



(86) Date de dépôt PCT/PCT Filing Date: 2003/07/28
(87) Date publication PCT/PCT Publication Date: 2004/02/19
(45) Date de délivrance/Issue Date: 2012/06/26
(85) Entrée phase nationale/National Entry: 2005/02/07
(86) N° demande PCT/PCT Application No.: EP 2003/008327
(87) N° publication PCT/PCT Publication No.: 2004/014663
(30) Priorité/Priority: 2002/08/06 (AT A 1191/2002)

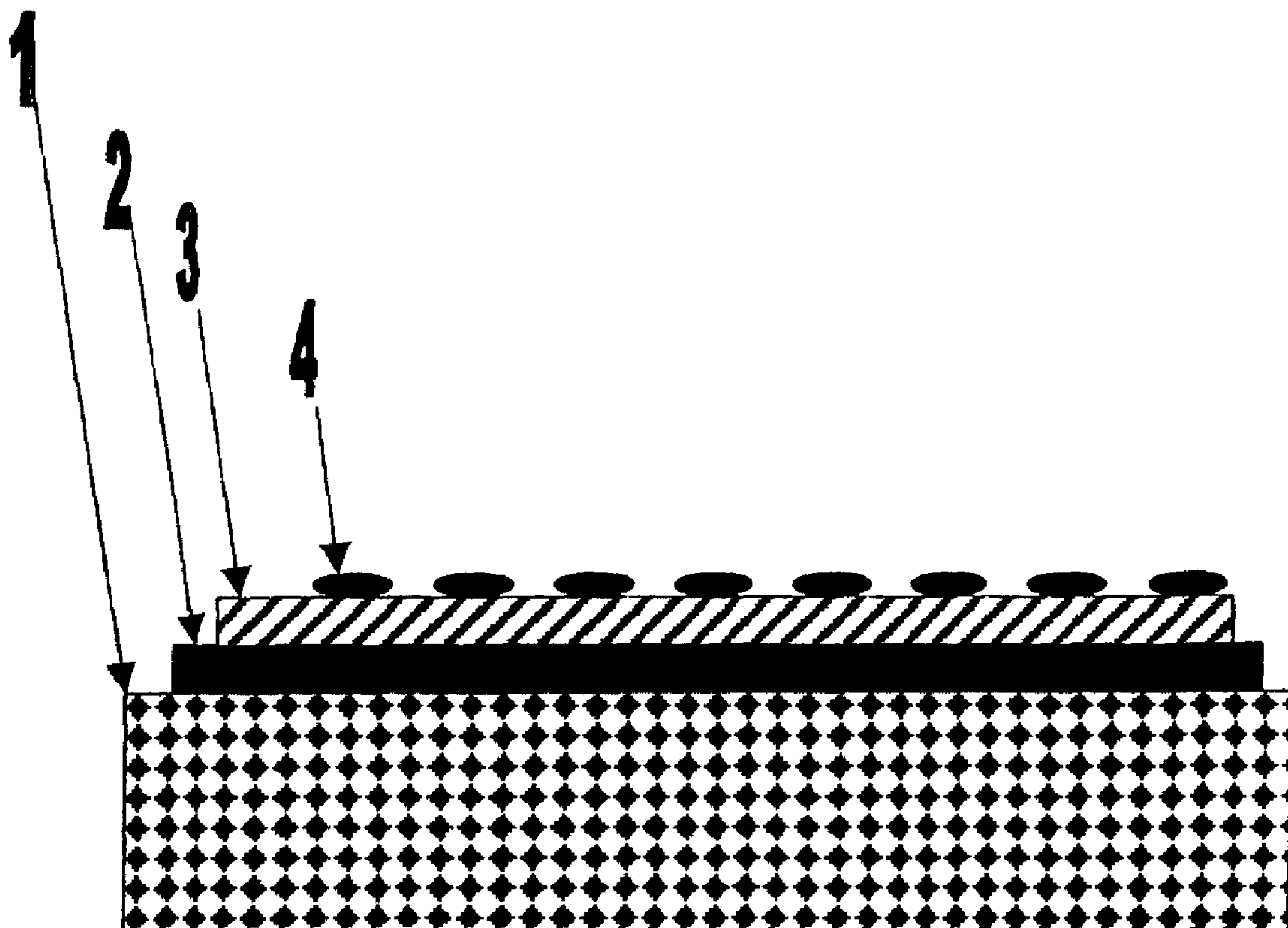
(51) Cl.Int./Int.Cl. *B42D 15/00* (2006.01),
B41M 3/14 (2006.01), *B42D 15/10* (2006.01)

(72) Inventeurs/Inventors:
KASTNER, FRIEDRICH, AT;
BERGSMANN, MARTIN, AT;
WALTER, HARALD, DE;
BAUER, GEORG, AT;
DOMNICK, RALPH, DE

(73) Propriétaires/Owners:
HUECK FOLIEN GES.M.B.H., AT;
NOVEMBER AG, DE

(74) Agent: RICHES, MCKENZIE & HERBERT LLP

(54) Titre : PROCEDE DE PRODUCTION DE CARACTERISTIQUES D'IDENTIFICATION INFALSIFIABLES
(54) Title: METHOD FOR PRODUCING TAMPER-PROOF IDENTIFICATION ELEMENTS



(57) Abrégé/Abstract:

A method for producing forgery-proof identification features, and forgery-proof identification features produced according to said method, each consisting of at least one electromagnetic wave-reflecting layer (2), one spacer layer (3) and one layer formed of metallic clusters (4), are described, wherein a partially or fully covering electromagnetic wave-reflecting layer followed by one or more partially and/or fully covering polymer layers (3) of defined thickness are applied to a base substrate (1), whereupon a layer formed of metallic clusters produced using a vacuum method or from solvent-based systems is applied to said spacer layer(s).

(57) Abstract: A method for producing forgery-proof identification features, and forgery-proof identification features produced according to said method, each consisting of at least one electromagnetic wave-reflecting layer (2), one spacer layer (3) and one layer formed of metallic clusters (4), are described, wherein a partially or fully covering electromagnetic wave-reflecting layer followed by one or more partially and/or fully covering polymer layers (3) of defined thickness are applied to a base substrate (1), whereupon a layer formed of metallic clusters produced using a vacuum method or from solvent-based systems is applied to said spacer layer(s).

WO 2004/014663

PCT/EP2003/008327

Method for Producing Tamper-Proof Identification Elements

The invention relates to a method for the production of forgery-proof identification features which exhibit a color-shift effect produced by metallic clusters which are separated from a reflecting layer by a defined transparent layer.

A method for forgery-proof marking of objects is known from WO 02/18155, where the object is provided with a marking consisting of an electromagnetic wave-reflecting first layer upon which an inert layer with a defined thickness transparent to electromagnetic waves is applied, followed by a third layer formed of metallic clusters applied to said inert layer.

The aim of the invention is to provide a method for the production of forgery-proof identification features on flexible materials, where the security against forgery is provided by a visible change in color at different viewing angles (color-shift effect), which is also to be machine readable. The method of production is to be unambiguously coded in the machine-readable spectrum.

The subject matter of the invention is therefore a method for production of forgery-proof identification features, each consisting of at least one electromagnetic wave-reflecting layer, one spacer layer, and one layer formed of metallic clusters, wherein a partially or fully covering electromagnetic wave-reflecting layer followed by one or more partially and/or fully covering polymer layers of defined thickness are applied to a base substrate, whereupon a layer formed of

metallic clusters produced using a vacuum method or from solvent-based systems is applied to the spacer layer.

Flexible plastic foils, made, for example, from PI, PP, MOPP, PE, PPS, PEEK, PEK, PEI, PSU, PAEK, LCP, PEN, PBT, PET, PA, PC, COC, POM, ABS, PVC, are preferred possibilities for the base substrate. The base foils are preferably 5 - 700 μm thick, with 8 - 200 μm being preferred, and 12 - 50 μm being especially preferred.

Furthermore, metal foils, made, for example, of Al steel, Cu steel, Sn steel, Ni steel, Fe steel, or stainless steel, which are 5 - 200 μm thick, preferably 10 to 80 μm , with 20 - 50 μm being especially preferred, can also serve as a base substrate. The surface of the foils can also be treated, coated or laminated, for example with plastic, or varnished.

Furthermore, cellulose-free or cellulose-containing paper, thermally activated paper, or composites with paper, for example composites with plastic, having a basic weight of 20 - 500 g/m^2 , preferably 40 - 200 g/m^2 , can also be used as a base substrate.

An electromagnetic wave-reflecting layer is applied to the base substrate. Preferably, this layer can be made of metal, such as, for example, aluminum, gold, chrome, silver, copper, tin, platinum, nickel and their alloys, for example, nickel-chrome, copper-aluminum and the like.

The electromagnetic wave-reflecting layer can be applied to partially or fully cover the surface using known methods, such as spraying, vaporizing, sputtering, printing (intaglio, flexo, screen, digital printing), varnishing, roller application methods, and the like.

For application which is partially covering, a method using a soluble color coating is especially suited for the production of partially covering metallization. In the first step of this method, a color coating which dissolves in a solvent is applied to the base substrate. In the second step, where applicable, this layer is treated using an inline-plasma, corona or flame process, and in the third step a layer of the metal or metal alloy to be structured is applied, whereupon, in a fourth step, the color coating is removed using a solvent, in combination with mechanical action, where applicable.

The soluble color coating can be applied to partially or fully cover the surface and the metal or metal alloy is applied to cover the surface partially or fully.

The color coating can be applied using any method desired, such as, for example, intaglio printing, flexo printing, screen printing, digital printing, and the like. The color coating or varnish used dissolves in a solvent, preferably in water, although a color coating which dissolves in any solvent desired, such as, for example, alcohol, esters and the like, can also be used. The color coating or varnish can be a common composition based on natural or synthetic macromolecules. The soluble color coating can be pigmented or non-pigmented. All known pigments can be used as pigments. TiO_2 , ZnS , kaolin, and the like are especially suitable.

Where applicable, the printed base substrate is then treated using an inline-plasma (low-pressure or atmospheric plasma), corona or flame process. A high energy plasma, such as, for example, an Ar or Ar/ O_2 plasma, cleans the surface of residual coloration from the printing colors.

At the same time, the surface is activated, with terminal polar groups created on the surface. This improves the adhesion of metals and the like to the surface.

Where applicable, at the same time as, or following, the use of plasma, corona, or flame treatment, a thin metal or metal-oxide layer can be applied as a bonding agent, for example by sputtering or

vaporization. Cr, Al, Ag, Ti, Cu, TiO₂, Si oxides, or chromium oxides are especially suited for this purpose. In general, this bonding agent layer is 0.1 nm - 5 nm thick, preferably 0.2 nm - 2 nm, with 0.2 nm to 1 nm being especially preferred.

This results in improved adhesion of the electromagnetic wave-reflecting metal or metal-alloy layer which is applied to partially or fully cover the surface.

An electromagnetic wave-reflecting layer partially covering the surface can, however, also be produced using a commonly known etching method.

The electromagnetic wave-reflecting layer is preferably approximately 10 - 50 nm thick, with, however, thicker or thinner layers also being possible.

If metal foils are used as a base substrate, the base substrate itself can already form the electromagnetic wave-reflecting layer.

The reflection of electromagnetic waves by this layer, depending, in particular, on the thickness of the layer or metal foil used, is preferably 10 - 100 %.

The polymer layer or layers following this layer can also be applied to cover the surface fully or partially.

The polymer layers consist of, for example, color coating or varnish systems based on nitrocellulose, or epoxy, polyester, rosin, acrylate, alkyd, melamine, PVA, PVC, isocyanate, or urethane systems.

This polymer layer essentially serves as a transparent spacer layer, but can be absorbing in a certain spectral range, depending on its composition. Where applicable, this absorbing characteristic can also be strengthened by the admixture of a suitable chromophore. By choosing different chromophores, a suitable spectral range can be selected. By this means, in addition to the color-shift effect, the polymer layer can also be constructed so that it is also machine readable. In this manner, for example, a yellow azo color coating, for example, analides; rodural, eosin, can be used in the blue spectral range (the range of approximately 400 nm). In addition, the color coating also changes the spectrum of the marking in a characteristic manner.

Depending on the quality of adhesion to the base strip or, where applicable, to a layer underneath it, this polymer layer can exhibit a dewetting effect, which leads to a characteristic, macroscopic lateral structuring.

This structuring can be changed in a targeted manner by, for example, modification of the surface energy of the layers, or by, for example, plasma treatment, corona treatment, electron or ion beam treatment, or by laser modification.

Furthermore, it is possible to apply a bonding agent layer with a different range of surface energy.

The polymer layer has a defined thickness, preferably 10 nm to 3 μm , with 100 - 1000 nm being especially preferred. If more than one polymer layer is applied, each of these can have a different thickness.

The polymer layer can be applied using any coating method desired, such as, for example, spreading, varnishing, pouring, spraying, printing (screen printing, intaglio printing, flexo printing, or digital printing method), or by using a roller application method.

The polymer layer is preferably applied using a method which permits layers of very homogeneous thicknesses to be applied over large areas. A layer of homogeneous thickness is necessary in order to guarantee that the appearance of the finished product has a uniform color. The tolerances are preferably no greater than $\pm 5\%$, preferably $\leq \pm 2\%$.

A printing method where the color coating or varnish is applied from a temperature-controlled varnish pan via an immersion cylinder and a transfer roller to the printing cylinder, with essentially only the depressions in the printing cylinder being filled with the color coating or varnish, is especially suited in this regard. A blade is used to remove excess color coating or varnish and, where applicable, further drying performed using a blower bar.

A layer formed of metallic clusters is then applied to the polymer layer. The metallic clusters can be made, for example, of aluminum, gold, palladium, platinum, chrome, silver, copper, nickel, and the like or their alloys, such as, for example, Au-Pd or Cr-Ni.

This cluster layer can be applied by sputtering (for example, ion beam or magnetron) or vaporizing (electron beam) from a solution, or by adsorption.

In the case of production of the cluster layer using vacuum processes, the growth of the clusters, and consequently their form and optical characteristics, can be advantageously influenced by adjusting the surface energy or roughness of the underlying layer, thereby changing the spectra in a characteristic manner. This can be done, for example, by thermal treatment during the coating process or by preheating the substrate.

In this way, for example, the form, and consequently also the optical characteristics, of the clusters can be influenced by adjusting the surface energy or condensation coefficient of the metal on the underlying layer.

These parameters can, for example, be the result of treating the surface with an oxidizing liquid, or, for example, with Na hypochlorite, or in a PVD or CVD process.

The cluster layer can be advantageously applied using sputtering, where the characteristics of the layer, in particular the thickness and structure, are primarily determined by the power density, the quantity and composition of the gas used, the temperature of the substrate, and the strip speed.

In the case of application from solution using wet chemical methods, in the first step, the clusters are produced in solution. The clusters are then derivatized, concentrated and applied directly to the polymer surface.

For application by means of printing methods, after the clusters have been concentrated, small amounts of an inert polymer, for example, PVA, polymethyl methacrylate, or nitrocellulose, polyester or urethane systems are mixed in. The mixture can then be applied to the polymer layer by means of a printing method, for example, by the screen, flexo or, preferably, intaglio method.

The cluster layer is preferably 2 - 20 nm thick, with 3 - 10 nm being especially preferred.

In addition, a protective layer may be applied using a vacuum or printing method.

In a preferred embodiment, the polymer layer is structured in a targeted manner by surface energy modification.

Due to the color effect, the structures then appear in high contrast through the subsequently applied cluster layer, making them easy for the eye to perceive. A structuring such as this therefore creates an additional forgery-proof feature.

Furthermore, this structuring can be converted into unique codes using fingerprint algorithms, which are then machine readable.

In this way, a structuring can be associated with a definite numerical value, whereby markings having the same production parameters, i.e. with the same color effect, become individualizable.

For use, in particular, as a security feature, the individual layer combinations can also be applied to separate substrates. In this way, for example, the electromagnetic wave-reflecting layer and the polymer spacer layer can be applied to a first substrate, which, for example, is applied to a document of value or incorporated into this document of value. The cluster layer can then be applied to another substrate, which is provided with an adhesive layer, where applicable. In accordance with the lock-and-key principle, when the two coated substrates are joined together, the characteristic color effect appears.

The base substrate can also already consist of one or more functional and/or decorative layers. A wide range of compositions can be used for each of these color coating or varnish layers. The compositions of individual layers can, in particular, vary according to their purpose, depending on whether an individual layer serves an exclusively decorative purpose, is to be a functional layer, or is to be a decorative as well as a functional layer.

The layers that are to be printed can be pigmented or non-pigmented. All known pigments, such as, for example, titanium dioxide, zinc sulfide, kaolin, ATO, FTO, ITO, aluminum, chrome oxides, and silicon oxides, can be used as pigments, with both solvent-containing varnish systems as well as solvent-free systems being usable.

Various natural or synthetic binding agents can be used binding agents.

The functional layers can, for example, have certain electrical and magnetic characteristics, and special chemical, physical and, in addition, optical characteristics.

For example, to adjust electric characteristics, for example conductivity, graphite, soot, and conducting organic or inorganic polymers can be used. Metal pigments (for example, copper, aluminum, silver, gold, iron, chrome lead and the like), metal alloys such as copper-zinc or

copper-aluminum or their sulfides or oxides, or, in addition, amorphous or crystalline ceramic pigments such as ITO and the like can be added. Furthermore, doped or non-doped semiconductors such as, for example, silicon, germanium or ion conductors such as amorphous or crystalline metal oxides or metal sulfides can be used as additives. In addition, polar or partially polar compounds, such as surfactants, or non-polar compounds, such as silicon additives or hygroscopic or non-hygroscopic salts, can be used or added.

To adjust the magnetic characteristics, paramagnetic, diamagnetic and, in addition, ferromagnetic materials, such as iron, nickel and cobalt or their compounds or salts (oxides or sulfides, for example) can be used.

The optical characteristics of the layer may be influenced by using visible coloring agents, or pigments or luminescent coloring agents, or pigments that fluoresce or phosphoresce in the visible, UV range or IR range, effect pigments, such as liquid crystals, nacre, bronzes and/or heat sensitive colors or pigments. These can be used in all possible combinations. In addition, phosphorescing pigments can also be used on their own or in combination with other coloring agents and/or pigments.

Various characteristics can also be combined by adding a variety of the above-mentioned additives. In this way, it is possible to use colored and/or conducting magnetic pigments, with all of the conducting additives mentioned being usable. In this way, for example, metals can be added to change a brown magnet color to the coloring of the metal, e.g., silver.

In addition, insulating layers, for example, can be applied. For example, organic substances and their derivatives and compounds, for example color coating and varnish systems, e.g., epoxy, polyester, rosin, acrylate, alkyd, melamine, PVA, PVC, isocyanate, and urethane systems, which can be radiation-hardened, for example by thermal or UV radiation, are suitable as insulators.

These layers can be applied using known methods, for example by vaporizing, sputtering, printing (for example, intaglio, flexo, screen and digital printing and the like), spraying, galvanizing, roller application methods and the like. The functional layer is 0.001 to 50 μm thick, preferably 0.1 to 20 μm .

Multi-layer constructions having different characteristics in the individual layers can be produced by repeating one or more steps of the method described one or more times. In this regard, by combining the different characteristics of the individual layers, for example layers with different conductivity, magnetizability, optical characteristics, absorption behavior and the

like, it is possible to produce, for example, constructions for security elements having several precise authenticity features.

Each of the layers can already be present on or can be applied to the substrate as a partially or fully-covering layer.

In this regard, the steps of the method can be repeated as often as desired, with, for example, the application of a color coating being omitted, where applicable, when a fully covering functional layer is applied.

However, it is also possible, for example, to apply partially covering metal layers using known direct metallizing methods or metallizing methods using etching, or to apply further layers using known multi-color printing methods.

Where applicable, the coated foil produced in such manner can also be additionally protected by a protective varnish layer or, for example, further improved by lamination or the like.

Where applicable, the product can be applied to the associated base material with a sealing adhesive, for example a hot or cold sealing adhesive, or, for example, for security paper, embedded in the paper during paper production using the usual methods.

These sealing adhesives can be provided with visible features, features visible in UV light, or fluorescent, phosphorescent or laser and IR radiation-absorbing features in order to make them more forgery-proof. These features can also be present in the form of patterns or symbols or exhibit color effects, with in principle as many colors as desired, preferably 1 to 10 colors or color mixtures, being possible.

In the case of one-sided coating, the base substrate can be removed after use or remain on the product. In this regard, where applicable, the base foil can be specially outfitted on the non-coated side to be, for example, scratchproof, antistatic and the like. The same applies in the case of a possible varnish layer on the base substrate.

In addition, the layer construction can be designed to be transferable or non-transferable, provided, where applicable, with a transfer varnish layer, which, where applicable, can exhibit a diffraction structure.

The construction according to the invention can also be applied to the base substrate in inverse order, where a layer formed from metallic clusters, produced using a vacuum method or from solvent-based systems, is applied to a base substrate, with one or more partially and/or fully covering polymer layers of defined thickness then being applied, followed by the application of a partially or fully covering electromagnetic wave-reflecting layer on the spacer layer.

In one aspect of the present invention, there is provided a method for the production of forgery-proof identification features, each consisting of at least one electromagnetic wave-reflecting layer, one spacer layer and one layer formed from metallic clusters, wherein a partially or a fully covering electromagnetic wave-reflecting layer followed by at least one of a partially covering optically transparent polymeric spacer layer or fully covering optically transparent polymeric spacer layer of defined thickness is applied to a base substrate, whereupon a layer formed from metallic clusters produced using a vacuum method by sputtering or vaporizing or from solvent-based systems by wet chemical methods or printing is applied to the spacer layer and the optically transparent polymeric spacer layer is formed of at least one polymeric layer with defined thickness, which is applied by spreading, varnishing, pouring, spraying, printing or by using a roller application method.

In yet another aspect of the present invention, there is provided a method for the production of forgery-proof identification features, each consisting of at least one electromagnetic wave-reflecting layer, one spacer layer and a layer formed from metallic clusters, wherein a layer formed from metallic clusters produced using a vacuum method by sputtering or vaporizing or from solvent-based systems by wet chemical methods or printing followed by at least one partially covering and fully covering optically transparent polymer spacer layer of defined thickness are applied to a base substrate, whereupon a partially or fully covering electromagnetic wave-reflecting layer is applied to the spacer layer; wherein the optically transparent polymeric spacer layer is formed of at least one polymeric layer with defined thickness, which is applied by spreading, varnishing, pouring, spraying, printing or by using a roller application method.

Fig. 1-6 present examples of security features according to the invention.

In these figures. 1 designates the base substrate, 2 the electromagnetic wave-reflecting first layer, 3 the transparent layer, 4 the layer constructed of metallic clusters, 5 an optically transparent substrate, 6 an adhesive or lamination layer.

Fig. 1 shows a schematic cross-section through a first continuously visible marking on a base substrate.

16a

Fig. 2 shows a schematic cross-section through a non-continuously visible first marking on a base substrate, as well as a second base substrate suitable for verification or rendering the marking visible.

Fig. 3 shows a schematic cross-section through a continuously visible first laminatable or adhesive marking.

Fig. 4 shows a schematic cross-section through another continuously visible second laminatable or adhesive marking.

Fig. 5 shows a schematic cross-section through a non-continuously visible first laminatable or adhesive marking, as well as a second base substrate suitable for verification or rendering the marking visible.

Fig. 6 shows a continuously coated forgery-proof marked base substrate in large-scale format, which is partially rolled up onto rollers.

In the markings shown in Fig. 1 to 5, an electromagnetic wave-reflecting first layer is designated with (2). This can be a thin layer made of, e.g., aluminum. The first layer (2) can, however, also be a layer formed of metallic clusters, which is applied to a substrate (1). The substrate (1) can be the base substrate which is to be marked. The inert spacer layer is designated with (3). The metallic clusters (4) are expediently produced, e.g., from copper.

In Fig. 3 to 5, the adhesive or lamination layer provided for further processing of the forgery-proof marked base substrate is labeled with (6). The change in the reflected light versus the incident light which creates the characteristic color spectrum is visualized in these two figures using a grayscale gradient in an arrow.

In the markings shown in Fig. 1 and 3, a third layer (4) produced from metal clusters is applied to the second layer (3), with the second layer (3) being applied to a reflecting layer (2). In addition, in Fig. 1 and 3, the reflecting layer is applied to a base substrate (1).

In Fig. 4, first the third layer (4) formed of metallic clusters is applied to a base substrate (1), then the second layer (3), then the reflective layer (2) and finally the adhesive or lamination layer (6).

In the markings shown in Fig. 2 and 5, only the optically transparent second layer (3) is applied to the electromagnetically reflecting first layer (2), which is applied to a base substrate (1). The marking is initially not visible. The markings only become visible when brought into contact with a substrate (5), which has a third layer (4) formed from metallic clusters applied to its surface. A color effect then appears, which is visible through the substrate (5). The base substrate (5) is expediently produced from a transparent material, e.g., from plastic, such as polyethylene terephthalate polycarbonate, polyurethane, polyethylene, polypropylene, polyacrylate, polyvinyl chloride, polyepoxide.

The marking functions as follows:

When light from a light source, such as a light bulb, laser, fluorescent lamp, halogen lamp, in special cases a xenon lamp, shines onto one of the markings shown in Fig. 1, 3 and 4, this light is reflected by the first layer (1). Due to an interaction between the reflected light and the third layer (4), formed of metallic clusters, a portion of the incident light is absorbed. The reflected light exhibits a characteristic spectrum which depends on a number of parameters, such as, e.g., the optical constants of the layer construction. The marking appears colored. The coloration serves to provide forgery-proof verification

of the authenticity of the marking. The resulting color effect depends on the viewing angle and can be identified with the naked eye as well as with a reading device operating in reflection mode, preferably a spectral photometer. A photometer such as this can, for example, record the coloration of the surfaces from two different angles. This is done either with one detector, using two light sources which are powered on appropriately and appropriately tilted relative to the detector, or by using two photometers to take measurements of the sample at the two angles at which it is illuminated.

The parameters which must be adhered to for the interactions to be generated are disclosed in US 5,611,998, WO 98/48275 and WO 99/47702 and WO 02/18155.

The coated base materials produced according to the invention can be used as security features in data media, documents of value, labels, tags, seals, in packaging, textiles and the like.

Examples:**Example 1:****Production of the cluster layer using wet chemical methods:****a) Synthesis of 14 nm gold clusters**

100 ml aqua dest is heated to boiling in a 250 ml flask. While stirring vigorously, first 4 ml 1 % trisodium citrate in aqua dest and then 1 ml 1 % tetrachloro gold acid in aqua dest are added.

Within a period of 5 min, the color of the reaction solution changes from nearly colorless to dark violet to cherry red. The supply of heat is then ended and the solution stirred further for approximately 10 min. Transmission electron microscope analysis of the resulting sol shows spherical particles having an average diameter of 14 nm. The clusters have a narrow size distribution ($cv < 20\%$). The maximum wavelength of optical absorption is 518 nm.

b) Derivatization of the gold clusters:

While stirring vigorously, 1 ml of a 1 % solution of BSA (Bovine Serum Albumin) in aqua dest is added to 100 ml of gold sol prepared according to the above synthesis. The solution changes color slightly from cherry red to a dark red. The optical absorption maximum remains unchanged. Absorption increases for wavelengths in the range of 550 nm and above. Defined separations between the particles can be seen in the transmission electron microscope.

c) Binding the gold clusters to a nitrocellulose surface:

The sol (nearly pH neutral, almost no salt) is rebuffed by adding 5 ml 1M sodium carbonate solution (pH 9.6). Only sufficiently protected clusters remain in solution and do not precipitate out. The sol can be concentrated by centrifuging or binds directly after application to the nitrocellulose-coated surface. When the thickness of the nitrocellulose layer is chosen appropriately, strong surface colorations form after the excess water has dried.

Example 2:**Production of the cluster layer using printing methods**

After concentrating the sol by a factor of 10, small amounts (e.g., 5 %) of a neutral polymer (e.g., PVA) are admixed to the sol. This makes printing with the usual intaglio printing cylinders possible. The colloids dry randomly oriented with the polymer in a very thin layer. Characteristic colors are observed as in Example 1c.

Example 3:**Production of the cluster layer using a vacuum method**

Under high vacuum conditions (base pressure $p < 1 \times 10^{-3}$ mbar), a 4 nm-thick Cu layer is sputtered onto a strip-shaped base substrate which has already been provided with a reflecting layer and a nitrocellulose layer acting as a transparent spacer layer.

The sputtering is performed using a magnetron plasma source with an output of 20 W/cm^2 at 25°C and Ar with a partial pressure of 5×10^{-3} mbar as the process gas. The strip speed is 0.5 m/s. Under these conditions, the Cu layer shows distinct island growth. The islands with an average diameter of several nm correspond to the clusters in the wet chemical method. Other characteristic color spectra are clearly observed.

Patent Claims:

- 1) A method for the production of forgery-proof identification features, each consisting of at least one electromagnetic wave-reflecting layer, one spacer layer and one layer formed from metallic clusters, wherein a partially or a fully covering electromagnetic wave-reflecting layer followed by at least one of a partially covering optically transparent polymeric spacer layer or fully covering optically transparent polymeric spacer layer of defined thickness is applied to a base substrate, whereupon a layer formed from metallic clusters produced using a vacuum method by sputtering or vaporizing or from solvent-based systems by wet chemical methods or printing is applied to the spacer layer and the optically transparent polymeric spacer layer is formed of at least one polymeric layer with defined thickness, which is applied by spreading, varnishing, pouring, spraying, printing or by using a roller application method.
- 2) A method for the production of forgery-proof identification features, each consisting of at least one electromagnetic wave-reflecting layer, one spacer layer and a layer formed from metallic clusters, wherein a layer formed from metallic clusters produced using a vacuum method by sputtering or vaporizing or from solvent-based systems by wet chemical methods or printing followed by at least one partially covering and fully covering optically transparent polymer spacer layer of defined thickness are applied to a base substrate, whereupon a partially or fully covering electromagnetic wave-reflecting layer is applied to the spacer layer; wherein the optically transparent polymeric spacer layer is formed of at least one polymeric layer with defined thickness, which is applied by spreading, varnishing, pouring, spraying, printing or by using a

roller application method.

- 3) The method according to claim 1 or claim 2, wherein the electromagnetic wave-reflecting layer and the polymer spacer layer are applied to a first base substrate and the layer formed from metallic clusters is applied to a second base substrate, wherein the first and second base substrates are brought into contact with one another.
- 4) The method according to any one of claims 1 to 3, wherein a protective layer is applied to the cluster layer.
- 5) The method according to any one of claims 1 to 4, wherein the layer upon which the spacer layer is applied is modified by treatment with oxidizing liquids or by a PVD or CVD process.
- 6) The method according to any one of claims 1 to 5, wherein the polymer spacer layer is structured by dewetting effects.
- 7) The method according to claim 6, wherein the dewetting structures of the structured polymer spacer layer are converted to unique codes using fingerprint algorithms.
- 8) The method according to any one of claims 1 to 7, wherein the polymer spacer layer is modified by treatment with Na hypochlorite, or by a PVD or CVD process.
- 9) The method according to any one of claims 1 to 8, wherein the polymer spacer layer contains a chromophore.

- 10) The method according to any one of claims 1 to 9, wherein at least one of functional and decorative layers are applied on the base substrate.
- 11) The method according to any one of claims 1 to 10, wherein the base substrate or base substrates are provided with a hot sealing varnish.

Fig.: 1

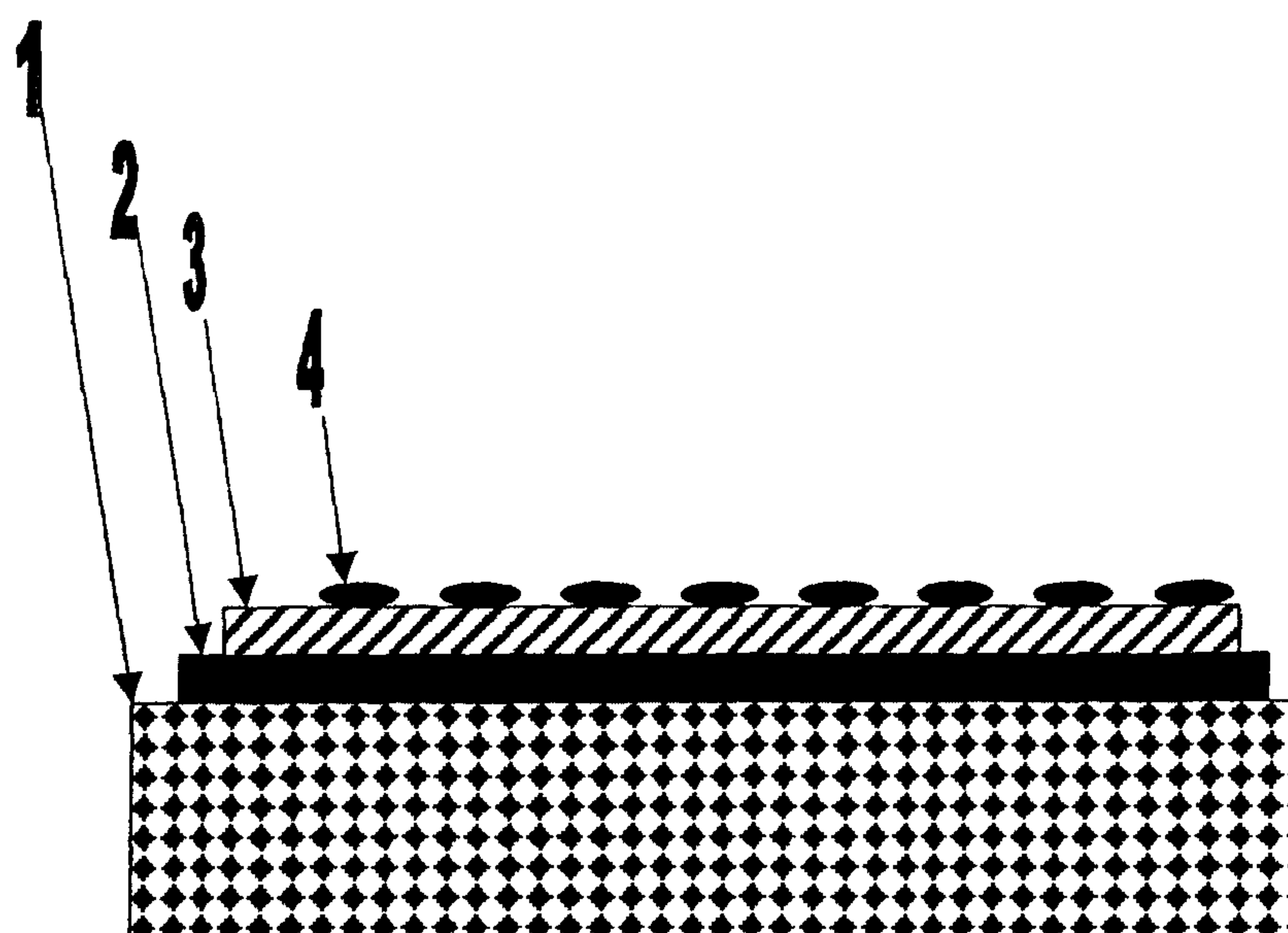


Fig. 2

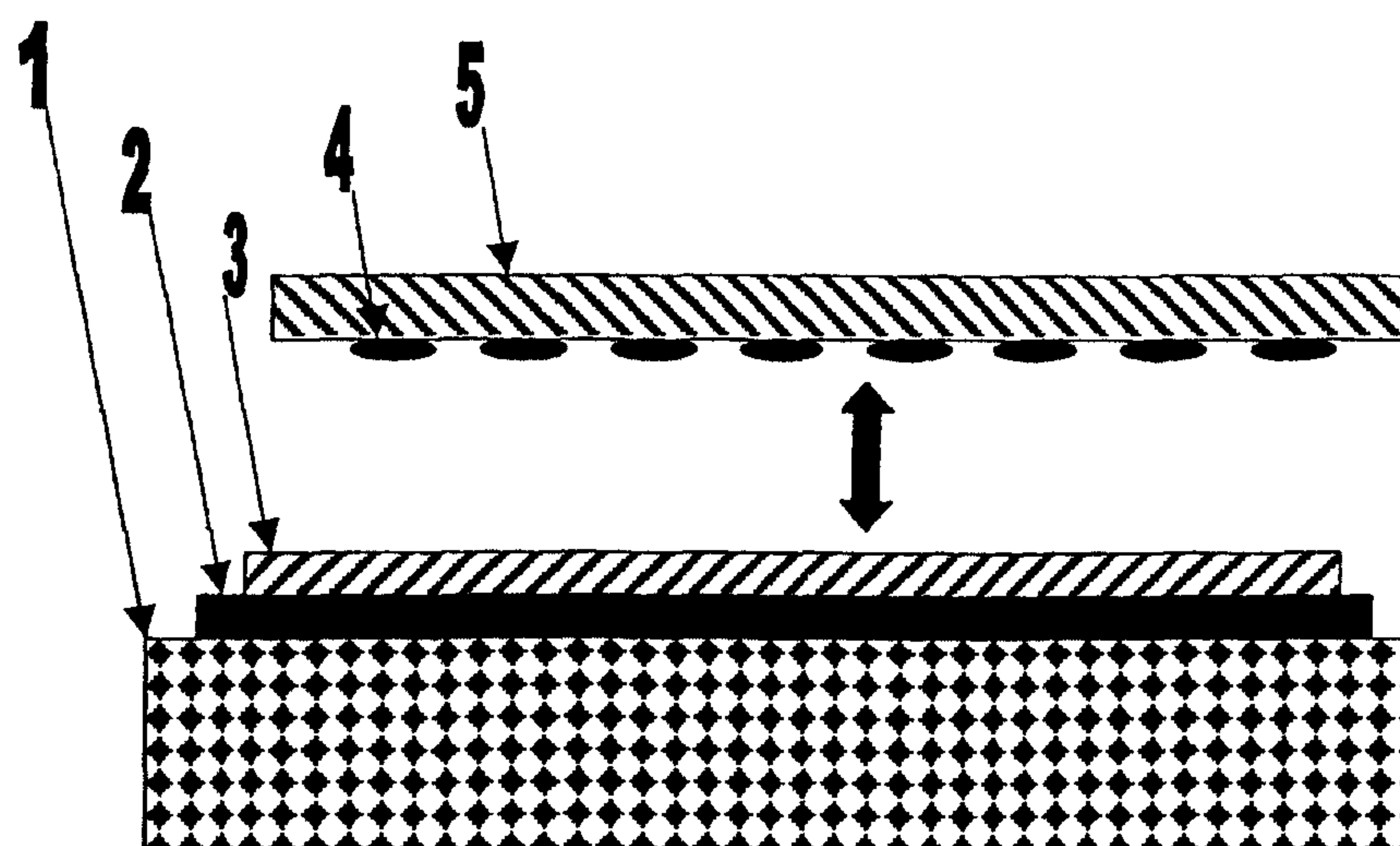


Fig. 3

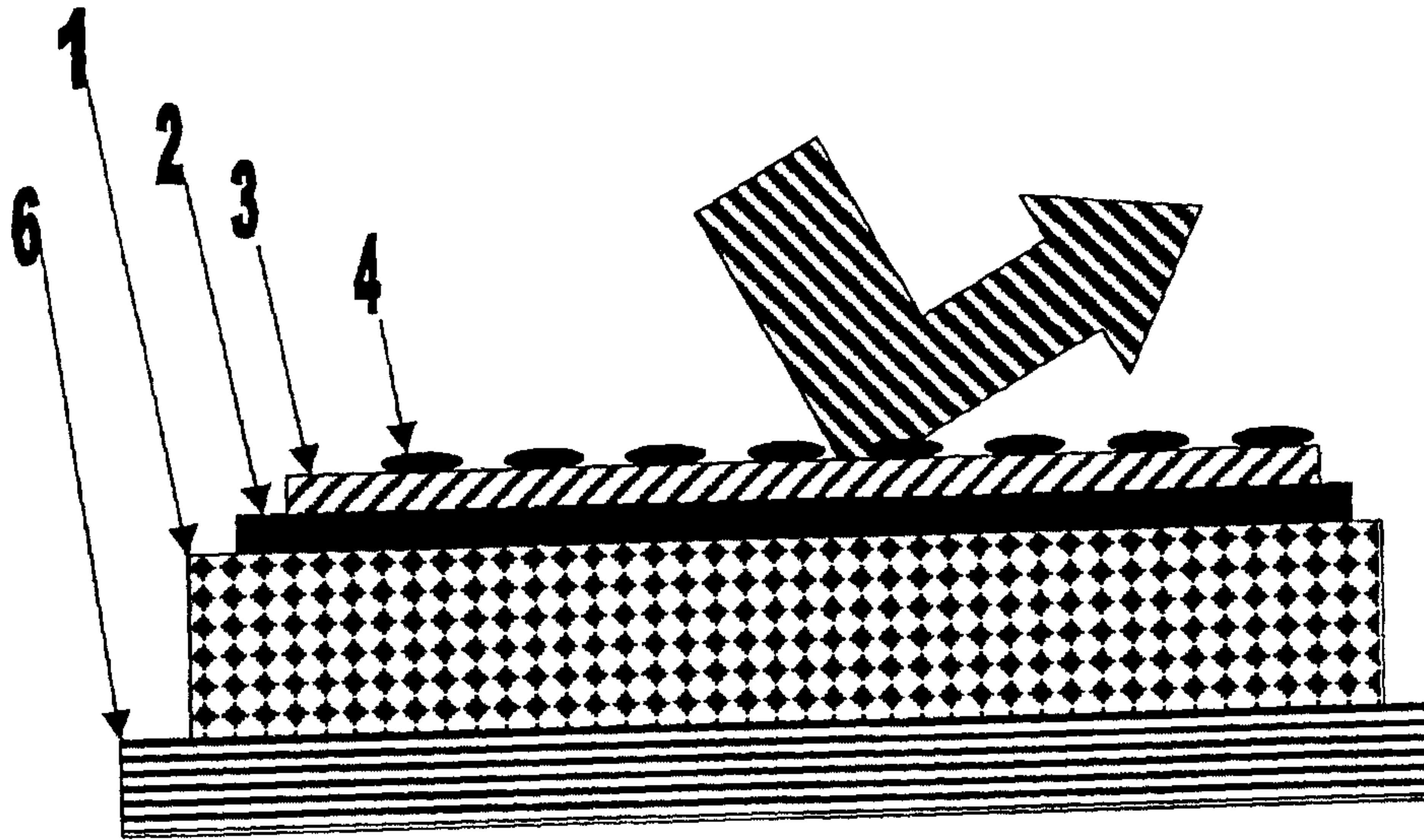


Fig. 4

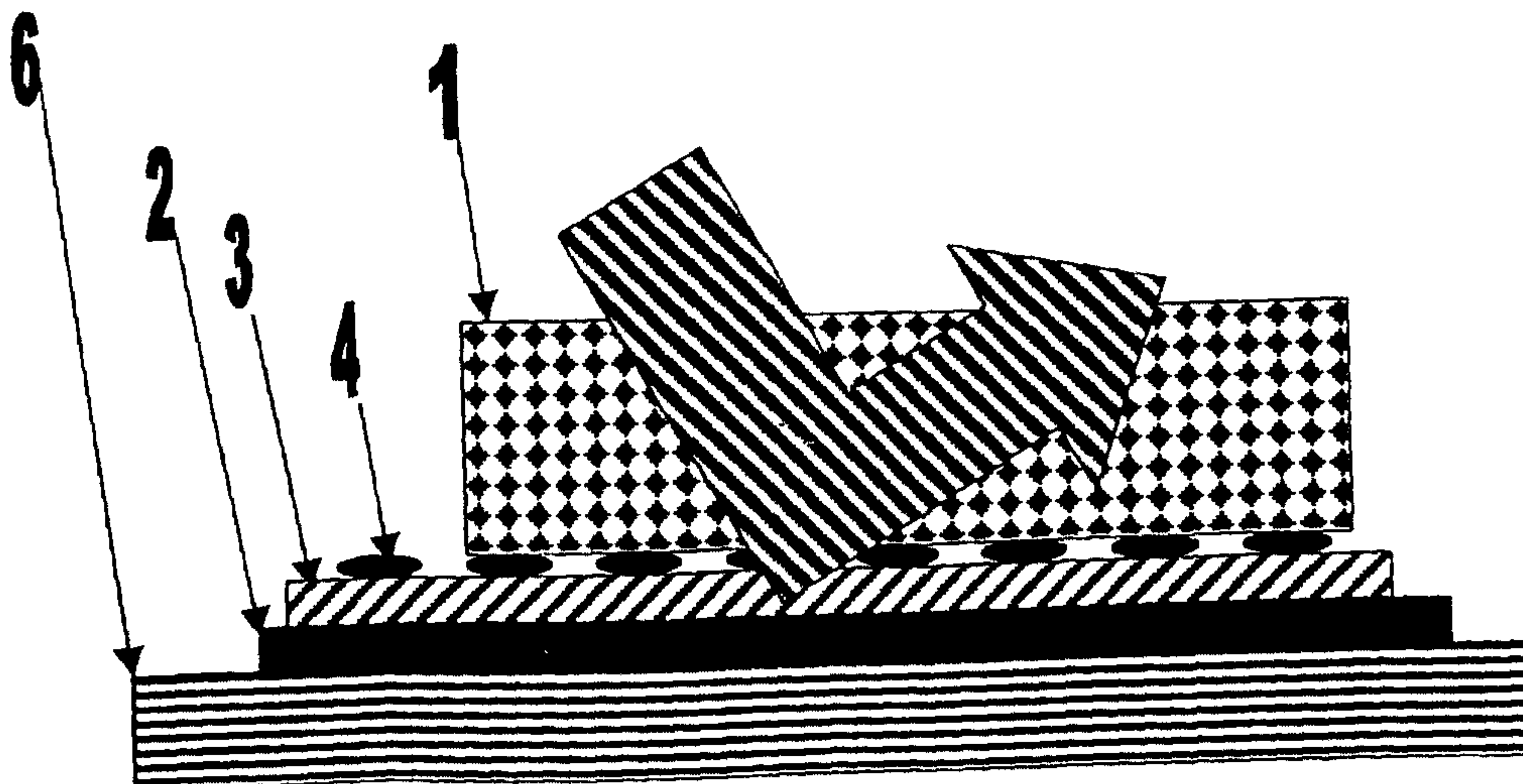
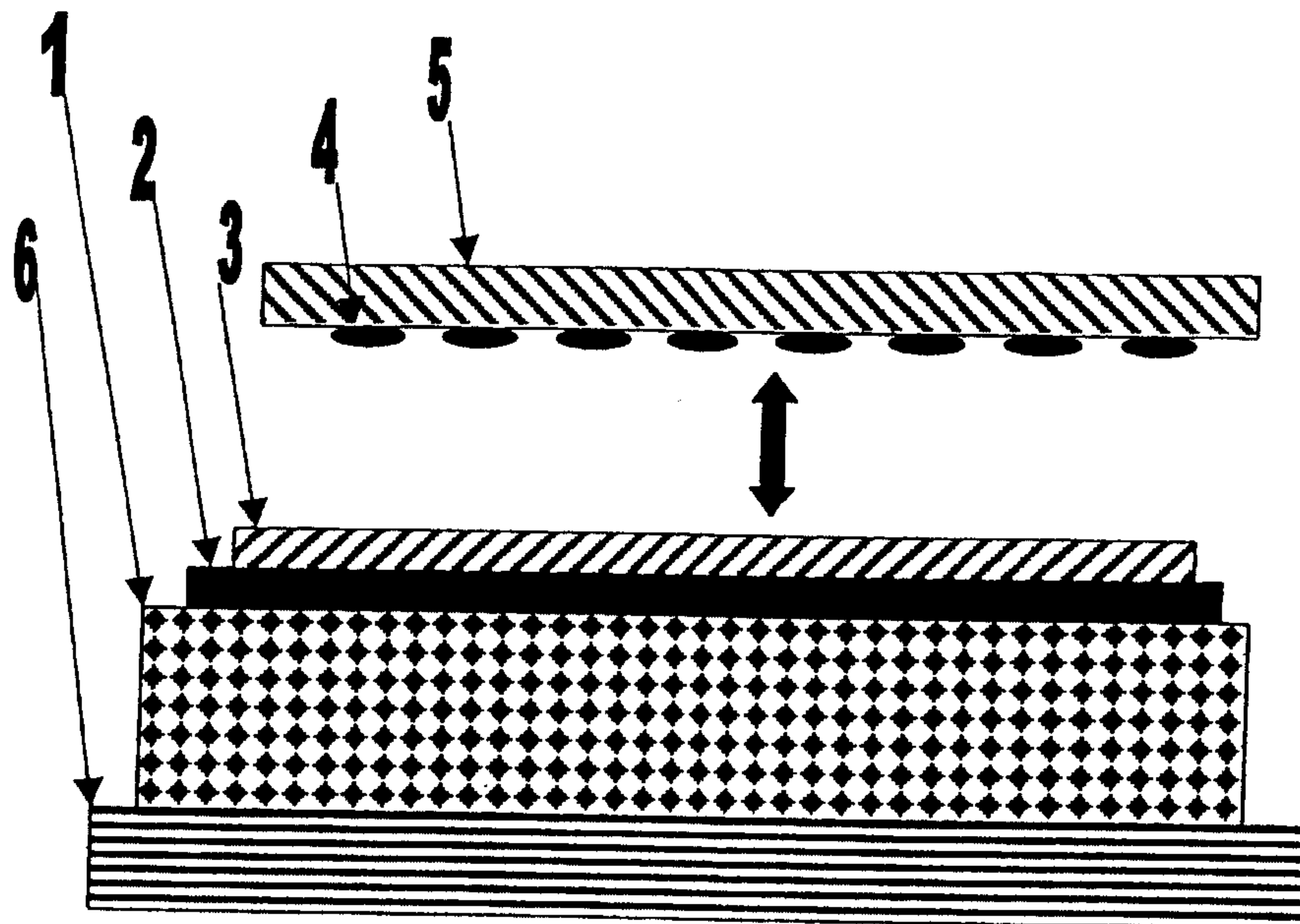


Fig. 5



WO 2004/014663

4/4

PCT/EP2003/008327

Fig.6

