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(54) **Multicoloured foil**

(57) Security document (1) comprising a security part  
comprising a foil area (2) comprising at least two visually  
distinguishable areas, wherein a first area (3) has a first  
colour and a second area (4) has a colour that is different  
and visually distinguishable therefrom.

In one embodiment further public security features  
that are visually perceivable by the general public have  
been provided in the first area (3), and further security  
features have been provided within the second area (4).

**EP 1 902 855 A2**

## Description

**[0001]** The invention relates to a security document provided with a foil security part.

**[0002]** It is known to provide security documents, such as banknotes, with a security feature, such as a foil area, particularly provided with a metal foil area.

**[0003]** The advantage of the foil area or part is that it cannot be copied, particularly not by means of a colour photocopier or computer peripheral equipment such as a colour laser printer or inkjet colour printer. Such foil as a result turns out to be a very good security element, because first of all it can easily be perceived by the public, and is hard to forge, the more so as in such a foil area highly advanced further security features can be provided. The security can furthermore be improved by providing the foil with a metal foil area.

**[0004]** In WO-A1-95/16574 a security document is described which is provided with a foil area that is subdivided into two areas each having a different structure as a result of which they are visually distinguishable.

**[0005]** In US-A-4.352.706 a metal foil is provided on a security document, particularly in such a manner that at a first angle a first image is visible and at a second angle an image that differs from the first is visible.

**[0006]** In US-A-5.009.486 a security feature is described provided with a coating that is built up such that interference effects occur as a result of which at a first angle a first colour is perceived and at a second angle a second colour.

**[0007]** WO-A1-2004/014665 regards a security feature comprising a metal foil layer of which the thickness is locally reduced so that visually distinguishable areas can be perceived.

**[0008]** The said features all are so-called public features that are visually easy to perceive and that enable the general public to verify whether or not a document is authentic. Characteristic for these security features is that by means of a technique that is not available to the general public a visual effect is caused. When, however, various different additional security features have been provided in a foil area, the foil area has become complex and the public might get confused as to whether the foil area is authentic.

**[0009]** Therefore there is a need for a further security feature. Moreover there is a need for improvement of the foil area as a security feature.

**[0010]** To that end the invention relates to a security document according to claim 1. Advantageous embodiments are described in the dependent claims.

**[0011]** Protection against forgery by means of two or three holographic depictions in the foil, that can each be made individually visible, is moreover clearly increased when each of the depictions is based on one or more different holographic techniques.

**[0012]** By separating two areas that are thus easily visually distinguishable, it is easy for the public to verify whether the foil area is authentic and genuine, and more

particularly whether the security features provided for that target group are there.

**[0013]** In security documents, particularly banknotes, the security features are subdivided into several groups or levels, namely:

- first-degree features: for the public in general;
- second-degree features: for shop keepers, tellers and other professionals handling money;
- third-degree features: machine readable features for use beyond national banks, for instance by automations, cash dispensers (ATMs), sorting machines, cash recycle machines, and the like;
- fourth-degree features: machine readable features for central banks, such as the European Central Bank or De Nederlandsche Bank;
- fifth-degree features: for banknote experts such as for forensic research.

**[0014]** In one embodiment of the security document according to the invention further public security features that are visually perceivable by the general public have been provided within the first area, and within the second area further security features have been provided. As a result the general public can easily visually verify whether a security document, and particularly the foil area thereon, is authentic. Preferably the further security features are not visually perceivable just like that, particularly not without using aids intended especially for that purpose. As a result it is easier for various target groups to check the authenticity, as the further features intended for said target group are all placed in a visually easily recognisable area.

**[0015]** In a further or other embodiment the first area has a different texture than the second area.

**[0016]** In a further or alternative embodiment the first area has a different gloss than the second area.

**[0017]** In a further or alternative embodiment the foil area comprises several areas, and the areas are distinct from each other because of colour differences. In this embodiment preferably several, for instance adjacent, areas can be distinguished. All these areas may have a different colour. Another possibility is to give adjacent areas mutually different colours, that means visually distinguishable colours. Preferably, in general, the colours and differences are selected such that they also show a distinction to for instance the colourblind.

**[0018]** In one embodiment the areas with a colour are provided with a transparent colour, preferably a transparent layer. As a result further visible security features can be incorporated in or under the layer.

**[0019]** In one embodiment at least one area comprises a metal layer, preferably a metal foil layer. A metal foil layer is not easily reproduced. Moreover the metal layer can be seen through the transparent coloured layer, and further advanced security features can be provided in or on the metal foil.

**[0020]** In one embodiment at least one area is colour-

less transparent. In that case the colour is determined by the transparent layer and/or glue layer, and/or the (local) colour of the lower layer is visible, usually the carrier of the security document. In case of a banknote the local colour, or image/image part of the banknote.

**[0021]** In one embodiment the public security features have been provided in or on a layer of the foil area, for instance on the metal foil, or in the form of parts cut away from the metal foil. In one embodiment the further security features have been provided in or on the foil area. In one embodiment the foil area comprises at least one metal foil area, of which at least one part of the surface is provided with at least one additional coloured layer, preferably a transparent or translucent coloured layer.

**[0022]** In one embodiment first-degree security features have been incorporated in at least one first area, and in at least one second area security features selected from the group of second-degree, third-degree, fourth-degree and fifth-degree security features. In one embodiment no first-degree security features have been provided in at least one area with security features selected from the group of second-degree, third-degree, fourth-degree and fifth-degree security features. In one embodiment no security features selected from the group of second-degree, third-degree, fourth-degree and fifth-degree security features have been provided in an area with first-degree security features.

**[0023]** In one embodiment the foil area comprises at least one first area and at least one second area. In one embodiment the areas connect to each other, preferably seamlessly. As a result an additional difficulty is created offering extra protection.

**[0024]** A foil area or foil part on security documents, such as banknotes, usually comprises a metal layer, usually aluminium, but possibly copper or another metal, in one embodiment a metal foil. Said layer usually is provided with mostly a synthetic protective layer. The foil area often is provided on the carrier by means of a glue layer. Security features may be incorporated in or on the protective layer, in or on the metal layer or metal foil, and even in the glue layer. A foil area according to the invention may if so desired comprise several metal foil areas, wherein in a further embodiment one or more metal foil areas are at least partially provided with one or more coloured transparent layers. As result areas that are visually distinguishable to the public are created. In or on one or more of said areas further public security features may be provided, that means security features that can be recognised as such by the public. For the foil area according to the invention in one embodiment an additional translucent coloured layer is provided on the metal foil layer. Another option is to provide the (colourless transparent) protective layer with a colourant.

**[0025]** Another aspect of the invention regards a security document comprising a security part comprising a foil area, wherein the foil area comprises at least one metal foil area, wherein at least a part of the metal foil area is provided with a transparent, coloured layer. In

one embodiment the transparent coloured layer is provided on the metal foil. In a further embodiment the metal foil area is provided with at least two areas each having a transparent, coloured layer having a different, visually distinguishable colour. Alternatively the foil itself may be locally coloured.

**[0026]** All embodiments mentioned can be combined, as a result of which the possibilities for an even better security increase. It is of importance that the foil area has at least two areas, which to the public are visually distinguishable by their colour. Further security features are distributed over the various areas in a predetermined way. In one embodiment the areas connect to each other, preferably seamlessly.

**[0027]** The invention further regards a security document provided with a foil area, and further image elements provided on the security document in a visually perceivable manner, which image elements include among others see-through registers, watermarks, printed image elements, visually perceivable tactile elements, wherein the foil area and the further visually perceivable image elements together form an image, or enhance the visual attention to each other. As a result the mutual positioning of the various parts, that are provided in process courses, becomes critical, which ensures an extra security that is visually easy to verify. In addition the user's attention is drawn to an important area, and it entices further inspection, which is beneficial to the security. Further, as the composition as a whole is visually "correct" and shows coherence, the authenticity can be assessed even without direct comparison with a specimen of which one is sure that it is authentic.

**[0028]** The invention further regards a security document provided with a foil area provided with at least two visually distinguishable areas, wherein the first area at a first angle of observation has a first colour, and the second area at a second angle of observation that differs from the first angle of observation has a second colour that is different from the first colour and is visually distinguishable therefrom. In one embodiment further public features may be incorporated in one of either areas and in the second area further security features or authenticity features. Further features described in this description may if so desired be combined therewith for an additional security.

**[0029]** The invention further regards a foil area, intended and suitable as foil area on a security document as described above.

**[0030]** The invention will be elucidated on the basis of a number of exemplary embodiments shown in the attached drawings, in which:

Figure 1 shows a security document provided with a foil area according to an embodiment of the invention;

Figure 2 shows an alternative foil area according to the invention;

Figure 3 shows a security document provided with an alternative foil area according to the invention;

Figure 4 shows an alternative foil area according to the invention;

Figure 5 shows different possible shapes of the foil area;

Figure 6 shows alternative shapes for a foil area extending over the full width of a security document;

Figure 7 shows a security document provided with a foil area having an overprint over the foil area;

Figure 8 shows an alternative embodiment of a security document of figure 7;

Figure 9 shows a security document provided with a foil area having tactile elements on the foil area;

Figure 10 shows an alternative embodiment of figure 9;

Figure 11 shows a further example of a security by means of a foil having different visually perceivable areas;

Figure 12 shows different ways a, b, c and d in which the public may move for instance a banknote to make the image visible;

Figures 13A and 13B show a movement of a banknote that appears to have the general public's preference (corresponds to figure 12A, north-south tilting);

Figures 14A, 14B and 14C show an example of an image that shows a visually different image at different angles, wherein the images have a logical connection;

Figures 15A-15C just like figures 14 show an example of an image that differs at different angles, yet having a logical mutual connection;

Figure 16 shows a further security feature based on a foil, considered from the rear side of the note;

Figure 17 shows yet a further security feature based on a foil, visually adjustable to the foil design by the print;

Figure 18 shows yet a further security feature based on a foil, by providing a tactual discernible print;

Figure 19 shows a schematic example of a sandwich of a base print, a foil and an overprint;

Figure 20 shows an example of a banknote provided with the security feature of figure 11.

**[0031]** In figure 1 a security document 1 provided with a foil area 2 is shown. The foil area in this case is round and has three distinguishable areas, namely a mid-area 3 having a first colour, an area 4 surrounding it and having a second colour and a transparent area 5 surrounding that. Due to the colour the foil area can be divided into two colour areas 3 and 4. In addition a metal foil may be provided underneath the mid-area in the foil, which metal foil may also extend over the area 4 surrounding it. Moreover by providing security features in the metal foil, such as holograms, high resolution structures, such as micro lines, micro diffraction structures, nano structures, small to very small texts, high-reflection structures that may or may not be combined with low-reflection structures, small perforations, transparent areas, and by distributing them over these areas, the possibility is created of verifying whether or not the foil area is indeed authentic. For instance one or more of the said security features can be provided in the mid-area 3 only. Some security features may also be provided in the mid-area 3, and others in the area 4 surrounding it. By providing areas with text wherein the metal layer has been removed, such as for instance the currency symbol of the Euro or the like or incorporating small images or flags such as stars, music, signs, and autographs in one of either coloured parts, and optionally a feature that is easily perceivable by the public, such as for instance a hologram or the like, in the second colour part, two clearly distinguishable areas are created that are easily perceivable to the public. The public can therefore address one of either colour areas when verifying, as the security features important to the public have been incorporated therein. The security features that are not intended for the public may be incorporated in the second colour area.

**[0032]** Figure 2 shows an alternative embodiment of a foil area 2 according to the invention, wherein again a first mid-colour area 3 is present, and surrounding it several colour areas 4, 4', 4'', 4''', in this example each having a different colour. If so desired the surrounding colours may gradually merge from the one colour into the other colour. The foil area is again provided with a transparent edge 5. In each distinguishable colour area for instance another security feature can be incorporated, which may or may not be a public feature or a further security feature. In addition metal foil may be provided underneath the entire colour area, or parts or areas thereof. In one embodiment the colour areas have been provided on the metal foil, and over it a colourless, transparent synthetic protective foil has been provided that extends beyond the metal foil and as a result forms the transparent colourless edge.

**[0033]** Figure 3 shows an alternative embodiment of a security document 1 provided with a foil area 2. In this case the foil area 2 extends over a small part of the longitudinal axis, and over the full width of the security doc-

ument 1. The foil part 2 again is provided with a first colour area 3, a second colour area 4 and colourless, transparent parts 5 along the edges.

**[0034]** Figure 4 shows an alternative embodiment of the foil part of figure 3, wherein this time the colourless, transparent edge extends around the foil area. The overall foil area here extends over the overall width of the security document. The metal foil area here has a first colour area 3 and further colour areas adjacent to colour area 3 and extending to the transparent edge. Said colour areas are indicated with the numbers 4, 4', 4" and 4"', wherein each area has a different colour.

**[0035]** Figure 5 shows various possible shapes of the foil area. The various areas may have the same contour. The contours may also differ to such an extent that two or more areas together as a result emphasise the contour or form a depiction therewith.

**[0036]** Figures 6A-F show more alternative embodiments of a foil area extending over the full width of a security document. The edges are not straight here, and in some embodiments they are not even continuous.

**[0037]** Figure 7 shows a security document according to the invention provided with a foil area 2 having a first colour area 3, a second colour area 4 and a colourless, transparent edge 5 around the foil area 2. A print 6 has been provided on the security document extending over both the security document surface and over the foil area 2. Preferably said overprint 6 is provided such that it extends continuously from the security document 1 over the foil area 2.

**[0038]** Figure 8 shows an alternative embodiment of the security document 1 of figure 7, wherein the foil area 2 extends over almost the full width of the security document 1. Again an overprint 6 is provided that runs over the security document 1 where it is not provided with a foil area as well as over the foil area 2. One of the overprint parts 6 here runs over the full foil area 2 such that it extends on both sides of the foil area 2 on the surface of the security document 1 where the foil area 2 does not extend.

**[0039]** Figure 9 shows an embodiment of a security document 1 provided with a foil area 2. The foil area 2 is provided here with a first colour area 3, a second colour area 4 and a colourless transparent edge 5, as has already been described before. A tactile element 7 has been provided on the foil area 2. Such tactile areas 7 in a banknote can be felt better on a smooth basis such as the foil area 2. Optionally the tactile element or elements may extend over the foil area 2 and over a part of the document 1 where there is no foil area, preferably continuously. As a result the tactile areas 7 are better perceivable to the general public as well as to the visually handicapped. The transition from a surface of the security document 1 to the foil area 2 and from the foil area 2 to the tactile element 7 is after all better perceivable.

**[0040]** Figure 10 shows an alternative embodiment of figure 9, wherein the foil area 2 extends over (almost the full) width of the security document 1. The foil area 2 in

this case is provided with a first colour area 3, a second colour area 4 and colourless transparent strips 5 which extend along the foil area 2 and indicate the transition from the foil area 2 to the rest of the security document 1. One of either colour areas is provided with tactile elements 7 on the foil area 2. If so desired either the one or the other colour area may be provided with a tactile element 7, or both colour areas 3, 4 can be provided with distinguishable tactile elements 7. If so desired the tactile elements 7 may also extend over the full foil area 2 and if so desired continue on a part of the security document 1 that has not been provided with such a foil area 2. Under the coloured areas metal foil may be provided, even several metal foil areas, even of different metals.

**[0041]** Figure 11 shows a further exemplary embodiment of a security feature according to the invention, wherein again a security document 1 is provided with a foil area 2. An indication has been provided over the foil area 2 by means of printing 6. In case of a banknote said indication may for instance be the denomination in print. The foil area 2 is provided with an area having a first colour 3, and an area having a second colour 4. The colour area 4 furthermore has been given a clearly distinguishable shape so that it strikes even more with respect to the colour area 3. In this colour area 4 for instance the public features may be incorporated that are easy to perceive by the public. An example of such public features may for instance be a hologram image or another technical feature that is easy to perceive by the public, such as for instance a feature wherein an image changes colour or something like that. Such security features are generally known per se in the art. The foil web 2 is further provided with a transparent part 5 through which the underlying print of the security document can be seen. Furthermore an indication 8 has been incorporated in the foil web, which indication 8 corresponds to the indication 6 printed over the foil, the indication 6 provided by means of printing. As a result the public can again easily verify whether the foil web is authentic and whether the foil web belongs to the document.

**[0042]** A security document may furthermore be provided with a security feature of which for instance the colour changes when the viewing angle changes. At the start of the introduction to the description a number of such features were mentioned, such as for instance holograms, interference coatings, metal foils on which various treatments have been performed such as changes in thickness and the like. There are various possibilities to make the various images or depictions visible, for instance by tilting the document 1 about a longitudinal axis (north-south, N,S) or moving it north-south (shown in figure 12A), or reciprocally moving or rotating it about a latitudinal axis (W, E, figure 12B), or rotating it anticlockwise (+, figure 12C) or clockwise (-, figure 12D). Tests proved that the general public prefers tilting a banknote about the longitudinal axis as shown in figures 13A and 13B, wherein the public usually first looks at the normal viewing angle, indicated with B, subsequently tilts +60°,

indicated with C, and then tilts -30° indicated with indication A.

**[0043]** The protection against forgery by means of three holographic depictions in the foil, that can each be made individually visible in the manner as shown in figure 13 is furthermore considerably increased when each of the depictions is based on one or more different holographic techniques. The selection can among others be made from:

- holographic image elements based on either a symmetric or asymmetric line structure;
- holographic image elements based on either a line grid or dot grid;
- parallel line structures and cross gratings;
- variation of line orientation in both horizontal and vertical or azimuth direction;
- variation of the resolution of the line grid and/or dot grids, for instance 600 lines/mm for image A, 1000 lines/mm for image B and 1400 lines/mm for image C;
- so-called lenticular structures (such as the Fresnel lens);
- so-called 'pumping effects';
- combinations of the above-mentioned techniques in a single holographic image or depiction.

**[0044]** To the expert it will be obvious that the above-mentioned holographic techniques are based on exploiting either laser technologies or electro beam curing technology (e-beam). For instance laser technique is more suitable for arranging a traditional 3-D portrait in a foil and with e-beam for instance asymmetric line structures can be written, optionally having a much higher resolution.

**[0045]** Tests showed that the public considers a combination of three different holographic depictions or images rather much. When two depictions have to suffice, the mid position, depiction B of figure 13A and 13B has to be cancelled. For that matter it is recommendable that the two or three depictions do not overlap too much, that means that the public can clearly perceive the various holographic images individually at the different angles of perception. The different depictions preferably are provided at the same position on the document.

**[0046]** Increasing the security is among others realised when two or three depictions are made in the foil using a combination of laser and e-beam technology, wherein for instance a first depiction is made by means of a laser technology and a second depiction by means of e-beam technology. Naturally more complex designs can also be made wherein for instance the first depiction, and optionally also a second or third depiction are built up from both laser and e-beam techniques. Preferably the parts of the depictions in the foil that have been made using various holographic techniques have been placed in register. As a result a registration between both techniques is necessary, which puts up further barriers against forgery.

**[0047]** Designs for the public part can be made based on structures (pixels and lines) and based on colour. An interplay between these two affords the best protection, figure 14 and 15 are examples of this.

**[0048]** Figures 14A-14C show a foil security feature provided with three areas 1, 2 and 3. The traffic light clearly contains colour information, whereas the car, designed in a line structure, drives from green to red when the viewing angle changes. Figure 14A corresponds to a viewing angle of approximately +60° of figure 13A, position C and shows a green traffic light. Figure 14B corresponds to a normal viewing angle of approximately 0° of figure 13A (position B) and shows a yellow traffic light. Figure 14C shows the foil element at a viewing angle of approximately -30° of figure 13A, that means position A, and shows a red traffic light. Due to the playful nature of the series of depictions, the foil element entices further inspection. The feature shown may optionally be combined with other features described herein.

**[0049]** Figures 15A-15C, like figure 14, show a foil security feature provided with three areas 1, 2 and 3. In this example the colour information is incorporated in the light signal emitted by the lighthouse. The areas 1, 2 and 3 each have their own colour, for instance changing from blue (area 1), through yellow (area 2) to red (area 3). The line structure information in this case is incorporated in the lighthouse cabin, for instance by creating a 3D-effect. This foil element has three areas, each having their own visually distinguishable colour.

**[0050]** Figure 16 shows, as considered from the rear side of the document, a foil area 2 on a security document 1, wherein the foil area 2 is provided with a transparent part 5 and a first colour area 4, in this case a piece of a jig-saw puzzle, and a second area 3, in this case having the shape of a little human figure with raised hands. A transparent contour is left free around the little human figure. When the note or security document is held against the light, the full area 3 is visible, for instance because with transparent parts, for instance in the form of little circles, the shape of the little human figure is cut away. The first colour area 4, in this case a piece of a jig-saw puzzle, in which the second colour area 3 is provided, are in register and form a see-through register. When the note or security document 1 is held against the light the full area 4 becomes visible, otherwise only a part thereof, namely colour area 3 having the transparent frame.

**[0051]** Figure 17 shows yet another embodiment of the foil feature according to the invention, wherein a security document 1 is provided with a foil area 2 provided with a transparent part 5, a first colour area 4 in the shape of a piece of a jig-saw puzzle in which further public features can be incorporated, a second colour area (in this case formed by the transparent part 5 that is provided over a basis having a certain colour or which has a colour itself), and a foil element 7 as further colour area that continues in the print elements 6. The foil area 2 thus forms a visually continuing unity with the elements of print parts 6. Moreover the parts 6 provided by means of printing, due

to their shape and order emphasise the colour area 4 that is provided for the public. As a result the public's attention is drawn to the colour area 4. Colour area 7 of figure 17 can either be incorporated as a foil element or as a print element (part of print parts 6).

**[0052]** Figure 18 shows another embodiment in which a security document 1 is provided with a foil part 2 provided with a transparent part 4 and a first colour area 3 in the shape of a piece of a jig-saw puzzle. The foil is partially overprinted by colour area 5, which is designed as a tactile feature.

**[0053]** Figure 19 shows a laminate of a print layer 1 provided underneath for instance by means of offset or screen printing, or a combination thereof, also called base print. Over it a foil layer 2 is provided in which the features according to the invention or other features have been provided. Over said foil layer 2 yet a further print layer 3 has been provided. The foil layer 3 is thus clamped in between two printing courses 1 and 3. The various printed image elements and the foil may together, as for instance shown in the various preceding figures, form an image or depiction or a coherent unity. In addition the various depictions together may tell a story. Moreover for instance the print elements may draw the public's attention to the foil security feature or the foil security features, which entices further inspection.

**[0054]** Figure 20 shows a foil as shown before in figure 11, used here on a Euro banknote, the overprint 6 in this case being a value number of 10 Euro and the base print being the usual printing course of a Euro note. In between, between the overprint 6, for instance intaglio, and the standard base print of a banknote, usually a combination of offset technique, a foil web 2 is provided which is provided with the features as already discussed above.

## Claims

**1.** Security document comprising a protection against forgery comprising two holographic depictions in a foil, that can each be made individually visible, by tilting about an axis of the security document, wherein each of the depictions is based on one or more different holographic techniques.

**2.** Security document according to claim 1, wherein the depiction can each be made individually visible by tilting about a longitudinal axis of the security document.

**3.** Security document according any one of the preceding claims, wherein one or more different holographic techniques have been selected from:

- holographic image elements based on either a symmetric or asymmetric line structure;
- holographic image elements based on either a line grid or dot grid;

- parallel line structures and cross gratings;
- variation of line orientation in both horizontal and vertical or azimuth direction;
- variation of the resolution of the line grid and/or dot grids, for instance 600 lines/mm for image A, 1000 lines/mm for image B and 1400 lines/mm for image C;
- so-called lenticular structures (such as the Fresnel lens);
- so-called 'pumping effects'; and

combinations of the above-mentioned techniques in a single holographic image or depiction.

**3.** Security document according to any one of the preceding claims, wherein the one depiction is visible at a viewing angle +60° with respect to a normal viewing angle, and the other depiction is visible at a viewing angle of -30° with respect to the normal viewing angle.

**5.** Security document according to any one of the preceding claims, wherein the protection against forgery comprises three holographic depictions in the foil, that can each be made individually visible.

**6.** Security document according to claim 5, wherein the third depiction is visible at a normal viewing angle.

**7.** Security document according to any one of the preceding claims, wherein the holographic depictions are individually perceivable.

**8.** Security document according to claim 7, wherein the depictions do not overlap each other too much.

**9.** Foil area, intended and suitable as foil surface on a security document according to any one of the preceding claims.

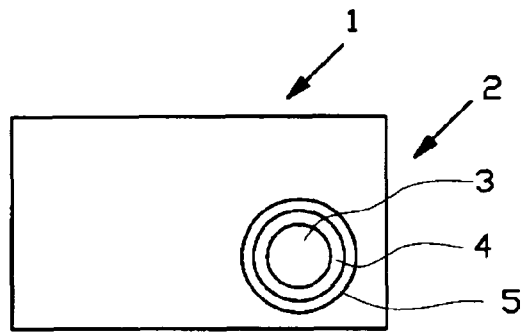


FIG. 1

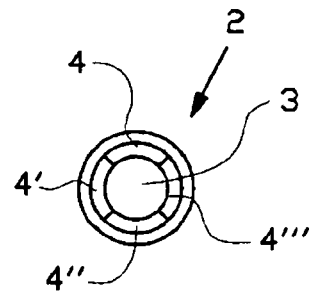


FIG. 2

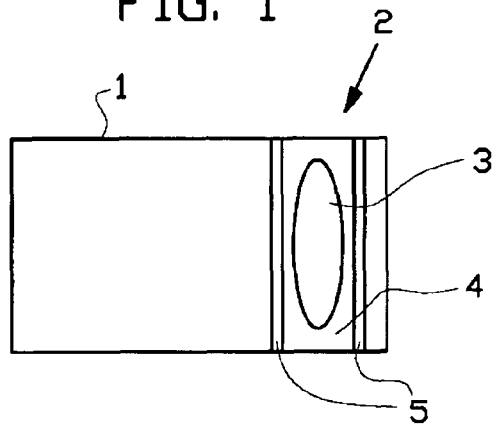


FIG. 3

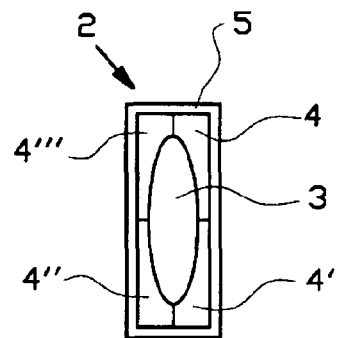


FIG. 4

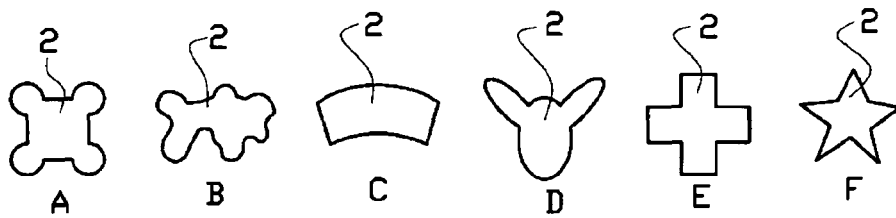


FIG. 5

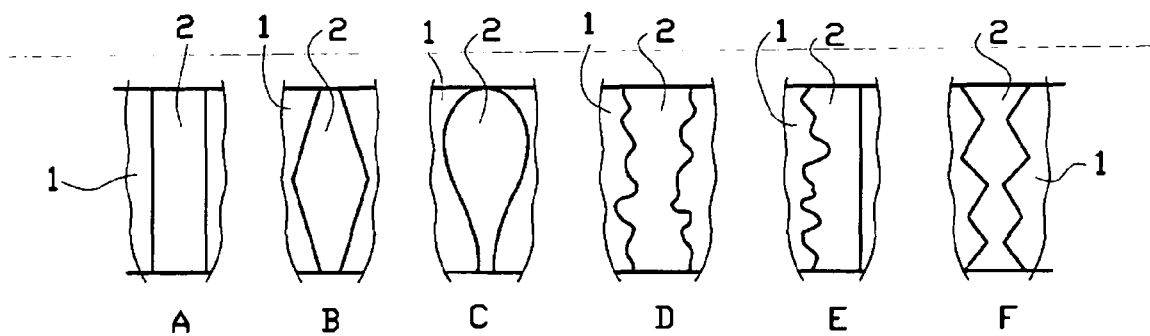


FIG. 6

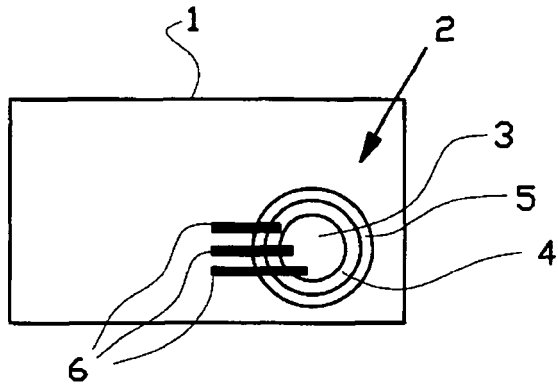


FIG. 7

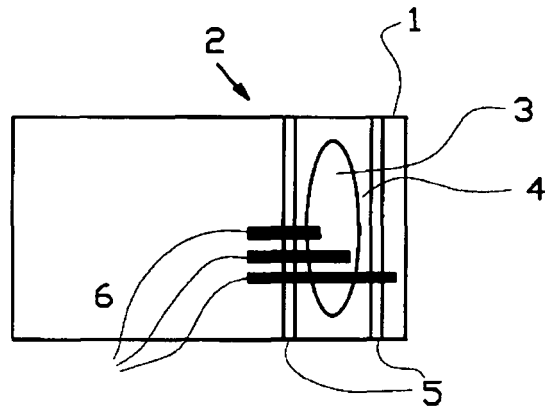


FIG. 8

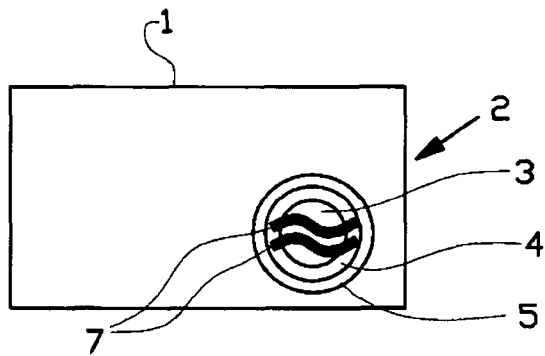


FIG. 9

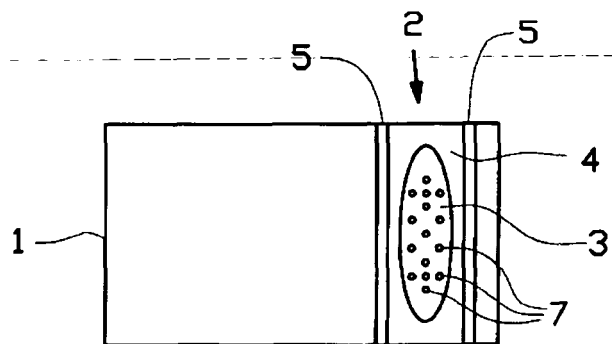


FIG. 10

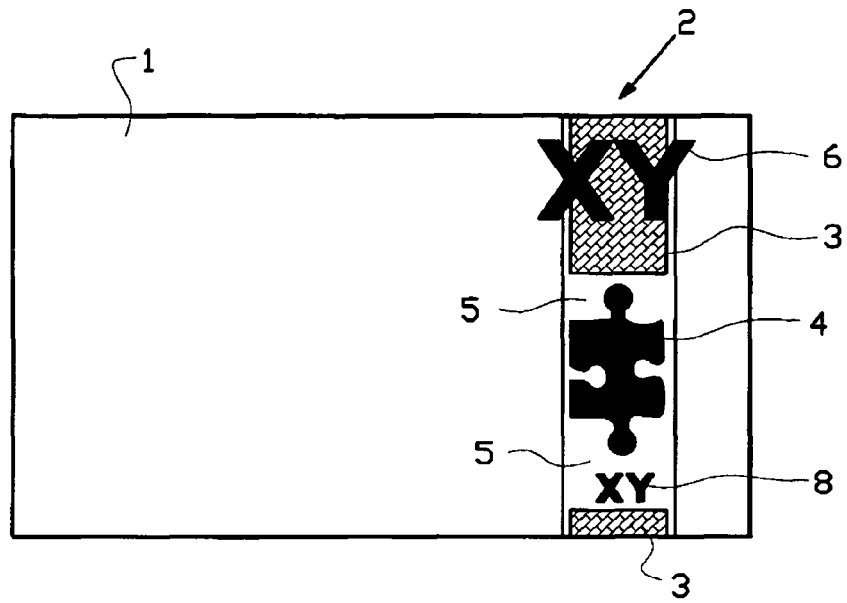


FIG. 11

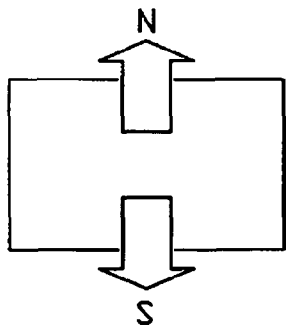


FIG. 12A

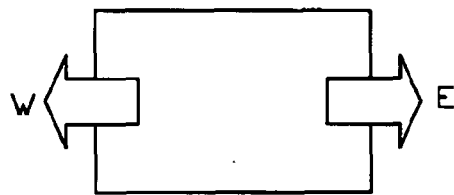


FIG. 12B

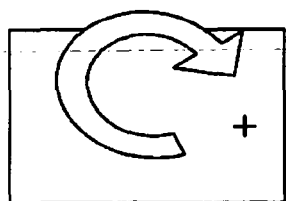


FIG. 12C

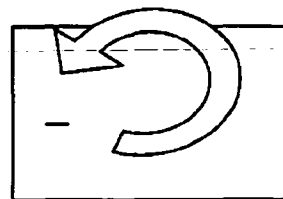


FIG. 12D

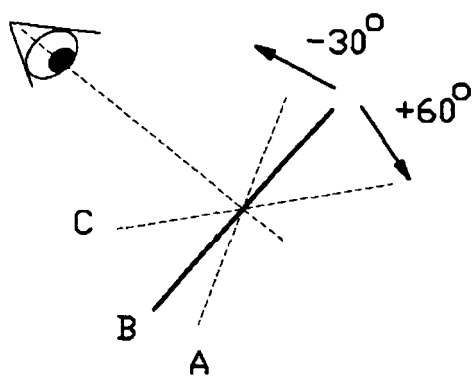


FIG. 13A

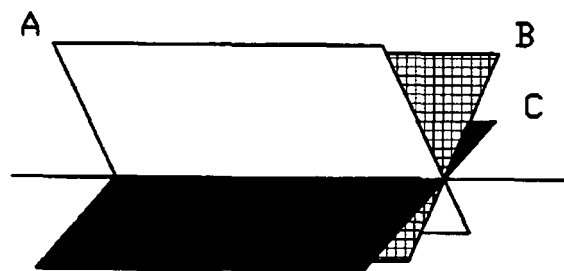


FIG. 13B

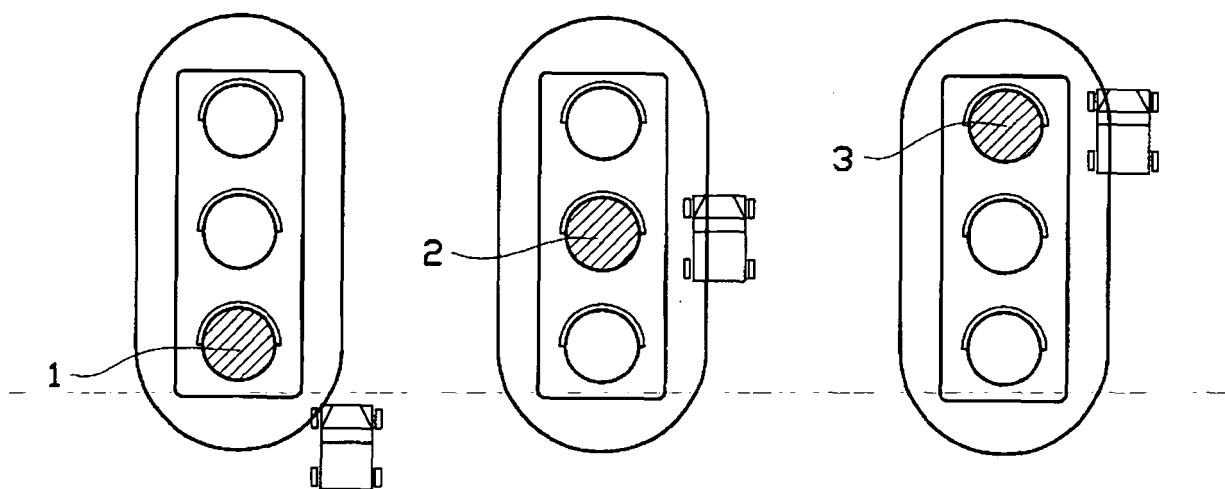


FIG. 14A

FIG. 14B

FIG. 14C

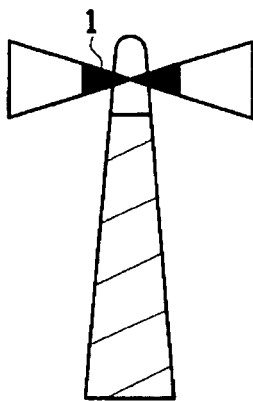


FIG. 15A

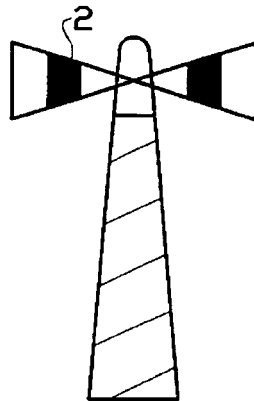


FIG. 15B

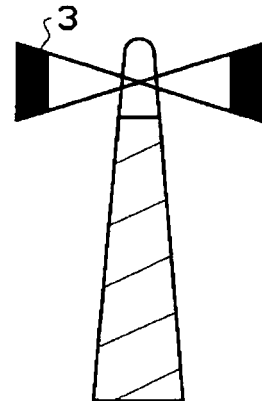


FIG. 15C

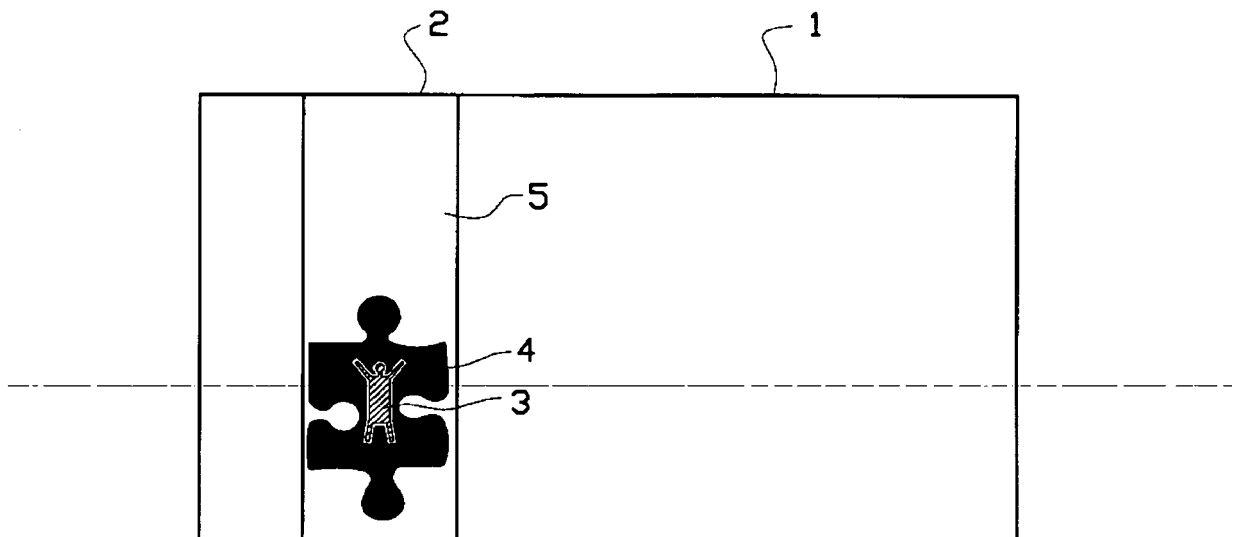


FIG. 16

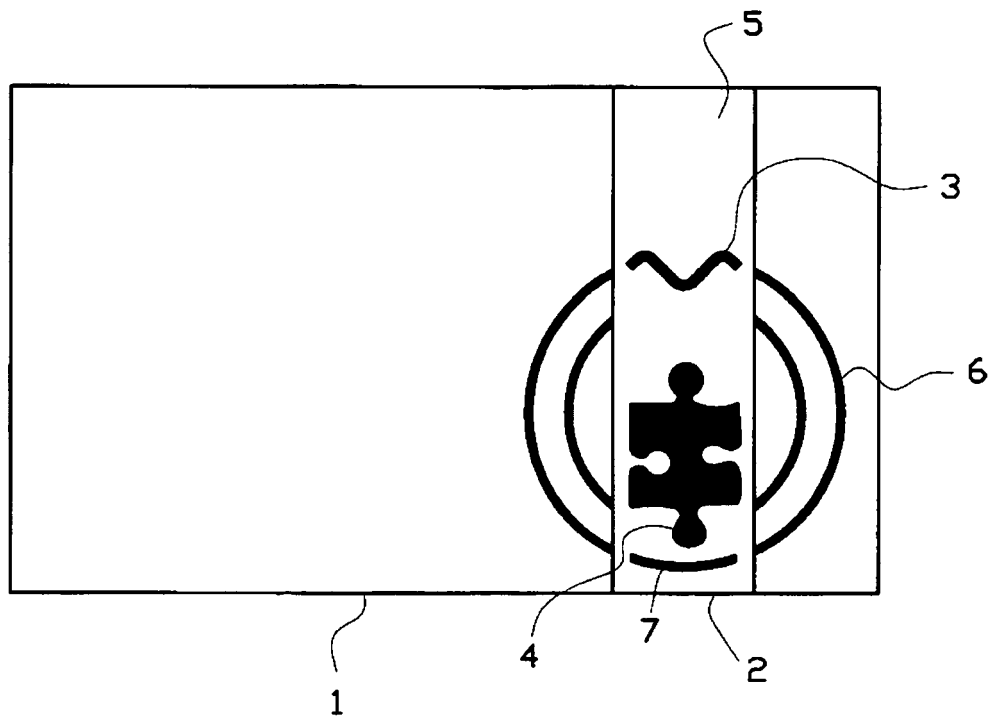


FIG. 17

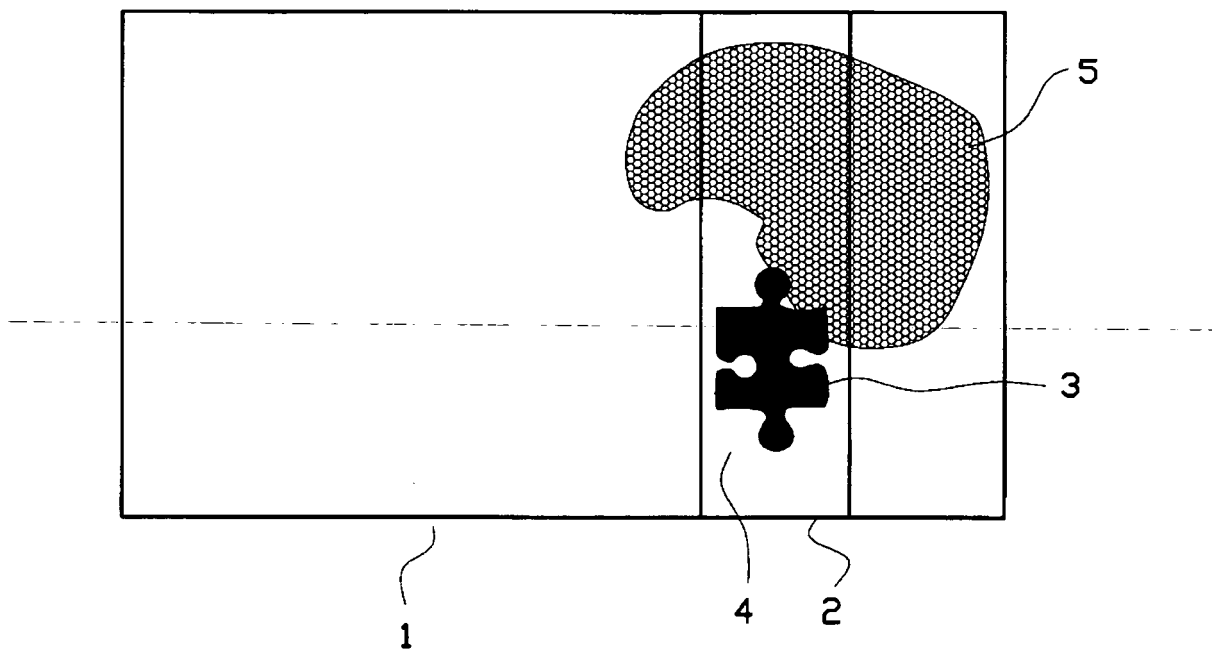


FIG. 18

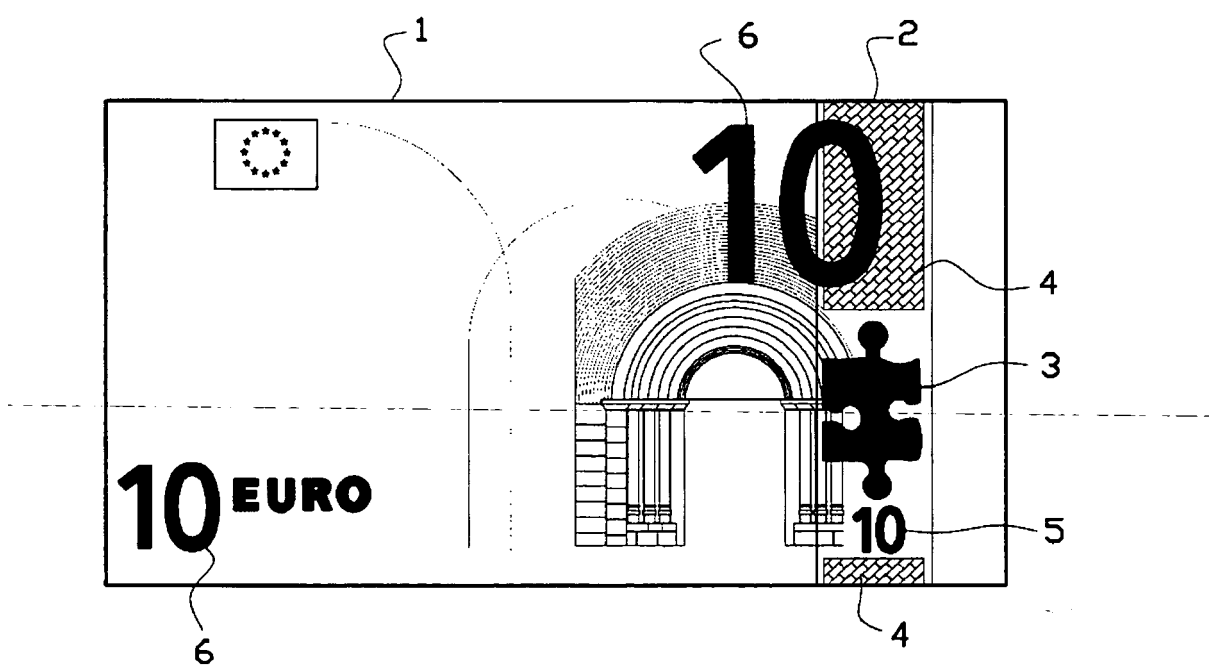
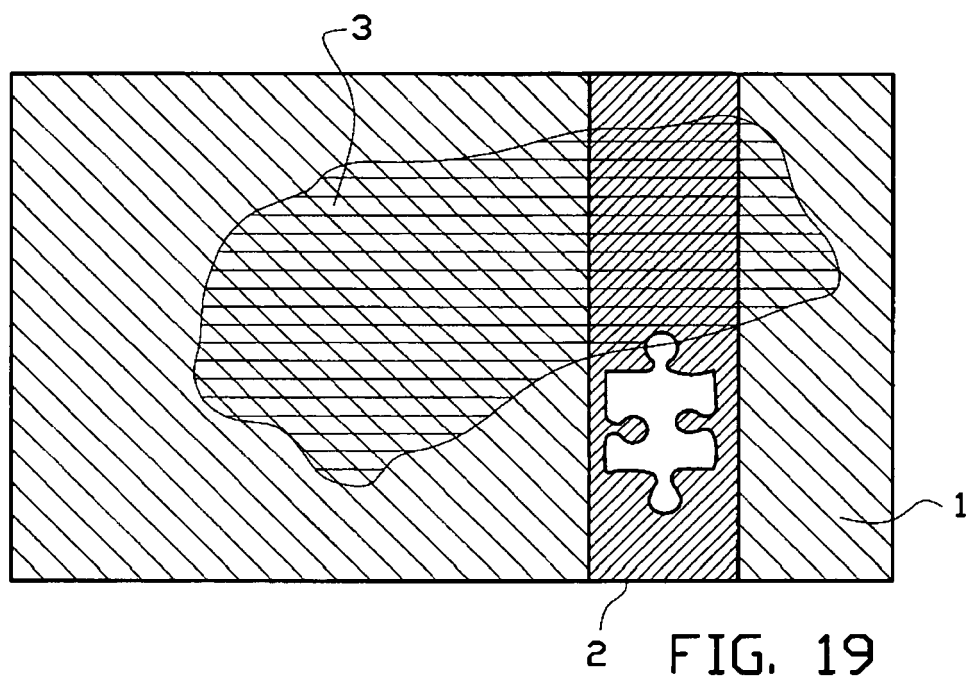


FIG. 20

**REFERENCES CITED IN THE DESCRIPTION**

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