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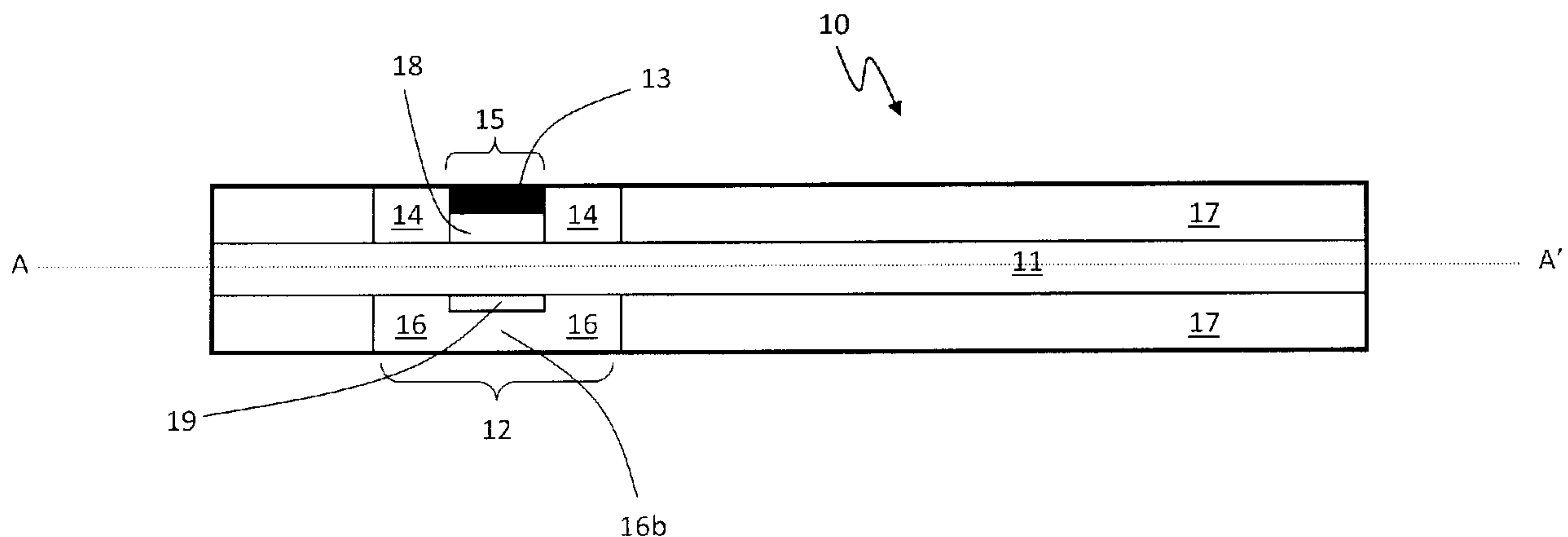


Fig. 4a

(57) **Abrégé/Abstract:**

Security documents, such as passports, bank notes and credit cards, often incorporate security devices that are difficult to replicate by conventional printing or copying techniques. Disclosed herein are security devices and methods for their production. In selected embodiments, the security devices may be used with polymer core materials in such a way that they simulate the appearance of known security devices more traditionally used with paper or other core materials.

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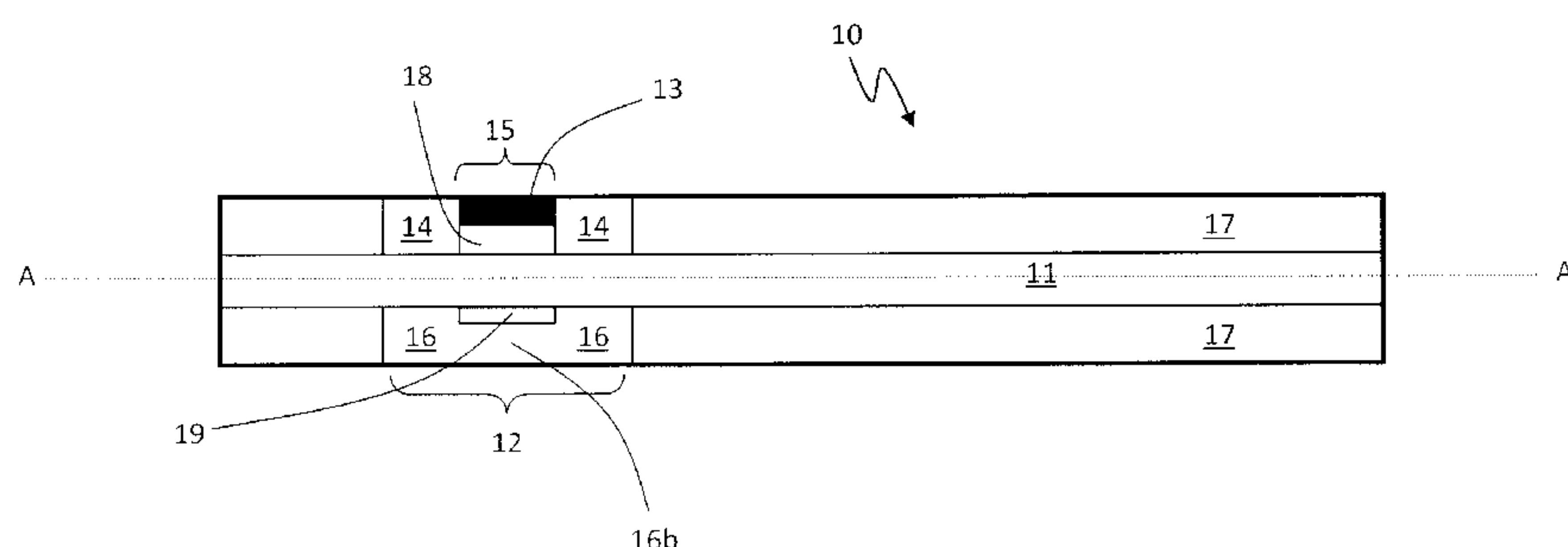


Fig. 4a

(57) Abstract: Security documents, such as passports, bank notes and credit cards, often incorporate security devices that are difficult to replicate by conventional printing or copying techniques. Disclosed herein are security devices and methods for their production. In selected embodiments, the security devices may be used with polymer core materials in such a way that they simulate the appearance of known security devices more traditionally used with paper or other core materials.

## SECURITY DEVICES, THEIR PRODUCTION AND USE

## FIELD OF THE INVENTION

The invention relates to security devices, their use, and methods to produce such  
5 security devices. Such security devices are typically incorporated into security documents  
of value, including documents which may be subject to counterfeiting, such as passports,  
banknotes and other articles.

## BACKGROUND TO THE INVENTION

10 Bank notes and other security documents frequently incorporate optically variable  
devices (OVDs) such as diffraction gratings or holographic optical microstructures as  
security features against copy and counterfeit. The increased use of such devices has  
been motivated by progress in the fields of computer based desktop publishing and  
scanning, which render conventional security print technologies, such as intaglio and  
15 offset printing, increasingly susceptible to counterfeit. One way to strengthen security  
documents against counterfeit is to combine security print with optically variable devices  
whose structures cannot be replicated by scanners, and which can exhibit optically  
variable effects such as colour changes by diffraction, movement effects, and distinct  
switches between images.

20 Holograms are widely used as security features in credit cards as they cannot be  
reproduced by photographic or photocopying techniques. To enhance the security of  
holograms and to prevent contact copies being made, a technique was developed for  
making holograms by a process of demetalization. Demetalized holograms and patches  
are often used in passports and ID cards to protect photographs and data. The image  
25 beneath the hologram is only visible when the document is tilted. Other OVDs include  
polymer or laminate microstructures in the form of foils that exhibit colour shifts in  
transmitted light passing through the foil and / or ambient light reflecting from the foil.  
Tilting the foil results in a visible colour-shift effect due to the laminate microstructure  
and / or Bragg stacking within the foil. Such devices provide particularly useful surface  
30 security features in applications where the substrate to which they are applied is flexible  
or foldable, such as in banknotes.

Security devices may also comprise strips or threads which are made from a transparent film provided with a continuous reflective metal layer, vacuum deposited aluminium on polyester film being the commonest example. Banknotes made using such security devices have been in general circulation in many countries for many years. When  
5 such security elements are fully embedded in security paper, and the paper is subsequently printed to provide the security document (e.g. a banknote), the thread cannot be discerned readily in reflected light but is immediately apparent as a dark image when the document is viewed in transmitted light. Such threads are effective against counterfeiting by printing or photocopying, since the optically variable effect cannot be  
10 simulated accurately, for example by printing a line on the paper.

The composition, size and positioning of security features may vary depending upon the desired security of the document. Typical security threads are composed of a polymeric film such as polyester, which may be metalized or coloured, and which may include micro-printed lettering denoting a title or message. The lettering can be produced  
15 by printing onto the substrate or by de-metalizing a metallic layer on the substrate. Micro-printed threads may be slit to produce either registered lettering with respect to the edge of the thread, or unregistered lettering designed so that the message always appears irrespective of thread slitting. Moreover, the positioning of the thread within the document may be strictly controlled to agreed criteria and may be concurrent with  
20 additional security features, such as a watermark. Traditionally, security threads are embedded within security paper in such a way that paper fibres cover both sides of the thread, making it considerably less visible in reflective light, but clearly visible in transmitted light.

In recent times, however, modern counterfeiting techniques have made use of  
25 sophisticated colour separation, printing and colour photocopy technology. Thus, it has become common to use a security thread comprising a thin layer of aluminium on a plastic support which is exposed on one side of the paper sheet at intervals along the length of the thread, the region of exposure being referred to as a 'window'. Again, the positioning of the windows may be controlled to allow registration of the window with  
30 respect of the document and other security features such as watermarks.

This latter development has resulted in enhanced security, and windowed paper

has been used for banknotes in many countries. A banknote of this type provides added security against counterfeiters as, when viewed in transmitted light, the strip is seen as a dark line and when viewed in reflected light on the appropriate side, the bright shining aluminium portions which are exposed at the windows are readily visible. The aluminium portions may provide further enhanced security if they incorporate holographic or other OVD features. Nonetheless, the reflected light appearance of the exposed aluminium portions of a security device can be simulated to a degree by modern materials and techniques.

Also known in the art is the use of polymer-based films or sheets as an alternative basic substrate for the production of security documents such as bank notes. In some countries such films are used instead of paper-based substrates for bank note production. In comparison to bank notes manufactured on a paper substrate, polymer film bank notes are highly resilient to tearing, wear and abrasion. As such the bank notes have a longer useable lifespan, and thus may remain in circulation for an extended period of time. However, it can be more difficult to incorporate security features and devices into such bank notes. As desired, such features may be printed or deposited upon the surface of the polymer-based films. Alternative techniques involve layering of polymer films for example to produce a laminate structure, wherein security features of devices may be incorporated between layers of the laminate structure. For example, United States patents 6,471,247 and 6,471,248, both issued October 29, 2002, disclose security documents comprising clear plastics material and a security thread or a printed security device, with opacifying ink applied to selective areas on both sides of the substrate such that pre-selected portions of the thread or printed device remain visible.

There is a continuing need for security devices and features for security documents, in order to render the task of document replication more difficult for a counterfeiter. In particular, there is a need for security devices and features suitable for use with polymer substrates.

## SUMMARY OF THE INVENTION

It is one object of the present invention, at least in preferred embodiments, to provide a security feature or device for a security document.

Certain exemplary embodiments provide for a security device for use with a security document, the security device comprising:

- 5                   a. a security feature comprising foil;
- a. a masking layer applied to the security feature to conceal at least a portion of the foil in reflected light.

Certain other exemplary embodiments provide for a security document comprising:

- 10           a. a core material;
- b. at least one security device as described herein, applied to one or both sides of the core material.

Certain other exemplary embodiments provide for a method for the production of a security device suitable for use in a security document, the method comprising the steps of:

- 15           a. providing a security feature comprising foil;
- b. applying a masking layer to at least a portion of the security feature to conceal the portion of the foil in reflected light.

Certain other exemplary embodiments provide for a method for the production of a security document, the method comprising the steps of:

- 20           a. providing a security feature comprising foil;
- b. applying to the security feature a masking layer to mask at least a portion of the foil;
- c. applying the security feature, together with the masking layer if present, to a first side of a core material of the security document;
- 25           d. optionally applying a fluorescent ink layer to a side of the core material opposite the first side, in alignment with the security feature; and
- e. optionally applying a further masking layer to the core material on a side opposite the first side, to at least partially conceal the fluorescent ink layer, if present;
- 30           wherein steps b and c may be performed in any order.

## BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 provides a plan view of a sheet of security paper containing a security feature viewed in reflected light (prior art, derived from Figure 1 of United States Patent 6,616,190)

Figure 2 provides a front view of an example security document incorporating an example security device.

Figure 3 provides a back view of an example security document incorporating an example security device.

Figure 4a provides a cross-sectional view of an example security document incorporating an example security device, taken along line A-A' in Figures 2 and 3.

Figure 4b provides a cross-sectional view of an example security document incorporating an example security device, taken along line B-B' in Figures 2 and 3.

Figure 5 illustrates an ambient colour shift observed with the security document illustrated in Figure 4.

Figure 6 illustrates a transmissive colour shift observed with the security document illustrated in Figure 4.

Figure 7 illustrates a fluorescent colour shift observed with the security document illustrated in Figure 4.

Figure 8 illustrates steps of an example method for the production of a security device.

Figure 9 illustrates steps of an example method for the production of a security document.

Figure 10 provides a front view of an example security document incorporating an example security device.

Figure 11 provides a front view of an example security document incorporating an example security device.

Figure 12a provides a front view of an example security document incorporating an example security device.

Figure 12b provides a front view of an example security document incorporating an example security device.

## DEFINITIONS:

Absorber layer: refers to any layer forming part of a Fabry-Perot structure, or any other optical interference structure, that causes at least some (e.g. 1-99%) of light incident upon or reflected back to the layer to be transmitted through the layer, with at least a portion of the light absorbed by the layer. In other selected embodiments 'absorber layer' refers to a thin metal layer which is part of a three layer Fabry-Perot reflection type interference filter and has the property of semi-transparency in the a portion of the optical spectrum for which a colour-shift effect is desired. A description of the operation of the Fabry-Perot reflectance interface filter and the role of the absorber layer in such a structure maybe found in reference (for example see Phillips, R.W. and Bleikom, "Optical Coatings for Document Security" Applied Optics, Vol. 35, No. 28, October 1, 1996, pp.529-5534. In selected embodiments the absorber layer may be the surface layer of a security device comprising an optical interference structure. An absorber layer may comprise any material or combination of materials that exhibit the light absorption / transmission properties described, including but not limited to at least one material selected from the group consisting of: metals, metal alloys, Chromium alloys, Inconel, aluminum, or a material selected from the group consisting of chromium, nickel, palladium, titanium, vanadium, cobalt, iron, tungsten, molybdenum, niobium, ferric oxide, and combinations or alloys thereof. In selected embodiments the absorber layer may optimally permit about 50% of visible, UV or IR light incident thereupon to be transmitted through the absorber layer, with about 50% of light being absorbed by the absorber layer. In this way, more obvious colour-shift properties may be observed. For example, a layer of Inconel having a thickness of about 6nm has been found to achieve such desired transmission / absorption and colour saturation characteristics. Adhesive / adhesive layer: refers to a substance optionally formed into a layer that causes adhesion of one layer of a security device and / or a security document to another. The adhesive may comprise any adhesive that is known in the art, but may be selected according the materials being subjected to the adhesion. Such adhesive materials may be selected from, but are not limited to, polyolefins and other well known polymers and co-polymers.

Furthermore, the adhesive materials may be curable at room temperature, or may be heat activated.

Colour: refers typically to a colour observed for visible or beyond visible (e.g. IR or UV) light emanating or reflecting from an optical interference structure or security device as disclosed herein. Any change that is observed in the colour, for example resulting from a change, formation or disruption of an optical interference structure, may result either in a change in the apparent colour observed from the structure or device at a fixed angle relative to a plane of the structure or device, and / or a change in the colour shift properties of the structure or device as it is tilted relative to a user. All such changes in optical properties are encompassed by the expression "colour-shift".

Core material: refers to any material used to form the main structure or sheet of a security document. The material is typically formed into a sheet or planar member, and may be composed of a substance selected from but not limited to paper, a plastic, a polymer, a resin, a fibrous material or the like. In selected embodiments the core material is of a material suitable for application thereto, either directly or indirectly, of a security device of the types disclosed herein. The security device, or elements thereof, may be applied or attached to the core material in any manner including the use of adhesive materials or layers, such as glues, or by overlaying an adhesive substance, film, varnish or other material over the top of the security device or components thereof. The core material may be smooth or textured, fibrous or of uniform consistency. Moreover, the core material may be rigid or substantially rigid, or flexible, bendable or foldable as required by the security document. The core material may be treated or modified in any way in the production of the final security document. For example, the core material may be printed on, coated, impregnated, or otherwise modified in any other way. In further examples a core material may comprise bi-axially oriented polypropylene film (BOPP) or derivatives thereof.

Fabry-Perot optical cavity structure: may take any form as known in the art, or in selected embodiments may comprise at least an absorber layer, a spacer layer, and a reflector layer as described herein.

Foil: refers to any type known in the art including any thin film for use in the production of a security feature or security device as defined herein. Optionally, the foil may be non-optically variable, or optically variable depending upon light conditions or orientation.

Examples of optically variable foils include those with Bragg stacking or Fabry-Perot

5 optical cavity structures. Any foil may, at least in some embodiments, have a thickness of from 0.1 to 20 $\mu$ m, or from 0.5 to 10 $\mu$ m. In selected embodiments a transfer foil may be thin or comprise a thin-film, with a thickness of from 0.1-20 $\mu$ m typically and is applied to a substrate using a thicker carrier layer to provide mechanical support during the lamination process. In such embodiments, the foil carrier does not remain attached to  
10 the security element or foil after lamination and the foil is released from the carrier by a release layer located between the foil and carrier. The adhesion of the foil to substrate is sufficiently strong during the lamination process to break the bond between the carrier and the release layer thus releasing the foil from the carrier. The carrier is removed from foil and does not typically remain bonded to the substrate; only the thin foil remains  
15 bonded to the substrate after lamination. Such carriers allow for lamination of the thin foils that would normally not have sufficient mechanical strength to remain intact during a lamination process to be applied to substrate without damaging the fragile layer or layers making up the foil. However, any foil may be applied to any substrate (or core material for a security document) via any method including hot or cold-foil stamping.  
20 Alternatively, a foil of any type may be applied by the use of a release layer, optionally with an adhesive layer such that contact (optionally with pressure) of the foil layer may cause transfer of the foil layer from one substrate to another.

Fluorescent ink / fluorescent ink layer: refers to any ink or combination of ink or toner compositions that include a luminescent material that converts at least part of incident  
25 energy into emitted radiation with a characteristic signature. Non-limiting examples include materials which exhibit fluorescent and/or phosphorescence. For example, such a fluorescent ink may be used to provide an ultraviolet (UV) fluorescent feature. Such a feature may be applied as an ink, which may be visible or invisible, for example by offset printing and may form an image made up of one to three colours (red, green, blue). The  
30 image is detected by exposure of the bank note to a UV light source (typically UVA at

365 nm). The fluorescent ink may be visible on a surface of a security document, or alternatively may be concealed or partially concealed beneath one or more other layers such as a masking layer. In selected embodiments the fluorescent ink may comprise a luminescent material which, when stimulated emits luminescent radiation at first and second wavelengths, the second wavelength being different from said first wavelength; and an optically variable device arranged to control emission of the luminescent radiation from said security device, and which, at a first angle or first range of angles of emission from said security device limits emission of luminescent radiation to a first colour including said first wavelength or a first range of colours including said first wavelength, and at a second angle or second range of angles of emission from said security device, different from said first angle or first range of angles, limits emission of luminescent radiation to a second colour including said second wavelength or a second range of colours including said second wavelength, wherein said second colour or range of colours is different to said first colour or range of colours.

Masking layer / opacifying layer: refers to any layer used in a security device as described herein to conceal or partially conceal a security feature from view in reflected light. The masking layer may be sufficiently opaque such that the security feature cannot be seen through the layer even in bright reflected light because at least 99% of the light incident upon the layer is substantially unable to penetrate the layer. A masking layer may also be less opaque such that a small percentage (e.g. 1 to 30%) of the light incident upon the layer may be transmitted through the layer, such that the security feature beneath may be slightly visible upon visual inspection in brighter reflected light conditions. Any masking layer may cover the security feature, or partially cover the security feature such that the security feature is entirely visible in reflected light conditions at those portions not covered by the masking layer. The regions of the security feature not covered by the masking layer are referred to as 'windows' through which the security feature may be seen. The degree of opacity of the masking layer may determine the amount of light incident to the layer that passes through the layer by light transmission. In selected embodiments it may be desired for the masking layer to exhibit a degree of translucency such that an amount (e.g. 1-99%) of light incident upon the masking layer may be

transmitted through each masking layer. In this way, a person holding a bank note or other security document up to a source of light may be able to observe the presence of a security feature forming part of a security device of the bank note without significant difficulty, because a degree of light transmission may occur through any masking layer immediately adjacent the security feature.

Opacifier material: refers to any substance used to form the masking layer as part of a security device as described herein. The material, once applied in the form of a layer of from between 0.001 and 10,000 microns in thickness, provides a degree of opacity such that between 0 and 90% of light incident upon the layer is transmitted through the layer.

The opacifier layer in security documents is typically, at least in some embodiments, 6 $\mu$ m thick on each side of the document. There is a balance between greater opacification with thicker layers and changes in the mechanical properties of document such as bending when opacification layers are greater than 6 $\mu$ m per side. Also thicker opacification layers have a greater tendency flake off than layers 6  $\mu$ m or less. Such opacifier materials include, but are not limited to, any form of at least partially opaque ink or toner compositions, or any form of emulsion or suspension composition wherein the suspended component contributes at least in part to the opaque or translucent properties of the material. For example, typical opacifier materials may include metal oxides such as titanium dioxide dispersed within a binder or carrier material. In selected embodiments the opacifier material, when applied as a layer, has an optical density of from 0.1 to 5.

Optical interference structure: refers to any structure that achieves interference of visible light incident upon the structure, such that light observed to be emanating from the structure appears different to the light incident upon the structure. For example, white light incident upon and reflected back from an optically variable foil may appear coloured, and the colour may change if the foil is tilted relative to the observer. An optical interference structure as described herein may also take the form of a planar optionally flexible device intended to form an independent layer or a layer on a substrate, or may take the form of a Flake or component of a Flake in accordance with such known devices in the art. Examples of optical interference structures include, but are not limited to, those disclosed in Optical Document Security, Third Edition, Rudolf L. Van Renesse, Artech

House 2005, Chapter 7 and references cited therein. Selected optical interference structures may comprise a multilayer structure or Fabry-Perot structure or other structure.

An incomplete optical interference structure comprises one or more layers of a typical optical interference structure, but lacks one or more layers required to complete the structure to give an optical affect. For example, in terms of Fabry-Perot optical cavity structures, an incomplete optical interference structure may comprise either a reflector layer or an absorber layer, optionally with a spacer layer in contact therewith.

10 Reflected light: refers to light incident upon a surface and subsequently bounced by that surface such that the reflected light is visible to the eye. The degree of light reflection may vary according to the surface, and the degree of light that is not reflected by the surface because it is scattered by, diffracted by, or transmitted through the surface and the material of the substrate.

15 Polymer core material: refers to any polymer or polymer-like substance suitable to form a core material in the form of a sheet-like configuration to be formed or cut into a size suitable for use as in security documents. The polymer core material may be a substantially uniform sheet of polymer material, or may take the form of a laminate structure with layers or polymer film adhered together for structural integrity, such as  
20 disclosed for example in international patent publication WO83/00659 published March 3, 1983, which is incorporated herein by reference.

Security document: refers to any document of importance or value. In selected embodiments, a security document may include features or devices intended to show that the document is a genuine and legitimate document, and not a non-genuine or  
25 illegitimate copy of such a document. For example, such security documents may include security features such as those disclosed herein. Such security document may include, but are not limited to, identification documents such as passports, citizenship or residency documents, drivers' licenses, bank notes, cheques, credit cards, bank cards, and other documents of monetary value.

30 Security device: refers to any device that may be added to a security document for the purposes of making that security document more difficult to copy or replicate. For

example, in accordance with selected embodiments described herein, a security device may comprise any security feature as described herein together with a masking layer to obscure at least part of the security feature from view by an observer.

Security feature: refers to any element, area, strip, thread or region thereof, with optical

5 properties intended to make the feature conspicuous either when observed in isolation or as part of a security document, for example in either reflected, transmitted, or any other light conditions. Such an element, area, strip, thread, or region thereof may be applied directly or indirectly to or incorporated into a core material of a security document for the purposes of providing a security feature to the document, or for the  
10 purposes of providing a component of a security device or feature for the document.

Security features typically include a structure or material(s) suitable to make the security feature conspicuous in transmitted and / or reflected light. For example, a security feature may include a metal or metalized layer to make the security feature conspicuous in transmitted light. Alternatively, for example, a security feature may include a coloured  
15 region, or a foil, thin-film foil or reflective layer best observed in transmitted or reflected light. The security feature optionally may comprise optically variable properties such that the feature appears different to a user depending upon light conditions, orientation, light wavelength, light intensity or any other variables related to the observation of the feature. In one example, a security feature may comprise a security thread incorporated  
20 for example into a bank note comprising a paper core material or substrate, and the thread may be concealed from view in reflective light by the core material, or alternatively the thread may be partially visible as it emerges in windows in the core material, or by virtue of its threading into the core material. In accordance with the teachings herein, where the core material is a polymer core material, the security feature  
25 may also take the form of an area or elongate strip adhered to the polymer core material (or an intermediate layer), or may be laminated between the polymer core material and one or more other layers. Security features may alternatively comprise any type of foil material, thin-film foil, optically variable layered materials or optical interference structures such as for example those comprising Bragg stacking of optical layers, Fabry-  
30 Perot optical cavity structures, holograms, or any other such structures. Regardless of the composition of the security feature, each feature may have any thickness. In selected

embodiments each feature has a thickness suitable for application to a security document. For example, the thickness of a security feature may be from 0.1 to 20 $\mu$ m, or in still further embodiments from 0.5 to 10 $\mu$ m. Each security feature may be produced by any suitable technique, and be applied to a security document by any known technique.

- 5 For example, in the case of foils and foil-like security features, such materials may be applied to a substrate of a security document by hot or cold stamping, or alternatively by way of a release layer from another location. In the case of foils comprising layered or laminate structures (e.g. Fabry-Perot structures) the foils may be prepared independent to the security document, or the layered structure may be manufactured in situ upon the
- 10 substrate of the security document.

Spacer layer: refers to any layer for spacing a reflector layer from an absorber layer of a Fabry-Perot structure, where present, either permanently or temporarily when checking the legitimacy of a security document as described herein, the layer comprising any material that permits at least a portion of visible light incident upon the material to pass

15 through the material. Optionally, a spacer layer may comprise silica. Optionally, a spacer layer may comprise any adhesive material having adhesive properties for example to adhere to a reflector layer and / or an absorber layer. Optionally, the material of a spacer layer is curable when exposed to a source of energy such as heat or UV radiation or other electromagnetic radiation. Optionally, the spacer layer comprises a material suitable for

20 printing the layer onto a surface such as a reflector layer or absorber layer by any suitable printing technique including, but not limited to, Gravure printing. An adhesive spacer layer may comprise any adhesive material including a material selected from but not limited to the group consisting of: acrylated urethanes, methacrylate esters, and mercapto-esters compounds. Optionally, any spacer layer may comprise an alternative

25 refractive index caused not only by a thickness of each layer, but optionally by the presence of other components in the layer, such as but not limited to nanoparticles etc. This applies regardless of whether the device pertains to a multilayer stack, a Fabry-Perot structure, or other optical interference structure. Moreover, the optical properties of a spacer layer, such as refractive index, can be adjusted as required by altering the chemical

30 composition of the deformable spacer layer. The moieties composing the spacer layer can be altered or high refractive index nanoparticles may optionally be added to the

material to alter the refractive index and other properties of the spacer layer. High index nanoparticles include but are not limited to zirconium dioxide ( $\text{ZrO}_2$ ), titanium dioxide ( $\text{TiO}_2$ ), hafnium oxide ( $\text{HfO}$ ) and niobium pentoxide ( $\text{Nb}_2\text{O}_5$ ). UV fluorescent dyes and pigments can also be incorporated into the spacer layer such that when the layer is exposed to a UV light source of appropriate wavelength the lamp's spectral output overlaps with the optical absorption profile of the fluorescent dye. Common document security UV lamps have outputs with peak emissions at 365nm. Fluorescent dyes and pigments may be selected that can be dispersed or dissolved in the deformable spacer layer. The completed Fabry-Perot cavity colour-shift feature may thus exhibit an angle dependant colour-shift in the observed fluorescent emission depending upon the optical properties of the cavity and fluorescent emission spectrum of dye(s), pigment(s) or combinations of fluorescent materials dispersed or dissolved in the spacer layer. In other embodiments emission intensity of the fluorescent emitter in the spacer cavity may vary with a change in viewing angle such that little or no colour-shift is observed. Optionally any spacer layer may comprise at least one adhesive material selected from acrylated urethanes, methacrylate esters, mercapto-esters and a UV curable adhesives. Optionally, the spacer layer may comprise a compressible or flexible material such as natural rubbers, latexes, urethanes, polydimethylsiloxanes and derivatives thereof (such as Dow Corning's Sylgard 184™ commonly used as a deformable substrate in the technique of micro-contact printing).

Transmitted light: refers to light that is incident upon a surface, layer or multiple layers, of which a portion of the light is able to pass through and / or interact in some way with the surface or layer or layers by transmission. Light may be transmitted through a layer or layers by virtue of the layer or layers not being entirely opaque, but instead permitting at least a portion (e.g. 0-99%) of the incident light to be transmitted through the layer or layers in view of the layer or layers exhibiting at least some degree of translucency.

Window: refers to a region or portion of a security device in which a component of a security device, such as a security feature, is exposed for visual inspection, because there is little or no translucent or opaque material to obscure the view of the exposed portions. A window may be present even if there are transparent or translucent layers, for example

of film, to cover the security device or components thereof, because the exposed portions of the security feature are still visible, at least in part, through the film. In further selected embodiments as disclosed herein 'window' refers to one or more portions of a security device as disclosed herein in which a masking layer does not extend  
5 across all of the surface of a security feature, such that portions of the security feature are exposed for visual inspection in reflective light.

## DETAILED DESCRIPTION OF THE INVENTION

Counterfeit security documents are a continuing concern. Techniques for the production of counterfeit security documents are becoming increasingly sophisticated. For this reason, the inventors have endeavoured to generate security devices that are  
5 exceptionally difficult to copy by counterfeit methods. Moreover, the inventors have endeavoured to develop, at least in preferred embodiments, new security devices for use with security documents that emulate the appearance of more traditional security devices. In this way the devices may appear familiar to an owner or user of a security document, even though they are produced by alternative techniques, and even though  
10 they may comprise an alternative structure to previous devices.

In selected embodiments, the security devices are suitable for any type of security document, and the devices are suitable for application to security documents based upon any type of core material including but not limited to paper and polymer core materials. For example, in the case of bank notes, it is well known that such documents may be  
15 produced using paper or polymer-based core materials. Most central banks still direct the production of bank notes based upon paper core materials. However a few, including the Australian central bank, direct the manufacture of bank notes based upon a polymer core material. As discussed, such bank notes present distinct advantages over paper bank notes. For example, relative to paper bank notes, polymer bank notes are exceptionally  
20 abrasion and tear resistant. Moreover, they are highly resistant to degradation or disintegration in water or other solvents. As a result of their robustness, polymer bank notes may remain in circulation for an average of several years. This lifespan is much higher than for paper bank notes, which must often be withdrawn from circulation within a matter of few months from their date of production due to wear and tear. Therefore,  
25 although polymer bank notes are at times more expensive to manufacture compared to paper bank notes, polymer bank notes require replacement from circulation on a far less frequent basis.

However, polymer bank notes (and other security documents based upon polymer core materials) are less amenable to incorporation of some types of security devices. For  
30 example, security threads have been incorporated into paper bank notes for many years. The threads are relatively easy to incorporate and retain in position due to the fibrous

nature of the paper core material, and the ease of combining layers of paper core material together. Depending on the manufacturing process it can be more difficult to incorporate a thread into a polymer core material. In particular, polymer core materials are not generally suitable for incorporation of security threads as an integral feature. The present invention, at least in selected embodiments, presents an advantage because the invention provides security devices and methods that permit a security device comprising a security feature (such as a security thread or other type of security feature) that has the appearance of being incorporated as an integral feature of the core material of a security document, even though the security feature is in fact applied by layering to a surface of the core material. In some embodiments the security feature (when forming part of a security document of the present invention) may have the appearance of being embedded within the material of the polymer core material in a similar manner to security features used in paper security documents, such that the security feature is visible within the document in transmissive but not reflective light. In further embodiments the security feature may form part of a security device such that it appears to be interwoven with the polymer core material of the security document (for example with windows so that portions of the security feature are visible in reflective light) even though the security feature is in fact layered upon the polymer core material.

In selected embodiments the security devices combine the use of foil together with a masking layer. As discussed herein, example foils may include, but are not limited to, thin films with a thickness of only a few microns thus making it possible for the masking material to cover some or all of the security feature. With traditional security threads known in the art, which may have a greater thickness (e.g. 20-40 $\mu$ m), it may be difficult or impossible for the opacifying material to cover the thread properly without reducing the performance or durability of the security document. The thickness of such traditional security threads may also result in some degree of detectable protrusion of the feature from the security document, even after it has been coated with a masking layer. For this reason, it can be challenging to make such security threads adopt the appearance of being incorporated or threaded into the substrate of the document. In direct contrast, the use of very thin foils as proposed herein, especially when combined with masking layer(s), has less effect upon the performance and durability of the security

document. Moreover, the use of foils can provide a security device that, at least in selected embodiments, can adopt the appearance of being an embedded feature within the substrate of the security document, especially when partially masked with opacifying layers. As such, the resulting security devices can better emulate threaded or interwoven security threads, even when applied to a polymer or polymer-hybrid substrate. In other embodiments, the thin profile of the foil security feature may reduce non-uniform stacking which can occur when thicker security threads are applied to the polymer substrate.

Thus, in selected embodiments there is provided a security device for use with a security document, the security device comprising:

- a. a security feature comprising foil;
- b. a masking layer applied to the security feature to conceal at least a portion (1-100%) of the foil in reflected light.

The security feature may take any form that is known in the art. For example, the security feature may comprise a metallic reflective layer deposited on a polymer or any other type of foil, and / or may incorporate optically variable features including but not limited to holograms or optically variable foils. Moreover, the shape and configuration may take any form suitable for use with a security document. For example, the security feature may comprise a specific area of material, or alternatively an elongate strip, band or an element with a thread-like appearance. For the purposes of application of the security feature to a security document, such application may be carried out via any means either before or after a masking layer is applied to the security feature. For example, in the case of foils and other security features, adhesive layers may be used to cause adhesion of the foil to a substrate surface of a security document. The foil may be released from a source by release of a release layer. Rolling of the foil layer onto the security document substrate, optionally with some degree of pressure, may improve the bonding of the foil layer to the substrate. Alternatively, hot or cold-stamping techniques known in the art may also be used for foil application.

Thin-film foils present useful security features in view of their thickness, which may be 20µm, and typically less than 10µm. Such thin-film foils are particularly suited to the production of security devices as disclosed herein in view of the fact that their degree

of protrusion from a substrate of a security document may be virtually undetectable by a user of the document. For example, the application of a thin strip of thin film foil (e.g. via a release layer) as well as a masking layer to mask intermittent portions of the foil from view may provide the illusion that the foil is interwoven into the substrate, even though it is simply layered or adhered to the substrate. Thus, in selected embodiments there is provided a security device suitable for application to a polymer substrate, wherein the device comprises visible portions of thin-film foil with other portions of the foil masked from view via a masking layer, such that the security feature has the appearance of a layer or thread interwoven or partially embedded into the polymer substrate once applied thereto.

In other embodiments, the masking layer may cover the security feature entirely, such that the security feature is concealed from view in reflected light. The masking layer may be applied to one or both sides of the security feature. If the masking layer contacts just one side of the security feature then the other side may be concealed from view in reflective light when the security device is applied to the core material, such that the security feature is sandwiched between the masking layer and the core material to give the appearance of being embedded in the core material at least when viewed in transmitted light.

In alternative embodiments, the masking layer may be absent from at least one portion of the security feature. In this way the security device may include one or more windows in the masking layer through which the security feature can be seen when reflected light is incident upon the surface of the device. For example, the security feature may have a metallic or optically variable appearance (especially if the security feature is manufactured for example to include a hologram or optically variable foil). Thus it may be desired to view the metallic or optically variable features of the security feature in reflected light. Importantly, by providing windows in the masking layer the security feature may have the appearance of being an integral feature of the core material. It is known in the art to provide a security device comprising a security feature for application to or incorporation into a paper core material, wherein the core material and / or the thread are cut or split so that the security feature may be intertwined or interwoven into the paper core material (e.g. this type of arrangement is sometimes seen

with security “threads”). This can be much more difficult to achieve using a polymer core material depending on the polymer core manufacturing process. Therefore the security devices and methods of the present invention, particularly those comprising windows in the masking layer, afford an opportunity to manufacture security devices for application to a polymer core material wherein the security devices at least appear to be interwoven or intertwined, or embedded into the core material, even though they are in fact layered onto the core material as herein described.

For example, in selected embodiments the security device may include a plurality of windows in the masking layer that are of a similar or identical size, and which are evenly distributed along the length of the security device. In this way the security device, when present upon a core material such as a polymer core material for a bank note, may have the appearance of having regularly exposed portions, as may be observed for example in Figure 1, which is derived from United States Patent 6,616,190 issued September 9, 2003, is incorporated herein by reference.

Further embodiments include security devices with staggered windows in masking layers to reveal the foil security feature on opposite sides of the same security document. Again, such embodiments may have the appearance of a foil threaded through the documents, even though the foil and masking layers comprise a layered structure. In some embodiments the foil of the windows may be completely exposed to air, or visible through a transparent window forming part of a thin film to which the masking layer(s) are attached. Such embodiments may further make use of fluorescent layers such as those including FlourOSMent™, wherein the appearance of the foil through the transparent windows may highlight a transmissive colour-shift for the foil, whereas the observed colour-shift through other semi-transparent portions of the device may highlight fluorescent colour-shifts. Either or both types of windows may be present on the security document at the same time.

In any of the embodiments described herein the masking layer typically comprises an opacifier material of sufficient opacity and thickness to conceal at least a portion of the security feature at least in reflected light. Moreover, in the production of the security device the masking layer may be applied to the security feature either before the security device is affixed to the core material of the security document. Alternatively, the masking

layer may be applied to the security feature after the security feature is affixed to the core material. As required, further layers may be added to the security device and / or to the core material. For example adhesive layers may be applied to the core material and / or the security feature and / or the masking layer to facilitate adhesion of the layers to one another. Further layers that may be present include thin film layers applied between the other layers, for example between the masking layer and the security feature.

Alternatively, a thin film layer may be applied as a final layer over the masking layer. Such thin film layers may assist in adhesion of the layers together or may contribute to the overall structural integrity of the security device.

The masking layer may be formed in any manner, either before or after the security device is applied to a core material. For example, opacifier material may be formed into a layer upon the security feature and / or core material by deposition of a solid or liquid precursor material upon at least a portion of the security feature. For example, a liquid or solid precursor material sprayed or, printed by techniques such as gravure, or otherwise directed in particulate form towards the security feature and / or the core material such that the liquid or solid particles of the precursor material impact the security feature and / or the core material to form a layer thereupon. Optionally, the layer may be thickened by repeated passes of a jet or nozzle (for spraying the precursor material) towards the security feature / core material.

Alternatively, the masking layer may be formed by forming the masking layer prior to its application to a security feature or core material. For example the masking layer may be cut from a pre-formed sheet of opacifier material formed by any method.

Optionally, the opacifier material may be applied (e.g. sprayed, painted etc.) onto a thin film in a desired pattern, such that the thin film provides integrity to the masking layer.

Alternatively, the masking layer may be a thin film. As required, the thin film may further comprise an adhesive backing or layer on a side opposite the opacifier material, to facilitate application of the masking layer to the security feature and / or the core material of the security document in a 'peel-and-stick' manner. In this way the thin film is sandwiched between the security feature and the opacifier material where present.

As previously discussed, the opacifier material may be absent from at least one portion of the masking layer, thereby to provide at least one window in the masking layer

through which the security feature is visible in reflected light. The same applies if the masking layer is applied to a thin film, or comprise thin film. The masking layer may include one or more portions where the opacifier material is absent such that the thin film is visible beneath. In selected embodiments the thin film is translucent or transparent, at least over the windowed portions of the masking layer, such that light incident upon each window passes easily through the thin film, reflects off the security feature beneath, and the reflected light is passed back through the thin film to the user's eye. Alternatively, for example where a FlourOSMent™ layer is present, a transmissive colour-shift may be observed even when there is no reflected light. Regardless, the presence of the thin film may, at least in selected embodiments, have minimum interference with a person's ability to view and perceive the security feature located beneath the masking layer and thin film.

Certain other exemplary embodiments encompass a security document comprising: any core material; and at least one of any security device as herein described. For example, certain embodiments may encompass a security document with one or more security devices on each side of the core material, each optionally including a security feature visible through windows in the masking material.

If required, the security device may be adhered to a first side of the polymer core material by an adhesive layer to assist in the binding of the core material and the security device to one another. Optionally, the security document may further include a layer of opacifier material on a side of the core material opposite to the first side, thereby to assist in concealment of the core material and / or a portion of the security feature in visible light. In effect, this may provide two layers of opacifier material over at least some portions of the security document, further increasing the opacity of the security document (or at least regions thereof) to transmissive light.

The security document may comprise a security device that includes one or more windows in the masking layer through which the security feature is visible from a first side of the security document in reflective light. The layer of opacifier material on a side of the core material opposite to the first side (if present) may if required be thinner over regions of the core material aligned with said one or more windows, for at least partial transmission of light incident to the one or more windows through the document. Thus,

opacifier material may be present or absent on a side of the security document opposite to the side comprising the security device. This may give rise to a range of desired effects for transmissive light incident to the security feature in the windows of the masking layer, with the degree of light transmission effecting the visual appearance of the security  
5 feature when held up to the light.

In further exemplary embodiments the security document may further comprise a layer of fluorescent ink or other fluorescent material on a side of the core material opposite the first side, at least substantially in alignment with the security feature on the first side. The presence of the layer of fluorescent ink may cause desirable effects to the  
10 reflected and transmitted light incident upon the security device. For example, the layer of fluorescent ink may, with ultraviolet (UV) light incident upon the layer, be caused to emit fluorescent light, and this property may in turn alter the visual affect of light passing back through the security feature, especially if the security feature includes an optically variable device such as an optically variable foil. For example, the emitted fluorescent  
15 light may be caused to undergo a colour shift by the optically variable device that would not normally be seen under normal ambient light conditions.

In further selected embodiments the core material of the security document comprises a polymer material. Any polymer material may be used that is amenable for formation into sheets. Preferably, the polymer material has properties of strength or  
20 resilience such that the sheets, once formed, are substantially resistant to tearing for example by hand.

Still further exemplary embodiments provide for a method for the production of a security device suitable for use in a security document, the method comprising the steps of:

- 25
- a. providing a security feature comprising foil;
  - b. applying a masking layer to at least a portion of the security feature to conceal the portion in reflected light.

If required in step b. at least one other portion of the security feature may remain visible in reflected light because it is not concealed by the masking layer. In this way, the  
30 masking layer may be applied or be formed on the security feature such that the security feature remains visible through one or more windows in the masking layer.

Step b. of applying a masking layer may be performed in any suitable manner. In selected embodiments the step may comprise:

- i. providing a masking layer in the form of a thin film; and
- ii. adhering the thin film to the security feature.

5 In further selected embodiments there is provided a method for the production of a security document, the method comprising the steps of:

- a. providing a security device as described herein;
- b. applying the security device to a first side of the core material of the security document; and
- 10 c. optionally applying a further masking layer to the core material on a side opposite the first side.

The invention will be further explained and described with reference to a series of Figures. These Figures merely disclose selected or preferred embodiments of the invention, and are not in any way intended to limit the scope of the appended claims. Although the Figures illustrate a security document in the form of a bank note comprising a polymer core material, this is for illustrative purposes only. The security device and the features shown may be applied to any security document comprising any core material as required.

20 Furthermore, although the figures illustrate an elongate strip or thread-like security feature, the shape and configuration of such a feature is not limiting to the scope of the appended claims. Indeed, each security feature may take the form of any shape, area, region or configuration suitable for use with a security document.

Figure 2 provides a front or plan view of a bank note shown generally at 10, which is comprised at least in part of a main polymer core material 11. The bank note 10 includes a region or band 12 that incorporates an example embodiment of a security device. In this embodiment the device includes a security feature 13 comprising an optically variable thin-film foil running generally across the width of the bank note in a direction at least substantially perpendicular to the longitudinal edges of the bank note.

30 In selected embodiments, the foil has a thickness of less than 100µm, and typically 10µm or less, such that the degree of protrusion of the layer is negligible or difficult to detect

upon hand manipulation of the document. In selected embodiments, the optically variable foil is applied to the substrate of the bank note 10 (optionally with the masking layer 14 already applied) by the use of a release layer for transfer of the foil to the substrate.

5           The majority of the security feature 13 is concealed from view because it is located beneath masking layer 14, which extends the width of the bank note and each side of the security feature 13. Furthermore, portions of the security feature 13 are covered over by masking layer 14 at regions 14a of the device. However, in the embodiment illustrated in Figure 2 the masking layer 14 does not cover the entire surface of security feature 13:  
10       regions 13a of the security feature 13 remain visible to the eye in reflected light due to the absence of the opacifier material of the masking layer at windows 15. Therefore, security feature 13 runs beneath the regions 14a of the masking layer, as denoted by the dashed lines.

          Figure 3 illustrates the same bank note shown in Figure 2, from a rear view to  
15       observe the opposite side. Effectively, the bank note has been flipped horizontally over. The core material 11 is shown, this time from an opposite site to the core material 11 shown in Figure 1, with the general position of the security feature 13 affixed to the opposite side of the core material shown again by way of dashed lines. Furthermore, a second masking layer 16 has been applied to the core material in a general pattern or  
20       arrangement that matches or opposes the masking layer 14 shown in Figure 2. The masking layer 16 includes regions 16a of full thickness with regard to the opacifier material of the masking layer. However, in regions 16b of the masking layer 16 the opacifier material is thinner (although in selected embodiments it may be absent) and overlays a band of fluorescent ink (not shown) printed upon the core material in line with,  
25       but on an opposite side of the core material 11 to the security feature 13. Regions 16b are aligned with windows 15 on the opposite side of the bank note (see Figure 2), such that a portion of light incident upon the rear side of the bank note may be transmitted through the regions 16b, through the core material 11 for interaction with the optically variable foil of the security feature 13 shown in regions 13a in Figure 2. The transmission  
30       of light in this manner is explained in more detail below with reference to Figure 6.

Lines A-A' and B-B' as shown in Figure 2 and 3 are lines of cross section illustrated in subsequent Figures. Figure 4a illustrates a cross section through bank note 10 at lines A-A'. Polymer core material 11 is shown as a continuous, uninterrupted sheet of polymer material with various device components and layers applied to each side of the core material. The thickness of the various components and layers are exaggerated compared to usual dimensions for illustrative purposes only. As discussed above, the use of thin-film foil for security feature 13 may result in less protrusion of the security feature 13 from the surface of core material 11. Thus, such foils are less problematic for bank note production (compared to threads of 20-40µm thickness) and are more amenable to the production of security devices with features that appear to be embedded in the substrate of the security document. Optionally, in selected embodiments, the foils may be applied to a substrate by the use of a release layer or hot or cold-foil application methods.

As per Figure 2, the region of the bank note that comprises the security device is shown at 12. The other regions of the bank note include an opacifier material 17 of a type known in the art to increase the general opacity of the bank note. The security feature 13 comprising optically variable thin-film foil is also shown with an adhesive layer 18 to secure or affix the security feature to the core material 11 by adhesion. Directly across the core material 11 from security feature 13 is fluorescent ink layer 19. The fluorescent ink layer may take any size, shape or form, and be located on either side of the security document, but in the presently illustrated embodiment is printed directly to the core material a few millimeters wide across the width of the bank note, so that it aligned with the security feature 13 adhered to the opposite side. Masking layers 14 and 16 correspond to the masking layers illustrated in Figures 2 and 3 respectively. Note that masking layer 14 is present either side of security feature 13 but does not cover the security feature due to the presence of window 15. In contrast the masking layer 16 on an opposite side of the core material 11 does cover fluorescent ink layer 19. The region of the masking layer 16 is, however, thinner over the fluorescent ink layer compared to regions either side, for the reasons discussed above.

Figure 4b provides another cross-sectional view of bank note 10, this time along lines B-B' as shown in Figures 2 and 3. The components and features of the bank note at this cross-section position are virtually identical to Figure 4a with important exceptions.

These relate to the configuration of masking layers 14 and 16 on each side of the core material. It will be noted that a portion 14a of masking layer 14 extends over security feature 13 to at least substantially obscure the security feature from view in reflected light. Likewise, a portion 16b of masking layer 16 extends over fluorescent ink layer 19, again to at least substantially obscure the fluorescent ink layer from view. Although the thickness of the layers shown in Figures 4a and 4b is exaggerated, it will be appreciated that in a finished bank note the layers may be too thin for a user of the bank note to detect how many layers are present. Thus the bank note, at least in selected embodiments, may have the appearance of comprising a security feature that is integrated (e.g. in accordance with standard techniques with paper core materials) directly into the core material of the bank note, even though the bank note comprises a polymer core material. In the embodiment illustrated, the security feature even has the appearance to a user that it is interwoven into substrate.

Figures 5, 6, and 7 illustrate the optical effect of light incident upon the bank note 10, and in particular the security device in region 12 of the bank note. Each of Figures 5, 6, and 7 provide the same cross-section A-A' as shown in Figure 4a.

Turning first to Figure 5 there is shown the effects of ambient light reflecting off the optically variable foil from a front side of the bank note. The ambient light 20 is directed towards security feature 13, which comprises thin-film optically variable foil. A user observing the bank note to receive light 21 may observe gold-coloured reflected light. However, if the bank note is tilted (or if the user moves position) such that the reflected light is received at position 22 then the user may observe magenta-coloured reflected light. Thus a colour-shift of the reflected light may be observed. Alternatively, a gold-to-green colour-shift may be observed if some black text is added behind the optically variable foil layer. The precise nature of the colour-shift will depend upon the nature or type of optically variable foil (or other optically variable device) used, upon the positioning of the user as well as the user's perception of colour. The colour-shifts described herein are merely for illustrative purposes only.

In contrast to Figure 5, Figure 6 illustrates an example of a colour-shift effect of light transmitted through the bank note 10. Ambient light 23 incident upon a rear side of bank note 10 may pass through the bank note as shown in Figure 6 by virtue of the

relative translucency of the bank note at the region of the security feature. Thus, at least a portion of ambient light 23 passes through region 16b of masking layer 16, through fluorescent ink layer 19, through adjacent core material 11, and through adhesive layer 18 such that the transmitted light becomes incident upon and interacts with the optically variable foil of security feature 13. By virtue of the nature of the transmitted light, the construction of the optically variable foil, and the angle of incidence of the light upon the foil, an alternative colour-shift may be observed by a user from the front side of the bank note 10. As shown, light passing directly or almost directly through the security feature at position 24 may be cyan in colour, whereas light diffracted by the optically variable foil of the security feature at position 25 may be magenta in colour. Thus a user of the bank note observing the transmitted light will observe a cyan-to-magenta colour shift as the bank note is tilted (or as the user moves position). Again, the precise colour shift will depend upon the optically variable device used, upon the position of the user, and also upon the user's perception of colour. Thus, the colour-shift described for transmitted light is for illustrative purposes only. If required, the masking layer 16 on the reverse side of the bank note 10, and in particular the thickness and / or density of region 16b of the masking layer 16, may be adjusted to increase or decrease the amount of light 23 that can be transmitted through the security feature 13. Alternatively, the transmitted light may be maximized by minimizing the thickness or eliminating completely the opacifying layer on the rear-side of the area aligned with the window on the opposite face of the document.

Turning now to Figure 7, the same bank note 10 is illustrated with cross-section A-A'. However, Figure 7 illustrates the colour-shift observed by reflection of fluorescent light. For example, if ultraviolet light 26 is directed towards security feature 13, then at least a portion of the UV light 26 may be transmitted initially through the optically variable foil of the security feature, as well as the adjacent core material 11. Subsequently, at least a portion of the transmitted portion of the UV light 26 may be reflected by the fluorescent ink layer 19, such that the reflection portion of the emitted fluorescent light is transmitted back through the core material 11 for interaction with the optically variable foil of the security feature 13. As shown, fluorescent light passing directly or almost directly through the security feature at position 27 may be red in

colour, whereas light diffracted by the optically variable foil of the security feature at position 28 may be green in colour. Thus a user of the bank note observing the fluorescent light emanating from the optically variable foil will observe a green-to-red colour shift as the bank note is tilted (or as the user moves position). Again, the precise colour shift will depend upon the optically variable device used, upon the position of the user, and also upon the user's perception of colour. Thus, the colour-shift described for reflected fluorescent light is for illustrative purposes only.

Further embodiments are directed towards methods for the production of security devices and security documents. Figure 8 illustrates the steps of a method for the production of a security device suitable for use on a security document, the method comprising:

in step 101 providing a security feature;

in step 102 applying a masking layer to at least a portion of the security feature to conceal at least the portion in reflected light.

In selected embodiments of such methods the security feature comprises a thin-film foil for example with a thickness of from 0.1-20 $\mu$ m, and step 101 comprises releasing the thin-film foil from a production substrate by way of a release layer.

In further selected embodiments of the method, in step 102 at least one other portion of the security feature is not concealed by the masking layer, thereby to provide windows in the masking layer through which the security feature is visible in reflected light.

In still further selected embodiments, step 102 comprises:

- i. providing the masking layer comprising a thin film; and
- ii. adhering the thin film to the security feature.

Still further exemplary embodiments of the methods are illustrated with reference to Figure 9, which provides for a method for the production of a security document. As shown, the method comprises:

in step 110 providing a security feature as disclosed herein;

in step 111 applying to the security feature a masking layer to mask at least a portion of the security feature;

in step 112 applying the security feature, and the masking layer if present, to a first side of the core material of the security document;

in optional step 113 applying a fluorescent ink layer to a side of the core material opposite the first side, in alignment with the security feature; and

5 in optional step 114 applying a further masking layer to the core material on a side opposite the first side, to at least partially conceal the fluorescent ink layer, if present;

wherein steps 111 and 112 may be performed in any order.

Further, in selected embodiments, the security device may comprise a security  
10 feature comprising a thin-film foil having a thickness of from 0.1 to 20µm and typically between 0.5 to 10µm thick, and in step 112 the thin-film foil is released from a production substrate by way of a release layer, optionally with the masking layer already applied thereto prior to its application to a substrate.

Further selected embodiments of the security documents and security devices will  
15 be further discussed with reference to specific examples, which are merely exemplary and in no way are intended to limit the scope of the appended claims.

#### EXAMPLE 1 – *Clear windows in combination with foil and masking*

In selected embodiments, the security documents or security devices as disclosed  
20 herein may include clear windows such that a user of the security document may see through the transparent or translucent window when studying the security features of the document. For example, with reference to Figure 10 there is shown a security document similar to that shown in Figure 2, with the exception that the security document includes transparent windows 30, 31 on either side of foil security feature 13 extending across the  
25 document (and masked at positions 14a by masking layer 14). Thus the windows 30, 31 further differentiate the security feature 13 from the rest of the polymer core material 11 of the bank note 10. Whilst a simple window configuration is illustrated in Figure 10, further embodiments encompass any other shape and configuration of windows.

30 EXAMPLE 2 – *Staggared thread, or irregular thread*

In further embodiments, exemplified by Figure 11, the appearance of the foil 13 as seen through windows 15 in masking layer 14 may take any shape or configuration. For example, in Figure 11 the windows are sized and arranged such that the foil 13 is exposed through windows 15 of different sizes, such that the foil has the appearance of being interwoven into the substrate 11 with the central portion exposed for a significant portion of the width of the document. Further embodiments encompass and other number, size and configuration of windows in the masking layer for exposure of the foil security feature beneath.

#### 10 EXAMPLE 3 – *Use of lenses and movement*

In any of the embodiments of the security documents and security devices as herein disclosed, the use of lenses and movement features (e.g. by diffraction gratings or holograms etc.) may enhance or alter the appearance of the foil and other elements of the security devices. Such lenses and movement features may be combined for example with fluorescent inks such as FluOSMent™. Further embodiments encompass the use of such lenses and movement features without limitation.

#### EXAMPLE 4 – *Masking layers with specific shapes and configurations*

In any of the embodiments disclosed herein the masking layer may take any form, shape or configuration. For example, the masking layer may have a shape or include windows such that letters or numbers are formed over the foil security feature beneath. Figure 12a illustrates one such example in which the number 5 (e.g. for a \$5 bank note) is present in the form of additional masking layer material formed within windows 15 over foil security feature 13. In contrast, Figure 12b illustrates a similar arrangement to Figure 12a except that foil in the shape of the number 5 is visible in the regions of masking layer between windows 15 (illustrated as regions 14a in Figure 2). Other embodiments may include any further shapes, configurations or combinations of letters and / or numbers to achieve the goal of providing graphics or text content to the security devices. Furthermore, the additional graphics or text content may be present on either one or both sides of the security device or security document as required.

EXAMPLE 5 – *Use of hybrid paper / polymer substrates Reference the Landqart patent*

Further embodiments of the security documents include those with both paper and polymer core materials (so-called “hybrid” documents) such as those disclosed in United States patent publication 2006/0198987 published September 7, 2006, which is  
5 incorporated herein by reference. For example, such security documents may include polymers such as polyimides, with paper substrate surfaces adhered to one or both sides of the polymer. Any of the security devices disclosed herein may be used in combination with hybrid core materials for security documents as required without limitation.

10 Whilst various embodiments of security devices, security documents, as well as methods for their production and use, are described and illustrated herein, the scope of the appended claims is not limited to such embodiments, and the invention encompasses further embodiments readily obtainable in view of the teachings presented herein.

## CLAIMS:

1. A security device for use with a security document, the security device comprising:
  - a. a security feature comprising foil;
  - b. a masking layer applied to the security feature to conceal at least a portion of the foil in reflected light.
2. The security device of claim 1, wherein the masking layer is absent from at least one other portion of the foil, thereby to provide at least one window in the masking layer through which the foil is visible in reflected light.
3. The security device of claim 1, wherein the device includes a plurality of windows of similar size spaced equally along the security feature.
4. The security device of claim 1, wherein the masking layer comprises an opacifier material to conceal at least a portion (0.1% to 100%) of the foil in reflected light.
5. The security device of claim 4, wherein the opacifier material is formed by deposition of a solid or liquid precursor material upon at least a portion of the foil, or a layer covering the foil, either before or after the foil is applied to a substrate of a security document.
6. The security device of claim 4, wherein the masking layer is formed by direct or indirect adhesion of a layer of the opacifier material upon at least a portion of the foil.
7. The security device of claim 6, wherein the opacifier material contacts a film adhered to the foil, such that the film is sandwiched between the foil and the opacifier material where present.

8. The security device of claim 7, wherein the opacifier material is absent from at least one other portion of the film, thereby to provide at least one window in the masking layer through which the foil is visible in reflected light through the film.

5 9. The security device of claim 4, wherein the opacifier material comprises a metal oxide.

10. The security device of claim 1, wherein the foil comprises a hologram, or is an optically variable foil.

10

11. The security device of claim 1, wherein the foil has a thickness of from 0.1 to 20  $\mu\text{m}$ .

12. The security device of claim 11, wherein the foil has a thickness of from 0.5 to 15 10  $\mu\text{m}$ .

13. The security device of claim 10, wherein the foil is attached to a release layer for release of the foil for application to a substrate of a security document.

20 14. The security device of claim 10, wherein the optically variable foil comprises a Fabry-Perot optical cavity structure.

15. The security device of claim 1, further comprising a fluorescent ink layer to convert UV light into visible or near infrared light .

25

16. A security document comprising:

a. a core material;

b. at least one security device according to any one of claims 1 to 15, applied to one or both sides of the core material.

30

17. The security document of claim 16, wherein the document includes two security devices, each applied to opposite sides of the core material.

18. The security document of claim 16, wherein a security device is adhered to a first side of the core material by an adhesive layer.

19. The security document of claim 16, wherein the document further includes:

c. a layer of opacifier material on a side of the core material opposite to the first side thereby to assist in concealment of the core material and / or a portion of the foilin reflected light.

20. The security document of claim 19, wherein the security device includes one or more windows in the masking layer through which the foilis visible from the first side in reflective light, and the layer of opacifer material on a side of the core material opposite the first side is thinner over regions of the core material aligned with said one or more windows, for at least partial transmission of light incident to said one or more windows through said security document.

21. The security document of claim 16, further comprising a fluorescent ink layer on a side of the core material opposite the first side, at least substantially in alignment with said security feature on said first side.

22. The security document of claim 21, wherein the security feature comprises an optically variable device, such that light incident upon the fluorescent ink is reflected as a fluorescence emission, which passes through the optically variable device thereby to cause a colour shift in the fluorescence emission as perceived by a user of the security document.

23. The security document of claim 16, wherein the core material comprises a polymer material.

24. A method for the production of a security device suitable for use on a security document, the method comprising the steps of:

5           a. providing a security feature comprising foil;  
applying a masking layer to at least a portion of the foil to conceal at least the portion in reflected light.

25. The method of claim 24, wherein the security feature comprises a thin-film foil with a thickness of from 0.1-20 $\mu$ m, and step a. comprises releasing the thin-film  
10 foil from a production substrate by way of a release layer.

26. The method of claim 24 or 25, wherein in step b. at least one other portion of the security feature is not concealed by the masking layer, thereby to provide windows in the masking layer through which the foil is visible in reflected light.

15 27. The method of claim 24, wherein step b. comprises:

- i. providing the masking layer comprising a film; and
- ii. adhering the film to the foil.

20 28. A method for the production of a security document, the method comprising the steps of:

- a. providing a security feature comprising foil;
  - b. applying to the foil a masking layer to mask at least a portion of the foil;
  - 25 c. applying the foil, together with the masking layer if present, to a first side of a core material of the security document; d. optionally applying a fluorescent ink layer to a side of the core material opposite the first side, in alignment with the foil; and e. optionally applying a further masking layer to the core material on a side opposite the first side, to at least partially conceal  
30 the fluorescent ink layer, if present;
- wherein steps b and c may be performed in any order.

29. The method of claim 28, wherein the security feature comprises a thin-film foil having a thickness of from 0.1 to 20 $\mu$ m, and step a. comprises releasing the thin-film foil, optionally with the masking layer already applied thereto, from a production substrate by way of a release layer.

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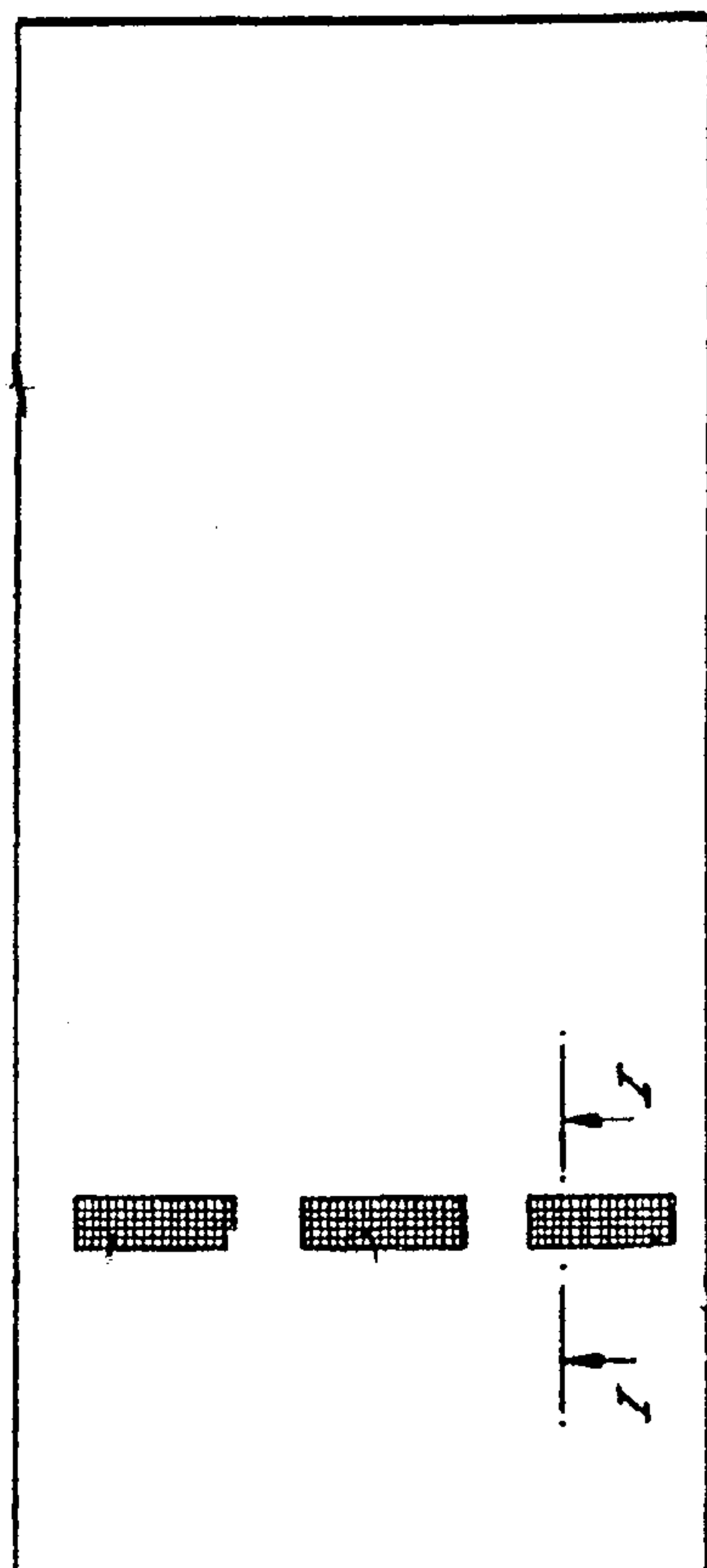


Fig. 1  
(Prior Art)

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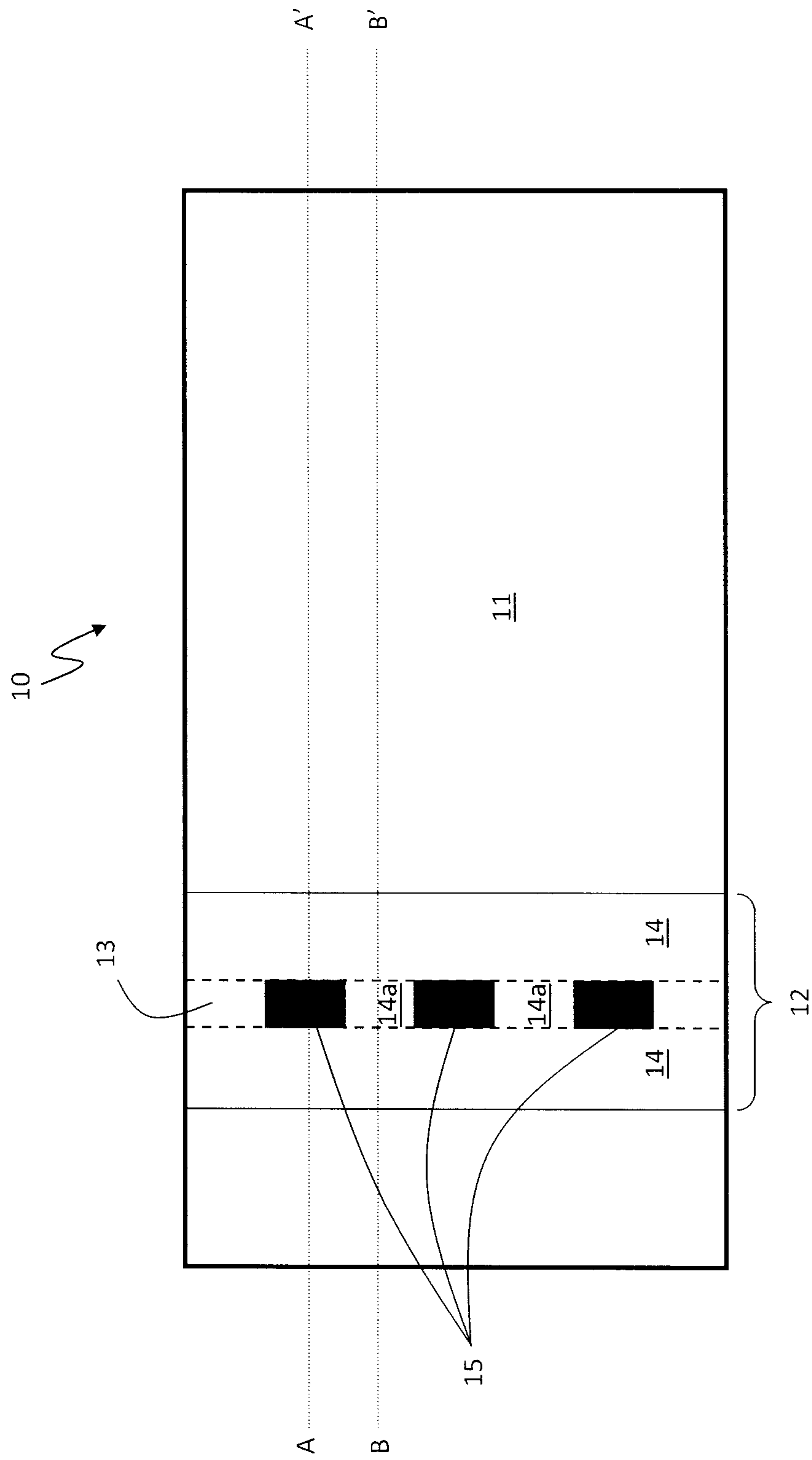


Fig. 2

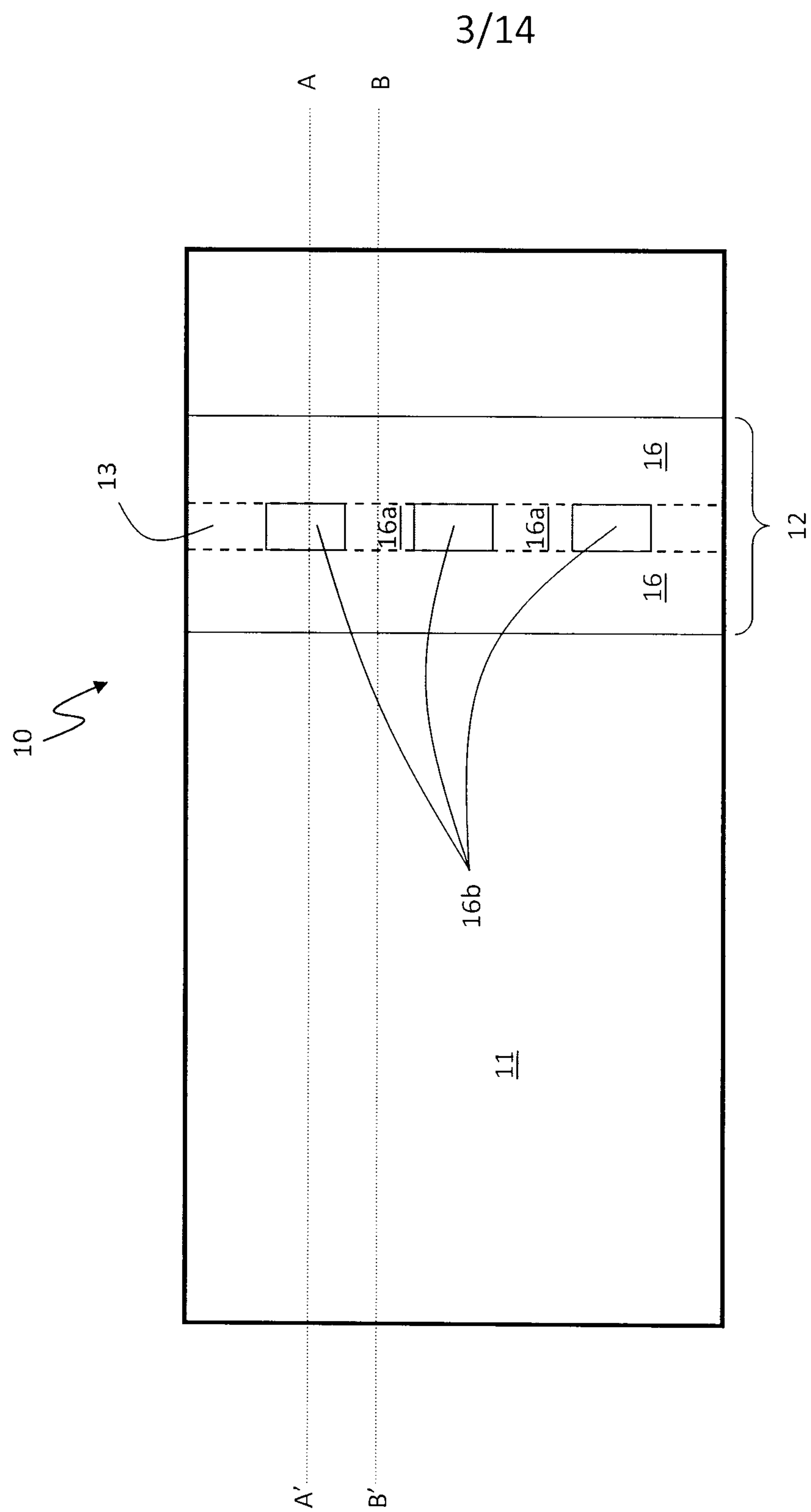


Fig. 3

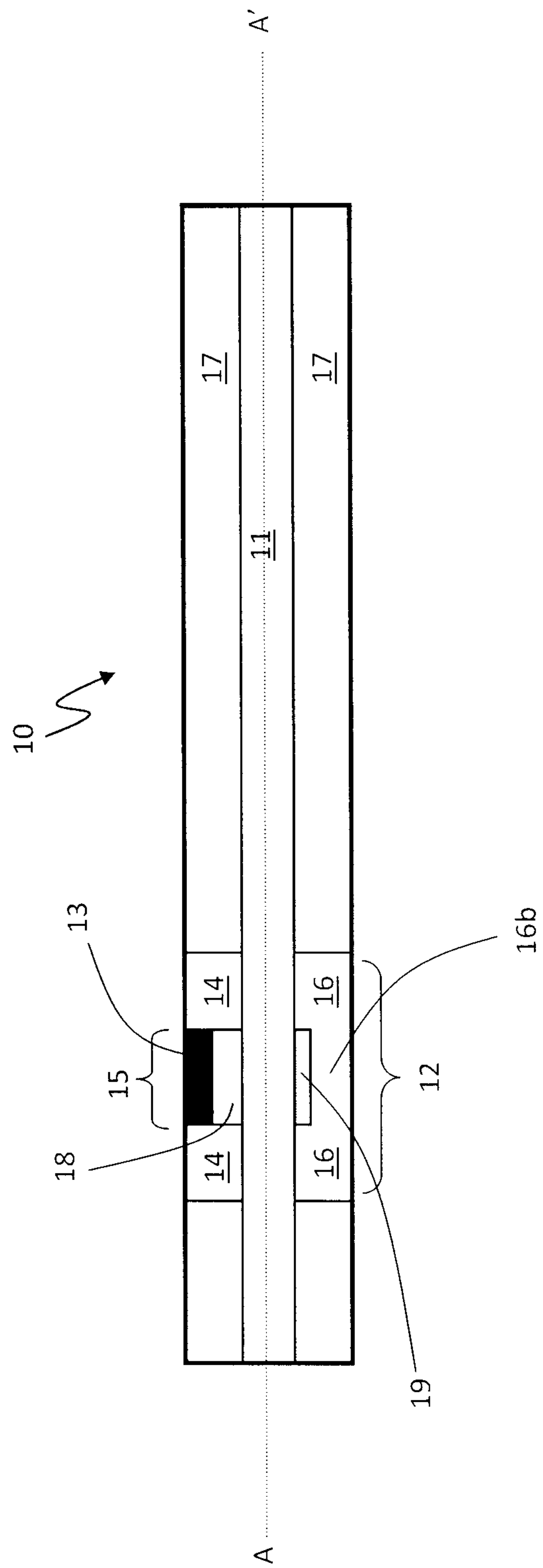


Fig. 4a

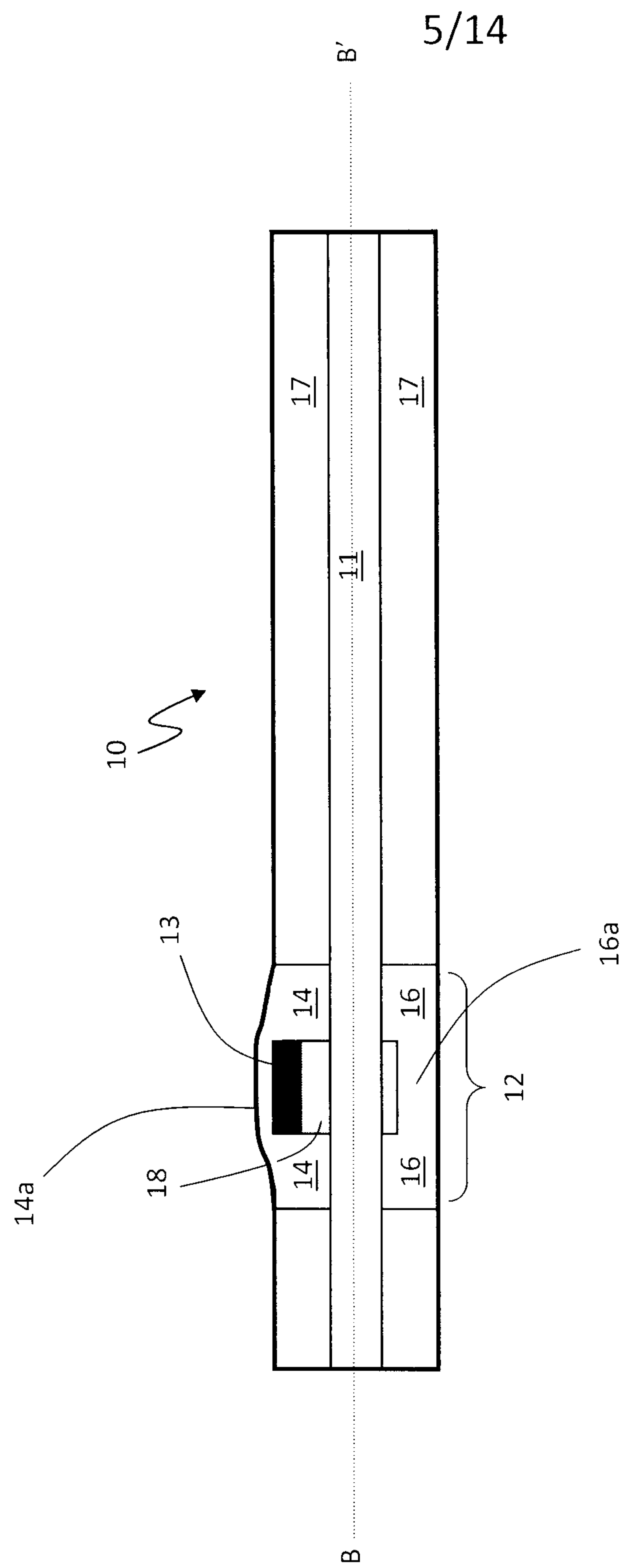


Fig. 4b

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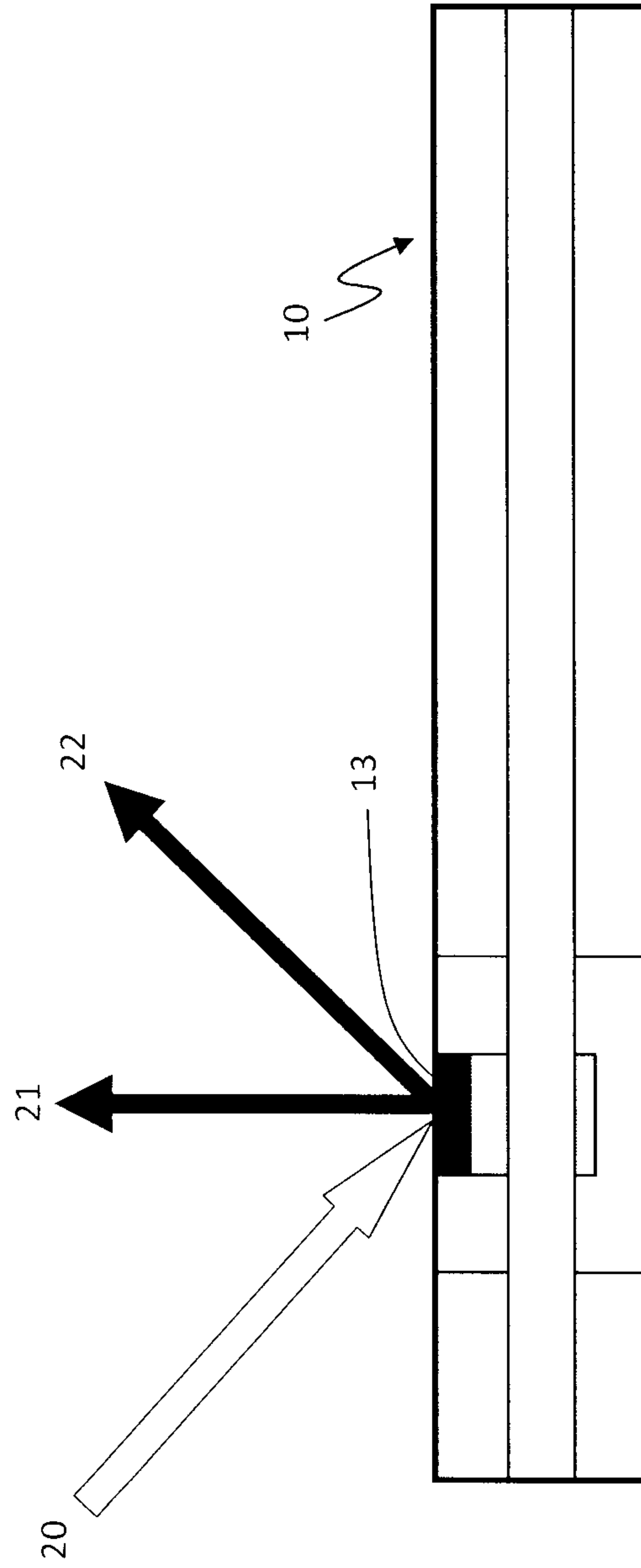


Fig. 5

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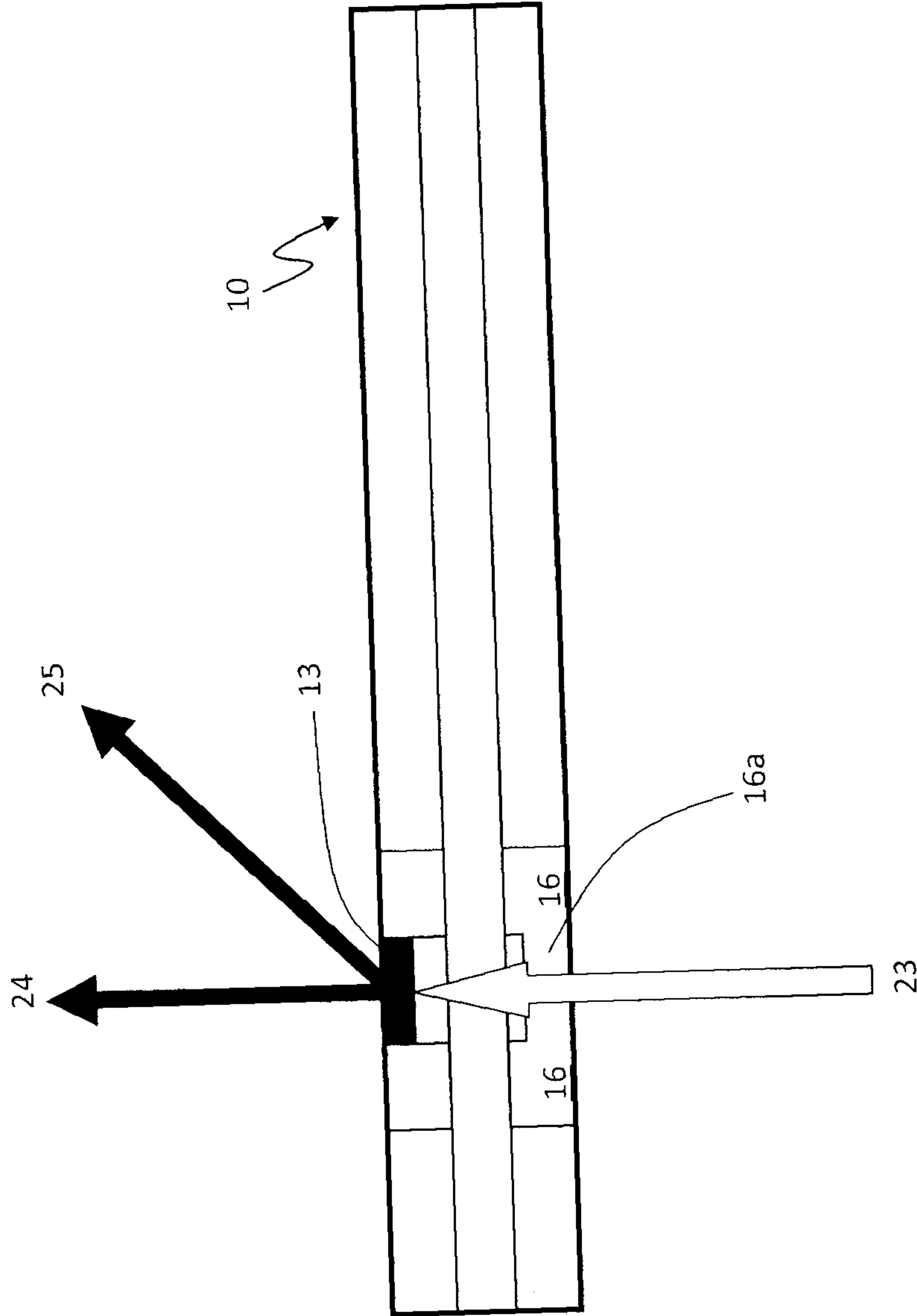


Fig. 6

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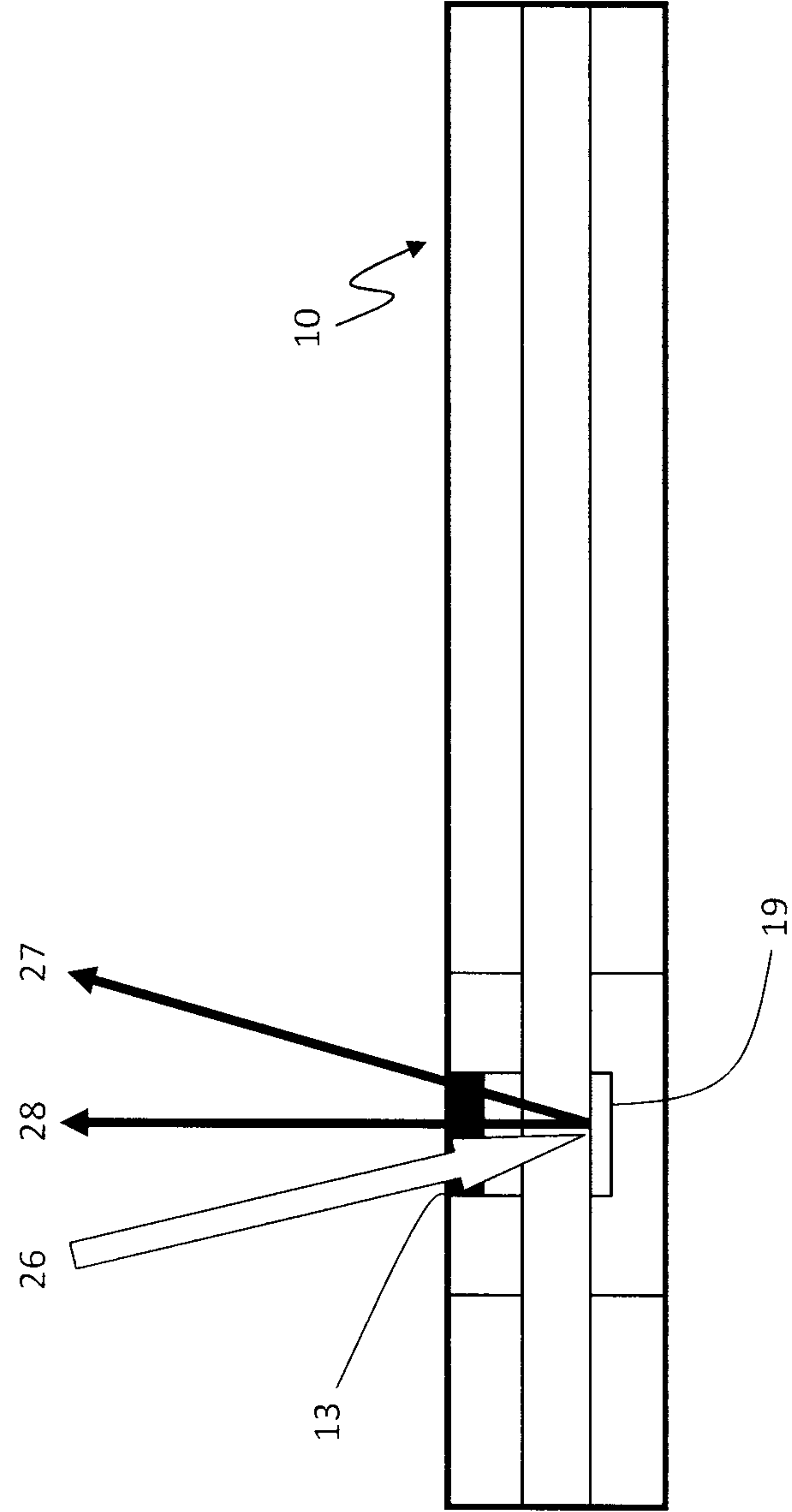


Fig. 7

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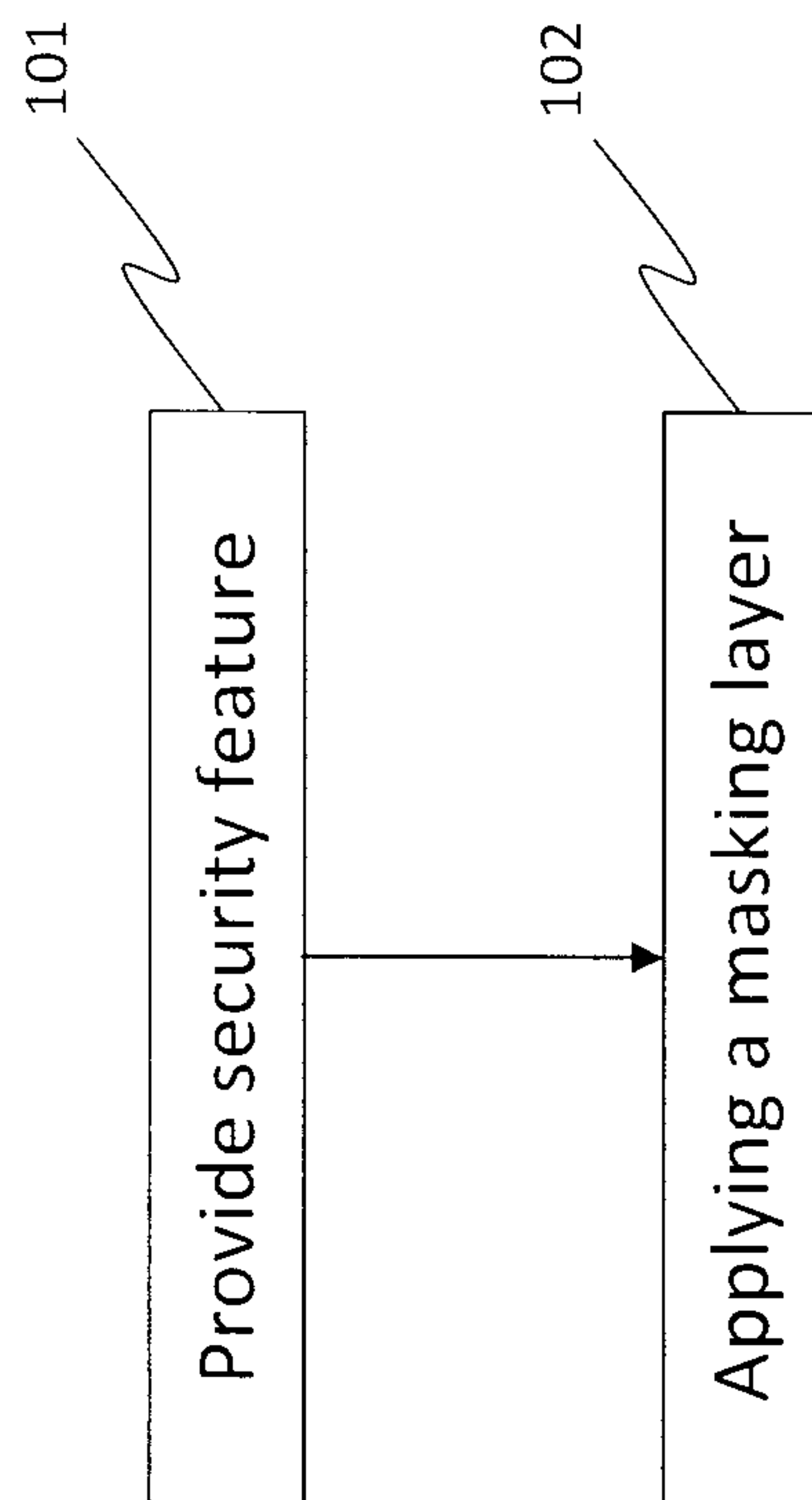


Fig. 8

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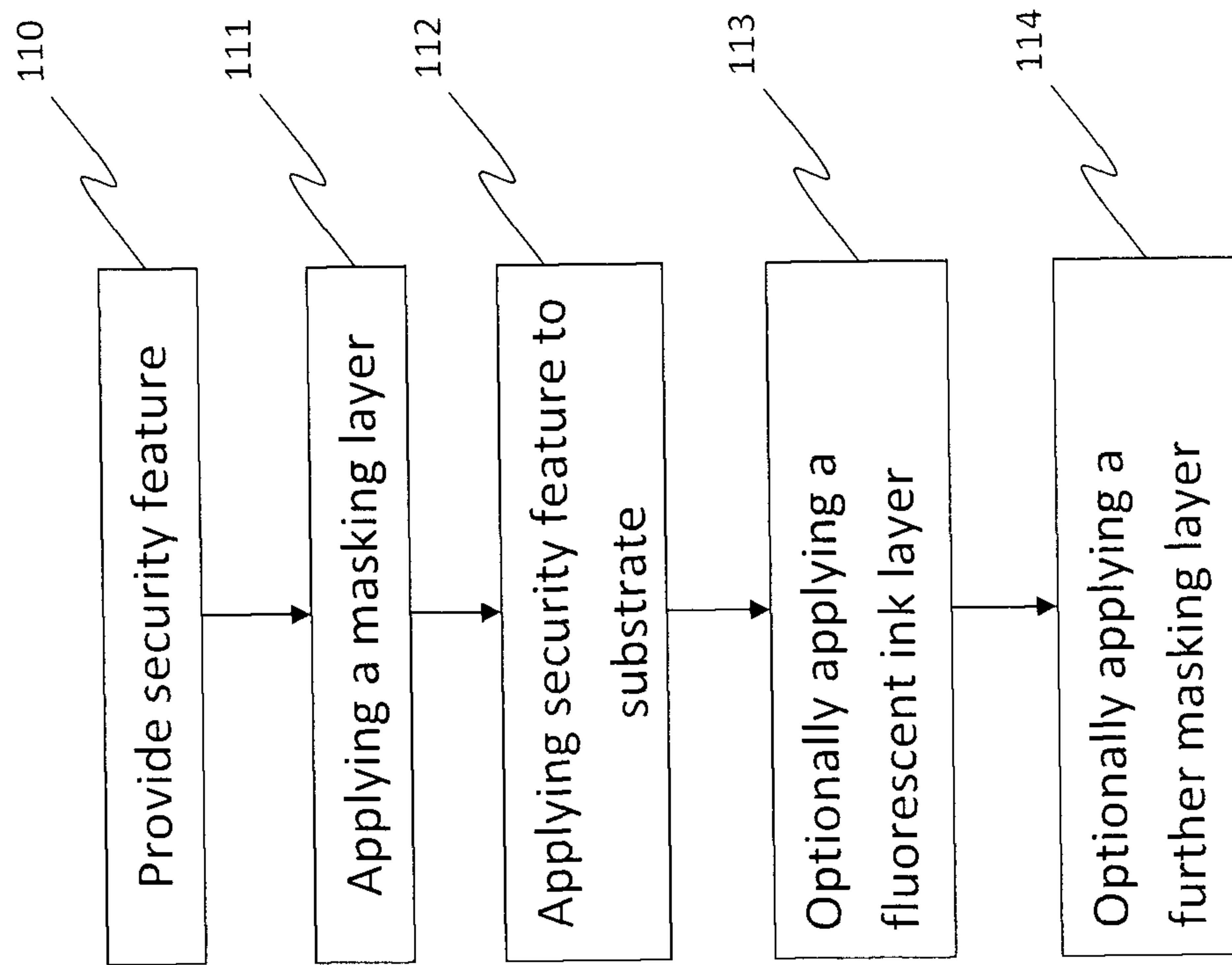


Fig. 9

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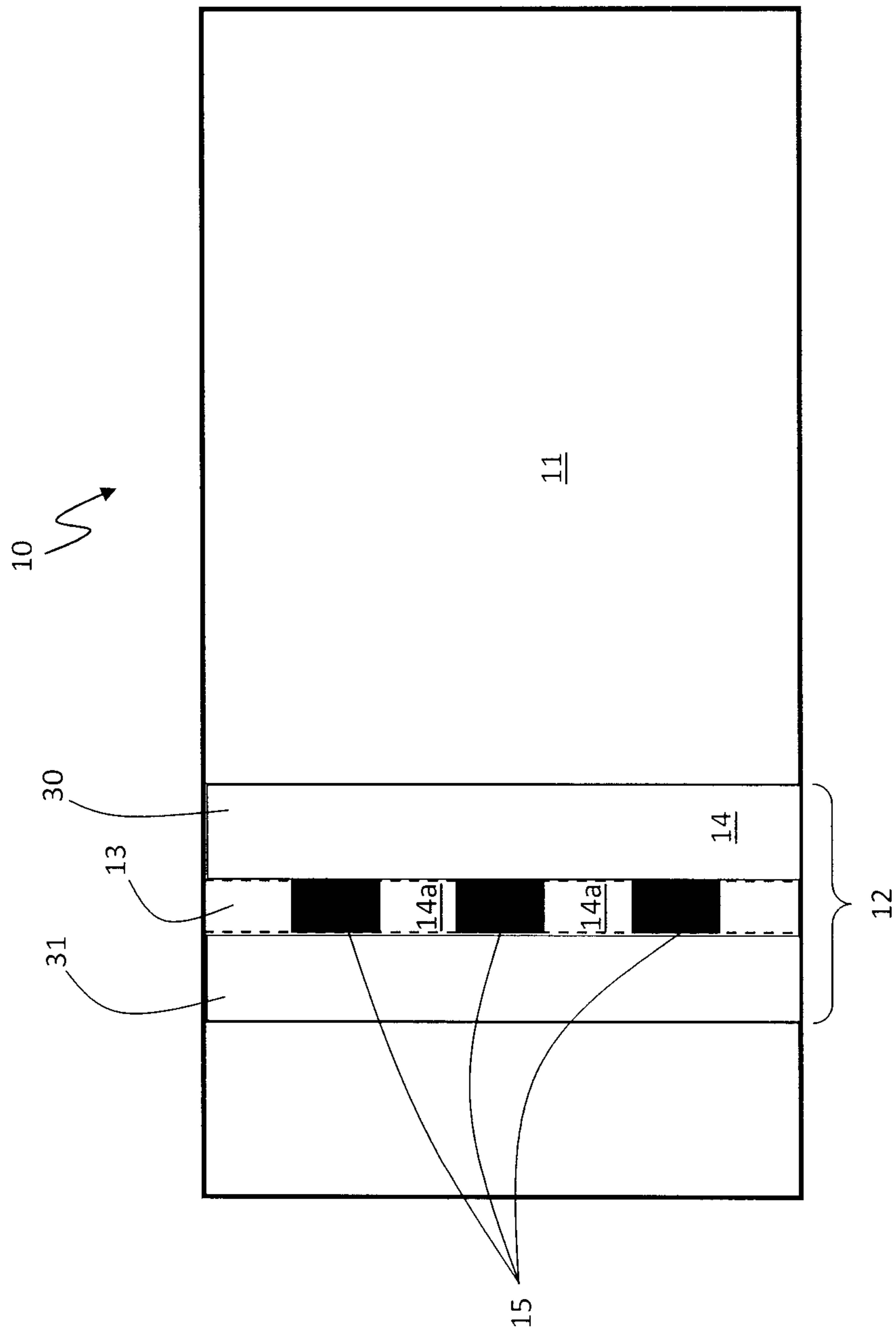


Fig. 10

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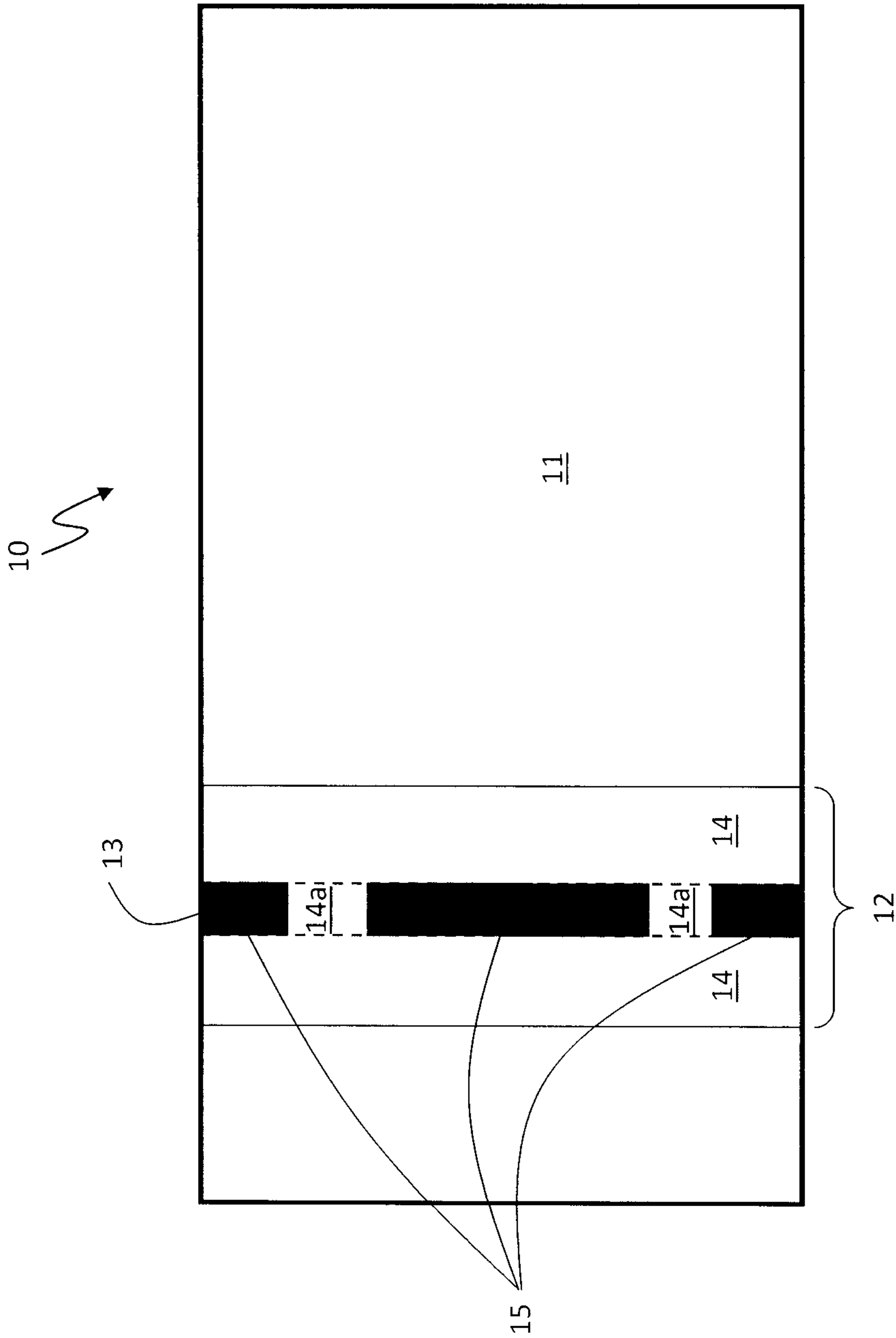


Fig. 11

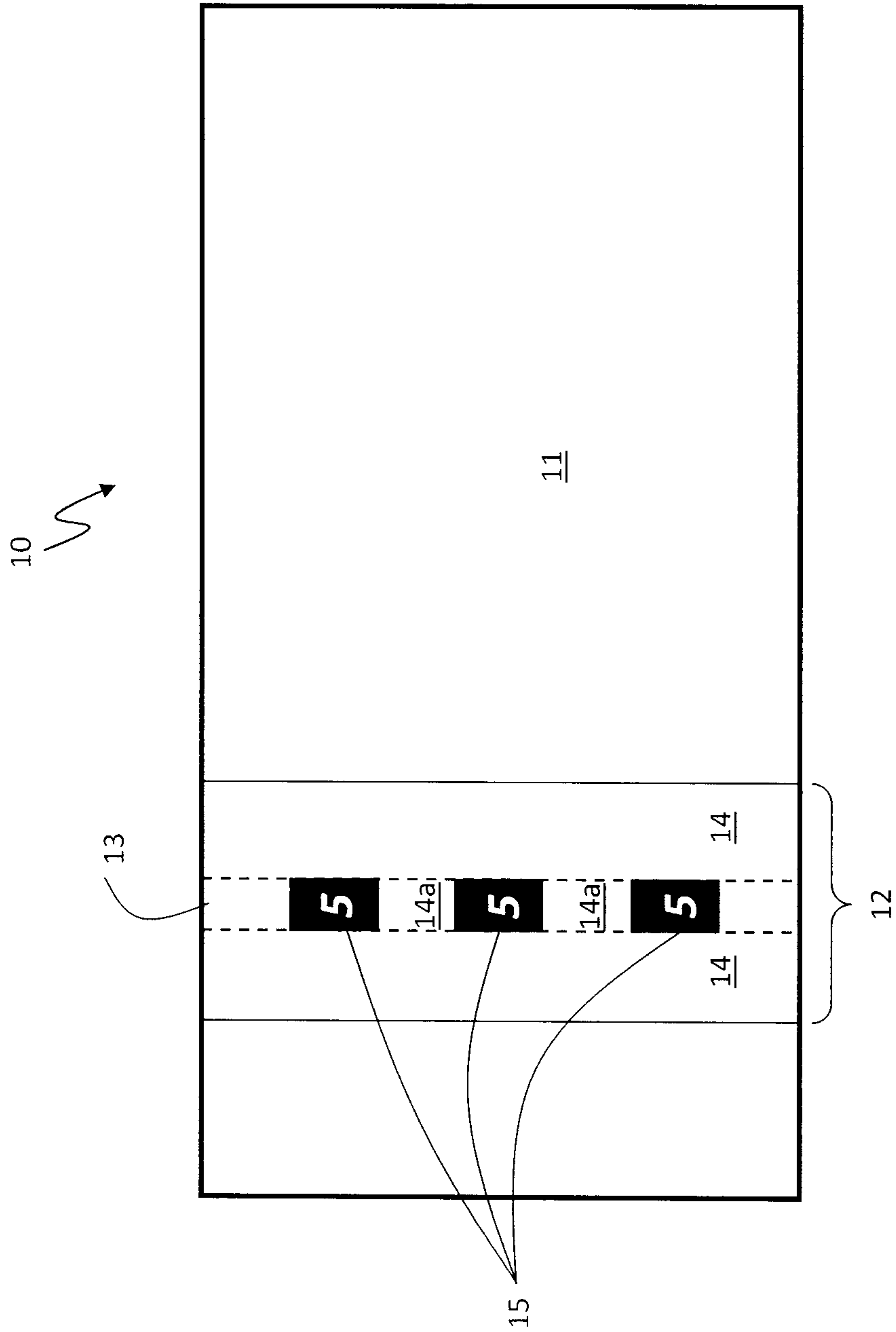


Fig. 12a

14/14

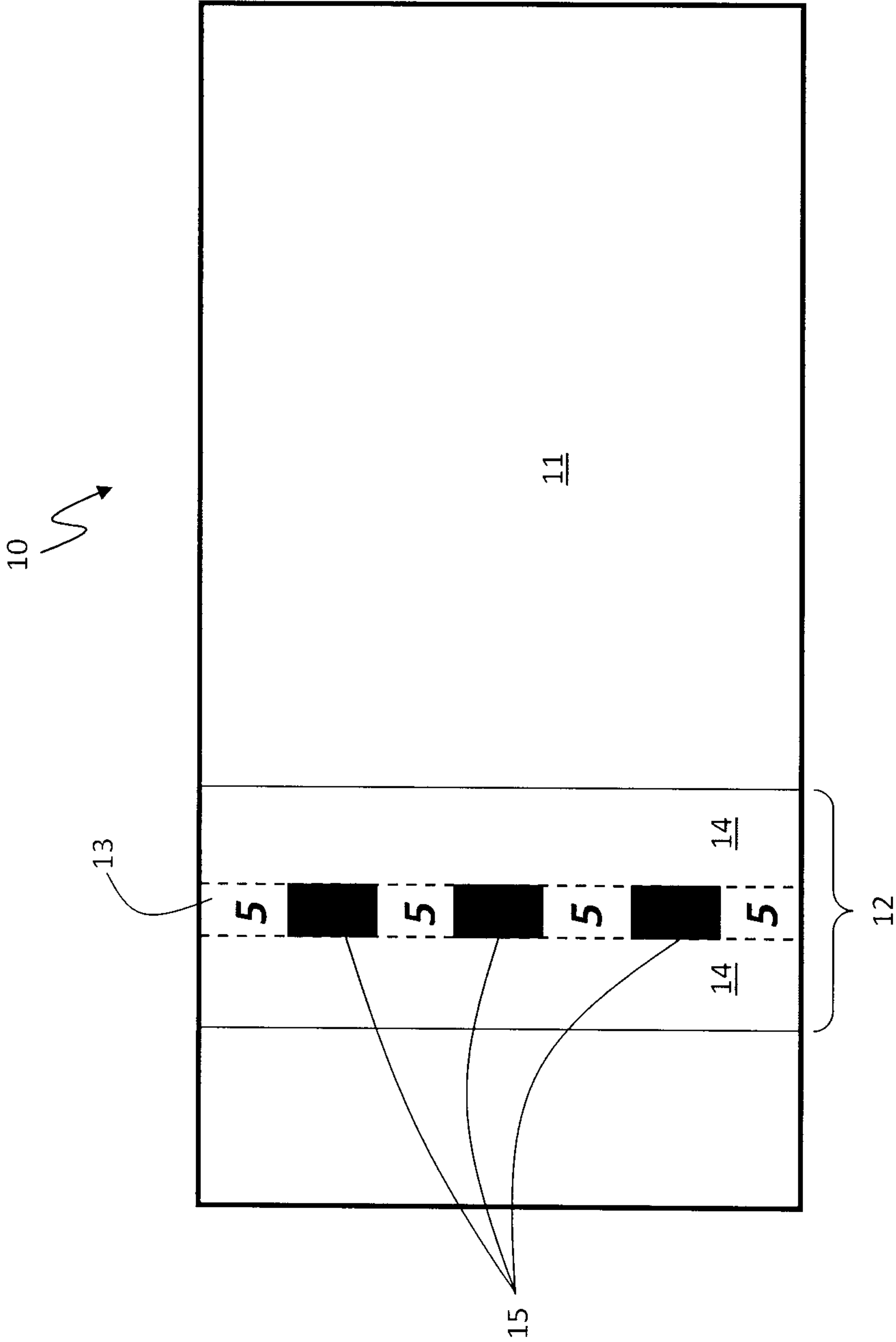


Fig. 12b

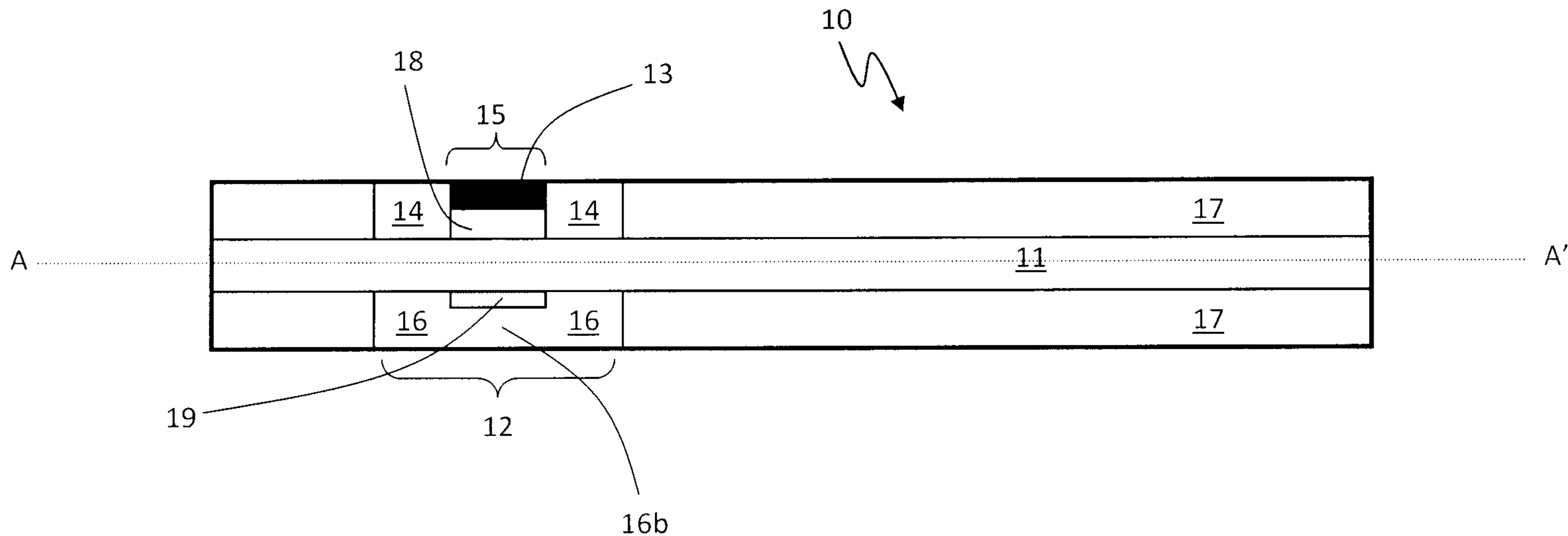


Fig. 4a