can be recognised both statically, i.e. direction-independently, both when viewed through the top side and when viewed through the bottom side.

Such a security object is difficult to forge for the very reason that a window filled with material transparent in the volume is to be incorporated into a material layer which is translucent or opaque in the volume. In addition, the first information is to be formed so that it extends over both the window and the view section. In addition to this, the second information is to be integrated into the document body as static information.

Definitions

A security object is a physical entity that has at least one security feature that makes it difficult or impossible to imitate, to unauthorisedly duplicate, to forge or the like, or that allows checking the authenticity and integrity of the security object. A security object may be a security document such as an identity card, driver's license, identification card, bank

card, etc. Likewise, a security object may also be a semifinished product, for example a passport card, which is or will be inserted into a security document, for example a passport.

A body is considered as a flat extended body, when the top side and bottom side have an extent which is substantially larger than a distance between the opposite top side and bottom side. This means that there is a side edge or a straight line bisecting the surface of the top side, which is longer than a distance of the top side and bottom side from each other. In particular, common security document formats, for example ID1 and ID3 formats, provide flat extended document bodies. All card-shaped common security document bodies are flat extended document bodies.

A material is referred to as transparent, when light propagation is possible according to geometric optics. This means that in the volume of the material no appreciable diffuse scattering takes place, but the light propagates in a straight line in the volume according to classic optics. A material transparent in the volume may also be included such that the above property is not in the visible spectral range for all wavelengths. However, the above property must be present for at least one wavelength range. Window glass or uncoloured plastics made of polycarbonate, polyethylene, PVC or other thermoplastic material can be formed as materials transparent in the volume.

A material is referred to as translucent in the volume when a rectilinear propagation of light, as would be effected according to geometric optics, is prevented by a diffuse scattering in the volume.

A material is referred to as opaque if it attenuates a significant amount of light transmission in the visible wavelength range. Overall, this property depends on a layer thickness of the opaque material. For example, typical 80g/m^2 paper, plastics coloured in the volume, reflective metal layers, and the like are considered opaque. All layers which attenuate at least 50% transmission of light in the light-building wavelength range at a layer thickness of 10 µm are considered to be opaque with absorbing colourants.

A lens array refers to an arrangement of a plurality of lens elements. Preferably, a lens array comprises similar lens elements. However, embodiments are also possible in which the individual lens elements are formed differently in groups or individually. A lens array preferably has a plurality of cylinder lens elements aligned parallel to one another and directly adjacent to one another.

An irreversible material change here refers to a material change in the volume of the document body, which is optically detectable, especially for a human, but also for an optical detection device such as a digital camera. Preferably, irreversible material changes are formed as blackenings or differently designed scattering centres in volume-transparent material.

A viewing direction or irradiation direction, which relates to a document body, is defined or specifiable by a solid angle relative to the surface normal of the top side of the document body and to the surface normal of the bottom side of the document body, respectively.

The view section refers to a section or region of the document body relative to the top side or bottom side, in which a view through the document body is prevented by at least one opaque or translucent material layer arranged in the document body, and in the case of an examination in plan view through the top side or bottom side, only that information can be detected which is arranged in transparent material between the top side or bottom side and the at least one translucent or opaque material layer, or on which surfaces facing the top side or bottom side are arranged. If the document body comprises a plurality of translucent or opaque material layers, then the respective material layers facing the top side or bottom side are instrumental and limit the storage area of the information that can be detected in plan view.

The window section refers to that section relative to the top side of the document, in which a view through the document body is possible due to the formation of material transparent in the volume between the top side and the bottom side of the document body.

A document body is a physical object provided for forming a security document. If this has a security feature, then this is also referred to as a security document body. Since the document bodies described here are intended for forming a security object, at some points this will also be referred to as a 'security document body' without explicitly addressing a security feature. Since document bodies generally have a plurality of security features, at some points these will also be referred to as a 'security document body' on which the security features explicitly described here are not yet completely formed. A security document body is then used as a synonym for a document body. The substrate layer is an independently practicable layer. A film of plastic material is called a substrate layer. The layers from which a lamination body is assembled are referred to herein as substrate layers.

The material layer here refers to a layer having substantially uniform material properties in a document body. As a rule, a material layer has emerged from a substrate layer during the lamination process. Thus, there is usually a correspondence between a material layer and a pre-lamination substrate layer. For the purpose of this correspondence, the terms substrate layer and material layer can be used synonymously.

Preferred embodiments

According to the invention, a security object defined in claim 1 is created.

Further, according to the invention there is provided a method of manufacturing a security object as defined in claim 10.

The second information according to the invention can thus be detected by the lens array independently of the viewing direction.

It has proved to be advantageous to select the first and the second information in such a way that they complement one another to form a total information item. As a result, the individual information can respectively be protected by the other information.

In one embodiment, it may be provided that the second information comprises a letter, a letter sequence, a word, a digit or a digit sequence which, when inserted into the first information, supplies the total information item.

Preferably, the total information item has a sense content that is recognisable to a human observer or a verification device and the total information item results only from the combination of the first information and the second information.

The second information can also be derived from the first information. For example, a scatter value function (hash value function) or the like may be desired. With knowledge of the scatter value function, the second information can be calculated from the first information. It can thus be checked whether the first information and the second information are correctly "linked" to each other via the scatter value function. If this test is negative, a forgery can be deduced.

In order to facilitate the verifiability of the total information item, it is provided that the total information item is stored in the document body for reference purposes as reference information in addition to the first information and the second information, which are respectively stored via irreversible material changes in the document body. This storage can be carried out for example by printing. It is also possible to electronically store this information in a microchip integrated in the document body or in a hologram or the like.

The document body is at least partially, preferably wholly, formed as a lamination body. This is produced by several substrate layers being brought together in a substrate layer stack and being connected to each other in a laminating step by introducing energy in a lamination step, wherein in the substrate layer stack a substrate layer translucent or opaque in volume is arranged, which forms the translucent or opaque material layer of the document body, wherein the substrate layer transparent or opaque in volume has a cut-out opening in a region corresponding to the window section, said recess being filled with a transparent material before or during the lamination step. The individual substrate layers used may be provided with further security features, in particular with security imprints or even perforations or the like, before lamination.

Preferably, the lens array is embossed on or in the surface of the document body during the lamination step by means of a laminating sheet in the top side of the lamination body.

Alternatively, the formation of the lens array can be effected by means of an embossing with an ultrasonic sonotrode or in another manner, for example by means of laser ablation, after the lamination.

In order to facilitate the laser marking and to be able to effectively localise the irreversible material changes, a laser-sensitive transparent material layer is preferably formed in the document body, in whose volume the focus positions of the lens elements of the lens array are located. A laser-sensitive material layer comprises a transparent material which contains substances that favour laser absorption locally without appreciably impairing the transparency. This means that blackening occurs in laser-sensitive layers with a lower energy density of the introduced laser light than with non-laser-sensitive layers which otherwise consist of identical plastic material.

In a development of the invention, the document body has a further or second material layer, different, preferably spaced apart from, the other or the first laser-sensitive material layer. This is located between the first laser-sensitive material layer and the bottom side of the document body. Most preferably, this is arranged between the bottom side and the translucent or opaque material layer. In such an embodiment, the second static information is preferably marked in the second laser-sensitive layer.

If the first and the second laser-sensitive layer are spaced apart from each other in the document body, upon closer inspection of the first information and the second information, at least when tilting the document body or otherwise changing the detection direction, it can be seen that the first information and the second information are not stored in the same level. As a result, a further difficult to emulate effect is created, which can be used to verify the authenticity of the document body or security object.

Only when it can be determined that the first and second information are stored in different levels of the document body is a document body verified as genuine in this embodiment.

Most preferably, the first and the second information are coordinated so that the second information is spatially arranged relative to the first information so that the total information item can be detected correctly. For example, the total information item may consist of an alphanumeric character string, wherein at least one character in the middle of the string is formed by the second information. For verification, the correct alignment can be used both in terms of the spacing of the characters from one another along the character string, i.e. in the reading direction, as well as a correct orientation of the character, formed by the second information, transverse to the reading direction relative to the remaining characters, as well as a character size, etc.

Embodiments in which the second information or at least one component of the second information, for example at least one alphanumeric character, is arranged directly adjacent to a section boundary between the view section and the window section, have proven to be particularly difficult to forge. Here, a distance of the component of the second information from the section boundary is preferably less than a mean character width of the one character string of the alphanumeric characters forming the total information item.

In particular, when a centre of the lens array does not coincide with an axis of symmetry of the front side of the document body and an irradiation direction of the laser radiation used for storing the directionally-dependent first information is determined by tilting the document body about an axis coincident with such an axis of symmetry of the document body, it is necessary to match the graphical information imparted to the laser light by spatial modulation according to the distance of the lens array from the tilting axis of the document body and the tilt angle to the distortion caused thereby to a planar projection on the top side of the document body.

Since the imprinting of the lens array as well as the concrete position of the section boundary may vary during the marking due to manufacturing tolerances and handling tolerances of the document body, in a preferred embodiment it is provided that a position of a section boundary between the window section and the view section is determined relative to a reference unit of a marking device and the spatial modulation and/or

positioning of the irradiation of the first laser light is carried out on the basis of the determined position of the section boundary. The determination of this section boundary is also crucial for the introduction of the second information.

In general, however, the document body is reversed before marking through the bottom side. In order to know the position of the section boundary precisely, in a preferred embodiment the section boundary is detected again before the introduction of the second information, and for the spatial modulation and/or positioning of the laser light for introducing the second information, the results of the second determination of the position of the section boundary are used.

For the introduction the first information, the position of the lens array relative to the reference unit of the marking device is additionally determined in a development of the invention, which causes an even more precise reproduction of the first stored information. This is preferably done by capturing an image of the top side of the document body, for example by means of a digital camera, while illuminating the top side with light under grazing incidence. In the captured image, the area of the lens array is easily recognisable by contrast with the surrounding surface of the top side.

A determination of the position of the section boundary is preferably carried out by detecting an image of the document body from the top side or from the bottom side of the document body, preferably in a direct plan view, wherein a lighting respectively takes place from the opposite side of the document body, so that a transmitted light image is detected. The section boundary can be detected as a contrast limit in the image. The detection device represents, for example, the reference device of the marking device. The laser is preferably arranged rigidly relative to this.

Further advantages of the invention will become apparent from the following description of the figures. In the figures:

Fig. 1 schematic sectional view through a security object designed as a security document;

Fig. 2 schematic plan view of a security object designed as a security document;

Fig. 3 view from a viewing direction through the top side of the security object designed as a security document;

Fig. 4 further embodiment of a security object designed as a security document;

Fig. 5 representation of a schematic production of a security object;

Fig. 6, 6a schematic representations of the situation for marking the first information;

Fig. 6b tilting the document body by an angle -θ with respect to the light incidence direction with the top side to mark a third information;

Fig. 6c schematic representation of the marking of the second information; and

Figs. 7a to 7d schematic views of the security object designed as a security document.

Fig. 1 schematically shows a sectional view through a security object 1 designed as a security document 2. The security document 2 comprises a document body 10. This is formed in the illustrated embodiment as a lamination body 100. The document body 10 has a top side 11 and an opposite bottom side 12. The document body 10 is formed flat, which means that an edge length 30 of the top side 11 is greater, preferably an order of magnitude greater, than a distance between the top side and bottom side, i.e. a document body thickness 40.

This is equivalent to an area of the top side 11 or an area of the bottom side 12 having an extension along one direction, for example the edge length 30 or an even areal extent, which is greater, preferably at least an order of magnitude greater, than the document body thickness 40.

The document body 10 in the illustrated embodiment is formed from five material layers from the top side 11 to the bottom side 12, which are joined together in a lamination process to form the lamination body 100. From the top side 11 to the bottom side 12, these are a transparent material layer 110, a first laser-capable transparent material layer 120, an opaque material layer 130 with a cut-out opening 135, which is filled with a transparent material 136, a second laser-capable substrate layer 140 and a further transparent layer 150. Other embodiments may have a different number of material layers. It is essential that at least one material layer is opaque in volume and this has a cut-out opening which is filled with a transparent material. In this area or section, all material layers arranged above and below are made transparent in the volume.

The document body 10 has a window section 280, in which all material layers 110 to 150 between the top side 11 and the bottom side 12 are all formed transparent in the volume. In addition, the document body 10 has a view section 270, in which a material layer, in the illustrated embodiment the material layer 130, is formed opaque in the volume. Thus, in a viewing or optical detection of an image of the document body 10 in a view section 270 through the top side 11, only that information which is stored on or above the opaque material layer 130 in the view section 270 can be detected. In the window section 280, however, information is also detectable, which is stored in the entire volume between the top side 11 and the bottom side 12 in the region of the window section 280. The window section 280 and the view section 270 immediately adjoin one another along a section boundary 290.

The document body 10 further comprises a microlens array 300 having a plurality of lens elements 310. In the illustrated embodiment, the lens array 300 has a plurality of similarly formed cylindrical lens elements 310. The lens array 300 extends to one part 320 via the view section 270 and with another part 330 via the window section 280 of the document body. The lens array 300 thus extends via a section boundary 290 between the view section 270 and the window section 280.

The terms top side 11 and bottom side 12 are always chosen here with respect to the document body 10 such that the microlens array 300 is formed on or in the top side 11 of

the document body 10. The terms do not give any information with regard to later use. The side of the document body 10 designated here as the bottom side 12 can also serve as the side which is essential for use.

A viewing- and detection-direction-dependent first information is additionally stored in the document body 10. This storage takes place in the document body 10 via first irreversible material changes 411. These are shown schematically in the figure shown respectively by the lower-case letter "a".

The storage takes place, for example, by irradiating the first information through the lens array into the security document along a direction 601, which also corresponds to a viewing direction for recognising the first information.

The material thicknesses of the transparent material layer 110 and of the first laser-capable material layer 120 are preferably selected such that focus positions of the lens elements 310 of the lens array 300 lie in the first laser-sensitive material layer 120. When marking, for example, laser light is radiated through a spatial light modulator, which may be formed, for example, as a unit of liquid crystal cells with polarisation filters. The spatially modulated light is focused by the lens elements 310 of the microlens respectively in focus positions and chosen in terms of intensity so that in the focus positions irreversible material changes, such as blackening, are performed. Since the blackening is effected only in the focus positions, the stored first information can be recognised from the first direction 601. When viewed from this direction 601, the blackening formed in the focus points, which correspond to the first information, is reimaged for a viewer. From other deviating directions, however, other areas of the laser-sensitive material layer are shown on which there is no blackening. Thus, the first information is stored in the document body 10 dependent on the viewing direction.

In addition, in the document body 10, a second information 420 is stored via second irreversible material changes 421, which are represented by the uppercase letter "A". The second information is designed as static information, i.e. stored so that it can be detected from all viewing directions through the top side 11. This can be effected by introducing the second information into the document body 10, for example via a laser marking,

through the bottom side 12 of the document body 10. For this purpose, laser radiation is spatially modulated with the second information and focused so that the largest energy density preferably occurs in the second laser-sensitive material layer, so that the second information is stored in the second laser-sensitive material layer 140 via the second irreversible material changes 421.

In a preferred embodiment, the first information 410 and the second information 420 are matched to one another such that from one viewing direction 601, from which the first information 410 can be detected, the first information 410 and the second information 420 complement each other to form a total information item 430. For example, the first information may be "aaa" and the second information "A". The total information item is then "aaaAaaa". Here, the second information 420 provides a component of the total information item 430, which is fitted into the first information 410 at a predetermined position. For example, the first information 410 may consist of a sequence of numbers "123 567" and the second information of the number "4". The total information item is then the sequence "1234567". It makes sense, therefore, that the total information item is chosen so that it has a sense content that can be easily checked by a viewer. In order to facilitate this, the information content of the total information item may be formed once more for example as a print or laser mark at another location in the security document for reference purposes as reference information 450.

To make forgery more difficult, preferably, the first and the second information are positioned relative to each other so that a subsequent forgery of components of the first or the second information is easily recognisable. For example, the first information and the second information are respectively formed from alphanumeric characters of the same character set and the same font size. The second information comprises one or more alphanumeric characters which, when viewed from the direction 601 from which the first information is detectable, insert into the latter such that the characters are correctly aligned with one another. In each case, the first information 410 always extends respectively over both the view section 270 and the window section 280. That is to say, the first information 410 has components 415 stored in the window section 280 and has components 416 stored in the view section 270. Embodiments are particularly difficult to forge, in which at least a component of the second information immediately adjacent to

the section boundary 290 is formed to fit into the first information formed across the section boundary 290.

Fig. 2 schematically shows a plan view of a security document 2 similar to that of Fig. 1. The same technical features are identified in all figures with the same reference numerals. Here, it is assumed that the first information 410 is stored in the document body 10 for vertical viewing by the microlens array. This means that in plan view both the first information and the second information are visible. It can be seen that the microlens array 300 is located both partially over the view section 270 and partially over the window section 280 and spans the section boundary 290. Likewise, the first information 410 "123 567" is partially formed in the view section 270 and partially in the window section 280, and thus also spans the section boundary 290. The second information 420 "IV" is fitted in the first information 410 so that the first information 410 and the second information 420 complement each other so as to form the total information item 430 "123IV567". Their information content is once again stored as reference information 450 in the security document, for example as a laser engraving at another point. The reference information 450 could also be formed as an imprint on the opaque material layer. It would also be possible to store this information in a hologram and/or in a chip, which optionally can also be integrated into the security document and are not shown here for reasons of simplification. The Roman notation "IV" of the number 4 is chosen here only to indicate that this digit is not stored directionally dependent through the bottom side as second information 420.

In Fig. 3 is a view from another viewing direction through the top side of the security document analogous to that shown in Fig. 2. It can be clearly seen that only the second information and the reference information 450 can be detected. The viewing-direction-dependent first information cannot be detected from this detection or viewing direction.

Fig. 4 shows a further embodiment of a security document 2 with a document body 10.

The same technical features are provided with the same reference numerals.

In this embodiment, the second laser-capable material layer is missing, so that the second information 420 is likewise stored in the first laser-capable material layer 120. This is done as in the embodiment of Figs. 1 and 2 by an irradiation of focused laser light through the bottom side 12 of the document body 10.

Fig. 5 schematically shows the production of a security object 1 in the form of a document body 10 in the form of a lamination body 100. First, substrate layers 210 to 250 are compiled, which correspond to the material layers 110 to 150 of the embodiment according to Fig. 1. This means that a transparent substrate layer 250, a first laser-capable transparent substrate layer 220, an opaque substrate layer 230 having a cut-out opening 235 and a transparent insert 238 filling this cut-out opening 235, a second laser-capable substrate layer 240 and a further transparent substrate layer 250 are collected in a collection station 1010. In a high-pressure high-temperature lamination process, the substrate layers 210 to 250 thus formed are assembled in a lamination station 1020 into a document body 10 which is formed as a lamination body 100. At the same time or subsequently, the microlens array 300 is embossed in the top side 11 of the formed document body 10. Preferably, the embossing is effected such that the structuring of the microlenses does not protrude beyond a top side plane 21 of the top side 11, which is defined by those sections of the top side 11 in which the microlens array 300 is not formed.

Such an embodiment protects the individual lens elements 310 of the microlens array 300 from damage.

The lamination body 100 thus produced is then placed in a marking device 1030. In this, the document body 10 is held in a holder 1110. The marking will be explained with reference to Fig. 6.

The holder 1110 is pivotable about a pivot axis 1120. The document body 10 is arranged in the holder 1110 so that the pivot axis 1120 is formed parallel to directions of longitudinal extension of the lens elements 310, which are formed as cylindrical lenses, of the microlens array 300. Since the microlens array 300 is not necessarily centred on the top side of the document body 10, the pivot axis 1120 typically does not coincide with a

central axis 350 of the lens array. In addition, slight manufacturing tolerances occur in the formation of the window section and the relative positioning of the microlens array relative to the window section and the section boundary, respectively. For these reasons, in order to precisely mark the first information and the second information, it is necessary to detect a position of the section boundary 290 and the window section 280 relative to the marking device 1030, respectively. For this purpose, the marking device 1030 has a camera 1130. This is arranged opposite a transmitted light source 1140. The light of this transmitted light source passes through the window section 280 of the document body 10 and is detected by the camera 1130. A detected view shows such a transmitted light view 1141 of the document body 10. The window section 280 is clearly visible as a bright area and the view section 270 as a dark area. As a result, the exact position of the boundary section 290, which does not necessarily have to be rectilinear, can be determined. In order to determine a position of the lens array 300 relative thereto, a strip light source 1150 is provided. A strip light view 1151 detected by the camera 1130 shows a clear contrast between the lens array 300 and the remaining surface 14 of the top side. This makes it possible to also determine the position of the lens array 300 precisely. The marking process is controlled by a control device 1200.

In Fig. 6a, the situation for marking the first information is shown schematically. In general, the first information stored for a viewing direction dependency is stored for a detection direction which does not coincide with a surface normal 13 of the top side 11 of the document body 10. Therefore, the document body 10 is pivoted in the holder 1110 usually by an angle θ relative to a light incident direction 1320. Incident light 1305 of a marker light source 1300, which is formed, for example, as a laser light source, is modulated in a spatial light modulator 1310 according to the first information. As a result, the first information is imparted to the light. Light is only transmitted through the spatial light modulator 1310 at each point where an irreversible material change 411 is to be induced in the security document; in other places it is blocked. This results in a graphic representation of the first information, which is decomposed into pixels. This can be formed in black/white or light/dark or in grayscale or brightness levels. Since the document body is pivoted by the angle θ with respect to the light incident direction 1320, it is necessary to calculate a distortion and position adaptation for the irradiation of the light to mark the first information depending on the determined position of the section

boundary 290 and optionally additionally in dependence on the position of the microlens array 300 and the angle.

In Fig. 6b, the document body 10 is tilted by an angle -θ with respect to the light incident direction with the top side. In this position, a third information is preferably stored in the document body. Thus, in the finished security document, there are two pieces of viewing angle dependent information, the first information 410 and the third information 440, which are visible under different viewing directions.

In Fig. 6c, the document body is pivoted by 180° relative to the light incident direction, so that a marking takes place through the bottom side 12. In this position, the second information 420 is introduced positionally matched to the first information 410, so that preferably the first information and the second information complement one another so as to form a total information item. The third information can also be designed so that it completes the second information to form a further total information item. The total information item and the further total information item are preferably printed, for example as printed information, for example on the substrate layer 230 (see Fig. 4) prior to lamination and can thus serve as reference information and further reference information which can be recognised in the finished document body 10 on the material layer 130 as an imprint.

Figs. 7a to 7d schematically show views of a security object 1 designed as a security document 2, which are manufactured in accordance with the method described above. When viewing the document body 10 at the angle θ with respect to the surface normal 13 of the security document, the first information 410 "123 567" can be detected together with the second 420 "IV" information. This is shown in Fig. 7a. In addition, the first reference information 451 "123IV567" and the second reference information 452 "765IV321" are detectable. If the first and second information 410, 420 are not precisely positioned relative to one another, this is visible to a viewer. Manipulations of the first or the second information or a separation of the document body and subsequent re-lamination usually lead to deviations of the relative positioning, so that such manipulations are easily recognisable. A boundary distance 550 of the second information

420 from the boundary section 290 is preferably smaller than a character length 551 of the string of the first information 410.

In Fig. 7b, the view is shown from a viewing direction -θ with respect to the surface normal. The third information 440 "765 321" can be seen together with the second information 420 "IV" and again the reference information 451, 452.

In Fig. 7c a vertical plan view of the security document 2 is shown. From this viewing direction, only the second information 420 "IV" can be recognised together with the reference information 451, 452. When viewed through the bottom side 12, which is shown in Fig. 7d, only the second information 420 as the mirror-inverted "VI" can be seen. The reference information cannot be seen when viewed from this bottom side 12, because the opaque material layer prevents a view through the document body 10 at those locations 461, 462 where the reference information should be visible.

It will be understood by those skilled in the art that only exemplary embodiments are described. The individual examples described in the various embodiments can be combined with one another, as far as it is within the scope of protection of the claims. Preferably, the first and the second information are additionally linked in terms of information technology, for example, the second information may represent a check or checksum of the alphanumeric characters of the first information. Likewise, the third information may be selected and linked to the second information in the same way. However, a fourth information may also alternatively be matched to the third information, which is also linked through the bottom side of the document body as static information stored via irreversible changes.

List of reference numerals

1	Security object
2	Security document
10	Document body
11	Top side
12	Bottom side
13	Surface normal
14	Remaining surface
21	Top side plane
22	Bottom side plane
30	Edge length
40	Document body thickness/distance from top side to bottom side
50	Top view
100	Lamination body
110	Transparent material layer
120	First laser-capable material layer
130	Opaque material layer
135	Cut-out opening
136	Transparent material
140	Second laser-capable material layer
150	Transparent material layer
210	Transparent substrate layer
220	First laser-capable substrate layer
230	Opaque substrate layer
235	Cut-out opening
236	Transparent substrate
238	Insert
240	Second laser-capable substrate layer
250	Transparent substrate layer
270	View section
280	Window section
290	Section boundary

300 Microlens array

310 Microlenses

320 One part

330 Further part

350 Central axis

410 First information

411 First irreversible material changes "a"

412 Alphanumeric characters

413 Average character width

415 Component of the first information stored in the window section

416 Component of the first information stored in the view section

420 Second information

421 Second irreversible material changes

430 Total information item

440 Third information

441 Third irreversible material changes

450 Reference information

451 First reference information

452 Second reference information

461 Location where the first reference information should be visible

462 Location where the second reference information should be visible

525 Boundary distance

601 One (viewing/marking) direction

602 Further (viewing/marking) direction

611 View from one viewing direction

612 Further view from the further viewing direction

641 View through the bottom

1010 Collecting station

1020 Lamination station

1030 Laser marking station

1110 Holder

1120 Pivot axis

1130 Camera

1140 Light source of transmitted light

1141 Transmitted light view

1150 Strip light source

1151 Strip light view

1200 Control device

1300 Marking light source

1305 Light

1310 Spatial light modulator

1320 Light incidence direction/marking direction

Patentkrav

1. Sikkerhedsgenstand (1) med et fladeagtigt udstrakt dokumentlegeme (10), der har en overside (11) og en overfor liggende underside (12), idet der på eller i dokumentlegemets (10) overside (11) er dannet et linseraster (300), og i dokumentlegemet er lagret en lasermarkeret og registreringsretningsafhængig første information (410) om et første sæt irreversible materialeforandringer i dokumentlegemet, hvis optiske registrerbarhed gennem linserasteret (300) er afhængig af en registreringsretning,
idet dokumentlegemet (10) har et kontrolafsnit (270), i hvilket dokumentlegemet (10) mellem oversiden (11) og undersiden (12) af dokumentlegemet (10) har et i volumen gennemskinneligt eller opakt materialelag, og stødende op til kontrolafsnittet (270) omfatter et vinduesafsnit (280), i hvilket dokumentlegemet (10) er dannet af i volumen transparent materiale mellem oversiden (11) og undersiden (12) af dokumentlegemet (10), og linserasteret (300) strækker sig både over mindst en del af vinduesafsnittet (280) og over mindst en del af kontrolafsnittet (270) og derved spænder over en afsnitsgrænse (290) mellem kontrolafsnittet (270) og vinduesafsnittet (280), og også den lasermarkerede og registreringsretningsafhængige første information (410) er dannet delvis i kontrolafsnittet (270) og delvis i vinduesafsnittet (280), og der endvidere i vinduesafsnittet (280) er lagret en lasermarkeret og statisk anden information (420) om andet sæt irreversible materialeforandringer i dokumentlegemet (10), idet den anden information (420) kan registreres optisk som statisk information både gennem linserasteret (300) på eller i dokumentlegemets (10) overside (11) og gennem dokumentlegemets (10) underside (12).

2. Sikkerhedsgenstand (1) ifølge krav 1, **kendetegnet ved, at** den første information (410) og den anden information (420) supplerer hinanden til en totalinformation (430).

3. Sikkerhedsgenstand (1) ifølge krav 2, **kendetegnet ved, at** totalinformationen (430) foruden det første og det andet sæt irreversible materialeforandringer i dokumentlegemet (10) er lagret som referenceinformation (450) til referenceformål.

4. Sikkerhedsgenstand (1) ifølge et af de foregående krav, **kendetegnet ved, at** mindst en del af den anden information (420) er lagret stødende uniddelbart op til afsnitsgrænsen (290).

5. Sikkerhedsgenstand (1) ifølge et af de foregående krav, **kendetegnet ved, at** totalinformationen (430) omfatter et meningsindhold, der kan registreres af mennesker, og som hverken er gengivet fuldstændigt grafisk gennem den første information (410) eller gennem den anden information (420).

6. Sikkerhedsgenstand (1) ifølge et af de foregående krav, **kendetegnet ved, at** der mellem oversiden (11) og det gennemskinnelige eller opakke materialelag er dannet et første lasersensitivt transparent materialelag, i hvilket det første sæt irreversible materialeforandringer er dannet.

7. Sikkerhedsgenstand (1) ifølge et af de foregående krav, **kendetegnet ved, at** der i dokumentlegemet (10) er dannet et andet lasersensitivt transparent materialelag, som er dannet mellem det første lasersensitive transparente materialelag og undersiden (12), og i hvilket det andet sæt irreversible materialeforandringer er dannet.

8. Sikkerhedsgenstand (1) ifølge et af de foregående krav, **kendetegnet ved, at** det andet lasersensitive transparente materialelag er anbragt mellem undersiden (12) og det gennemskinnelige eller opakke materialelag.

9. Sikkerhedsgenstand (1) ifølge et af de foregående krav, **kendetegnet ved, at** dokumentlegemet (10) omfatter et laminationslegeme umfasst, der er dannet af forskellige substratlag, idet det gennemskinnelige eller opakke materialelag er dannet af et gennemskinneligt eller opakt substratlag, som i vinduesafsnittets (280) område har en udsparing, som er fyldt med et transparent materiale.

10. Fremgangsmåde til fremstilling af sikkerhedsgenstanden (1) ifølge et af kravene 1 til 9, omfattende trinnene:

tilvejebringelse eller fremstilling af et fladeagtigt udstrakt dokumentlegeme (10), der har en overside (11) og en overfor liggende underside (12),

idet der på eller i oversiden (11) er dannet eller dannes et linseraster (300), og

lagring af en første lasermarkeret registreringsretningsafhængig information, idet der gennem linserasteret (300) fra en retning indstråles rumligt moduleret laserlys, og i fokusområder for linserne i linserasteret (300) forårsages et første sæt irreversible materialeforandringer,

idet dokumentlegemet (10) tilvejebringes eller fremstilles med et kontrolafsnit (270), i hvilket dokumentlegemet (10) mellem oversiden (11) og undersiden (12) af dokumentlegemet (10) har et i volumen gennemskinneligt eller opakt materialelag, og med et til kontrolafsnittet (270) tilstødende vinduesafsnit (280), i hvilket dokumentlegemet (10) er dannet af i volumen transparent materiale mellem oversiden (11) og undersiden (12) af dokumentlegemet (10), og linserasteret (300), idet linserasteret (300) forløber både over mindst en del af vinduesafsnittet (280) og over mindst en del af kontrolafsnittet og derved spænder over en afsnitsgrænse (290) mellem kontrolafsnittet (270) og vinduesafsnittet (280), og lagringen af den første information (410) udføres således, at også den lasermarkerede og registreringsretningsafhængige første information (410) er dannet delvis i kontrolafsnittet (270) og delvis i vinduesafsnittet (280), og der endvidere i vinduesafsnittet (280) gennem undersiden (12) indstråles yderligere rumligt moduleret laserlys, og der lasermarkeres og lagres en statisk anden information (420) om et andet sæt irreversible materialeforandringer i dokumentlegemet, idet den anden information (420) kan registreres optisk som statisk information både gennem linserasteret (300) på eller i dokumentlegemets (10) overside (11) og gennem dokumentlegemets (10) underside (12).

11. Fremgangsmåde ifølge krav 10, **kendetegnet ved, at** den anden information (420) vælges således, at denne suppleres med der første information (410) til en totalinformation (430), som har et registrerbart meningsindhold, der hverken er gengivet fuldstændigt grafisk gennem den lagrede første information (410) eller gennem den anden lagrede information.

12. Fremgangsmåde ifølge krav 10 eller 11, **kendetegnet ved, at** dokumentlegemet (10) i det mindste delvis er dannet som laminationslegeme

(100), idet flere substratlag (210-250) bringes sammen med hinanden i en substratlagsstabel og ved tilførsel af energi i et laminationstrin forbindes fladeagtigt med hinanden, idet der i subtratlagsstablen anbringes et i volumen gennemskinneligt eller opakt substratlag, som danner det gennemskinnelige eller opakke materialelag i dokumentlegemet (10), idet det i volumen gennemskinnelige eller opakke substratlag i et område, der korresponderer med vinduesafsnittet (280), har en udsparing, som fyldes med et transparent materiale før eller under laminationstrinnet.

13. Fremgangsmåde ifølge et af kravene 10 til 12, **kendetegnet ved, at** en beliggenhed af en afsnitsgrænse (290) mellem vinduesafsnittet (280) og kontrolafsnittet (270) i forhold til en referenceenhed bestemmes af en markeringsindretning, og den rumlige modulation og/eller placering af indstrålingen af det første laserlys udføres på grundlag af den bestemte beliggenhed af afsnitsgrænsen.

14. Fremgangsmåde ifølge et af kravene 10 til 13, **kendetegnet ved, at** der til bestemmelse af afsnitsgrænsen (290) beliggenhed registreres og bedømmes en afbildning af vinduesafsnittet (280) med gennemfaldende lys.

15. Fremgangsmåde ifølge et af kravene 10 til 14, **kendetegnet ved, at** der endvidere bestemmes en beliggenhed af linserasteret (300), idet der registreres og bedømmes en strejflysoptagelse af dokumentlegemets (10) overside (11), og linserasterets (300) beliggenhed i forhold til afsnitsgrænsens (290) beliggenhed tages med i betragtning udførelsen af modulationen af det første lys og/eller placeringen af det første laserlys.

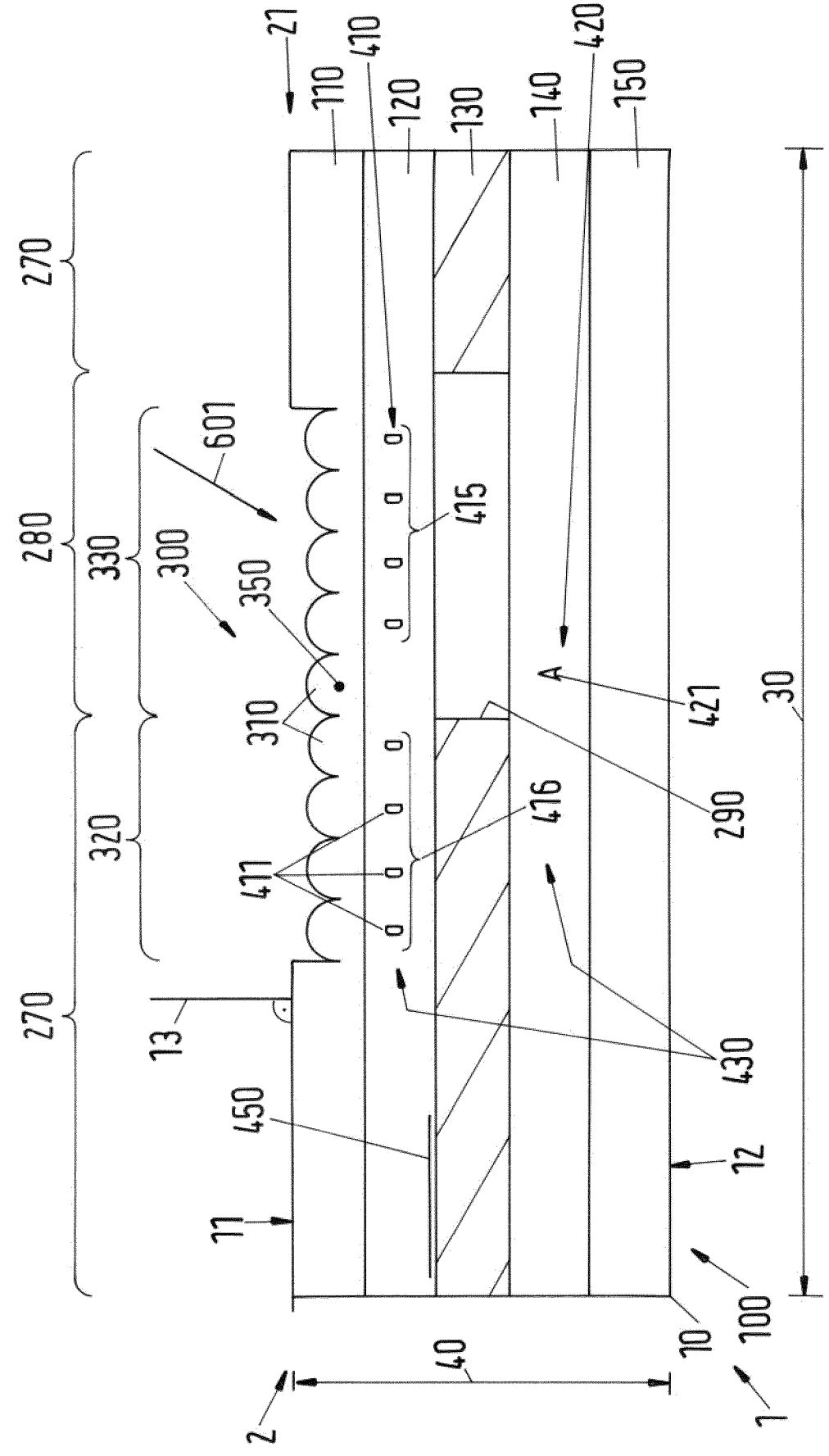

21
110
410
120
130
140
420
150
270
280
330
300
601
350
415
310
320
411
416
290
421
A
30
270
13
450
430
11
12
10
100
40
2
1

Fig.1

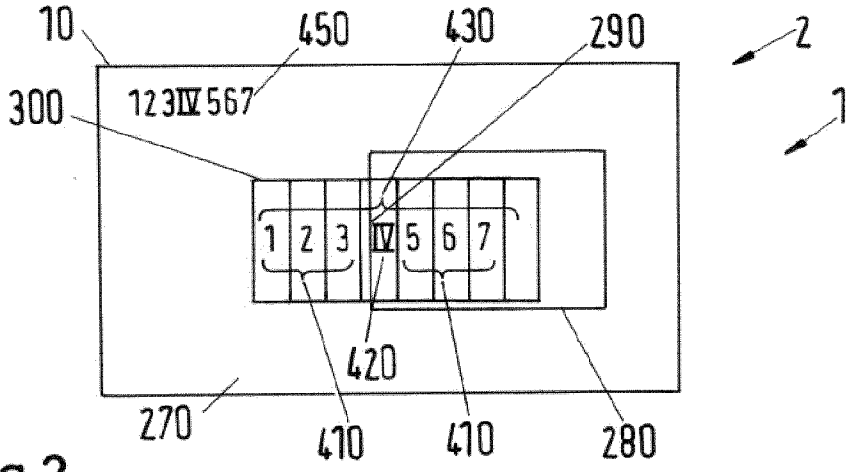


Fig.2

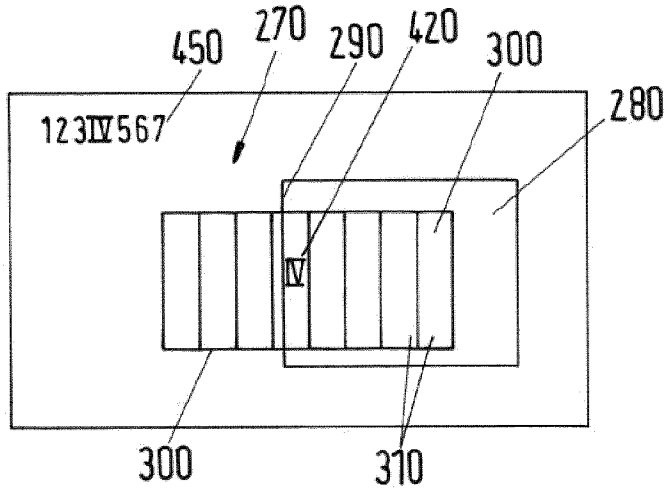


Fig.3

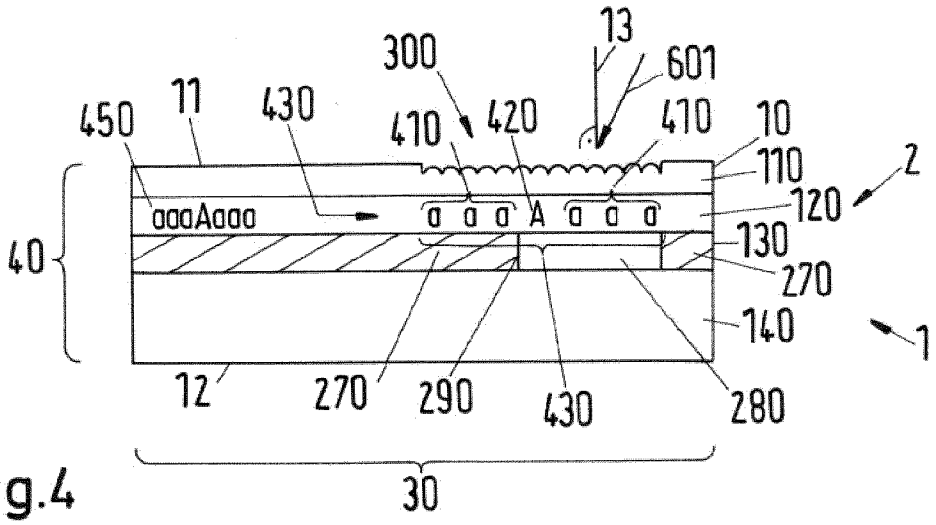


Fig.4

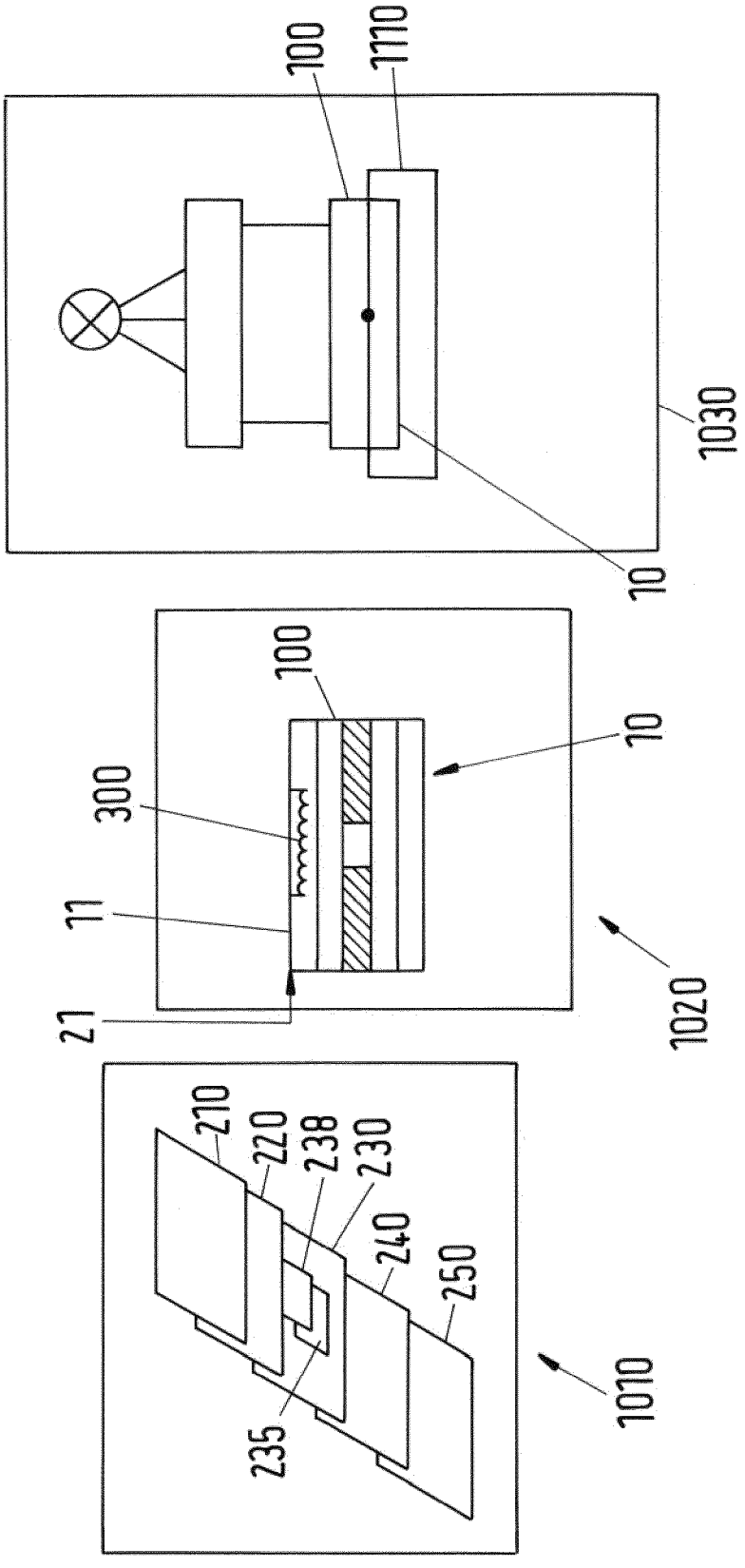
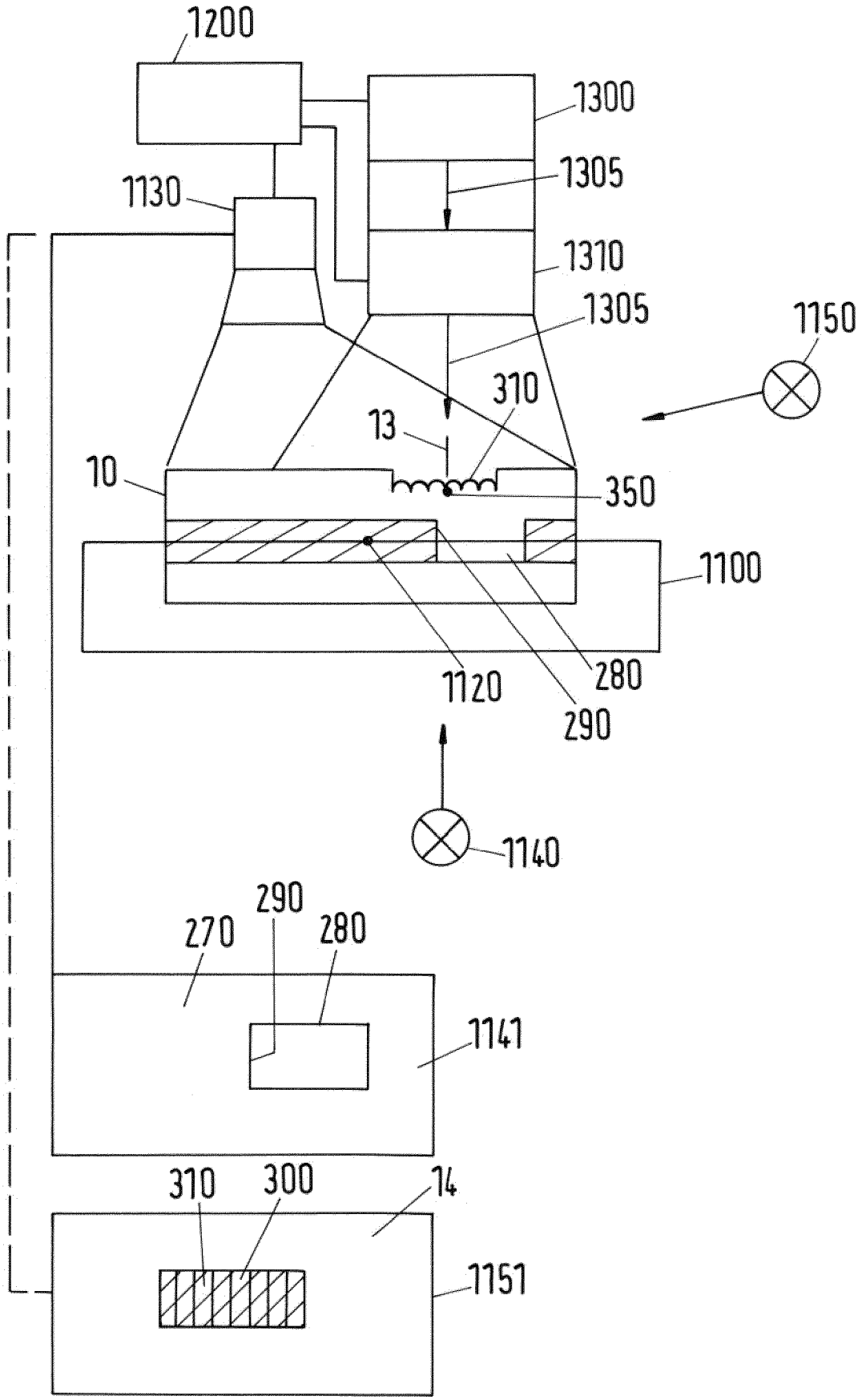

100
1110
1030
10
100
10
300
11
21
1020
210
220
238
230
240
250
235
1010

Fig.5


1200
1300
1305
1130
1310
1305
1150
310
13
10
350
1100
1120
280
290
1140
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270
280
1141
310
300
14
1151

Fig.6

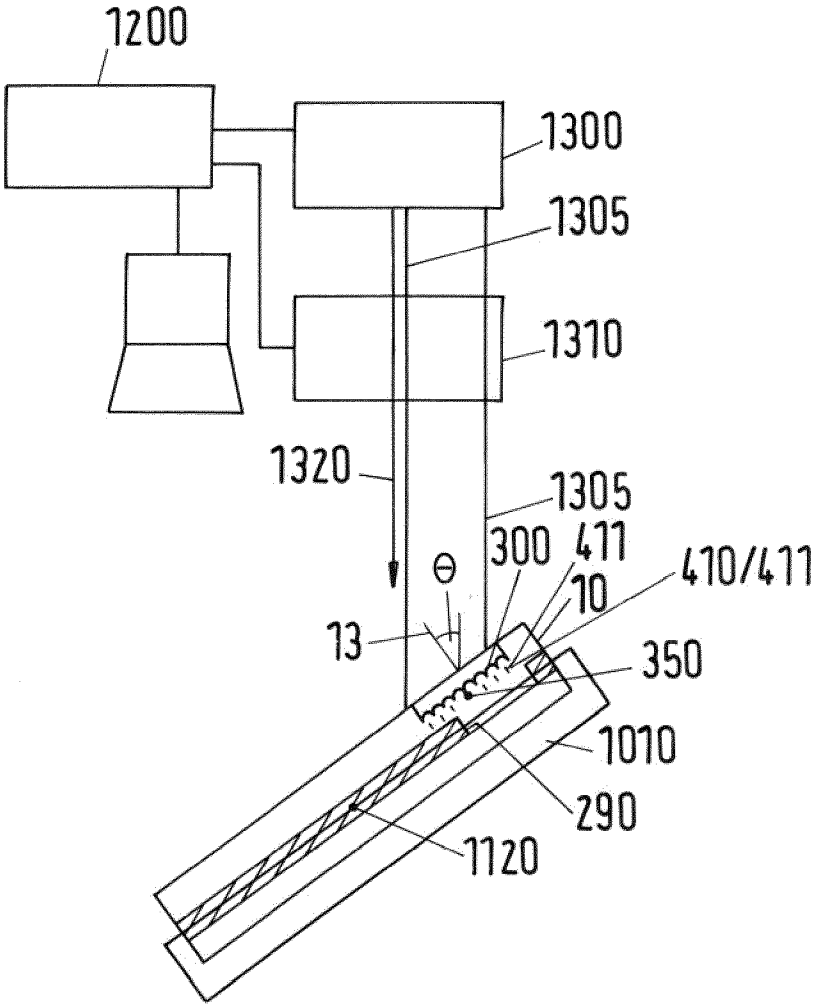
1200
1300
1305
1310
1320
1305
300
411
410/411
θ
10
13
350
1010
290
1120

Fig.6a

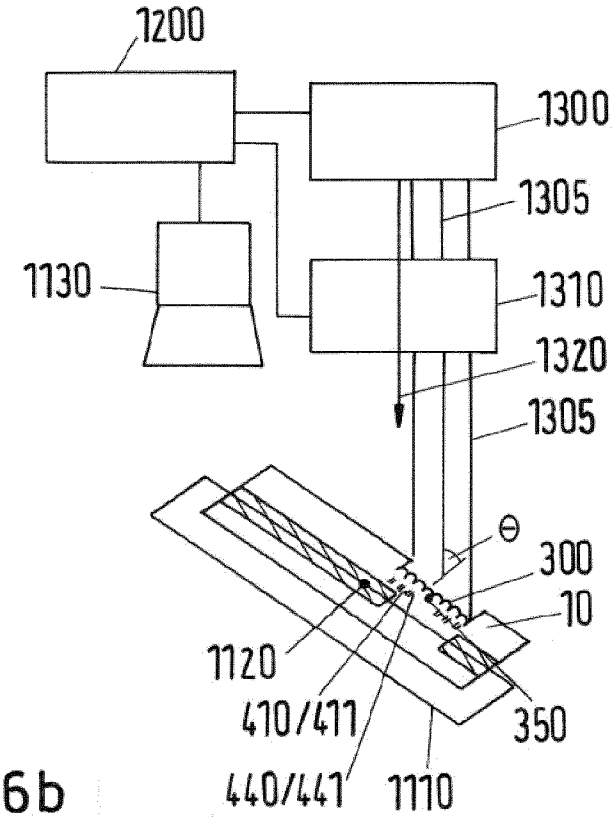
1200
1300
1305
1130
1310
1320
1305
Θ
300
10
1120
410/411
350
440/441
1110

Fig.6b

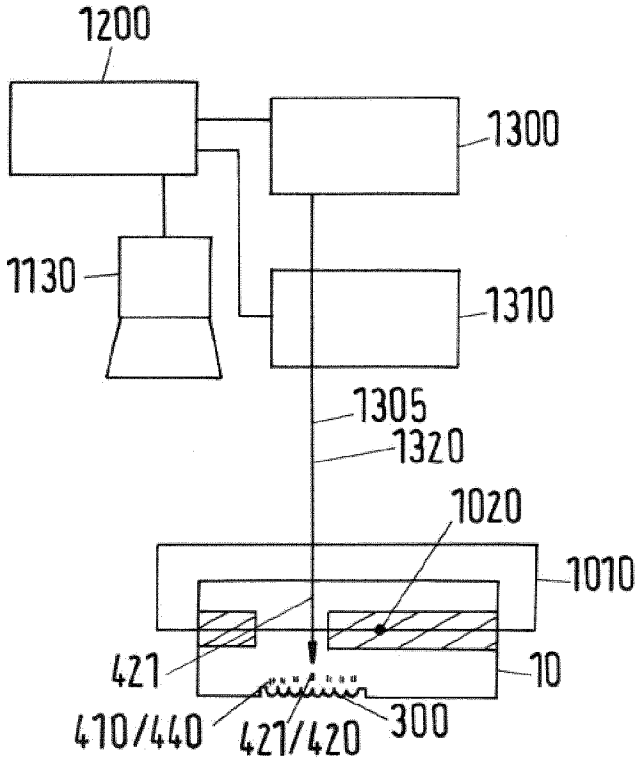
1200
1300
1130
1310
1305
1320
1020
1010
421
10
410/440
421/420
300

Fig.6c

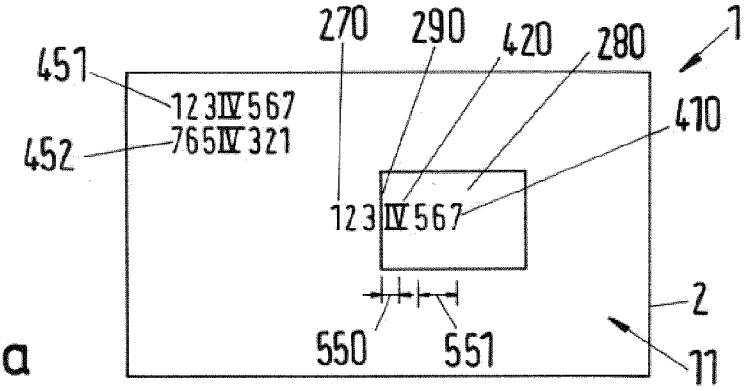

Fig.7a

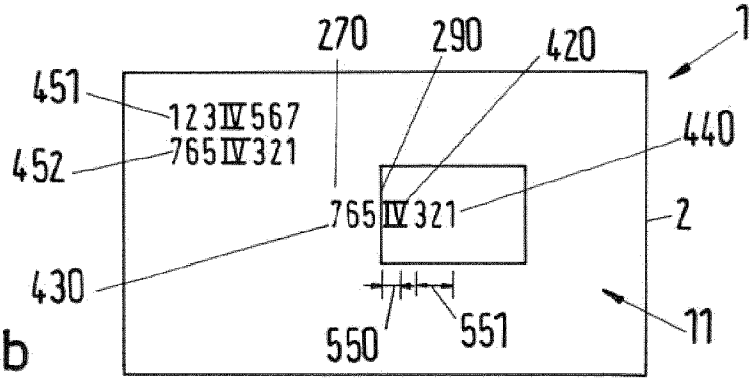

Fig.7b

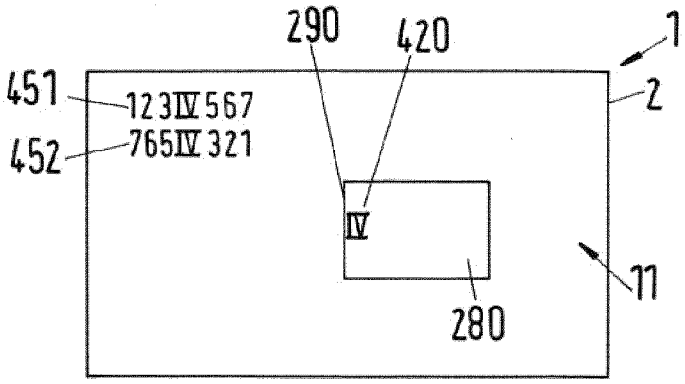

Fig.7c

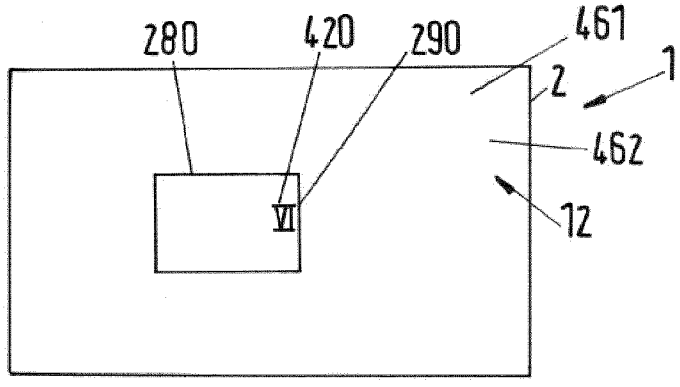

Fig.7d