(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 091 832 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
23.11.2022 Bulletin 2022/47

(21) Application number: **21305655.9**

(22) Date of filing: **19.05.2021**

(51) International Patent Classification (IPC):
B42D 25/46 *(2014.01)* ***B42D 25/475*** *(2014.01)*

(52) Cooperative Patent Classification (CPC):
B42D 25/46; B42D 25/475

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(71) Applicant: **Thales DIS France SA**
92190 Meudon (FR)

(72) Inventors:
- **ODDOU, Laurent**
  13705 La Ciotat (FR)
- **TIBILETTI, Lucie**
  13705 La Ciotat (FR)

(74) Representative: **Milharo, Emilien**
Thales Dis France SAS
Intellectual Property Department
Avenue du Jujubier
BP 90, Z.I. Athélia IV
13705 La Ciotat (FR)

(54) **DATA CARRIER WITH DUAL-CURE COATING**

(57) A method of producing a data carrier (1) comprising the steps of i) providing one or more layers (2, 2a,), ii) providing at least one coating (3, 3a), preferably a varnish, and iii) generating a carrier body (4) comprising the one or more layers (2, 2a, ...) and the coating (3, 3a). The coating (3, 3a) is dried in a drying step and cured in a curing step, wherein, in terms of time, the drying step occurs before the curing step.

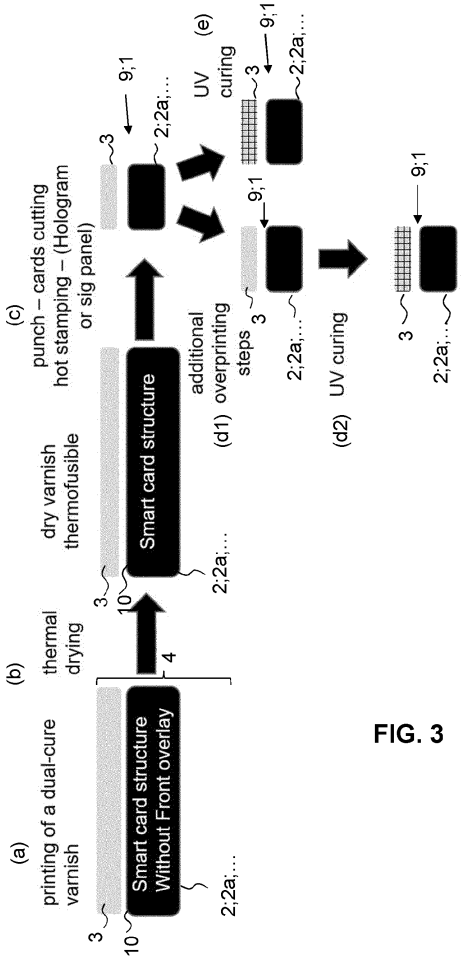

FIG. 3

EP 4 091 832 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to a method of producing a data according to claim 1, to the use of a coating for the production of a data carrier according to claim 13, to a data carrier according to claim 14, and to a security document according to claim 15.

PRIOR ART

[0002] Data carriers such as smart carts are typically composed of layers, of different plastics natures and thickness. Most frequently, the top and bottom layers, named overlays, are transparent and thin, have a protective role for the internal layers and the various printing and elements they may contain, and are holding hot stamped elements of security or decoration. The bonding between these different layers is obtained by a lamination process. However in spite of good adhesion level after lamination, the overlay may suffer from delamination, especially on the edge of the corner of the data carrier. As a consequence, the internal layer scan be degraded. This issue is even more sensitive on specific data carriers such as those comprising on-boarding a metal piece and or those with low bondability material such as foils cards.

SUMMARY OF THE INVENTION

[0003] It is an object of the present invention to provide an improved data carrier. In particular, it is an object to provide a data carrier that can be easily processed and at the same time is resistant against damages.

[0004] This object is achieved with the method according to claim 1. In particular, a method of producing a data carrier is provided, wherein the method comprises the steps of i) providing one or more layers, ii) providing at least one coating, preferably a varnish, and iii) generating a carrier body comprising the one or more layers and the coating. The coating is dried in a drying step and cured in a curing step, wherein, in terms of time, the drying step occurs before the curing step.

[0005] That is, the coating preferably is a dual cure coating. In other words, it is preferred that the coating is configured to be subjected to different or separate steps, namely at least a drying step as well as a curing step.

[0006] Purely curable coatings such as UV curable varnishes are generally very hard due to their high cross-linking level that is generated upon their curing. Consequently, such coatings are prone to problems during manufacturing being common in the card industry. For instance, the coatings are too brittle for certain method steps such as punching and they do not accept processing steps such as hot stamping steps or overprinting steps. An advantage of these coatings however is that their abrasion resistance is typically very high. Purely solvent-based coatings are generally too soft to provide acceptable abrasion resistance, and thus do not bring enough protection to the data carrier such as to the internal layers of the carrier body. However, as thermofusible compounds they generally accept hot stamping steps and overprinting steps and they furthermore do not produce burrs or cracks or the like during punching steps.

[0007] The present invention is based on the insight that the usage of a dual cure coating enables a combination of the advantages of both solvent and curable coating technologies.

[0008] The coating can be provided by printing in at least one printing step. The coating is preferably provided by offset printing and/or by screen printing in the printing step. Additionally or alternatively the coating is preferably directly printed onto at least part of at least one of the one or more layers in the printing step.

[0009] If the coating is provided by screen-printing, also referred to as silkscreen printing, the coating is preferably transferred onto at least a part of one or more of the layers using a mesh. It is furthermore preferred that said mesh has a mesh count of between 50 to 200 threads per centimetre, more preferably between 70 and 150 threads per centimetre, and particularly preferably between 77 and 140 threads per centimetre. Additionally or alternatively, it is preferred that the mesh has a mesh count of at least 50 threads per centimetre, more preferably of at least 70 threads per centimetre, and particularly preferably of at least 77 threads per centimetre. Additionally or alternatively it is preferred that the mesh has a mesh count of 200 threads per centimetre or less, more preferably of 150 threads per centimetre or less, and particularly preferably of 140 threads per centimetre or less.

[0010] The expression "directly printed" means that the coating is applied so as to be in direct, i.e. immediate contact with at least part of the layer(s) it is applied on. In other words, there are no further compounds such as adhesives or primers or adhesion promoters being provided between the coating and the layer(s) it is applied on. Instead, the coating itself is chemically or physically attached or adhered to the layer.

[0011] The coating preferably constitutes a top layer of the carrier body. Additionally or alternatively the coating constitutes a bottom layer of the carrier body. Additionally or alternatively the coating constitutes at least one internal layer of the carrier body.

[0012] It is preferred that two or more layers are arranged above one another. In other words, it is preferred that a stack comprising two or more layers is formed. This stacking of the layers preferably takes place during at least one

collation step. To this end it is particularly preferred that the top layer of this stack comprises or consists of the coating. Additionally or alternatively it is particularly preferred that the bottom layer of this stack comprises or consists of the coating. Additionally or alternatively it is particularly preferred that one or more internal layers of this stack comprise or consist of the coating. The coating is therefore preferably provided in the form of a layer, as well. The top layer and the bottom layer of the carrier body or of the stack are understood as the layers facing towards an outside of the data carrier. Consequently, the one or more internal layers are arranged between the top layer and the bottom layer. The carrier body preferably comprises or consists of said stack, i.e. of one or more stacked layers as well as of the coating. Hence, in the thus produced carrier body the coating is an integral compound of the carrier body.

[0013] Moreover, in terms of time, the collation step preferably occurs after the printing step. That is, it is preferred to firstly print the coating onto one or more of the layers and to thereafter stack the layers, at least one of which comprising the coating.

[0014] The coating is preferably at least partially dried, more preferably entirely dried in the drying step before it is cured in the curing step. Additionally or alternatively the coating is preferably at least initially comprises one or more solvents, and wherein said one or more solvents are at least partially, preferably entirely evaporated during the drying of the coating in the drying step.

[0015] In particular, it is preferred that at least 50 % or more, preferably at least 70 % or more, and particularly preferably at least 90 % or more of the one or more solvents are evaporated in the drying step. Moreover, it is preferred that the coating defines a volume, and that said volume of the coating is dried. In other words, it is preferred to not only dry a surface region of the coating but to dry a surface region as well as an inside of the coating.

[0016] Additionally or alternatively, it is preferred that the coating is at least partially cured, preferably entirely cured in the curing step.

[0017] In terms of time, the curing step preferably occurs directly or indirectly after the drying step.

[0018] A coating being cured directly after the coating is dried means that there are no other method steps being performed between the drying step and the curing step of the coating. In other words, the step of drying and the step of curing are successive steps. However, it is likewise conceivable that the step of drying and the step of curing are not successive steps but that there are one or more further method steps being performed between said steps of drying and curing. This latter case is referred to as "the coating being cured indirectly after the coating is dried".

[0019] The coating is preferably thermally dried in the drying step and/or the coating is preferably ventilation dried in the drying step.

[0020] Furthermore, the coating is preferably dried in a heating device. The heating device is preferably configured to evaporate the one or more solvents of the coating. A conceivable heating device is a heating tunnel, although other heating devices as they are known in the art are likewise conceivable.

[0021] The coating is preferably dried in the drying step at a heating temperature being in the range of about 30 °C to 100 °C, more preferably in the range of about 40 °C to 90 °C, and particularly preferably in the range of about 50 °C to 80 °C. Additionally or alternatively the heating temperature preferably is at least 30 °C or more, more preferably at least 40 °C or more, particularly preferably at least 50 °C or more. Additionally or alternatively the heating temperature preferably is 100 °C or less, more preferably 90 °C or less, particularly preferably 80 °C or less.

[0022] The heating temperature can be kept constant or can be varied during the drying step. For instance, the heating temperature could increase with an advancing of the drying step. In other words, the heating temperature at a beginning of the drying step is preferably lower than the heating temperature at an end of the drying step. Said variation of the heating temperature can be achieved by a single heating device whose heating temperature is varied. However, it is likewise conceivable that two or more heating devices are used, and wherein the heating temperatures of the heating devices differ from one another. To this end it is particularly preferred to use a heating tunnel comprising two or more ovens heating at different heating temperatures, wherein the data carrier is transferred through the ovens.

[0023] The coating is preferably dried in the drying step during a drying time being in the range of about 10 seconds to 10 minutes, more preferably in the range of about 20 seconds to 5 minutes, and particularly preferably in the range of about 30 seconds to 2 minutes. Additionally or alternatively the drying time is preferably at least 10 seconds or more, more preferably at least 20 seconds or more, particularly preferably at least 30 seconds or more. Additionally or alternatively the drying time preferably is 10 minutes or less, more preferably 5 minutes or less, particularly preferably 2 minutes or less.

[0024] The coating is preferably UV-cured in the curing step by irradiating electromagnetic radiation in the ultraviolet region of the electromagnetic spectrum. Additionally or alternatively the coating is preferably cured in the curing step by a radical polymerization, in particular by a radical UV polymerization

[0025] A dose of the irradiated electromagnetic radiation that is irradiated in the curing step is preferably in the range of about 100 mJ/cm^2 to 1500 mJ/cm^2, more preferably in the range of about 200 mJ/cm^2 to 1200 mJ/cm^2.

[0026] The carrier body is preferably generated by laminating the one or more layers and the coating in at least one lamination step. Furthermore, the coating is preferably in contact with one or more lamination plates of a lamination device in the lamination step. Moreover, it is preferred that the coating is preferably at least partially transparent after

the lamination of the carrier body. That is, it is preferred that the coating of the data carrier in a final state is at least partially transparent. Again in other words, it is preferred that the coating does not present a colour change such as a yellowing after lamination. Instead, it is preferred that the coating keeps a predictive or desired transparency colour after lamination.

[0027] One or more processing elements are preferably generated in and/or on and/or below the coating with respect to the extension direction in at least one processing step. In other words, when seen along the extension direction, one or more processing elements can be arranged before and/or after the coating and/or within the coating. To this end it is particularly preferred that the processing elements and the coating are in direct contact with one another, e.g. by directly applying the processing elements on the coating and/or by directly applying the coating on the processing elements. Directly applied processing elements or a directly applied coating is understood that there is a direct, i.e. immediate contact established between the processing elements and the coating. Additionally or alternatively the method preferably further comprises at least one punching step, wherein at least one data carrier element is punched of the carrier body. Additionally or alternatively the method preferably further comprises at least one milling step, wherein at least one cavity is milled into the carrier body. Additionally or alternatively the method preferably further comprises at least one embedding step, wherein at least one module is embedded into the cavity.

[0028] The data carrier element being produced in the punching step preferably corresponds to the generation of the data carrier in its final or desired shape, i.e. the generation of the data carrier with its final or desired geometrical extensions. In fact, it is particularly preferred that said data carrier element is punched out of one or more data carrier sheets comprising the one or more layers and the coating. To this end it is particularly preferred that the one or more data carrier sheets correspond to the carrier body before a punching step is performed. Said one or more data carrier sheets preferably are of a larger geometrical extension than the final or desired geometrical extension of the data carrier element or the data carrier after the punching step. Hence, by punching out the data carrier element, a data carrier or a data carrier element of a smaller size can be obtained. It is furthermore preferred to punch two or more data carrier elements out of the data carrier sheets, whereby two or more data carriers of a desired or final shape are obtained. The expression "punching" can also be understood as cutting, shear cutting, knife-edge cutting, pinch cutting, splitting, tearing, breaking, routing, drilling, etc. That is, any sort of action that allows the generation of a data carrier element (or data carrier) of a particular size. The punching step can be performed with a punching device as it is known in the art. That is, the punching device preferably comprises a male punching element, also called swage, and a female punching element, also called die, and wherein the female punching element interacts with the male punching element. The milling step can be performed with a milling device that is known in the art.

[0029] The module being embedded in the embedding step preferably corresponds to an electronic module such as an integrated circuit or the like.

[0030] The one or more processing elements are preferably stamped, particularly preferably hot stamped, to the coating in the processing step. Additionally or alternatively the one or more processing elements are at least partially printed, preferably ink-jet printed and/or silkscreen printed, on and/or below the coating with respect to the extension direction in the processing step. Additionally or alternatively the one or more processing elements preferably constitute one or more security elements and/or one or more personalization elements.

[0031] That is, the one or more processing elements are preferably generating during the production of the data carrier.

[0032] The one or more processing elements preferably have the shape of an image and/or of an alphanumeric character. Non-exhaustive examples of an image are a portrait or photograph or biometric information such as a fingerprint e.g. of the holder of the data carrier, an outline of a country, a state coat of arms, a state flag, a signature panel, etc. Non-exhaustive examples of an alphanumeric character are a date of birth, a name, a social security number e.g. of the holder of the data carrier, an expiry date, etc. It is furthermore preferred that the one or more processing elements are configured to interact with incoming electromagnetic radiation. For instance, the one or more processing elements preferably correspond to a hologram. Thus, the one or more processing elements can be seen as security elements. A security element can serve the purpose of securing the data carrier against unauthorized manipulation such as forgery. The one or more processing elements can also be seen as personalization elements, i.e. their provision on the data carrier personalizes the data carrier. In other words, personalized information such as personal data of the holder of the data carrier can in this way be attributed to the data carrier.

[0033] The print preferably comprises or consists of ink, in particular of ink-jet ink and/or silkscreen ink. Said ink is preferably a commercially available print. It is furthermore preferred that the ink comprises optically variable pigments, like a flip flop ink. The ink may give a tactile effect to the cards or the data carrier.

[0034] It is furthermore preferred that at least one post-lamination coating is applied to the data carrier after lamination. Said post-lamination coating is preferably configured and/or arranged so as to provide texture and/or a relief to the data carrier. The post-lamination coating is particularly preferably printed on a top layer of the data carrier. Said top layer preferably comprises or consists of the coating. Thus, the coating is preferably compatible with said post-lamination coating. Additionally or alternatively it is preferred that the coating accepts an ink jet graphical personalization and/or a thermo-transfer personalization and/or a retransfer graphical personalization as they are known in the art. Generally

speaking, it is preferred that the coating and any other coating and/or ink or the like as commonly used in the field of technology exhibit an adhesion between one another.

[0035] In terms of time, the processing step and/or the punching step and/or the milling step and/or the embedding step preferably occurs after the drying step and/or before the curing step.

[0036] In other words, the one or more processing elements are preferably generated after the coating is dried and/or before the coating is cured. Additionally or alternatively, the one or more data carrier elements (or the data carriers with their final or desired shapes) are preferably generated after the coating is dried and/or before the coating is cured. Additionally or alternatively, the one or more cavities are preferably generated after the coating is dried and/or before the coating is cured. Additionally or alternatively, the one or more modules are preferably embedded into the cavities after the coating is dried and/or before the coating is cured.

[0037] A preferred sequence of the different method steps is as follows: A first step preferably is the punching step. A second step preferably is a processing step such as a stamping step, in particular a hot stamping step. A third step preferably is a milling step. A fourth step preferably is an embedding step.

[0038] The coating preferably corresponds to a two-component varnish. Additionally or alternatively, the coating preferably comprises or consists of at least one volatile compound and at least one non-volatile compound. Additionally or alternatively, the coating preferably comprises or consists of at least one solvent and at least one polymer and/or polymerizable compound such as a monomer and/or an oligomer, the coating preferably furthermore comprises at least one binder and/or at least one photoinitiator and/or at least one oil and/or at least one filler and/or at least one additive.

[0039] The volatile compound is preferably configured to evaporate.

The non-volatile compound is preferably configured to remain on and/or in the data carrier, in particular on and/or in the carrier body such as on at least one of the layers.

The non-volatile compound preferably comprises or consists of at least one polymer and/or at least one polymerizable compound such as at least one monomer or oligomer. The non-volatile compound preferably furthermore comprises at least one binder and/or at least one oil and/or at least one filler and/or at least one additive.

The volatile compound preferably comprises or consists of at least one solvent.

The solvent preferably comprises or consists of at least one organic solvent, particularly preferably of at least one aliphatic hydrocarbon and/or at least one cycloaliphatic hydrocarbon and/or at least one aromatic hydrocarbon and/or at least one alcohol and/or at least one glycol and/or at least one glycolether and/or at least one ketone and/or at least one ester and/or at least one lactone.

Conceivable aliphatic hydrocarbons are hexane, preferably n-hexane, white spirit, and cyclohexane.

Conceivable aromatic hydrocarbons are xylene, benzene and solvent naphtha. Conceivable alcohols are primary alcohols such as propanol, n-butanol, or isobutanol, secondary alcohols, tertiary alcohols and polyols such as glycerol.

Conceivable glycolethers are butylglycol, butyldiglycol, ethyleneglycol, and diethylglycol. Conceivable esters are acetate compounds such as aliphatic acetates, aromatic acetates, and heterocyclic acetates, for example butylacetat, ethylacetat and 2-butoxyethylacetat. Conceivable ketones are butanon and aceton.

[0040] The polymer can be a monosaccharide or a polysaccharide or derivatives thereof, such as a sugar derivative or a cellulose derivative. The polymer can likewise be a resin.

The polymerizing compound is preferably configured to form a resin after polymerization. The resin preferably is a synthetic resin. Preferred synthetic resins are alkyd resins, acrylic resins, polyacrylate resins, epoxy resins, polyester resins, and polyurethane resins.

The polymerizing compound is preferably a compound that forms a synthetic resin, for example, an alkyd resin, an acrylic resin, a polyacrylate resin, an epoxy resin, or a polyurethane resin after polymerization.

[0041] The solvent preferably comprises an evaporation number in the range of about 0.1 to 100, more preferably in the range of about 0.1 to 50, and even more preferably in the range of about 0.1 to 10, such as in the range of about 0.5 to 5 or 0.5 to 2. A particularly preferred range is between about 0.8 to 1.5. Additionally or alternatively the evaporation number is preferably about 100 or less, more preferably about 50 or less, and even more preferably about 10 or less. A particularly preferred evaporation number is about 5 or less, such as about 2 or less. Additionally or alternatively an evaporation number of the solvent preferably is about 0.1 or more, such as 0.5 or more or 0.8 or more.

[0042] The solvent preferably comprises a viscosity in the range of about 0.1 to 10 cP, more preferably in the range of about 0.25 to 5 cP, and particularly preferably in the range of about 0.5 to 3 cP. Additionally or alternatively the solvent preferably has a viscosity of at least about 0.1 cP or more, preferably of at least about 0.25 cP or more, and particularly preferably of about 0.5 cP or more. Additionally or alternatively the solvent preferably comprises a viscosity of about 10 cP or less, preferably of about 5 cP or less, and particularly preferably of about 3 cP or less.

[0043] The solvent preferably comprises a surface tension of in the range of about 1 to 100 mN/m, more preferably in the range of about 10 to 80 mN/m, and particularly preferably in the range of about 20 to 60 mN/m. Additionally or alternatively the solvent preferably comprises a surface tension of at least about 1 mN/m or more, preferably of at least 10 mN/m or more, and particularly preferably of at least 20 mN/m or more. Additionally or alternatively the solvent preferably comprises a surface tension of about 100 mN/m or less, preferably of about 80 mN/m or less, and particularly

preferably of about 60 mN/m or less.

[0044] A preferred binder comprises at least one resin, particularly preferably at least one synthetic resin, and at least one hardener.

The binder preferably comprises or consists of one or more polymers and/or copolymers thereof and/or of one or more polymerizing compounds and/or at least one drying oil and/or at least one resin.

The polymer can be a monosaccharide or a polysaccharide or derivatives thereof, such as a sugar derivative or a cellulose derivative. The polymer can likewise be a resin.

The polymerizing compound is preferably configured to form a resin after polymerization.

[0045] The resin preferably is a synthetic resin. Preferred synthetic resins are alkyd resins, acrylic resins, polyacrylate resins, epoxy resins, polyester resins, and polyurethane resins.

The polymerizing compound is preferably a compound that forms a synthetic resin, for example, an alkyd resin, an acrylic resin, a polyacrylate resin, an epoxy resin, or a polyurethane resin after polymerization.

[0046] That is, it is conceivable that at least one resin is present in the coating in an initial state, i.e. before any steps such as the curing step are performed. Said resin preferably provides a thermofusible part of the coating. It is likewise conceivable that at least one resin is formed in the coating during one or more steps such as the curing step, in particular by the polymerisation of the one or more polymerizing compounds such as one or more monomers and/or one or more oligomers. That is, it is preferred that the coating of the data carrier in a final state comprises at least two resins. The final state is understood as a state where all method steps have been performed.

[0047] At least one photoinitiator is preferably present in the coating in the initial state. Said photoinitiator is preferably configured to be active upon an exposure to UV radiation.

[0048] The hardener, or curing agent, can be an amine compound such as 1,3-diaminobenzol, a polyaziridine compound, an aliphatic amine compound such as diethylentriamine or 4, 4-diaminodicyclohexylmethane, an imidazole compound, an anhydride compound, a phenol compound such as a compound, e.g. bisphenol A, a thiol compound, a silane compound such as triethoxy silane, a carbodiimide compound, a hydrazide compound, or an isocyanate compound.

[0049] The filler preferably comprises or consists of calciumcarbonat and/or bariumsulfat and/or silica and/or aluminium hydroxide.

[0050] The coating preferably corresponds to a commercially available compound. The coating particularly preferably is a commercially available varnish.

[0051] For example, it is preferred that the coating, i.e. varnish, comprises or consists of Mara® Cure 1 KG HY 911. That is, it is preferred that the varnish comprises or consists of 2-butoxyethylacetate, n-butyl acetate, 2,2-bis(acryloyloxymethyl)-1,3-propanediyl diacrylate, solvent naphtha (petroleum), light aromatic, a mixture of 3-[3-(2H-benzotriazol-2-yl)-5-(1,1-dimethylethyl)-4-hydroxypenyl]propionates of branched and linear C7-C9 alkyl, benzene, (1-methylethenyl), homo-polymer, ar-(2-hydroxy-2-methyl-1-oxopropyl) derivs, glycerol, propoxylated, esters with acrylic acid, and (1-methyl-1,2-ethanediyl)bis[oxy(methyl-2,1-ethanediyl)] diacrylate 2-hydroxyethyl methacrylate. That is, a preferred coating comprises one or more acetate compounds, acrylate compounds, solvent naphtha, benzene compounds, glycerol compounds, and ester compounds.

[0052] It is likewise preferred that the coating, i.e. varnish, comprises or consists of Mara® Cure 1 KG HY 914. That is, it is preferred that the varnish comprises or consists of n-butyl acetate, 2,2-bis(acryloyloxymethyl)-1,3-propanediyl diacrylate, 2-butoxyethyl acetate, solvent naphtha (petroleum), light aromatic, a mixture of 3-[3-(2H-benzotriazol-2-yl)-5-(1,1-dimethylethyl)-4-hydroxypenyl]propionates of branched and linear C7-C9 alkyl, and 2-hydroxyethyl methacrylate. That is, a further preferred coating comprises one or more acetate compounds, acrylate compounds, solvent naphtha, and ester compounds.

[0053] It is likewise preferred that the coating, i.e. varnish, comprises or consists of FOTOTEX 3D FINE and/ or of FOTOTEX 3D SUPERMATT. That is, it is preferred that the varnish comprises or consists of y-butyrolactone, dipentaerythritol pentaacrylate, 2-methoxy-1-methylethyl acetate, 1-methoxy-2-propanol, 2,2-dimethoxy-1,2-diphenylethan-1-one, and silicone acrylate. That is, a further preferred coating comprises one or more lactone compounds, acrylate compounds, acetate compounds, alcohol compounds, and ether compounds,

[0054] It is likewise preferred that the coating, i.e. varnish, comprises or consists of Norilux® DC-10. That is, it is preferred that the varnish comprises or consists of 2-methoxy-1-methylethyl acetate, n-butyl acetate, 2-butoxyethanol, solvent naphtha (petroleum), 2,2-bis(acryloyloxymethyl)-1,3-propanediyl diacrylate, dipropylene glycol methyl ether, bisphenol-A-epichlorohydrin, and tris(nonylphenyl) phosphite. That is, a further preferred coating comprises one or more acetate compounds, acrylate compounds, glycol compounds, ether compounds, alcohol compounds, and bisphenol compounds.

[0055] It is furthermore preferred that the coating is configured so as to not pollute any tools used to manufacture the cavity receiving the module In particular, it is preferred that the coating is configured such that no burrs appear on the coating after the milling step.

[0056] It is furthermore preferred that the coating has a thermal stability being high enough so as not to be modified by heat applied during embedding step. In particular, it is preferred that a thermal stability of the coating is such that no

color change on a surface of the coating occurs after the embedding step and/or that no cracks and/or no deformation occur after the embedding step.

[0057] One or more of the layers preferably comprise or consist of one or more transparent materials and/or of one or more plastics, preferably transparent plastics. It is particularly preferred that one or more of the layers comprise or consist of polycarbonate (PC) and/or polyethylene terephthalate (PET) and/or amorphous polyester and/or co-polyester (A-PET, PET-G) and/or semi-crystalline polyester (boPET) and/or polyvinyl chloride. Additionally or alternatively it is preferred that one or more of the layers comprises or consists of at least one metallic compound.

[0058] That is, the data carrier preferably is a data carrier comprising or consisting of one or more metallic compounds such as one or more metallic layers. Additionally or alternatively the data carrier preferably is a data carrier comprising or consisting of one or more transparent and/or plastic compounds such as transparent and/or plastic layers. Additionally or alternatively the data carrier preferably is a data carrier comprising or consisting of one or more plastic compounds as well as one or more metallic compounds. That is, the data carrier preferably is a so-called foil card having at least one layer that comprises a combination of a polymer or plastic material such as polyvinyl chloride (PVC) and metallic compounds. Said layer is preferably generated by providing a layer of polymer or plastic material which is metallized. Preferred metallic compounds are metals and/or alloys, preferably selected from the group comprising or consisting of iron, chromium, tungsten, copper, zinc, aluminium and mixtures thereof, the metallic compound particularly preferably comprising or consisting of stainless steel and/or tungsten and/or tungsten alloy and/or brass and/or aluminium.

[0059] In another aspect a coating for the production of a data carrier comprising a carrier body that comprises one or more layers and the coating is used, wherein the coating is dryable and curable.

[0060] Said coating and/or the data carrier preferably corresponds to a coating and/or data carrier as described above. Hence, any explanations provided with regard to the method likewise apply to the use of a coating and vice versa.

[0061] In another aspect a data carrier is provided, the data carrier comprises one or more layers, and at least one coating. The one or more layers and the coating form a carrier body. The coating is dried and cured. In particular, the coating has been dried prior to being cured.

[0062] Here again it should be noted that said data carrier preferably corresponds to a data carrier as described above such that explanations provided with regard to the method likewise apply to the data carrier and vice versa. For instance, it is particularly preferred that the coating constitutes a top layer of the carrier body and/or a bottom layer of the carrier body.

[0063] In another aspect a security document comprising or consisting of at least one data carrier as described above is provided, wherein the security document preferably is a smart card, an identity card, a passport, a credit card, a bank note or the like.

[0064] Tt should be understood that the data carrier *per se* can correspond to a security document. This is the case if the data carrier is provided in the form of an identity card, for example. However, it is likewise conceivable to introduce or incorporate the data carrier into a security document. In the case of a passport for example the data carrier could correspond to or could be incorporated in a page of the passport.

BRIEF DESCRIPTION OF THE DRAWINGS

[0065] 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. 1a-1d show sectional views of a data carrier being produced according to a method of the state of the art during different method steps;

Fig. 2a-2e show sectional views of a data carrier being produced according to the method of the invention during different method steps;

Fig. 3 shows a schematic overview of a method of producing a data carrier according to the invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

[0066] With respect to the figures, different aspects of the method of producing a data carrier 1 according to the invention shall be explained in greater detail. To this end figures 1a to 1d depict a data carrier 1' being produced according to a method as it is known in the state of the art during various of its production stages. Figures 2a to 2e in turn depict different production stages of a data carrier 1 being produced according to the method of the invention.

[0067] In fact, in the method according to the state of the art a first layer 2' is provided, wherein on a top surface 10' of which a processing element 11' in the form of a printed layer is applied, see figure 1a. As follows from figure 1b, several layers 2', 2a', 2b', 2c' as well as several processing elements 11', 11a' can be provided during a so-called collation step, i.e. the different layers 2'-2c', 11'-11a' are assembled by means of stacking the layers on top of one another. In the present case four layers 2'-2c' are provided as internal layers 12'-12c' , wherein the uppermost layer 2'

and the lowermost layer 2c' comprise on their top surface 10' and bottom surface 13', respectively, in each case a processing element 11', 11a'. Furthermore, a top layer 5' and a bottom layer 6' are provided, wherein the top layer 5' is arranged on the processing element 11' being arranged on the uppermost internal layer 2' and the bottom layer 6' is provided on the processing element 11a' being provided on the lowermost internal layer 2c'. Since the top layer 5' and the bottom layer 6' constitute the uppermost and lowermost layer of the data carrier 1', these layers 5', 6' can be referred to as overlay layers. After the stacking of the layers 2'-2c', 11'-11a', the layers are connected to one another during a lamination step, see figure 1c. As becomes readily apparent from figure 1c, during the lamination of the data carrier 1' the top layer 5' and the bottom layer 6', or the overlay layers, are in contact with lamination plates 7, 7a of a lamination device. After lamination of the data carrier 1', further personalization elements 8', 8a' such as security elements and/or personalization elements are applied on a top surface 14' and a bottom surface 15' of the top layer 5' or uppermost overlay layer and the bottom layer 6' or lowermost overlay layer, respectively, see figure 1d. In the depicted example, all layers 2'-2c', 5'-6' apart from the processing elements 11', 11a', correspond to transparent plastic layers. These layers 2'-2c', 5'-6' are said to form a carrier body 4'.

[0068] As follows from figure 2a, a data carrier 1 being produced according to the method of the invention likewise comprises the step of providing one or more layers 2-2d, and wherein at least one processing element can be applied on a surface of one or more of said layers. In fact, in the depicted example a processing element 11 in the form of a personalization element and/or a security element is applied on a top surface 10 of a first layer 2, see figure 2a. Here, said processing element corresponds to a printed layer 11 that is silkscreen printed over the entire top surface 10 of said layer 2, wherein a mesh between 77 and 140 threads / cm is used. Thereafter, said processing element 11 is overprinted with a coating 3 according to the invention, see figure 2b. After the application of the coating 3, the coating 3 is allowed to dry in a drying step. After the coating 3 has been dried, the coating 3 is cured in a curing step. That is, the coating 3 corresponds to a dual cure coating. The drying of the coating 3 is achieved here by an evaporation of solvent comprised in the coating 3. Furthermore, said drying occurs in a heating tunnel, at a heating temperature between 50°C to 80°C, and during a drying time between 30 seconds to 2 minutes. The entire coating 3 is allowed to dry. In other words, the coating 3 can be said to define a volume 16, and wherein said entire volume 16 is allowed to dry. Again in other words, the surface regions 17, 18 of the coating 3 as well as an inside 19 of the coating 3 are dried. After the coating 3 has been totally dried, the coating 3 enables a manipulation and stacking of the layers 2-2d without being scratched.

[0069] Figure 2c depicts a data carrier 1 comprising five layers 2-2d being arranged on top of one another, wherein a top surface 10 of the uppermost layer 2 and a bottom surface 13 of the lowermost layer 2d comprise in each case a processing element in the form of a printed layer 11, 11a. Said five layers 2-2d are referred to as internal layers 12-12d and correspond here to transparent layers made of plastics. Moreover, on a top surface 20 of the processing element 11 being arranged on the uppermost internal layer 2, 12 and on a bottom surface 21 of the processing element 11a being arranged on the lowermost internal layer 2d, 12d a coating 3, 3a according to the invention has been applied. The internal layers 2-2d, 12-12d and the coatings 3, 3a are said to form a carrier body 4. Moreover, and in contrast to the data carrier 1' being produced according to the method of the state of the art, the coating 3 in the region of the uppermost internal layer 2, 12 forms a top layer 5 of the data carrier 1 and the coating 3a in the region of the lowermost internal layer 2d, 12d forms a bottom layer 6 of the data carrier 1. Said top layer 5 and bottom layer 6 can be referred to as overlay layers. In other words, the overlay layers 5, 6 of the data carrier 1 according to the invention are provided by means of the coatings 3, 3a. As is furthermore indicated in figure 2c, an extension direction E extending from the coating 3 constituting the top overlay layer 5 towards the coating 3a constituting the bottom overlay layer 6 can be defined. After this stacking of the layers 2-2d, 5-6 during the collation step the different layers 2-2d, 5-6 are connected to one another by lamination in a lamination step, see figure 2d. As seen in figure 2d, during the lamination of the data carrier 1 the lamination plates 7, 7a of a lamination device are in direct contact with the coatings 3, 3a, wherein the coating 3, 3a does not stick nor transfer to the plates 7, 7a. Furthermore, after the lamination the coating 3, 3a maintains its transparent colour.

[0070] After the lamination step a punching step is performed, wherein a data carrier element 9 of a smaller size is obtained (depicted in figure 3). Said data carrier element 9 can be seen as the data carrier 1 of a desired or final shape. The coating 3, 3a prevents the generation of burrs or cracks.

[0071] After the punching step, a processing step such as a stamping step is performed, see figure 2e. Here, said stamping corresponds to a hot stamping, wherein processing elements 8, 8a such as personalization elements or security elements e.g. in the form of holograms or signature panels, etc., are stamped to the overlay layer 5, i.e. to the coating 3.

[0072] After the stamping step, a milling step, wherein at least one cavity is milled into the carrier body, and an embedding step, wherein at least one module is embedded into the cavity, are performed (not depicted). The coating 3, 3a prevents the generation of burrs or cracks on an edge of the cavity. The coating 3, 3a furthermore prevents a pollution of the tool used to manufacture the cavity receiving the module. Moreover, a thermal stability of the coating 3, 3a is such, that the coating 3, 3a is not modified by any heat being applied during the embedding step.

[0073] Different options regarding the further processing of the data carrier 1 exist. Firstly, it is possible to cure the

coating 3, 3a in a curing step by exposing the data carrier 1 to UV radiation. A UV dose preferably is between 200mJ/cm^2 to 1200mJ/cm^2. Secondly, it is conceivable that a further processing step is performed, wherein further processing elements such as further security elements and/or further personalization elements are provided on the data carrier 1. For instance, said further processing elements can be electrical and/or graphical elements being provided on the coating. The coating 3, 3a is not cured at this stage and accepts a printed processing elements, e.g. printed graphical elements as it exhibits a good adhesion. Further processing elements are of course likewise conceivable, e.g. a thermo-transfer or a retransfer of the processing elements. After such a further processing step, the coating 3, 3a is cured, preferably again by exposing the data carrier to UV radiation. A UV dose is also in this case preferably in the range of 200mJ/cm^2 to 1200mJ/cm^2.

[0074] As an example, figure 3 schematically illustrates the various steps of a method according to the invention, wherein a data carrier 1 in the form of a smart card is generated. The various steps are preferably performed in the following successive order:

(a) One or more layers 2, 2a, ... that will participate in the formation of a carrier body 4, here called smart card structure, and a dual cure coating 3, in particular a dual cure varnish, are provided. The dual cure varnish 3 is printed on a top surface 10 of the smart card structure 2, 2a,;
(b) The dual cure varnish 3 is thermally dried, whereby a dry and thermofusible varnish 3 is obtained;
(c) The data carrier 1 comprising the dry and thermofusible varnish 3 and the smart card structure 2, 2a, is subjected to a punching step, wherein a data carrier element 9 of a smaller size is obtained. After punching, the data carrier element 9, that can also be referred to as data carrier 1 of a final shape, is subjected to a processing step, which corresponds here to a hot stamping step. In the hot stamping step, processing elements such as holograms or signature panels are generated in the varnish 3.

[0075] Thereafter, different further steps are conceivable, namely:

(d1) Further processing steps such as additional overprinting steps can be performed, wherein further processing elements such as additional overprints are applied onto the varnish;
(d2) The data carrier 1 comprising the further processing elements is cured by exposing the data carrier to UV radiation;

[0076] Alternatively, it is conceivable that:

(e) No further processing steps are performed. Instead, the data carrier 1 is cured after the processing step, here the hot stamping step.

[0077] Hence, the method according to the invention produces a data carrier 1 that is resistant to abrasion and scratches because of the thermoset network being generated upon the curing of the coating 3, 3a, wherein the coating 3, 3a prevents an overlay delamination and at the same time allows hot stamped elements or overprinted elements being generated.

LIST OF REFERENCE SIGNS

1, 1’	data carrier	11’, 11a’	processing element
2, 2a, ...	layer	12, 12a, ...	internal layer
2’, 2a’, ...	layer	12’, 12a’, ...	internal layer
3, 3a	coating	13, 13’	bottom surface
4, 4’	carrier body	14, 14’	top surface
5, 5’	top layer	15, 15’	bottom surface
6, 6’	bottom layer	16	volume
7, 7a	lamination plate	17	surface region
8, 8a	processing element	18	surface region
8’, 8a’	processing element	19	inside
9	data carrier element	20	top surface
10, 10’	top surface	21	bottom surface
11, 11a	processing element	E	extension direction

Claims

1. A method of producing a data carrier (1) comprising the steps of:

    - Providing one or more layers (2, 2a, ...),
    - Providing at least one coating (3, 3a), preferably a varnish,
    - Generating a carrier body (4) comprising the one or more layers (2, 2a, ...) and the coating (3, 3a),

    characterized in that the coating (3, 3a) is dried in a drying step and cured in a curing step, wherein, in terms of time, the drying step occurs before the curing step.

2. The method according to claim 1, wherein the coating (3, 3a) is provided by printing in at least one printing step, and wherein the coating (3, 3a) is preferably provided by offset printing and/or by screen printing in the printing step, and/or wherein the coating (3, 3a) is preferably directly printed onto at least part of at least one of the one or more layers (2, 2a, ...) in the printing step.

3. The method according to any one of the preceding claims, wherein the coating (3) constitutes a top layer (5) of the carrier body (4), and/or
wherein the coating (3a) constitutes a bottom layer (6) of the carrier body (4), and/or
wherein the coating constitutes at least one internal layer of the carrier body (4).

4. The method according to any one of the preceding claims, wherein the coating (3, 3a) is at least partially dried, preferably entirely dried in the drying step before it is cured in the curing step, and/or
wherein the coating (3, 3a) at least initially comprises one or more solvents, and wherein said one or more solvents are at least partially, preferably entirely evaporated during the drying of the coating (3, 3a) in the drying step.

5. The method according to any one of the preceding claims, wherein, in terms of time, the curing step occurs directly or indirectly after the drying step.

6. The method according to any one of the preceding claims, wherein the coating (3, 3a) is thermally dried in the drying step and/or wherein the coating (3, 3a) is ventilation dried in the drying step.

7. The method according to any one of the preceding claims, wherein the coating (3, 3a) is UV-cured in the curing step by irradiating electromagnetic radiation in the ultraviolet region of the electromagnetic spectrum, and/or
wherein the coating (3, 3a) is cured in the curing step by a radical polymerization, in particular by a radical UV polymerization

8. The method according to any one of the preceding claims, wherein the carrier body (4) is generated by laminating the one or more layers (2, 2a, ...) and the coating (3, 3a) in at least one lamination step, and
wherein the coating (3, 3a) is preferably in contact with one or more lamination plates (7, 7a) of a lamination device in the lamination step, and/or
wherein the coating (3, 3a) is preferably at least partially transparent after the lamination of the carrier body (4).

9. The method according to any one of the preceding claims, wherein one or more processing elements (8, 8a) are generated in and/or on and/or below the coating (3) with respect to an extension direction (E) in at least one processing step, and/or
further comprising at least one punching step, wherein at least one data carrier element (9) is punched of the carrier body (4), and/or
further comprising at least one milling step, wherein at least one cavity is milled into the carrier body (4), and
preferably further comprising at least one embedding step, wherein at least one module is embedded into the cavity.

10. The method according to claim 9, wherein said one or more processing elements (8, 8a) are stamped, preferably hot stamped, to the coating (3) in the processing step, and/or
wherein said one or more processing elements (8, 8a) are at least partially printed, preferably ink-jet printed and/or silkscreen printed, on and/or below the coating (3) with respect to the extension direction (E) in the processing step, and/or
wherein said one or more processing elements (8, 8a) constitute one or more security elements and/or one or more personalization elements.

11. The method according to claim 9 or 10, wherein, in terms of time, the processing step and/or the punching step and/or the milling step and/or the embedding step occurs after the drying step and/or before the curing step.

12. The method according to any one of the preceding claims, wherein the coating (3, 3a) corresponds to a two-component varnish, and/or
wherein the coating (3, 3a) comprises or consists of at least one volatile compound and at least one non-volatile compound, and/or
wherein the coating (3, 3a) comprises or consists of at least one solvent and at least one polymer and/or polymerizable compound such as a monomer and/or an oligomer, the coating preferably furthermore comprises at least one binder and/or at least one photoinitiator and/or at least one oil and/or at least one filler and/or at least one additive.

13. Use of a coating (3, 3a) for the production of a data carrier (1) comprising a carrier body (4) that comprises one or more layers (2, 2a, ...) and the coating (3, 3a), wherein the coating (3, 3a) is dryable and curable.

14. A data carrier (1) comprising:

- one or more layers (2, 2a, ...); and
- at least one coating (3, 3a);

wherein the one or more layers (2, 2a, ...) and the coating (3, 3a) form a carrier body (4),
wherein the coating (3, 3a) preferably constitutes a top layer (5) of the carrier body (4) and/or a bottom layer (6) of the carrier body (4),
characterized in that the coating (3, 3a) is dried and cured.

15. A security document comprising or consisting of at least one data carrier (1) as produced in the method according to any one of claims 1 to 12 and/or as claimed in claim 14,
wherein the security document preferably is a smart card, an identity card, a passport, a credit card, a bank note or the like.

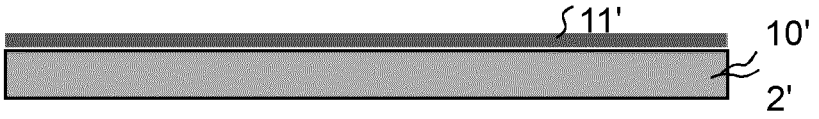

FIG. 1a

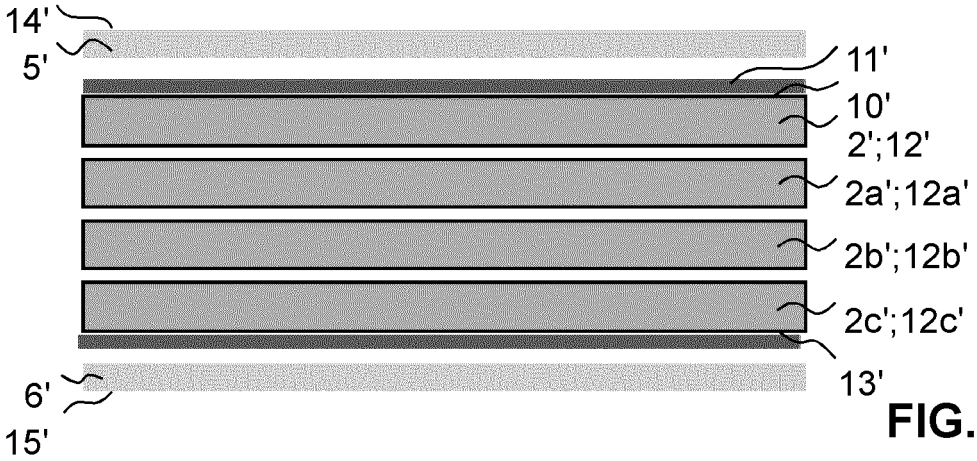

FIG. 1b

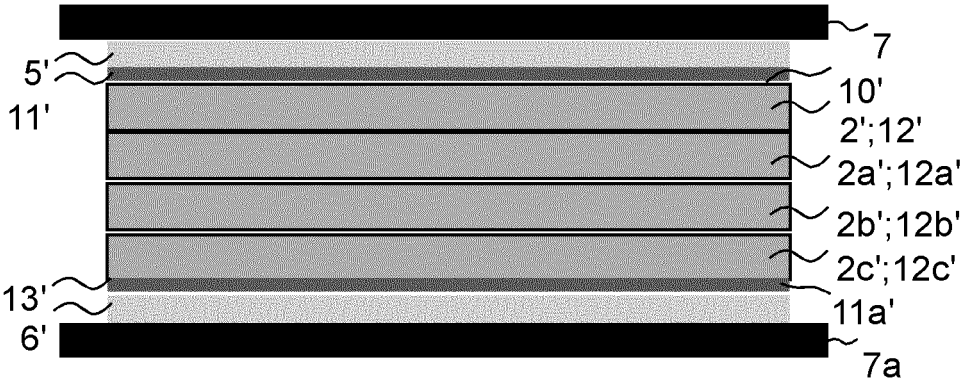

FIG. 1c

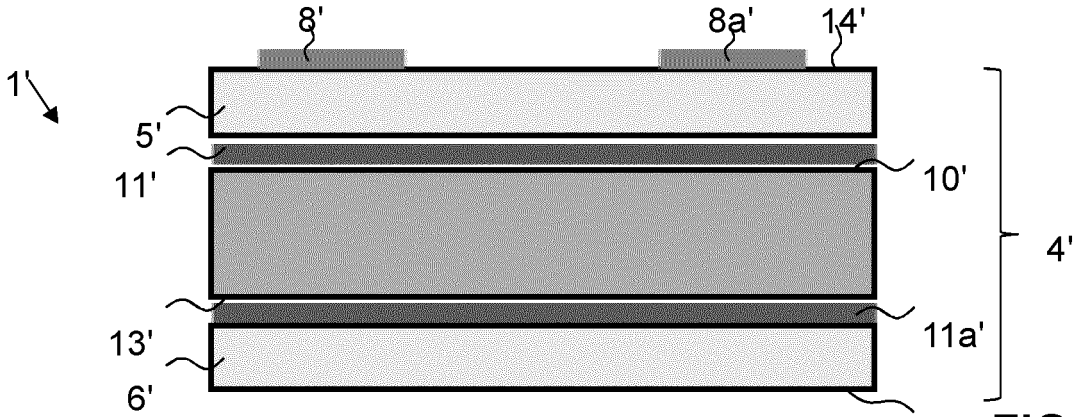

FIG. 1d

FIG. 2a

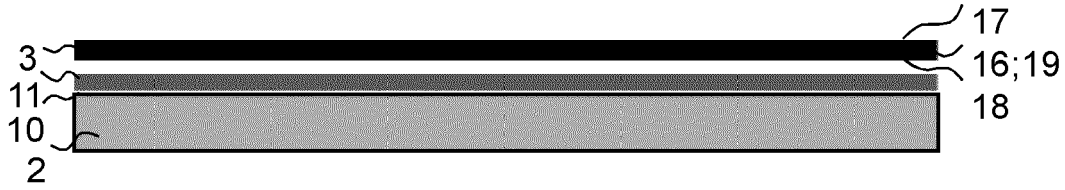

FIG. 2b

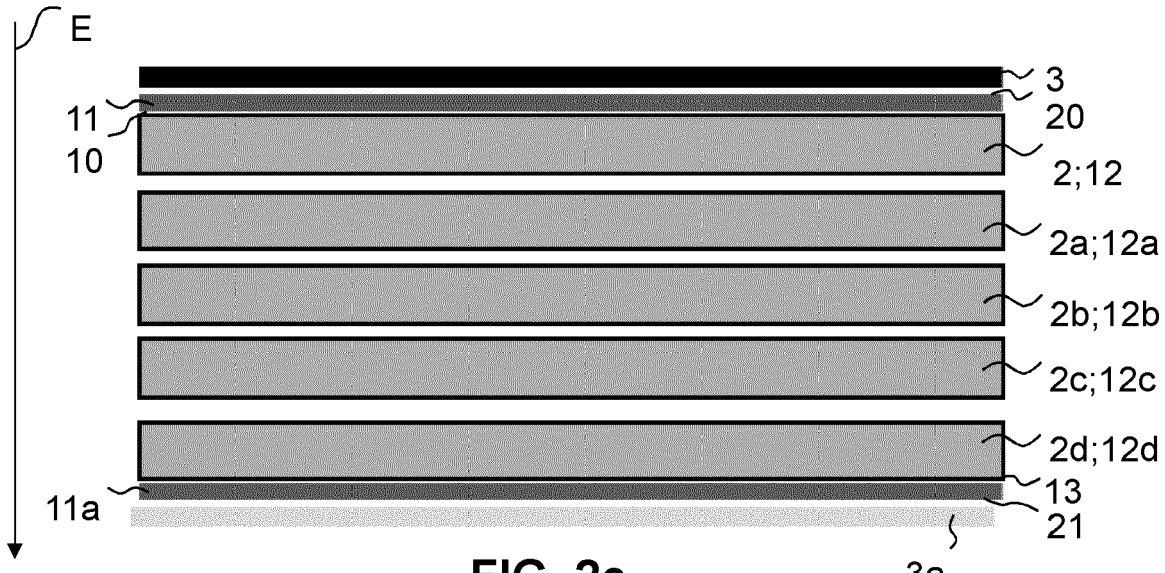

FIG. 2c

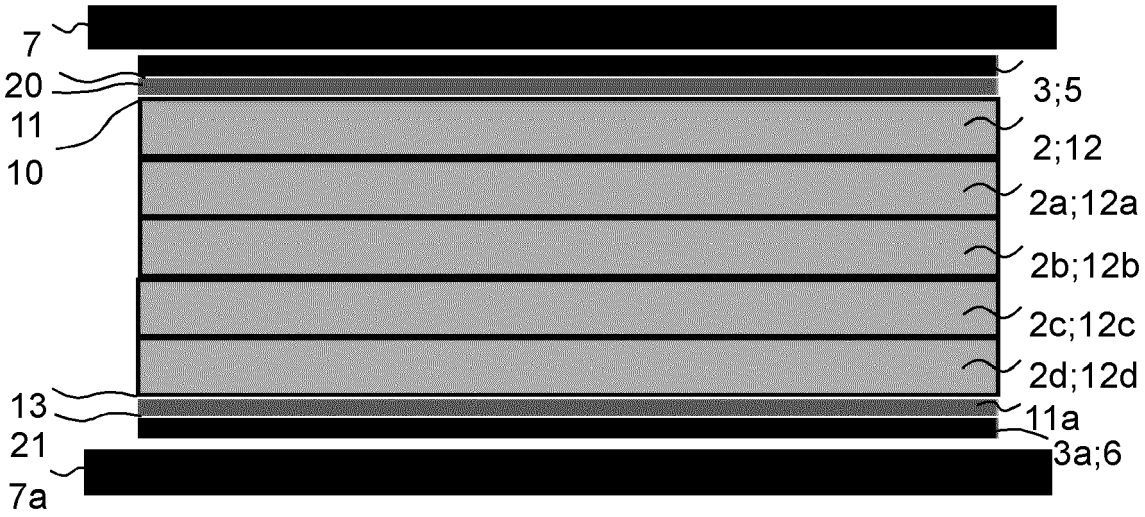
7
20
11
10
13
21
7a
3;5
2;12
2a;12a
2b;12b
2c;12c
2d;12d
11a
3a;6

FIG. 2d

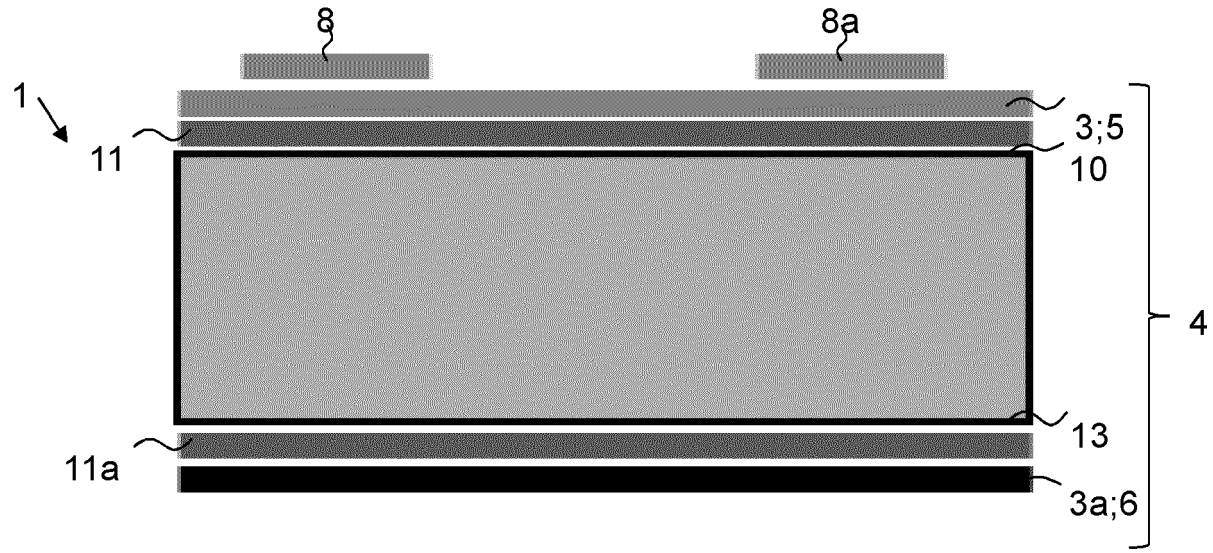
8
8a
1
11
11a
3;5
10
13
3a;6
4

FIG. 2e

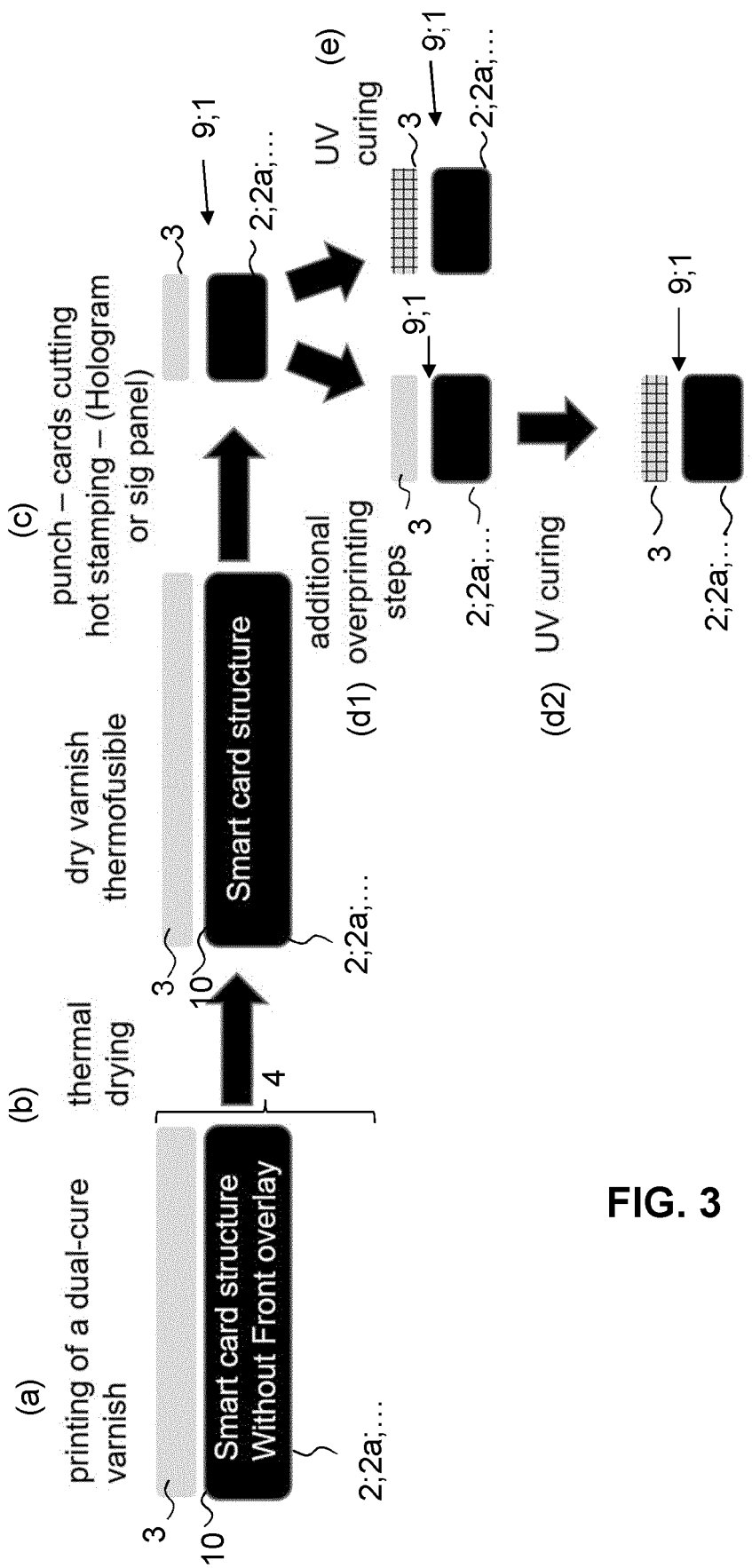
(a)
printing of a dual-cure varnish
Smart card structure Without Front overlay
3
10
2;2a;...
(b)
thermal drying
4
(c)
dry varnish thermofusible
Smart card structure
3
10
2;2a;...
punch – cards cutting hot stamping – (Hologram or sig panel)
3
9;1
2;2a;...
(d1) additional overprinting steps
9;1
3
2;2a;...
(d2) UV curing
3
9;1
2;2a;...
(e) UV curing
3
9;1
2;2a;...

FIG. 3

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 21 30 5655

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 2014/067715 A1 (SICPA HOLDING SA [CH]) 8 May 2014 (2014-05-08)	1-7,9, 10,12-15	INV. B42D25/46
Y	* page 10, line 24 - line 25; claim 10 *	8,11	B42D25/475
Y	WO 2021/030383 A1 (FED CARD SERVICES LLC [US]) 18 February 2021 (2021-02-18) * pages 32,33,55 *	8,11	
A	EP 3 235 651 A1 (GEMALTO SA [FR]) 25 October 2017 (2017-10-25) * paragraphs [0029], [0044] *	8,11	

TECHNICAL FIELDS SEARCHED (IPC)

B42D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	4 November 2021	Langbroek, Arjen

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 21 30 5655

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

04-11-2021

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2014067715 A1	08-05-2014	AR 093100 A1	20-05-2015
		AU 2013339747 A1	02-04-2015
		BR 112015006556 A2	20-03-2018
		CA 2884872 A1	08-05-2014
		CL 2015001091 A1	07-08-2015
		CN 104870582 A	26-08-2015
		CO 7400863 A2	30-09-2015
		DK 2912125 T3	13-02-2017
		EA 201590832 A1	31-08-2015
		EP 2912125 A1	02-09-2015
		ES 2614246 T3	30-05-2017
		HK 1213589 A1	08-07-2016
		HU E030494 T2	29-05-2017
		IL 238055 A	29-05-2017
		JP 6183927 B2	23-08-2017
		JP 2015533904 A	26-11-2015
		KR 20150073978 A	01-07-2015
		MX 366092 B	27-06-2019
		PH 12015500656 A1	11-05-2015
		PL 2912125 T3	28-04-2017
		PT 2912125 T	03-01-2017
		SG 11201501959W A	28-05-2015
		TW 201425401 A	01-07-2014
		UA 113457 C2	25-01-2017
		US 2015259565 A1	17-09-2015
		WO 2014067715 A1	08-05-2014
WO 2021030383 A1	18-02-2021	NONE	
EP 3235651 A1	25-10-2017	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82