

Security Document

A security document having a base body made of paper, polymer, composite materials, or the like, an effect film, particularly a hologram or the like, and a circuit, the circuit being positioned between the base body and the effect film and/or embedded in the effect film, and being connected to an antenna positioned between the effect film and the base body.

Providing security documents with security features, such as gravure printing, watermarks, security strips, holograms, Kinegrams, or the like, is known, in order to be able to check the authenticity of a security document and make the security document as secure from counterfeiting as possible. It is typical in this case to apply multiple different security features to a security document. These known security documents have the disadvantage that by adding a further security feature, the manufacturing time and the manufacturing costs of the security document are increased. Furthermore, these known security documents have the disadvantage that they cannot be individualized and the features cannot be adapted and/or updated after the security document is issued.

WO 01/43066 A1 discloses a check card having a circuit located thereon, which is connected to an antenna, a hologram able to be attached over the circuit. A check card according to WO 01/43066 A1 has the disadvantage that this arrangement of a circuit with an antenna and a hologram on a check card requires a large overall height, through which the circuit and/or the hologram may be damaged easily. In particular, the circuit and/or the hologram may be sheared off unintentionally on an edge or

the like when handling the check card. In addition, a special tool is required for sealing the chip/antenna/hologram element onto the check card using a thermoplastic film, in order to avoid damage to the chip because of the high sealing pressure required.

EP 1 179 811 A1 specifies a security document having a hologram, in which a chip is integrated in the hologram, the mirror layer of the hologram being implemented as an antenna. Because the hologram is used as the antenna, the overall height may be reduced in comparison to the element known from WO 01/43066 A1, but at the cost of the following disadvantages. The mirror layer of a hologram is typically made of aluminum and has a very low thickness, which may be approximately 30 nm. A security document according to EP 1 179 811 A1 has the disadvantage that aluminum has a low conductivity, because of which it is a poor antenna material, and because of the low thickness of the mirror layer, the antenna may only receive a small amount of energy, due to which the range of the antenna is low and the distance between a read device and the antenna must be small, because of which the read device must be positioned precisely in relation to the antenna. Therefore, the susceptibility to error when reading out the information of the circuit is increased, so that it may be completely impossible to read out the information because of a distance, which may not be reduced, required by the construction. This construction-required distance is determined, for example, by the thickness of the hologram. A further disadvantage of the security document according to EP 1 179 811 A1 is that the chip must be positioned very precisely in relation to the mirror layer during manufacturing in order to be able to ensure a conductive

connection between the chip and the antenna, through which the manufacturing costs are increased.

A module for an IC card, an IC card, and the manufacturing of an IC card are described in EP 0 919 950 A1. A chip connected to an antenna is inserted into a recess of the card, the chip being embedded in the laminated card. An embodiment according to EP 0 919 950 A1 has the disadvantage that it leads to a thick, inflexible construction.

US 6,111,303 A describes a card having a chip which is inserted into a depression of a base layer IC card. In this case, this chip is connected to an antenna which is formed by wire loops, the wire loops running between the bottom of the depression of the card and the IC and the depression being filled in with a resin after the chip is inserted. In a further method step, a PVC layer is glued to the base layer. An embodiment according to US 6,111,303 A has the disadvantage that it merely leads to a thick, inflexible construction, and the large antenna area which is formed by the wire loops may not be concealed in a transparent and/or translucent base body. Therefore, a security feature which is concealed to the user may not be implemented.

US 6,170,880 B1 specifies a check card, a chip being positioned below a hologram in a recess of the chip card. Furthermore, an antenna is provided, the antenna being positioned essentially between the effect film (the hologram) and the base body. The internal construction of a chip card of this type leads to a large overall height and an inflexible construction. This makes it largely impossible to implement chip cards of this type as very thin and flexible.

For banknotes, embedding a chip completely in the paper mass during the manufacturing of the paper of the banknotes and selecting its dimensions so small that subsequent printing processing is possible is known from DE 196 01 358 C2. Banknotes according to DE 196 01 358 C2 have the disadvantage that the chip, which represents a costly security feature, is already introduced in the step of paper manufacturing, because of which all of the rejects which arise in the individual production steps up to the finished banknote are also provided with a chip, due to which high manufacturing costs result, since experience has shown that the total rejects of the production chain may be approximately 20%. In addition, the antenna must be positioned on the chip, through which the disadvantages of a low energy transfer and accordingly a lower range also result here.

The object of the present invention is therefore to specify a security document of the type cited at the beginning, in which the disadvantages of the known achievements of the object are avoided. In particular, the present invention has the object of refining a security document of the type cited at the beginning in such a way that the protrusion of the chip/antenna/hologram element above the surface of the security document may be kept small. The use of a special tool for applying the element to the security document is also to be avoided. In addition, the emission and the storage of data from and/or in the chip is to be achieved reliably with the smallest possible energy consumption. Furthermore, it is the object of the present invention to provide a security document in which the information stored in electronic form is largely protected from undesired

manipulations and the memory has a high resistance to mechanically and/or chemically caused damage.

It is a further object of the present invention to specify a security document of the type cited at the beginning which may be manufactured simply, in the fewest possible work steps, and without a large outlay for apparatus, and in which at least a part of the security features remain hidden to a bearer of the security document.

A further object of the present invention is to specify a security document of the type cited at the beginning, which may be stacked easily and processed using machines, particularly counted or the like.

This is achieved according to the present invention in that the security document is a banknote. Banknotes represent security documents which are in circulation in large numbers. It is especially important in this case if individual banknotes may be identified rapidly and easily, through which it is possible to recognize banknotes having a predefinable identification. This is especially of interest for economic prognoses and in crimefighting. Furthermore, the advantage thus results that the circuit may be applied to the base body with the antenna and the effect film in one work step, so that the work steps required for manufacturing a security document according to the present invention largely correspond to those of a known security document having an effect film, e.g. a hologram, without a circuit. The circuit and the antenna are largely protected from mechanically and chemically caused damage by the effect film, no additional protective layers or the like having to be provided for the circuit. By positioning the circuit in a depression of the base body, the overall height of the base body, the circuit

having the antenna, and the effect film may be kept low. Because of this, the effect film protrudes only slightly above the base body or may even terminate in a plane therewith, so that the security document according to the present invention is well stackable and stacks of a few hundred up to thousand security documents may even be produced. Furthermore, the danger of damage to the effect film and/or the circuit, particularly through shearing, is reduced. A further advantage is that the effect film may be used as a carrier when applying the circuit.

In a refinement of the present invention, the circuit may be implemented as a chip. The circuit may be manufactured easily and cost-effectively using a chip.

In a further embodiment of the present invention, the circuit may be programmable. Information may thus be stored in the security document by different institutions, through which the history of a security document may be traced.

According to a further embodiment of the present invention, the antenna may comprise a metal layer, particularly made of copper, gold, silver, or the like, and be applied to an antenna film. Through the antenna film, the antenna may be protected from damage, copper being a good and cost-effective conductor, through which the required dimensions of the antenna, and also the signal strengths of the transmit and receive signals of the antenna, may be kept small. During manufacturing, the antenna film may also be used as the storage medium and carrier for multiple antennas and possibly the circuits connected thereto.

In a refinement of the present invention, the circuit and the antenna may be embedded in a first adhesive layer. Through the embedding in the first adhesive layer, the

circuit in the antenna may be bonded in a simple way to the effect film and/or the base body, the first adhesive layer additionally representing a protective layer for the circuit and the antenna.

In a further embodiment of the present invention, the antenna may be positioned between the circuit and the base body. If the information of the circuit is read out from the side of the base body facing away from the effect film, then through this arrangement the greatest possible range and an overall improvement of the transmit and receive properties of the antenna are achieved, through which the susceptibility to error of the system is reduced in particular.

Furthermore, the present invention relates to a method for manufacturing a security document according to the present invention having a base body made of paper or the like. The object of the present invention is to specify a method, using which the safety document described above may be manufactured simply and cost-effectively.

This is achieved according to the present invention in that, on an antenna film having a metal layer, particularly comprising copper, gold, silver, or the like, a chip contacting the metal layer is attached, the chip is embedded in a first adhesive layer, an effect film, particularly a hologram or the like, is applied to the first adhesive layer, a second adhesive layer is applied to the side of the antenna film diametrically opposing the metal layer, and the second adhesive layer is bonded to a depression of the base body.

The advantage thus results that the effect film and the chip may be applied to the base body in one work cycle, through which the manufacturing time of the security

document according to the present invention is kept low. Furthermore, the effect film and the chip may be applied to the security document in one of the last work steps during manufacturing, the rejects of the preceding production chain able to be separated out previously, through which the manufacturing costs of the security document may be kept as low as possible. Furthermore, it may be necessary during preceding work steps, particularly if a gravure printing method is used, to apply high pressures to the security document. Because of the subsequent application of the chip, it is not necessary to design these work steps while taking the danger of damaging an already applied chip into consideration, through which these work steps may be designed more simply and cost-effectively. A further advantage is that the effect film possibly projects only slightly beyond the base body, through which the danger of damage to the effect film and/or the chip, particularly through shearing, is reduced.

The present invention will be described in greater detail with reference to the attached drawing, in which embodiments are illustrated.

- Figure 1 shows an embodiment of a security document according to the present invention;
- Figure 2 shows a chip, containing a circuit, of the embodiment in Figure 1;
- Figure 3 shows a hologram of the embodiment in Figure 1, which is bonded to a carrier film;
- Figure 4 shows an antenna film having antennas, a chip being connected to each antenna;
- Figure 5 shows the antenna film in Figure 4, a first adhesive layer being applied to the antenna film;

Figure 6 shows the antenna film in Figure 5, a second adhesive layer being applied to the side diametrically opposing the antenna; and

Figure 7 shows the antenna film in Figure 6, a hologram having a carrier film being applied to the first adhesive layer.

Figure 1 shows an embodiment of a security document according to the present invention having a base body 1, an effect film 2, and a circuit 3. The circuit 3 is positioned between the base body 1 and the effect film 2. In other embodiments, at least a part of the circuit may be embedded in the effect film 2.

The base body 1 may be made of paper, polymer, composite materials, cotton, plastic, or the like and is preferably implemented as a thin film or the like. The effect film may comprise a hologram 2, a Kinegram, thin-film interference films, a metal-coated film, or the like.

An antenna 4 is positioned between the hologram 2 and the base body 1, the circuit 3 being connected to the antenna 4. Furthermore, the circuit 3 is positioned in a depression of 11 of the base body 1. It appears favourable in this case if the depression 11 is implemented as a watermark. The depression 11 may make up approximately a third to approximately a half of the total thickness of the base body 1.

The depression 11 of the base body 1 may also be produced through blind tooling. Furthermore, the depression 11 may be introduced into the security document using stamping or perforation, over which the hologram is applied. In this case, the circuit 3 and/or the antenna 4 may fill up the depression 11, implemented as a hole. A film application or the like for covering the hole may be provided on the

side of the security document diametrically opposing the hologram 2, if necessary.

In this context, it appears favourable if the antenna 4 is positioned between the circuit 3 and the base body 1, i.e., essentially on the bottom of the depression 11. If the information of the circuit 3 is read out from the side of the base body 1 facing away from the hologram 2, the greatest possible range and an overall improvement of the transmit and receive properties of the antenna 4 is achieved through this arrangement, through which the susceptibility to error of the system is reduced in particular.

According to Figure 2, the circuit may be implemented as a chip 3, which has contact points 31 for the contact to the antenna 4. Using the chip 3, the circuit may be manufactured independently, through which a modular construction of the antenna 4, the circuit 3, and the hologram 2 is achieved and, in the event of different embodiments, a chip 3 having a different circuit and/or a different effect film 2 may be used easily. Furthermore, the chip 3 may be programmable, so that the information stored therein may be changed even after it is applied to the security document. It appears advantageous in this case if only a part of the information may be changed and an identification number or the like is unchangeable. The chip 3 and the antenna 4 may particularly be implemented as a transponder.

Figure 3 schematically shows a hologram 2, which comprises a mirror layer 21, a middle layer 22, and a cover layer 23, the mirror layer 21 typically being made of a metallic material, particularly aluminum. A separation layer 24 and a carrier layer 25 are positioned above the cover layer 23. Using the carrier layer 25, multiple holograms 2 may be positioned and layered on a spool or the like. After the hologram 2 is applied to the base body 1, the carrier layer 25 may be separated from the hologram 2 using the separation layer 24.

A part of a manufacturing method for the security document according to the present invention is illustrated in Figures 4 through 7. According to Figure 4, the antenna 4 is applied to an antenna film 41 in this case. Through the antenna film, the antennas 4 are uniformly spaced apart from one another and multiple antennas 4 may be manipulated easily. The antenna 4 comprises a metal layer 42, which has good conductivity, through which the antenna 4 may be implemented having small dimensions. Copper, gold, silver, or the like appear especially suitable as the material of the metal layer 42. The chip 3 is connected to the antenna 4 using an adhesive 32, the contact points 31 being connected in a conductive way to the antenna 4. The chip 3 may be produced as a unit with the antenna 4 and the antenna film 41.

Figure 5 shows how the antenna 4 and the chip 3 are embedded in a first adhesive layer 51, the adhesive layer 51 completely covering the chip 3.

As shown in Figure 6, a second adhesive layer 52 is applied to the side of the antenna film 41 diametrically opposing the antenna 4, after which, as shown in Figure 7, the hologram 2 having the carrier film 25 is applied to the

first adhesive layer 51. Finally, the second adhesive layer 52 is bonded to the depression 11 of the base body and the carrier film 25 and the separation layer 24 are separated from the hologram 2.

In other embodiments, the hologram 2 may first be applied to the first adhesive layer 51 and the second adhesive layer 52 may be applied subsequently. The construction shown in Figure 7 may, however, be performed in any other sequence. With this construction, low precision requirements for the positioning of the hologram 2 over the circuit 3 are sufficient.

It appears advantageous that the hologram 2 and the circuit 3 may be applied to the base body 1 in one work step, through which the shortest possible manufacturing time of the security document according to the present invention is achieved. Furthermore, the hologram 2 forms a protection from mechanically and/or chemically caused damage for the circuit 3. Mechanically and/or chemically caused damage of the circuit 3 also results in damage to the hologram 2, which represents an optical security feature, because such damage is immediately apparent.

In this method according to the present invention, the circuit 3 may be applied to the security document at the end of the manufacturing method. If the security documents are checked after individual manufacturing steps and defective security documents are removed, it may be ensured that only a small number of rejected security documents occurs after the application of the circuit 3 and the effect film 2. The manufacturing costs of the security document according to the present invention may thus be kept low. Furthermore, the circuit 3 and/or the effect film 2 are prevented from being able to be damaged during a

manufacturing step of the security document according to the present invention, since the circuit 3 and the effect film 2 are not yet applied to the security document during this manufacturing step. The positioning of the effect film 2, the circuit 3, and the antenna 4 is performed in a single work step, independently from the manufacturing of the security document according to the present invention, the preassembled package of effect film 2, circuit 3, and antenna 4 being applied to the security document according to the present invention. Great flexibility in the event of an alteration of the effect film 2, the circuit 3, the shape of the antenna 4, or the like is thus also achieved. Since most bearers of the security document will remain unaware of the presence of the circuit 3, they also may not make any intentional attempts at manipulation of the information of the circuit 3. Through the arrangement of the circuit 3 in the depression 11 of the base body, the total height of the base body 1, the antenna 4, the circuit 3, and the hologram 2 possibly projects only slightly above the base body 1 without the depression 11, through which the danger of damage to the hologram 2 and/or the circuit 3 and/or the antenna 4 is reduced. Furthermore, the relatively smooth transition between the base body 1 and the hologram 2 appears capable of keeping the presence of the circuit 3 hidden to most bearers of the security document.

The security document according to the present invention may particularly be implemented as a banknote. If the circuit 3 is implemented as programmable, the path of a banknote may be traced, which is particularly of interest for crimefighting. Furthermore, valuable suggestions for economic policy may be produced using money flow analyses

and the efficiency of political measures may be checked and forecast better in this way.

The circuit 3 is completely covered by the hologram 2, so that the presence of the circuit 3 remains hidden to most bearers of the banknote. If all visible security features are counterfeited by counterfeiters, it may nonetheless be determined rapidly and easily that it is a counterfeit using a reading device for the information of the circuit 3.

What is claimed is:

1. A security document having a base body (1) made of paper, polymer, composite materials, or the like, an effect film (2), particularly a hologram or the like, and a circuit (3), the circuit (3) being positioned between the base body (1) and the effect film (2) and/or embedded in the effect film (2), and being connected to an antenna (4) positioned between the effect film (2) and the base body (1), and the circuit (3) being positioned in a depression (11) of the base body (1), particularly a watermark or the like, characterized in that the security document is a banknote.
2. The security document according to Claim 1, characterized in that the circuit is implemented as a chip (3).
3. The security document according to Claim 1 or 2, characterized in that the circuit (3) is programmable.
4. The security document according to Claim 1, 2, or 3, characterized in that the antenna (4) comprises a metal layer (42), particularly made of copper, gold, silver, or the like, and is applied to an antenna film (41).
5. The security document according to one of Claims 1 to 4, characterized in that the circuit (3) and the antenna (4) are embedded in a first adhesive layer (51).

6. The security document according to one of Claims 1 through 5, characterized in that the antenna (4) is positioned between the circuit (2) and the base body (1).

7. A method for manufacturing a security document having a base body made of paper, polymer, composite materials, or the like, preferably according to one of Claims 1 through 6, characterized in that on an antenna film (41) having a metal layer (42), particularly comprising copper, gold, silver, or the like, a chip (3), which contacts the metal layer (42), is attached, the chip (3) is embedded in a first adhesive layer (51), an effect film (2), particularly a hologram or the like, is applied to the first adhesive layer (51), a second adhesive layer (52) is applied to the side of the antenna film (41) diametrically opposing the metal layer (42), and the second adhesive layer (52) is bonded to a depression (11) of the base body (1).