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(54) Security document comprising electronic security means

(57) According to the present invention, a security document, particularly a banknote comprises a substrate (1) and on-board power supply (7) for driving a new class of electronic security means utilising the on-board power supply. The advantage of having an on-board power supply is that all electronic means using electric energy can be considered as security devices, i. e. all electronic devices having appropriate functions allowing an identification and/or authentication of the banknote without the use of an external apparatus. It is a major aspect of the invention that the on-board power supply means is a photovoltaic cell means the electrical power of which is self-generating and self-sustaining.

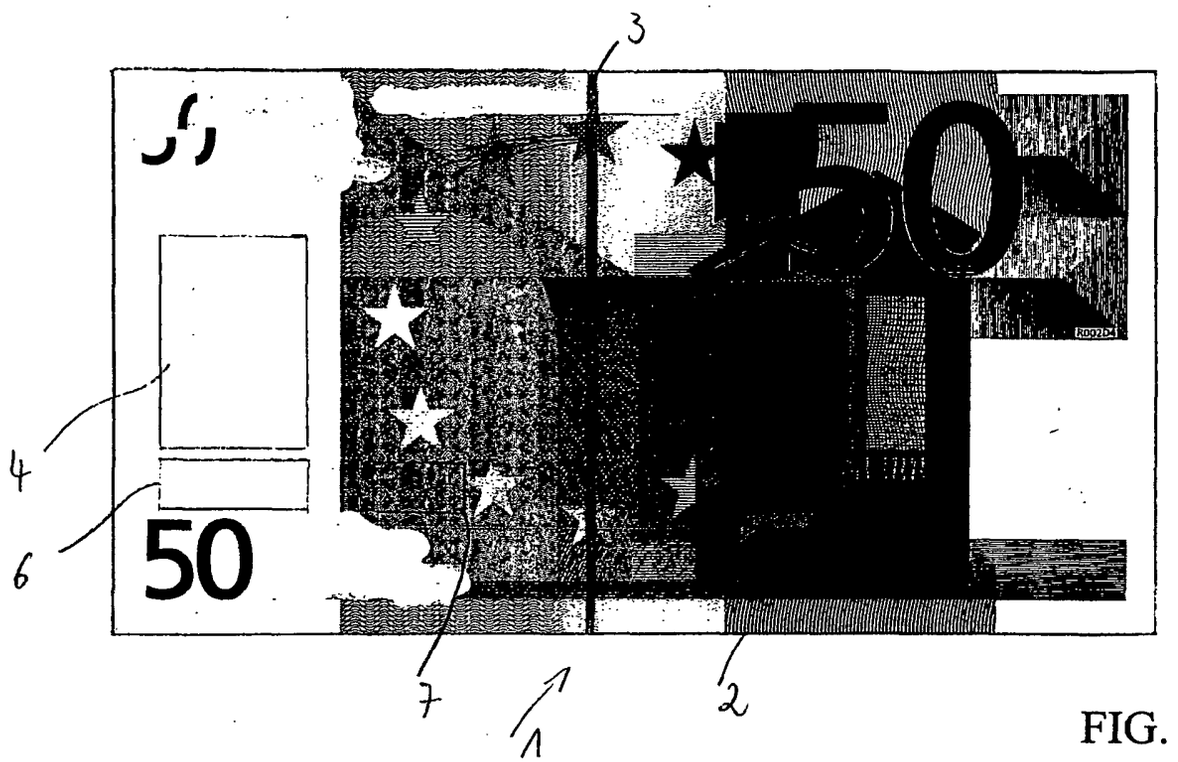

FIG. 1

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Description

[0001] The present invention relates to a security document, particularly a banknote comprising on-board electric power supply means for driving a new class of electronic security means utilizing on-board power supply.

[0002] Although the invention refers to security documents, for example banknotes, passports, identity cards, checks, stocks, bonds etc., reference is made hereinafter to banknotes.

[0003] The identification and authentication of banknotes is a long-standing problem. In order to solve this goal, security means for banknotes have been developed and are being developed to allow users and/or machines to discriminate between genuine and forged banknotes and/or to discriminate among different values of banknotes.

[0004] Among the techniques adopted are the use of special papers, special inks and patterns, the inclusion of watermarks and security threads as well. For example, some of these techniques are disclosed in US-A-4 462 866, US-A-4 652 015, US-A-4 943 093 and US-A-5 161 829. One of the advantages of the above security means is that there is no consumption of energy is involved. Therefore, most of the banknotes make use of the above techniques.

[0005] Although these traditional security means have been derived from sophisticated technological developments, it must be realised that they are becoming dated and more vulnerable to technological advances. Therefore, new security means have to be developed.

[0006] Photovoltaic cells have been known since the 19th Century and found numerous applications in a wide field of electric devices, particularly consumer products such as electronic calculators, watches etc, as well as aerospace applications, notably in satellites for instrument power.

[0007] It is an object of the present invention to provide a security document, particularly a banknote, with a new class of electronic security means for allowing users and/or machines to discriminate between genuine and counterfeited banknotes and/or to discriminate among different values of banknotes.

[0008] This problem is solved with the features of claim 1. Preferred embodiments of the invention are the subject matter of the dependent claims.

[0009] According to the present invention, the security document, particularly the banknote, comprises an on-board electrical power supply. The advantage of having an on-board power supply is that all means using an on-board power supply can be considered as new electronic security means, which have appropriate functions allowing users and/or machines to discriminate between genuine and counterfeited banknotes and/or to discriminate among different values of banknotes.

[0010] According to the invention, electronic security means are defined as electronic means using electric energy provided by an on-board power supply, without utilizing an external power supply, and allowing users and/or machines to discriminate between genuine and counterfeited banknotes and/or to discriminate among different values of banknotes without utilizing an external power supply.

[0011] It is an important aspect of the invention that the new class of electronic security means using electric energy of an on-board power supply basically allows an identification and/or authentication of the banknote by the user without utilizing an external apparatus.

[0012] According to a preferred embodiment of the invention, the electronic security means using electric energy comprises means for displaying predetermined data allowing users an identification and/or authentication of the banknote without utilizing an external reader device.

[0013] Because of the problem of power supply, the principle of providing banknotes with new security means comprising electronic components allowing an identification and/or authentication of the banknotes without utilizing an external reader device, have never been considered.

[0014] According to a further embodiment of the invention, the electronic security means is a means, particularly an integrated circuit (IC) capable of storing and emitting predetermined data in a non-contacting manner for the identification and/or authentication of the banknote. For example, such chips to be integrated into the banknote are described in DE-A-196 30 648 and DE-A-196 01 358. These chips, however, make use of an external reader/writer device, but only for communication and not for energising.

[0015] Some examples of electronic security means that can be used in combination with the on-board power supply means are means comprising a microchip, electroluminescent material, electro-active polymers/materials, light-emitting diodes, light-emitting polymers and polymeric electronic displays.

[0016] The banknote substrate can be produced of paper, plastic/polymer, elemental metallic/metallic alloy foils or a mix composite of two or more of the mentioned substrate-type materials.

[0017] Banknotes based on polymer substrates, for example biaxially oriented polypropylene, are currently in circulation in dozen countries.

[0018] It is a major aspect of the invention that the on-board power supply means is a photovoltaic (PV) cell means. Photovoltage may be defined as the conversion of light energy to electrical voltage by a material. The photovoltaic cell can function under normal white light of the electromagnetic spectrum but can also be tailor-made to work apart from normal white light at some other specific wavelengths of the electromagnetic spectrum.

[0019] The inventors have recognized that photovoltaic cells are not only capable as suitable power supply means for electric and electronic devices, such as

electronic calculators etc., but that also a security document, particularly a banknote, can be provided with a photovoltaic cell as an on-board power supply to have the above advantages. The photovoltaic cell enables generation and supply of electrical power, which is self-generating and self-sustaining.

[0020] The photovoltaic cell composition can be prepared by those skilled in the art of PV cell research, development and production. For example, the photovoltaic cells can be made of single crystalline or multicrystalline silicon, amorphous silicon, CuInSe2 and its alloys, CdTe and its alloys, polymer sandwiched between different contacts (e.g. A1 and ITO) for collecting a short-circuit photocurrent, etc., for example, in "thin-film" PV cell technology.

[0021] In a preferred embodiment of the invention a thin-film photovoltaic cell is incorporated into the banknote, which is thinner and lighter than other PV cells since they require less semiconductor material. Thin-film PV cells have been commercially available for many years. An important advantage of thin-film PV cells is that they can be created on flexible surfaces. Therefore, in the case that the banknote itself is made of flexible material, even a relative large surface of the banknote can be provided with the PV cell without decreasing the flexible properties of the banknote.

[0022] According to a specific embodiment of the invention, the photovoltaic cell means is directly applied on the surface of the front and/or reverse side of the security document, for example by hot stamping as a stripe or a patch. Hot stamping is a generally known dry printing method in which a heated die and foil are used to apply graphics to a part.

[0023] The photovoltaic cell can also be applied by other printing technology (e. g. inkjet, offset, screen, etc.) onto the banknote surfaces as a solid area. Screen printing is a known method to produce plastic PV cells (Shaheen, S. E., Radspinner, R., Peyghambarian, N. & Jabbour, G. E. Fabrication of bulk heterojunction plastic solar cells by screen printing. *Applied Physics Letters*, 79, 2996 - 2998, (2001)).

[0024] Preferably, the photovoltaic cell is integrated into a graphical design printing of the substrate means of the banknote so that the cell does not become apparent at once.

[0025] According to an alternative embodiment of the invention, the photovoltaic cell means is embedded into a substrate means of the banknote, which has transparency properties. Substrate means having transparent properties are, for example, polymer substrate means. Thus, the photovoltaic cell is protected from environmental, i. e mechanical and chemical attacks.

[0026] Security threads and holograms are widely used for authentication. The photovoltaic cell can be part of or integrated into the security thread or the hologram of the banknote.

[0027] For the purpose of illustrating the present invention, there are shown in the accompanying drawings embodiments which are presently preferred; it being understood that the invention is not limited to the precise arrangement and instrumentalities shown.

FIG. 1 is a schematic view of a first embodiment of a banknote comprising a photovoltaic cell on its front side,

FIG. 2 is a schematic cross sectional view of the banknote of FIG. 1, and

FIG. 3 is a schematic cross sectional view of a second embodiment of the banknote comprising a photovoltaic cell embedded into the substrate of the banknote.

[0028] FIG. 1 shows a schematic view of the front side of a banknote according to the invention. The banknote comprises a substrate 1 made of flexible material. A graphical design printing 2 is provided on the front and reverse side of the substrate. The banknote comprises a security thread 3 made of a metal strip and a hologram 4.

[0029] Furthermore, an electronic security device for providing predetermined data in a non-contacting manner, for example an integrated circuit (IC), is integrated into the substrate, and a display means for indicating predetermined data, for example a LCD display, is applied onto the front side of the substrate of the banknote (FIG. 2). A security device which can be integrated is, for example, described in EP-A-0 905 657, which is made part of the disclosure of the present specification. The security device and display means using electric energy are designated with the reference numbers 5 and 6. The on-board power supply 7 for both the IC 5 and the LCD display 6 is also applied on the front side of the substrate. The on-board power supply is a photovoltaic cell 7, preferably a thin-film PV cell created on a flexible carrier. The LCD display 6 should also be created on a flexible carrier. The photovoltaic cell and the LCD display are attached to the substrate preferably via flexible adhesive layers 8. For the case that the cell and/or the display are provided on non-flexible carriers and the substrate of the banknote is made of flexible material the cell and the display should be attached on non-flexible adhesive layers, respectively.

[0030] FIG. 3 is an alternative embodiment of the banknote comprising the security device 5, the display means 6 and the on-board power supply 7 for driving the security device and the display means as well, which is a photovoltaic cell. This embodiment differs form the embodiment of FIG. 1 and 2 in that the substrate 1 of the banknote is made of transparent material and the photovoltaic cell and the LCD display means are integrated into the substrate to protect these devices from mechanical and chemical attacks.

Claims

1. Security document comprising substrate means (1) and security means (5, 6), **characterised in that** the security document comprises an on-board electrical power supply means (7) and that said security means is an electronic security means (5, 6) using electric energy of said on-board electrical power supply means (7).

2. Security document according to claim 1, wherein the security document is a banknote including said substrate means (1) comprising said security means (5, 6) using electric energy.

3. Security document according to claim 1 or 2, wherein said on-board electrical power supply means is a photovoltaic cell (7), particularly a thin-film photovoltaic cell, particularly on a flexible surface.

4. Security document according to claim 3, wherein said substrate means (1) of said banknote having a front and reverse side, said photovoltaic cell (7) being directly applied on the surface of the front and/or reverse side of said banknote.

5. Security document according to claim 3, wherein said substrate means (1) of said banknote has transparency properties, said photovoltaic cell means (7) being embedded into said substrate.

6. Security document according to claim 3, wherein said banknote comprises a hologram (4), said photovoltaic cell being integrated into said hologram.

7. Security document according to claim 3, wherein said banknote comprises a security thread (3), said photovoltaic cell (7) being integrated into said security thread.

8. Security document according to claim 3, wherein said substrate means (1) of said banknote comprises a graphical design printing (2), said photovoltaic cell being integrated into said printing.

9. Security document according to one of claim 1 to 8, wherein said electronic security means using electric energy comprises opto-electronic means (6) for displaying predetermined data.

10. Security document according to one of claims 1 to 9, wherein said security means using electric energy comprises an integrated circuit (5).

11. Security document according to claim 10, wherein said integrated circuit (5) is capable of emitting predetermined data in a non-contacting manner.

12. Security document according to one of claims 1 to 11, wherein said substrate means (1) of said banknote comprises one or more materials selected of the group consisting of paper, plastic, polymer, elemental metallic foils and metallic alloy foils.

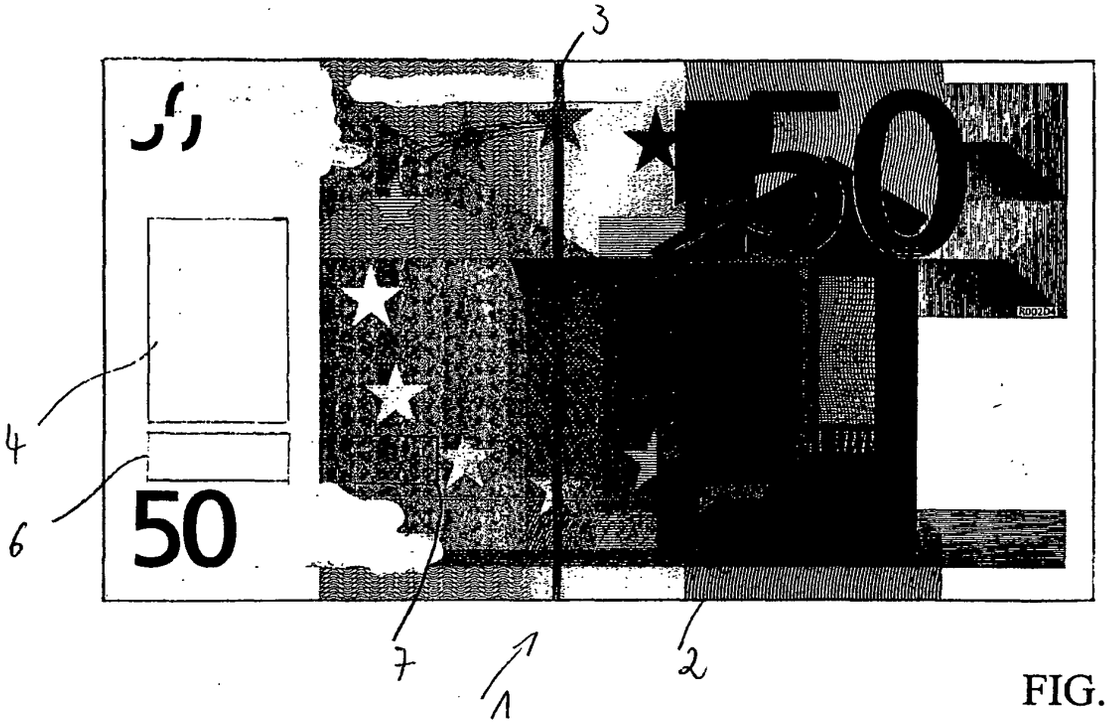

FIG. 1

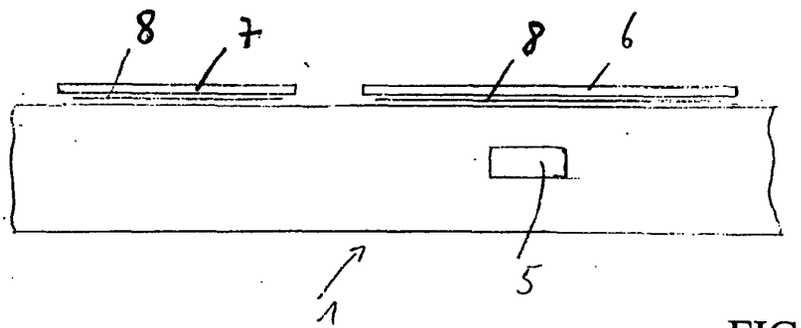

FIG. 2

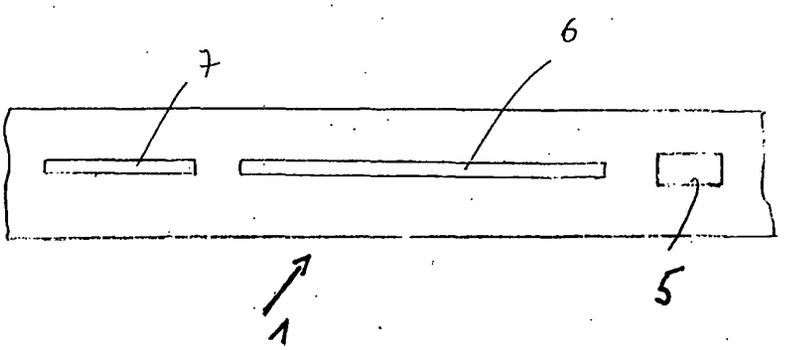

FIG. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 02 02 8535

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	EP 1 134 694 A (INFINEON TECHNOLOGIES AG) 19 September 2001 (2001-09-19) * column 1, line 48 - column 5, line 5; figures 1-6 *	1	B42D15/00
A	WO 00 07151 A (SIEMENS AG ;BROSOW JOERGEN (US)) 10 February 2000 (2000-02-10) * page 12, line 14 - page 20, line 39; figures 1-6 *	1	
A	EP 1 148 440 A (HITACHI LTD) 24 October 2001 (2001-10-24) * column 9, line 5 - column 26, line 20; figures 1-29 *	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			B42D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	16 May 2003	Evans, A

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16-05-2003

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