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(54) **Electronic security means for security documents using a linear dynamo for power generation**

(57) Security document comprising substrate means and at least one electronic security means (2), characterized in that said security document also comprises at least one coil (3) electrically connected to said electronic security means and at least one magnetic means (4). The security document can be manufactured by providing said coil, said magnetic means and said electronic security means on said substrate means. It is particularly useful for checking its authenticity, wherein said magnetic means is moved across the surface of said coil and a status change of said electronic security means is observed.

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Description

BACKGROUND OF THE INVENTION

1. Field of the invention

[0001] The present invention relates to electronic security means for security documents such as banknotes, passports, chequebooks, etc, and more preferably to electronic security means comprising display means (such as liquid crystals, or microencapsulated electronic ink) to provide a visible display change when a voltage is generated in a coil located on said security document by electromagnetic induction.

2. Description of the Related Art

[0002] The use of self-authenticating security features for producing documents serves for protecting them against unauthorized reproduction by forgers. This is necessary, in particular, for securities such as banknotes, checks, traveller's checks, stocks, etc. There is also a need for securing papers which do not have a direct monetary value, such as identification papers, passports etc., against unauthorized copying.

[0003] In particular, in the case of securities, which are circulated daily, for example, banknotes, a forger may succeed in copying the optically recorded document contents, for example, the optical printed image of the banknotes, in a deceptively precise way. A protection against this is the authenticity feature contained in the safety paper, used for producing the documents, as a result of the structure imparted to the safety paper during manufacture which authenticity feature supposedly practically cannot be copied by a forger with the means available to him. Moreover, the application of watermarks or the introduction of a safety thread into the paper is known. These conventional measures, however, can no longer be considered satisfactory in view of the advances of the working means employed by forgers. In particular, in the case of global political crisis regions the war-conducting groups or even entire countries employ forgery as warfare. Accordingly, the resources employed for forgery are correspondingly great.

[0004] EP 1 431 062 suggests security documents comprising substrate means, on board-electrical power supply means, such as photovoltaic cells, and electronic security means using said on-board power supply means. However the security feature cannot be activated by the user of the feature, if necessary. In addition a security feature of that kind is limited by the capacity of the power supply means and/or the availability of the corresponding power generating source.

[0005] CN 1 184 303 describes an anti-counterfeiting feature that consists of power source, controller and driver circuit and panel display. The display is produced by means of semiconductor technology and fine processing and is said to be difficult to counterfeit. However the use of semiconductor technology and the necessity for a display controller and driver circuit will limit the size, flexibility and durability of this device.

[0006] WO 01/69523 A1 discloses a sheet or a strip that is made of paper or a support material similar to paper, e.g. a bank note, wherein an electronic circuit made of organic semiconductor material is printed thereon or laminated therein. The electronic circuit can have a flat spiral or can be connected to the metallic strip of a bank note by means of a printed conductor. Thereby said flat spiral or said strip should act as an antenna for receiving and/or transmitting signals. However, the use of a magnetic means in order generate a voltage in said coil is neither disclosed nor suggested in WO 01/69523 A1.

SUMMARY OF THE INVENTION

[0007] The main objective of the present invention is to provide a more flexible and reliable overt security feature for secured documents that can be authenticated by a member of the general public, and which has improved forgery-proof properties.

[0008] In addition the security feature shall be highly flexible, comparable small in thickness and highly durable.

[0009] In carrying out these and other objects of the present invention, there is provided a security document comprising substrate means and at least one electronic security means, wherein said security document also comprises at least one coil electrically connected to said electronic security means and at least one magnetic means. Thereby a highly flexible and reliable overt security feature for secured documents is made available that can be authenticated by a member of the general public in a very simple way, and which has improved forgery-proof properties.

[0010] In particular, the security feature of the document can be activated by the user in a comparatively simple way, e.g. by moving said magnetic means across the surface of said coil. This results in the generation of small amounts of electrical power that operate the electronic security means and display the security feature.

[0011] One particular advantage of the concept of the present invention is that no electrical circuitry, which will limit the thickness, robustness, durability and flexibility of the secure document, is required to interface between the coil and the display.

[0012] In addition, the present invention overcomes the size, flexibility and durability limitations of conventional electro-optic displays, electrical power sources and electrical interconnects. The security document of the present invention is extremely thin. Furthermore the security document of the present invention exhibits a very high flexibility, and a very high durability.

[0013] Especially suitable variations of the security document of the present invention are described in the dependent products claims.

[0014] The process claims describes particularly suitable methods for the manufacture of the security document of the present invention and the use claims refer to particularly favourable ways of using the security document of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015]

FIG. 1 is a plan view illustrating a preferred embodiment of the security document of the present invention.

FIG. 2 is a perspective view (with the thickness of the components greatly enhanced) illustrating a preferred way of using the security document of the present invention.

FIG. 3 is an example voltage profile as a magnetic means is swiped past the coil of the security document of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0016] The following is a detailed description of the present invention. It provides a security document comprising substrate means and at least one electronic security means. The term "security document", as used herein refers to all kind of documents that contain at least one feature that can be used to prevent counterfeiting by providing authentication, identification or classification of the document. In particular, they include banknotes, passports, chequebooks, identity cards, credit cards and/or debit cards.

[0017] According to the present invention the security document also comprises at least one coil. Thereby the term "coil" refers to a metallic or conductive wire wound circularly or spirally and comprising a series of at least two loops.

[0018] In principle, the coil can be made of any material known in the art. However, the use materials having a resistivity ρ of less than $10^6\ \Omega \cdot cm$, very preferably of less than $10^{-2}\ \Omega \cdot cm$, when measured at 25°C, is particularly favourable. Especially suitable materials enclose copper, silver, gold, platinum, tin.

[0019] In a very preferred embodiment of the present invention, the coil has a planar coil pattern, preferably in the form of a spiral. A spiral is a curve which turns around some central point or axis, getting progressively closer to or farther from it, depending on which way one follows the curve. A two-dimensional spiral may be described using polar coordinates by saying that the radius r is a continuous monotonic function of θ.

[0020] The coil preferably comprises at least 10 turns, more preferably at least 100 turns, and most preferably at least 1000 turns.

[0021] According to one especially preferred embodiment of the invention the security document comprises at least two coils electrically connected in series to increase the voltage output.

[0022] In another especially preferred embodiment of the present invention the security document comprises at least two coils electrically connected in parallel.

[0023] In still another preferred embodiment the coil comprises a magnetic backing layer. Particularly suitable materials in that context include those mentioned with respect to the magnetic means.

[0024] According to the present invention the coil is electrically connected to said electronic security means. Thereby the term "electrical connection" refers to a connection of both ends of said coil via a material preferably having a resistivity ρ of less than $10^6\ \Omega \cdot cm$, very preferably of less than $10^{-2}\ \Omega \cdot cm$, when measured at 25°C. By the way of contrast two articles will be "electrically isolated one from another" if there is no electrical connection between said articles, in particular via a material having a resistivity ρ of less than $10^6\ \Omega \cdot cm$, when measured at 25°C.

[0025] The connection of the coil to the electronic security means is preferably achieved via one or more electrically conducting tracks. Thereby the electrically conducting tracks can be made of any electrically conducting material, but the use of copper tracks has proven of particular advantage.

[0026] The security document of the present invention also comprises at least one magnetic means. Magnetic means are well known in the art and refer to materials, which exert an attractive or repulsive (magnetic) force on other materials. Some well-known materials that exhibit easily detectable magnetic properties are iron, some steels, and the mineral lodestone.

[0027] Magnetic forces are fundamental forces that arise due to the movement of electrical charge. Maxwell's equations describe the origin and behaviour of the fields that govern these forces. Thus, magnetism is seen whenever electrically charged particles are in motion. This can arise either from movement of electrons in an electric current, resulting in "electromagnetism", or from the quantum-mechanical orbital motion and spin of electrons, resulting in what are known as "permanent magnets".

[0028] The physical cause of the magnetism of objects, as distinct from electrical currents, is the atomic magnetic dipole. Magnetic dipoles, or magnetic moments, result on the atomic scale from the two kinds of movement of electrons. The first is the orbital motion of the electron around the nucleus; this motion can be considered as a current loop, resulting in an orbital dipole magnetic moment along the axis of the nucleus. The second, much stronger, source of electronic magnetic moment is due to a quantum mechanical property called the spin dipole magnetic moment.

[0029] The overall magnetic moment of the atom is the net sum of all of the magnetic moments of the individual electrons. Because of the tendency of magnetic dipoles

to oppose each other to reduce the net energy, in an atom the opposing magnetic moments of some pairs of electrons cancel each other, both in orbital motion and in spin magnetic moments. Thus, in the case of an atom with a completely filled electron shell or sub shell, the magnetic moments normally completely cancel each other out and only atoms with partially-filled electron shells have a magnetic moment, whose strength depends on the number of unpaired electrons.

[0030] The differences in configuration of the electrons in various elements thus determine the nature and magnitude of the atomic magnetic moments, which in turn determine the differing magnetic properties of various materials. In the present invention, the magnetic behaviour preferably results from Diamagnetism, Paramagnetism, Molecular magnetism, Ferromagnetism, Antiferromagnetism, Ferrimagnetism, Metamagnetism, Spin glass and/or Superparamagnetism.

[0031] Particularly suitable magnetic means include

- Magnetic metallic elements, which, due to their unpaired electron spins, are magnetic when found in their natural states, as ores. Iron ore (magnetite or lodestone), cobalt, and nickel, as well the rare earth metals gadolinium and dysprosium (when at a very low temperature) are particularly preferred; and wherein the use of iron ore (magnetite or lodestone), cobalt, and/or nickel has proven best.
- Ceramic or ferrite magnetic means, which are made of a sintered composite of powdered iron oxide and barium/strontium carbonate ceramic.
- Alnico magnetic means, which are made by casting or sintering a combination of aluminium, nickel and cobalt with iron and small amounts of other elements added to enhance the properties of the magnetic means. Sintering offers superior mechanical characteristics, whereas casting delivers higher magnetic fields and allows for the design of intricate shapes.
- Injection moulded magnets, which are a composite of various types of resin and magnetic powders, allowing parts of complex shapes to be manufactured by injection moulding.
- Flexible magnets which are similar to injection moulded magnets, using a flexible resin or binder such as vinyl, and produced in flat strips or sheets.
- Rare earth (lanthanide) magnets, which have a partially occupied f electron shell (which can accommodate up to 14 electrons.)
- Samarium cobalt magnets, which are highly resistant to oxidation, with higher magnetic strength and temperature resistance than alnico or ceramic materials.
- Neodymium iron boron (NdFeB) magnets, which have the highest magnetic field strength. Use of protective surface treatments such as gold, nickel, zinc and tin plating and epoxy resin coating can provide corrosion and thermal protection where required. $Nd_2Fe_{14}B$ is particularly favoured in that context.

[0032] In the present invention, ferromagnetic materials are especially preferred. Particularly suitable ferromagnetic materials include Co, Fe, $FeOFe_2O_3$, $NiOFe_2O_3$, $CuOFe_2O_3$, $MgOFe_2O_3$, MnBi, Ni, MnSb, $MnOFe_2O_3$, $Y_3Fe_5O_{12}$, CrO_2, MnAs, Gd, Dy and/or EuO, wherein materials having a Curie temperature, the temperature above which they cease to be ferromagnetic, above 20°C, more preferably above 100°C, most preferably above 250°C are particularly favoured.

[0033] In another preferred embodiment the magnetic means comprise at least one Heusler alloy, i. e. a ferromagnetic metal alloy whose constituents are not themselves ferromagnetic in their pure forms.

[0034] Furthermore the use of amorphous (non-crystalline) ferromagnetic metallic alloys has proven of particular advantage, that are preferably obtained by very rapid quenching (cooling) of a liquid alloy, such as a transition metal-metalloid alloy, made from about 80% transition metal (usually Fe, Co, or Ni) and a metalloid component (B, C, Si, P, or Al) that lowers the melting point. Another example of such an amorphous alloy is Fe80B20 (Metglas 2605), which has a Curie temperature of 647 K and a room-temperature (300 K) saturation magnetization of 125.7 milliteslas (1257 gauss), compared with 1043 K and 170.7 mT (1707 gauss) for pure iron from above. The melting point, or more precisely the glass transition temperature, is only 714 K for the alloy versus 1811 K for pure iron.

[0035] The actual shape of the magnetic means is not critical and can be square, rectangular, round or oval in shape, for example. However, the exposed surface of the magnetic means, i. e. the surface facing the viewer, preferably comprises at least two areas having a different magnetisation. According to one very preferred embodiment of the invention the magnetic means comprises at least two areas of through plane magnetisation, wherein the field gradients of said areas have opposite directions. Thereby the field gradients are preferably perpendicular to the main surface of the security document.

[0036] According to another very preferred embodiment of the invention the magnetic means comprises at least two areas of in plane magnetisation, wherein the field gradients of said areas have opposite directions. Thereby the terms "through plane" and "in plane" refers to the directions in relation to the main surface of the security document.

[0037] The strength of the magnetic field of the magnetic means is preferably at least 0.3 Tesla.

[0038] Further details regarding magnetic means can be found in the technical literature, especially in

- Charles Kittel Introduction to Solid State Physics, Wiley: New York, 1996;
- Neil W. Ashcroft and N. David Mermin Solid State Physics, Harcourt: Orlando, 1976;
- John David Jackson Classical Electrodynamics, Wiley: New York, 1999;
- E. P. Wohlfarth, ed. Ferromagnetic Materials, North-

Holland, 1980;
- "Nanofoam makes magnetic debut" Physics World 17 (5), 3, May 2004;
- "Heusler alloy" Encyclopedia Britannica Online, retrieved Jan. 23, 2005;
- F. Heusler, W. Stark, and E. Haupt Verh. der Phys. Ges. 5, 219, 1903;
- Griffiths, David J. Introduction to Electrodynamics (3rd ed.), Prentice Hall, 1998;
- Tipler, Paul Physics for Scientists and Engineers: Electricity, Magnetism, Light, and Elementary Modem Physics (5th ed.), W. H. Freeman 2004; the content of which is incorporated herein by reference.

[0039] The coil and/or the magnetic means may be impregnated and over-coated with a soft, flexible polymer material to both enhance robustness and flexibility and provide a protective layer.

[0040] The size of the coil and the magnet and the coil are suitably selected in a way that when the magnetic means is moved across the surface of the coil (gap: 1 mm; velocity of the movement magnetic means/coil: 0.5 m/s) the voltage generated is preferably at least 0.1 V, more preferably at least 0.5 V, and in particular at least 1.0 V.

[0041] In one especially preferred embodiment of the present invention at least one coil and at least one magnetic means are provided on the same side of the security document.

[0042] In another preferred embodiment of the present invention the security document comprises one or more means for storing the energy generated by moving the magnetic means across the surface of the coil. In this way the magnetic means can be moved across the surface of the coil several times in order to build up enough electrical energy that can then be used to subsequently activate an electronic security means that may require higher voltage and power levels than can be achieved through a single pass.

[0043] In a further preferred embodiment of the present invention the security document comprises a transformer to step-up the voltage from low levels to higher levels.

[0044] However, the use of means for storing the energy and/or the use of transformers significantly add to the complexity of the concept and are therefore limited to particular fields of application.

[0045] The electronic security means of the security document is not particularly limited and can be any known in the art. However, it is particular advantageous that the security means is an overt security feature, when activated. The term "overt feature", as used herein refers to a feature can be simply verified by a member of the general public using just the feature itself, and with no requirement for additional apparatus. Features in which the feature can only be read by special machine apparatus are so-called "covert features" which are not preferred for the purposes of the present invention.

[0046] In addition, the electronic security means is preferably a low power display means having an electric power consumption of preferably 1 mW or less, and in particular of 10^{-5} W or less.

[0047] Particularly suitable electronic security means for the purposes of the present invention include electrophoretic ink display means, liquid crystal display means and/or polymer light emitting diodes, wherein electrophoretic ink display means, and liquid crystal display means are especially favoured.

[0048] The kind of the substrate means used in the present invention is not critical. However the use of substrate means comprising paper, plastic, polymer, elemental metallic foils, metallic alloy foils and/or synthetic paper is preferred.

[0049] The security document of the present invention is comparatively thin and its thickness is preferably smaller than 100 μm. In one especially preferred embodiment, the overall thickness of the coil, not including the substrate thickness, is between approximately 10 to 50 μm. The overall thickness of the magnetic means, not including the substrate thickness, is between preferably 10 to 50 μm. The thickness of the interconnects between the power source and the display is preferably within the range from approximately 1 to 30 μm. The thickness of the electronic security means, not including the substrate means, depends on the kind of security means actually used, but is preferably in the range from 25 to 300 μm.

[0050] Methods for the production of a security document of the present invention are obvious to the skilled person. The substrate means is preferably provided with the coil, the magnetic means and the electronic security means, wherein all components, including the electronic security means, may be provided simultaneously onto a common substrate. Alternatively, for substrates that are not compatible with the manufacturing techniques required for the electronic security means, the coil and the magnetic means and the interconnects may be provided onto the substrate before or after, preferably before the display assembly is attached to the substrate. In this latter case, electrical connection will be made by ensuring that exposed printed contact pads on the substrate align with contact pads on the electronic security means.

[0051] The coil and/or the magnet means may be deposited by a variety of methods including sol-gel, spray pyrolysis, hot wall pyrolysis, flash evaporation, vacuum sputtering, chemical vapour deposition, printing, laser scribing, electroless deposition technique, electroplating and electrochemical deposition. The deposition technique that is considered to be most suitable for the intended application is printing, wherein offset printing, flat bed screen printing, rotary screen printing, tampo, flexo printing, gravure and/or inkjet printing are particularly preferred.

[0052] The offset printing works by transferring an ink onto an imaged metal cylinder, which is then passed over a water roller. The ink repels the water, keeping the image on the cylinder sharp. This is then transferred onto an offset cylinder and then onto the substrate.

[0053] Particularly preferred cylinders are made by a lithographic process. The process is preferably reel-to-reel but can also be sheet fed.

[0054] Screen-printing is a process in which a high viscosity ink is squeezed by a squeegee blade through a patterned mesh onto a substrate to form an image.

[0055] Preferred screen printing meshes are made from PET or Nylon although steel is also usable. The screens are made by painting the entire mesh with a UV-curable polymer. The required artwork is then printed onto a film as an opaque image. This is placed over the mesh as a mask and the whole screen is exposed to UV light. Where the paint is exposed to the UV it cross-links and hardens, filling the holes in the mesh. The ink behind the mask, which has not been exposed, is then washed out, leaving the image on the screen.

[0056] The resolution of the image is governed by the cross-sectional area and profile of the mesh, the blade pressure and the particulate loading of the ink.

[0057] Screen printing inks can vary from those used for graphics, which have a nanometre-size pigment dispersion, to those containing 10 micron plus silver flake. To achieve a high resolution image a large pigment size must be avoided to prevent the mesh filtering the ink.

[0058] The profile of the mesh in conjunction with the blade pressure governs the thickness of deposit for a given ink. If too high a profile is used, the thickness of ink deposited can be too great, which can cause the ink to slump, thereby reducing the image quality.

[0059] Rotary screen-printing is essentially the reel-to-reel version of flatbed screen-printing with the image being produced on a patterned cylindrical mesh rather than a flat mesh.

[0060] In the tampo process, an image is produced on a rubber stamp onto which ink is transferred. The image is then printed onto the substrate. The material the stamp is made from dictates the resolution of the printed image. Engraved metal plates can be used but preferably a stamp is made from a photo-imageable rubber compound.

[0061] In the flexo printing the image is created in the same way as for the tampo process, but the difference is that it is wrapped around a metal cylinder to act as a roller. Ink is transferred to it by means of a second roller and then onto the substrate.

[0062] Like flexo printing, gravure is another high-speed reel-to-reel process. It is used instead of the flexo process when high volumes of high-resolution images are required. In the gravure process a steel cylinder is etched to produce the image roller.

[0063] The term inkjet printing is broadly used to describe any digitally-controlled printer, although it originated from the first piezo-electric driven inkjet heads.

[0064] In a piezo-electric head a voltage is applied to a piezoelectric material, which surrounds a compressible ink chamber, firing the ink out of the chamber nozzle. When the voltage is removed, the ink chamber relaxes, drawing more ink into the chamber from a reservoir to refill it.

[0065] Bubble-jet technology is similar to the piezo-electric inkjet, the difference being that the bubble-jet uses heat to expand the ink and fire it out of nozzle.

[0066] In continuous inkjet printing the ink is pumped continuously through the printer under pressure. The ink is electrically charged and as it is fired, the flight of droplet is controlled electro-statically.

[0067] Laser scribing can be used for scribing extremely fine features. The process uses a laser to cut away copper to form an image, this is known as ablation. The cut produced by the laser leaves a jagged edge behind it as well as debris from the oblation process.

[0068] However, the use of other methods is also contemplated as falling within the scope of the present invention.

[0069] For checking authenticity of the security document of the present invention the magnetic means is preferably moved across the surface of the coil and a status change of the electronic security means is observed. Thereby a voltage is generated in the coil that operates the electronic security means.

[0070] The gap between the surface of the coil and the magnetic means is preferably as low as possible, particularly smaller than 5 mm, more preferably smaller than 2 mm, even more preferably smaller than 1 mm, and most preferably within the range of 0.01 mm to 0.5 mm.

[0071] The velocity of the movement of the magnetic means parallel to the surface of the coil is preferably at least 0.1 m/s, very preferably at least 0.5 m/s, most preferably at least 1 m/s.

[0072] Furthermore it has proven of particular advantage to repeatedly move the magnetic means across the surface of the coil.

[0073] The magnetic means that is passed over the coil will have a North pole and a South pole. As such, both a positive voltage and a negative voltage will be induced in the coil with a single swipe of the magnet past the coil. The exact nature of the voltage profile with position of the magnet will depend on the orientation of the magnet poles with respect to the coil axis. This is a useful feature of the present invention since the change from positive to negative voltage potential can also, if the display is configured appropriately, cause a change in the image state of the display.

[0074] In this invention only a very low voltage is required, since especially for electrophoretic-type displays, such as microencapsulated electrophoretic inks or electrophoretic liquid crystal-type displays, only a very low level of electrical current is required for operation of the display. However, the power induced in the coil may be sufficient for operation of display devices that require higher powers such as semi-conductor LEDs, electrochromic displays, thermochromic displays and electroluminescent displays. These possible variations are contemplated as falling within the scope of the present invention.

[0075] Referring now to the figures, a particular pre-

ferred embodiment of the invention will be discussed. Fig. 1 is a plan view of said particular preferred embodiment wherein the thickness of the elements is greatly exaggerated for clarity. The security document comprises a thin flexible substrate 1 and a thin flexible coil 3 deposited or printed onto said substrate 1. Both ends of the coil is electrically connected, via flexible electrically conducting tracks 5, which may be printed or deposited on the substrate 1, to a thin and flexible low power display 2. The display 2 may be printed or deposited onto the substrate or adhered to the substrate before or after the printing and/or deposition of the other components of the feature. In any case, electrical connectivity is made between the display 2 and the coil 3. In addition the security document also comprise a magnetic means 4 also printed or deposited on the substrate 1. Thereby the coil 3 and the magnetic means 4 are located on the same side of the substrate. Furthermore the coil 3 is designed such that the movement of the magnetic means 4 over the surface of the coil 1 generates sufficient electric voltage and current to operate the display 2.

[0076] Alternatively two coils 1 could be utilised in which both coils are electrically connected to the display 2. These coils 1 could be printed on top of each other or adjacent to each other. The direction of the windings in the different coils 1 could be the same or reverse. The winding direction will determine the polarity (positive or negative) of the generated voltage for a given positive or negative rate of change of flux. A plurality of coils 1 with different winding directions may be used.

[0077] In fact it will be possible to design both the coils 1 and the magnetic means 4 in such a way, with features that may be hidden from normal detection (such as position and orientation of the North and South poles in the magnetic means 4 and direction of electrical winding in the coils 1) to give rise to a specific voltage profile when the magnetic means 4 is swiped past the coil 1, which in turn gives rise to a specific pre-determined changing optical image within the display 2.

[0078] Fig. 2 is a perspective view illustrating the use of security document for checking its authenticity. Thereby the substrate 1 is folded and the magnetic means 4 is moved across the surface of the coil 3 and a status change of the display 2, i. e. the electronic security means is observed.

[0079] Fig. 3 is an example voltage profile as a magnetic means 4 is swiped past the coil 3 of the security document of the present invention. The voltage is given in V and the time is given in s. The power generated by is sufficient to operate a low power display, such as a electrophoretic-type display.

Claims

1. Security document comprising substrate means and at least one electronic security means, **characterized in that** said security document also comprises at least one coil electrically connected to said electronic security means and at least one magnetic means.

2. Security document according to claim 1, **characterized in that** said security document is a banknote, a passport, a chequebook, an identity card, a credit card or a debit card.

3. Security document according to claim 1 or 2, **characterized in that** said coil has a planar coil pattern.

4. Security document according to at least one of the preceding claims, **characterized in that** said coil has at least 10 turns.

5. Security document according to at least one of the preceding claims, **characterized in that** said coil comprises copper.

6. Security document according to at least one of the preceding claims, **characterized in that** the exposed surface of said magnetic means comprises at least two areas having a different magnetisation.

7. Security document according to at least one of the preceding claims, **characterized in that** said magnetic means comprises at least two areas of through plane magnetisation, wherein the field gradients of said areas have opposite directions.

8. Security document according to at least one of the preceding claims, **characterized in that** said magnetic means comprises at least two areas of in plane magnetisation, wherein the field gradients of said areas have opposite directions.

9. Security document according to at least one of the preceding claims, **characterized in that** said magnetic means comprises a ferromagnetic material.

10. Security document according to claim 9, **characterized in that** said magnetic means comprises iron, cobalt, nickel, a Heusler alloy, europium oxide and/or chromium (IV) oxide.

11. Security document according to claim 10, **characterized in that** said magnetic means comprises an alloy comprising iron, cobalt and/or nickel, and/or a ferrite.

12. Security document according to claim 11, **characterized in that** said magnetic means comprises $Nd_2Fe_{14}B$.

13. Security document according to at least one of the preceding claims, **characterized in that** said coil and/or said magnetic means are coated with a pro-

tective layer.

14. Security document according to at least one of the preceding claims, **characterized in that** said security document comprises electrically conducting tracks electrically connecting said coil to said electronic security means.

15. Security document according to at least one of the preceding claims, **characterized in that** said electronic security means is an overt security feature.

16. Security document according to at least one of the preceding claims, **characterized in that** said electronic security means is a low power display means.

17. Security document according to claim 16, **characterized in that** the power needed by said lower power display is 1 mW or less.

18. Security document according to claim 16 or 17, **characterized in that** said low power display means are electrophoretic ink display means, liquid crystal display means and/or polymer light emitting diodes.

19. Security document according to at least one of the preceding claims, **characterized in that** said substrate means comprises paper, plastic, polymer, elemental metallic foils, metallic alloy foils and/or synthetic paper.

20. Security document according to at least one of the preceding claims, **characterized in that** its thickness is smaller than 100 μm.

21. Method for the production of a security document according to at least one of the preceding claims, wherein said coil, said magnetic means and said electronic security means are provided on said substrate means.

22. Method according to claim 21, **characterized in that** said magnetic means and/or said coil are provided onto said substrate means by the use of sol-gel, spray pyrolysis, hot wall pyrolysis, flash evaporation, vacuum sputtering, chemical vapour deposition, printing, laser scribing, electroless deposition technique, electroplating and/or electrochemical deposition.

23. Method according to claim 21 or 22, **characterized in that** electrical interconnections are provided on said substrate means and said magnetic means, said coil and said electronic security means are provided onto said electrical interconnections.

24. Method according to at least one of the claims 21 to 23, **characterized in that** said electronic security means is provided before or after the provision of said magnetic means and said coil.

25. Method according to at least one of the claims 21 to 24, **characterized in that** said magnetic means and said coil are provided on the same side of said security document.

26. Use of a security document according to at least one of the claims 1 to 20 for checking its authenticity, wherein said magnetic means is moved across the surface of said coil and a status change of said electronic security means is observed.

27. Use according to claim 26, **characterized in that** the gap between the surface of said coil and the surface of said magnetic means is smaller than 5 mm.

28. Use according to claim 26 or 27, **characterized in that** the velocity of the movement of the magnetic means parallel to the surface of the coil is at least 0.1 m/s.

29. Use according to at least one of the claims 26 to 28, **characterized in that** said magnetic means is repeatedly moved across the surface of said coil.

Fig. 1

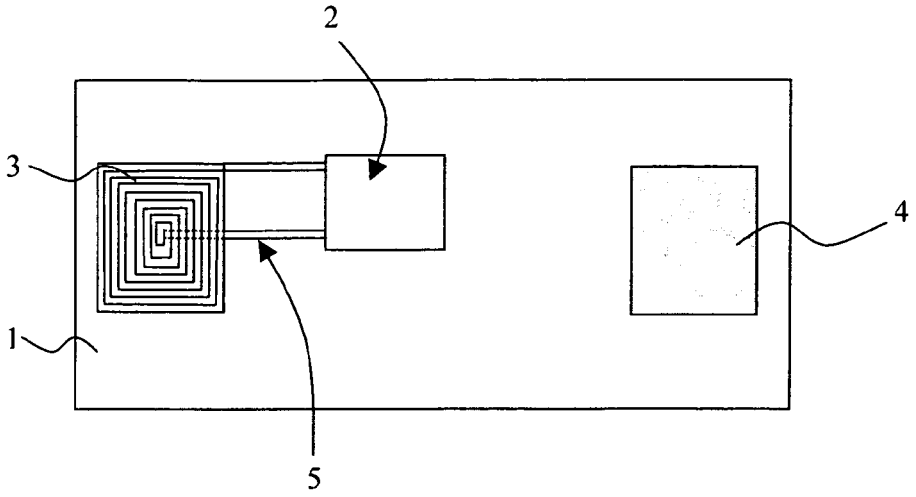


Fig. 2

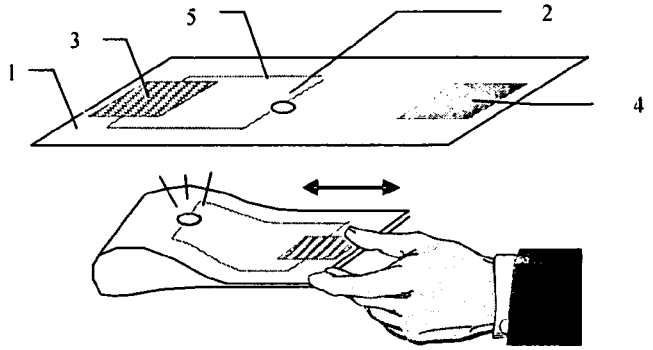
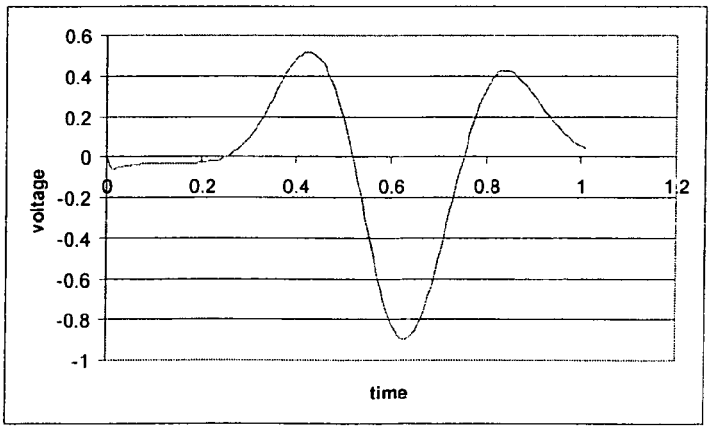


Fig. 3



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Application Number
EP 06 00 1669

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Place of search	Date of completion of the search	Examiner
The Hague	13 September 2006	Evans, Andrew

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