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(54) Improvements in security features

(57) The invention pertains to a security element such as a security thread (1) for a security document comprising at least one layer of metallization (2) or metallic print, wherein said layer (2) is electric contact with at least one sacrificial element (5) protecting the metallization (2) or metallic print from corrosion. it furthermore pertains to a method for making such a security threat, a security document comprising such a security thread, and to a method for making such a security document.

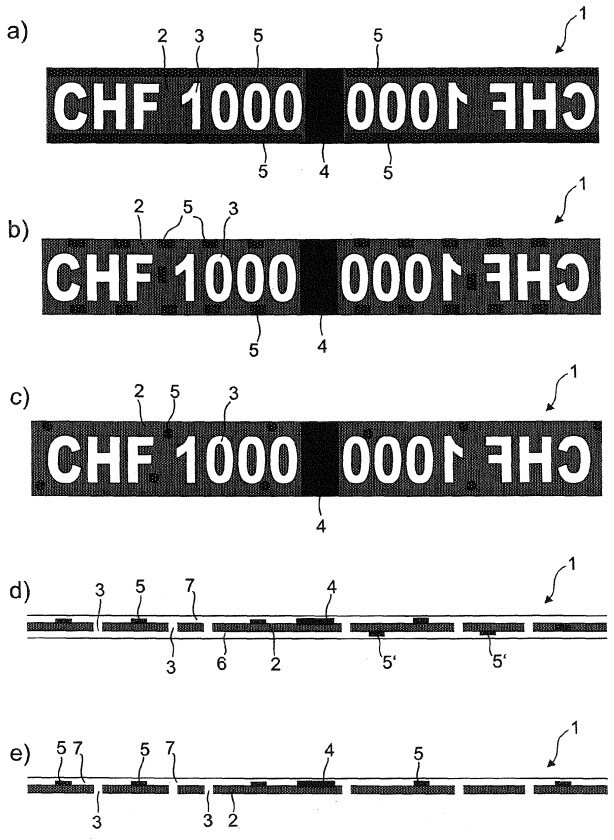

FIG. 1

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Description

TECHNICAL FIELD

[0001] The present invention relates to improvements in security threads and to printable security substrates such as banknotes having incorporated improved security threads according to this invention as well as to methods for making security documents comprising such security threads and to methods for making such security threads.

PRIOR ART

[0002] Security paper, for example for the production of banknotes, passports, certificates and similar applications, often incorporate security threads to impede counterfeiting. Such security threads are incorporated in the paper production process. The threads can be fully embedded, e.g. covered on both sides with paper fibers, or embedded in such a way that the thread is exposed on one side of the paper at least in some areas, resulting in a so-called windowed security thread. Methods to obtain fully embedded security threads or windowed threads, respectively, are well known to the person skilled in the art.

[0003] Security threads often show text, numerals, symbols or other characters as an additional anti-counterfeiting means. Such indicia can be printed as positive or negative print or combinations thereof. Preferably, such indicia are created in metallic color, either by printing of metallic pigment containing inks or by selective deposition or/and selective removal of a metallic layer. Security threads showing indicia in metallic color offer an efficient anti-counterfeiting means. If such a thread is incorporated in paper, the thread and the metallic indicia are almost invisible if the paper is looked at in reflection. If the paper is observed in transmission, however, the metallic areas and characters are easily visible. Such metallic security threads are therefore preferred over security threads printed with e.g. black inks. The black ink also shows in reflection, not only in transmission, offering a less potent anti-counterfeiting means.

[0004] Security threads can be equipped with many additional overt, covert and machine readable properties, such as fluorescence, electrical conductivity, microtext, holography, color-shifting properties, magnetic properties. In the latter case, magnetic substances are applied to the security thread. The magnetic substances can be printed, e.g. as lines along the sides of a security thread or as blocks along the length of a security thread. Magnetic substances such as magnetite or other ferrous-ferric oxides can be used. Many other magnetic substances are known to the person skilled in the art, including substances with higher and lower coercitivity than magnetite. The magnetic substances are usually opaque and of a dark color and will therefore be printed on a metallized area of the security thread. The metallic layer on a security thread consists usually of aluminium. A carrier substrate, usually a polyester foil, is coated with a thin layer of metallic aluminium, e.g. in a vacuum deposition process. In this metallized foil, transparent indicia can be created by a number of methods known in the art, e.g. by selective etching. The substrate is then coated with an adhesive layer and a second polyester foil is laminated to the carrier substrate to protect the aluminium layer.

SUMMARY OF THE INVENTION

[0005] It is observed for security threads according to the state-of-the-art, but also for other security elements with thin metallic layers such as holograms patches or the like, that as time progresses the metallized areas or the metal printed areas can start to develop transparent areas, to fade and become transparent. It is the object of the present invention to remedy to this deficiency.

[0006] Indeed it has been observed that the thin aluminium layer, although protected by a polyester carrier and a protective polyester foil, is subject to corrosion phenomena. Aluminium is usually a very corrosion resistant material so this finding is rather surprising. Metallic aluminium forms an oxide layer that protects underlying metallic aluminium from progressing corrosion. This natural protective oxide layer is only a few Angstroms in thickness. Studies have shown that a natural oxide layer of typically 35 Å forms on an aluminum surface, 50 Å in a humid oxygen atmosphere (Hart, R. K., Proc. Roy. Soc., A236, 68, 1956). The thin aluminium layer on the polyester carrier is also only a few Angstroms thick, such that formation of aluminum oxide, aluminum hydroxide or mixed aluminum oxides/hydroxides can at least partially remove the metallic appearance of the aluminium. Aluminium oxides/hydroxides are transparent, the metallic properties are therefore lost if such a reaction occurs, and indicia in the security layer can become illegible. Such reactions can occur, even if the aluminium layer is protected by polyester foils from both sides. Corrosion often starts from the edge of the security thread and progresses over time. The polyester foil and the adhesives used to laminate the protective polyester foil to the metallized polyester carrier are both not entirely impermeable for mositure, oxygen etc. and may have low, e.g. ionic, conductivity. Security threads consisting magnetic materials are especially prone to corrosion of the aluminium layer. The metallic aluminium disappears preferably over the magnetic bits of a security thread, exposing the magnetic areas or leading to feathered edges and transparent areas of the metallization over time.

[0007] The purpose of this invention is thus to provide an efficient means to protect the aluminium layer from being corroded. It is as such well known that corrosion phenomena are the result of electrochemical reactions (so-called redox reactions). It is further known as such that, the higher the oxidation potential of a substance is, or, in other words, the less noble the substance is, the easier it will react end the more subject it is to corrosion.

[0008] If two compounds, such as e.g. two metals, are brought into galvanic contact, the one compound with the higher oxidation potential will react in a corrosive environment, protecting the more noble substance from being attacked.

[0009] For example, pipes made of iron can be protected from corrosion by connecting the pipes to containers holding metallic magnesium. The magnesium with an oxidation potential of Eox=2.37 V will corrode more easily than the iron with an oxidation potential Eox=0.44 V, thus protecting the iron pipes from being attacked. The magnesium in this example acts as what is known as a sacrificial anode. The details of the electrochemical reactions involved are described, for example, in "Chemie", Brown/LeMay, Ed 3, pages 595-599. Accordingly, ships propellers made of copper alloys can e.g. be protected in a similar fashion by attaching blocks of zinc to it. The copper with an oxidation potential Eox= 0.34 V is being protected by the zinc, that reacts, at an oxidation potential of Eox=0.76, more easily and corrodes instead of the copper alloy.

[0010] The gist of the present invention is to protect a security element, such as a security thread, from corrosion by applying the concept described above to the metallic layer of this security element, e.g. by incorporating a sacrificial anode, e.g. a substance with higher oxidation potential than the one of the metallic layer to be protected, into the security element.

[0011] For example, if the security element is a security thread containing a metallic aluminium layer, on this aluminium layer, patches of e.g. calcium can be deposited. Other metals with higher oxidation potential than Aluminium (Eox= 1.66), that can be used as sacrificial anode accordingly, are Magnesium (Eox=2.37), Sodium (Eox=2.71), Calcium (Eox=2.87), Barium (Eox=2.9), Potassium (Eox=2.93), Lithium (Eox=3.05).

[0012] Such anodic protection is especially suitable in security threads containing magnetic substances. As noted above, the aluminium layer is preferably affected by corrosion in areas where magnetic bits are situated. These magnetic bits can contain substances of lower oxidation potential than aluminium which will speed up the corrosion process of the aluminium layer. In ferrous-ferric oxides for example, traces of metallic iron with an oxidation potential of Eox=0.44 V will not be corroded as long as they are in contact with metallic aluminium with Eox=1.66, which will instead corrode quickly and completely.

[0013] In a preferred embodiment, a substance of higher oxidation potential than aluminium is dispersed as pigment in a printable formulation and this ink is printed in e.g. dots, patches, stripes, indicia or any other form onto the aluminium layer or onto any additional layer on the aluminium layer. This substance can, for example be a metallic pigment, for example calcium powder. In a preferred embodiment, the ink is printed in stripes along the cutting edges of the security element. In another preferred embodiment, the ink is printed in blocks between demetallized areas on the security element. In yet another preferred embodiment, the ink is printed between the aluminium layer and a layer of magnetic ink. In yet another preferred embodiment, the magnetic ink contains a substance of higher oxidation potential than the aluminium layer. Obviously, the substance can be deposited in another suitable process than printing, such as for example coating, dip coating, vacuum deposition, physical vapour deposition, chemical vapour deposition, galvanic deposition, etc.

[0014] In another preferred embodiment, a substance of higher oxidation potential than aluminium is dispersed in the adhesive layer used to adhere the protecting polyester layer to the metallized polyester carrier. Preferrably, this substance is in the form of micro- or nano-sized particles. Alternatively, metallorganic substances can be used.

[0015] In another preferred embodiment, a substance of higher oxidation potential than aluminium is dispersed in an intermediate layer between the aluminium layer and the adhesive layer used to adhere the protecting polyester layer to the metallized polyester carrier, e.g. a primer layer. Preferrably, this substance is in the form of micro- or nano-sized particles. Correspondingly therefore, and so to speak to summarise, the present invention relates to security element, e.g. a thread or hologram, for a security document comprising at least one layer of metallization or metallic print, wherein said layer is electric/galvanic contact with at least one sacrificial element protecting the metallization or metallic print from corrosion. In this context, an electric contact is formed if any charged particles such as electrons or ions can migrate between the metallic element and the sacrificial element. An ion conducting bridge, e.g. an electrolyte, between the two element is also to be understood as an electric contact.

[0016] According to a first preferred embodiment, the sacrificial element comprises metal with higher oxidation potential than the metal of the metallization or metallic print.

[0017] The metallization or metallic print can be applied in a first layer of a thickness in the range of 1-400 Å, preferably in the range of 5-50 or 10-25 Å, and wherein the sacrificial element is applied as a second layer adjacent to said first layer in the form of a fully covering layer, or in the form of stripes, dots, patches and combinations thereof, wherein the sacrificial element can be applied on one or both sides of the first layer. It is also possible to apply the sacrifical element to the cutting edges of a security thread only, e.g. by running the security thread through a dipping bath or a galvanic dipping bath. The security thread can for this purpose be connected to a power source, forming an electrode.

[0018] The metallization or metallic print can be based on elementary aluminium, wherein sacrificial element can be based on at least one of the following elementary metals selected from the group of: calcium, magnesium, sodium, calcium, potassium, barium, lithium and combinations or/and alloys thereof.

[0019] The security thread may comprise a plastic carrier layer on which the metallization is deposited, wherein a preferably further comprises a protective layer.

[0020] However the security thread may also be a structure which does not comprise a carrier layer, typically in this case the structure is applied to one of the paper layers of the security document by heat sealing or cold foiling and on at least one of its faces it comprises a heat sealing material or a pressure sensitive, cold sealing adhesive layer, respectively. It can even be applied in the form of a patch instead of a stripe. Holographic patches and stripes are built very similarly to the security threads described above, also having a reflective aluminium layer.

[0021] According to yet another preferred embodiment, it further comprises at least one area with a magnetic material, which is preferably in direct contact with the metallization or metallic print.

[0022] According to yet another preferred embodiment, the sacrificial element is optically concealed, preferably in that metallization and/or metallic print is applied on both sides thereof, or in that a camouflage layer is applied on the side opposite to the metallization and/or metallic print.

[0023] The metallization and/or metallic print may comprise or consist of negative indicia and/or positive indicia, which preferably alternate and do not overlap with magnetic areas along the length of the security thread.

[0024] Furthermore the present invention relates to a security document, in particular paper based security document, comprising a security thread as outlined above, wherein preferably the security thread is at least partially embedded in the security document or attached to it. Such a security document may comprise a central plastic layer bordered on both sides by a paper layer attached to the central plastic layer without the aid of adhesives, and wherein the security thread is located between one of the paper layers and the central plastic layer, wherein preferably at least one of the paper layers comprises an opening through which the security thread is visible.

[0025] Furthermore the present invention relates to a method for making a security thread as outlined above, wherein onto a carrier layer metallization is applied, either by first full area application and subsequent etching to form indicia or by templated deposition to form indicia, and wherein prior to and/or subsequent to the application of the metallization at least one sacrificial element is deposited such that it is in galvanic contact with the metallization.

[0026] in addition to that the present invention relates to a method for making a security document as outlined above , wherein the security thread is either embedded into a paper layer during the papermaking process, or wherein the security thread is applied to a paper layer, preferably in a heat sealing process.

[0027] Further embodiments of the invention are laid down in the dependent claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028] Preferred embodiments of the invention are described in the following with reference to the drawings, which are for the purpose of illustrating the present preferred embodiments of the invention and not for the purpose of limiting the same. In the drawings,

Fig. 1 shows in a) a view onto a negative text metallized security thread with striped sacrificial elements, in b) a view onto a negative text metallized security thread with dotted sacrificial elements according to a second embodiment, in c) a view onto a negative text metallized security thread with dotted sacrificial elements according to a third embodiment, in d) a schematic cut through a negative text metallized security thread with carrier foil; in e) a schematic cut through a negative text metallized security thread without carrier foil in f) a view onto a positive text metallized security thread with dotted sacrificial elements and in g) a schematic cut through a another negative text metallized security thread.

DESCRIPTION OF PREFERRED EMBODIMENTS

[0029] Figure 1 shows a first embodiment according to the present invention. It shows a view onto a security thread 1 which essentially comprises a full surface metallization 2, which is provided with transparent openings or recesses 3, which form negative indicia such as letters, pictures, pictograms, numbers, signs, etc. The concept of such negative text metallic layer based security threads is as such well known in the art and can be combined with fluorescent features, etc. for example. In this case it is combined with magnetic features, in that magnetic areas 4 are interposed between two negative text areas. The figures are to be understood as being just one section of an essentially unlimited length security thread of repeating patterns.

[0030] In order to protect the metallic layer, which is in the range of a few angstroms thickness only, from the above-mentioned corrosion, in this case in the border area stripes of sacrificial material 5 are deposited. They are deposited such as not to interfere with the negative text 3. In this case they are only provided along the edges of the security thread, they may, in particular in view of the corrosive power of the magnetic areas, also be located adjacent to these areas 4.

[0031] Figure 1b shows another embodiment, in this case the sacrificial material 5 is not applied as stripes but as dots 5 in positions where needed.

[0032] Figure 1c shows yet another embodiment, in this case the dots are circular dots distributed randomly over the metallized area 2. It is to be noted that also the distribution of these sacrificial material 5 structures can be used as an additional security feature.

[0033] In these figures the sacrificial material 5 elements are distributed such as to be essentially invisible or at least not to interfere with the optical appearance of the metallization and/or negative text. In order to make sure that this is indeed the case, the sacrificial material 5 elements may also be provided between two layers of metallization.

[0034] Figure 1d show a cut through an embodiment of such a negative text security thread. Typically such a structure comprises a plastic carrier layer 6, onto which the metallization is deposited as a full surface layer, and subsequent to this the negative text is etched away in a chemical process forming the recesses 3 which give rise to the transparent negative text. It is also possible to apply the layer 2 in a printing process. Normally on the opposite side there is further provided another layer 7, for the protection of the metallization and/or magnetic area 4.

[0035] As indicated in this figure on the right side, it is possible to provide sacrificial material patches 5 on both sides of the metallization, or it is also possible, as shown on the very right side, to provide the sacrificial material patches 5 so as to be completely buried within the metallization layer or rather such that metallization is present on both sides of the patches.

[0036] As indicated schematically in figure 1e it is not necessary for all applications to have a carrier layer 6, it is also possible to have a structure which is actually not provided with a carrying structure, such a structure however needs to be applied to a paper layer of security document using a carrier transfer foil in for example a heat sealing process, wherein this carrier transfer foil is removed after application of the functional layers 2, 4, 5.

[0037] As indicated in figure 1f also positive text made of metallization can be protected, in this case it is typically necessary to provide a sacrificial material patch 5 for each of the galvanically isolated graphical elements, so for each letter, number, sign, which is not in contact with another metallization element which is already protected with sacrificial material 5.

[0038] In another embodiment indicated in figure 1 g), the sacrificial material is dispersed within a layer covering the whole area of the layer in the security thread carrying the metallization elements, regardless of the position or geometry of the metallization elements. In addition to that the structure displayed here has two carrier layers 6.

LIST OF REFERENCE SIGNS

[0039]

1 security thread

2 metallization/metallic print

3 negative sign/indicia

4 magnetic patch/bit

5 sacrificial metal element

6 carrier foil

7 protective lacquer layer

Claims

1. Security element (1), in particular for a security document, comprising at least one layer of metallization (2) or metallic print, wherein said layer (2) is electric contact with at least one sacrificial element (5) protecting the metallization (2) or metallic print from corrosion.

2. Security element (1) according to claim 1, wherein the sacrificial element (5) comprises metal with higher oxidation potential than the metal of the metallization (2) or metallic print.

3. Security element (1) according to any of the preceding claims, wherein the metallization (2) or metallic print is applied in a first layer of a thickness in the range of 1-50 Å, preferably in the range of 10-25 Å, and wherein the sacrificial element (5) is applied as a second layer adjacent to said first layer in the form of a fully covering layer, or in the form of stripes, dots, patches, particles dispersed in the metallization (2) or metallic print, and combinations thereof, wherein the sacrificial element (5) can be applied on one or both sides of the first layer.

4. Security element (1) according to any of the preceding claims, wherein the metallization (2) or metallic print is based on elementary aluminium, and wherein sacrificial element (5) is based on at least one of the following elementary metals selected from the group of: calcium, magnesium, sodium, calcium, barium, potassium, lithium and combinations and/or alloys thereof.

5. Security element (1) according to any of the preceding claims, wherein it comprises a plastic carrier layer (6) on which the metallization (2) is deposited, and wherein a preferably further comprises a protective layer (7).

6. Security thread (1) according to any of the preceding claims, wherein it does not comprise a carrier layer.

7. Security element (1) according to any of the preceding claims, wherein it further comprises at least one area (4) with a magnetic material, which is preferably in direct contact with the metallization (2) or metallic print.

8. Security element (1) according to any of the preced-

ing claims, wherein the sacrificial element (5) is optically concealed, preferably in that metallization (2) and/or metallic print is applied on both sides thereof, or in that a camouflage layer is applied on the side opposite to the metallization and/or metallic print.

9. Security element (1) according to any of the preceding claims, wherein it is in the form of an security thread, a security patch or a security tag, in particular a hologram patch, a hologram stripe or a hologram thread.

10. Security thread (1) according to claim 9, wherein the metallization (2) and/or metallic print comprises negative indicia (3) and/or positive indicia, which preferably alternate and do not overlap with magnetic areas (4) along the length of the security thread.

11. Security document, in particular paper based security document, comprising a security element, in particular a security thread or a security hologram according to any of the preceding claims, wherein preferably the security thread is at least partially embedded in the security document or attached to it.

12. Security document according to claim 11, wherein it comprises a central plastic layer bordered on both sides by a paper layer attached to the central plastic layer without the aid of adhesives, and wherein the security thread is located between one of the paper layers and the central plastic layer, wherein preferably at least one of the paper layers comprises an opening through which the security thread is visible.

13. Method for making a security thread (1) according to any of the preceding claims 1-10, wherein onto a carrier layer (6) metallization is applied, either by first full area application and subsequent etching to form indicia or by templated deposition to form indicia, and wherein prior to and/or subsequent to the application of the metallization at least one sacrificial element (5) is deposited such that it is in galvanic contact with the metallization.

14. Method for making a security document according to any of the claims 11-12, wherein the security thread is either embedded into a paper layer during the papermaking process, or wherein the security thread is applied to a paper layer, preferably in a heat sealing process.

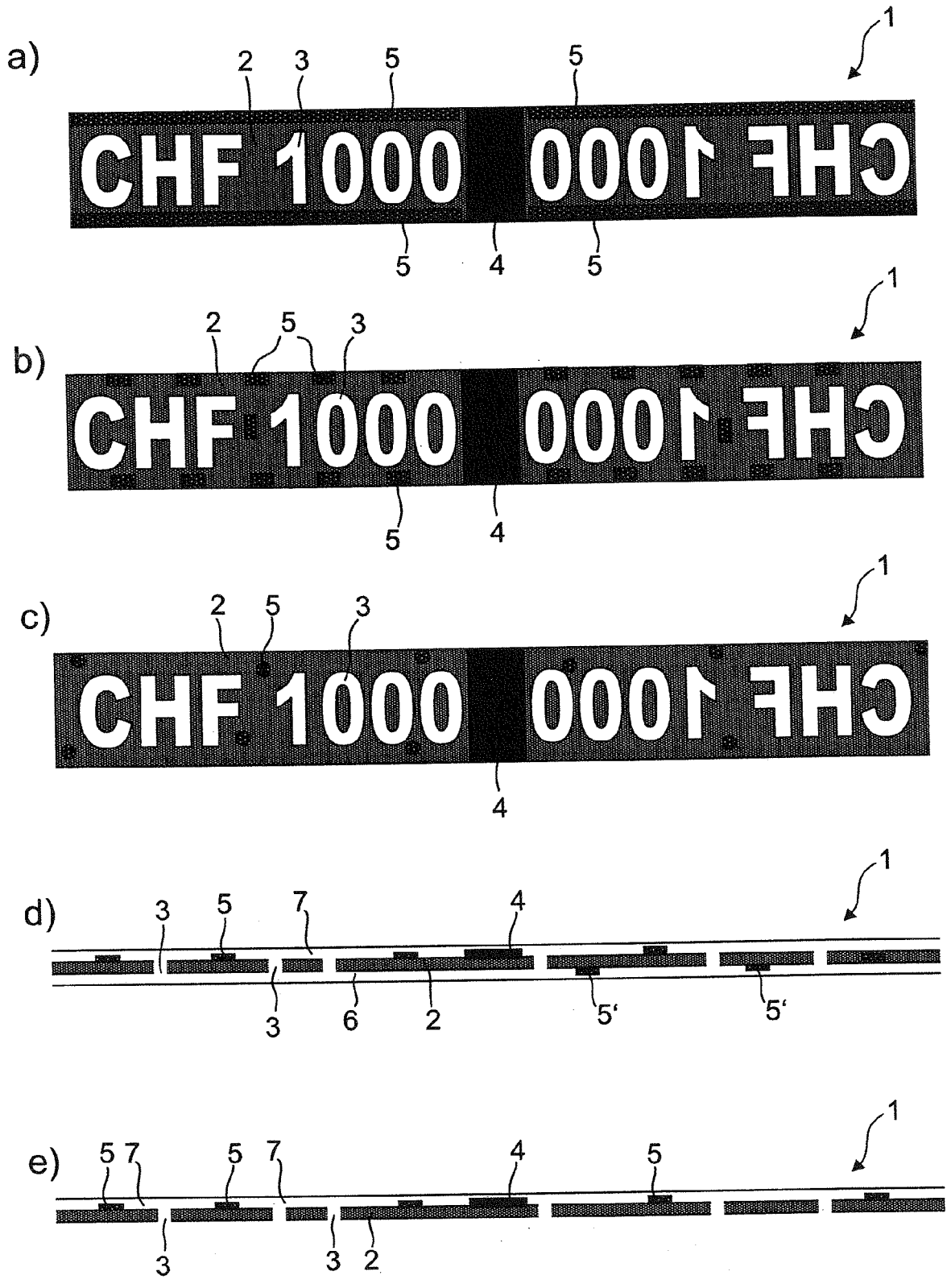

FIG. 1

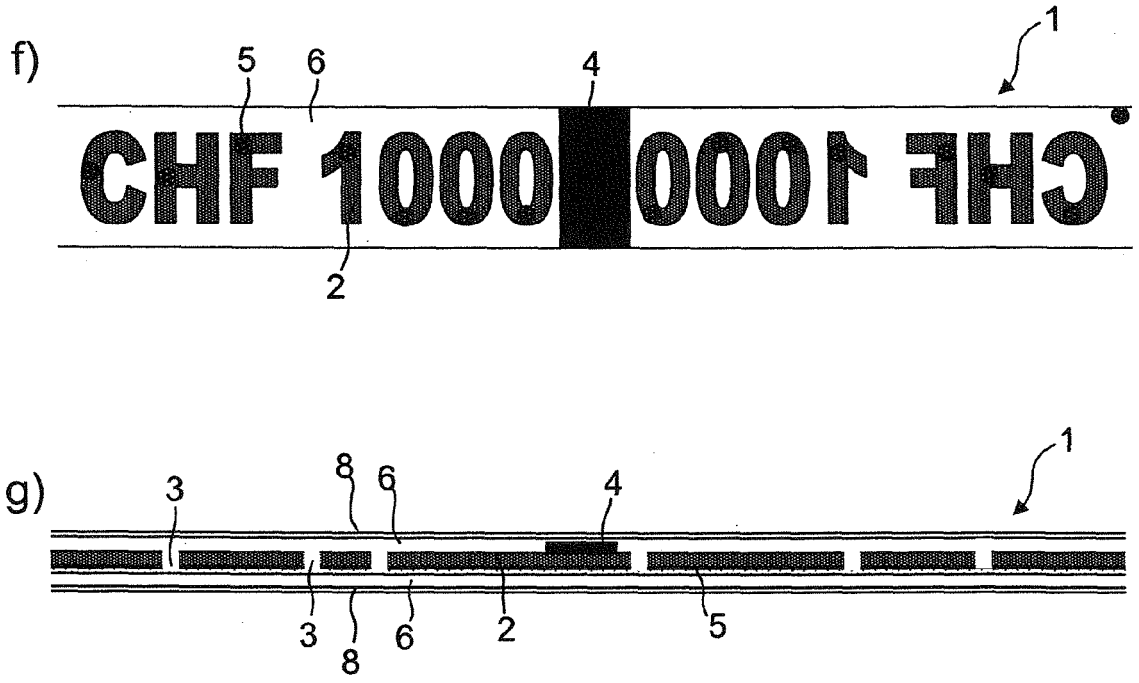

FIG. 1

REFERENCES CITED IN THE DESCRIPTION

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Non-patent literature cited in the description

- **HART, R. K.** *Proc. Roy. Soc.,* 1956, vol. A236, 68 **[0006]**
- **BROWN ; LEMAY.** Chemie. 595-599 **[0009]**