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PROCESS FOR SERIES PRODUCTION OF SECURITY-PROTECTED OBJECTS AND MACHINE IMPLEMENTING THE PROCESS

The invention relates to a process for series production of security-protected objects and a machine that implements this process.

Security means used to authenticate identity documents are generally impersonal, such as holographic figures, and recurrent, in other words, the same for a large series of documents. They are therefore not highly effective means of protection against falsification and counterfeiting. For example, we find the same hologram with the same pattern on all credit cards. In the case of identity cards, we always find the same ultraviolet-sensitive patterns. Falsification and counterfeiting are then easy for a forger, as long as he does not damage these security elements or if he can procure them.

The personalization of the security elements considerably reduces the possibilities of falsification and makes counterfeiting very difficult. A personalized security element is a component that includes an information item taken from the card. Any modification of this information item on the card (a name or number for example) then requires its modification on the security element too; in other words, it is then necessary to counterfeit not only this element, but also its environment: the counterfeiter will need the raw material of the medium and the technical skills to make the modifications.

Optical security elements, in particular holograms, offer the most effective protection against falsification and counterfeiting, since the hologram, thanks to its physical properties, has the double advantage that it cannot be copied by simple reprography (using "toner") or other photocopying processes, and that it has a strong visual effect. However, it is not yet known how to personalize holograms in real time. Known holograms are either stamped or volume holograms recorded in the thickness of a silver-based photosensitive material. In these two cases, the recording process makes use of techniques

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incompatible with industrial card manufacturing processes. For example, the development of volume holograms recorded in silver metals necessitates the use of liquid chemical products.

It is known how to record holograms in real time with classic industrial methods, using new photosensitive materials of photopolymer type. The hologram recording process using these new materials has the advantage of being totally dry, unlike the other processes mentioned previously, whether they use materials based on silver or bichromated gelatine.

A system enabling complete fabrication of an identity document containing a personalized hologram is complex. This complexity makes it impossible to produce this type of document at local scale using simple machines, since, apart from the usual printing and lamination modules, the machine must include a hologram recording module composed of a laser emitter and a fragile optical system. The synchronization of all the modules is difficult. Moreover, the recording of such an optical component imposes severe stability conditions on the whole system. Finally, the recording speed of the hologram considerably limits the card production rate. The implementation and maintenance of such a system implies permanent surveillance by qualified operators.

The object of the present invention is a fabrication process for objects security-protected by holograms that can be implemented using traditional industrial methods, in a simple manner and in large volumes without requiring qualified operators for monitoring and that can produce documents that are very difficult to falsify or counterfeit.

The invention also proposes a machine that implements said fabrication process and that is simple, inexpensive, easy to use and requires minimal maintenance.

The process according to the invention is a process for series production of objects security-protected by at least one hologram, characterized in that it consists in prerecording for each object at least one holographic mirror in a photosensitive material, in personalizing the holographic mirror by locally modifying the fringe distance according to a specific pattern representing at least part of the information specific to the object and/or the person(s) authorized to hold the object, in security-protecting the object by attaching to it the corresponding personalized mirror(s), and in protecting at least part of the assembly using protective means to prevent falsification.

According to one aspect of the process according to the invention, said object is an identification document, said specific pattern is a characteristic element of the document and its holder, and the document assembled with its hologram(s) is protected by a protective film preventing falsification.

According to another aspect of the process according to the invention, the personalization of the holographic mirror is performed by attaching to the holographic mirror a film of photosensitive material that is exposed to a pattern representing information specific to the object and its holder, the mirror and the material then being developed in a thermal chamber.

The machine according to the invention includes a first station with means of storage and unreeling of strips of holographic mirrors and strips of photosensitive material, a station for personalizing the holographic mirrors, a station for assembling the objects with their corresponding mirrors, and a lamination station.

The invention will be better understood on reading the following detailed description of an embodiment, which is non-limitative and taken only as an example, with reference to the attached drawings of which:

- figures 1 and 2 are respectively front view and a plan view of a machine producing holographic mirrors, like the one used by the invention;

- figure 3 is a simplified view of a document production machine according to the invention.

The invention is described below in reference to the fabrication of security-protected identity cards. However, it is of course not limited to this application and can be implemented for fabrication of various other security-protected objects or documents (credit cards, access control cards, passports, etc.) and for personalized marking of high-value objects (luxury goods, etc.).

The machine described below uses as a security device a hologram that is personalized in real time, in other words it is produced at the same rate as the actual documents to which it will be attached and as the protection layers. Here the initial product from which the personalized hologram is produced is a holographic mirror. This mirror is preferably factory-made by the manufacturer of the blank photosensitive material, although obviously the machine of the invention, described below with reference to figure 3, can incorporate a holographic mirror fabrication station based on known techniques and described below with reference to figures 1 and 2.

A holographic mirror is a network of fringes obtained from the interference between two coherent light beams and recorded in the volume of a photosensitive material, hereinafter called material M. The fringe distance is determined by the wavelength of the coherent light used and by the recording conditions of the fringes (angle between the two beams). The wavelength (in other words, the color) of the light reflected by the hologram is directly determined by the fringe distance according to Bragg's Law.

Such holographic mirrors are mass produced; they appear as small squares or rectangles mounted on a strip of blank photosensitive film. A station 1 fabricating such holographic mirrors is shown schematically in figures 1 and 2. The blank photosensitive film 2, wound with a support/protection strip on a reel 3, is mounted at station 1. The film is unreeled and passes into a recording module 4 where it is exposed to an interference system that

creates interference fringes recorded in the thickness of this material. Next, the film is fixed in a station 5, and finally it is wound on a storage reel 6. The station 4 has, of course, masks with rectangular openings in order to record only a rectangular area 7 on the film, this area advantageously corresponding to that of the required security thumbnail. The station 1 is of known design, so it will not be described here in more detail.

The machine 8 producing security-protected documents will be described with reference to figure 3. This machine 8 includes a first station 9 in which the film carrying holographic mirrors is laminated onto a film of personalization material, hereinafter called material P. This material P is a specific photopolymer which, under the action of heat, modifies the properties of the mirror (it increases the fringe distance and the modulation amplitude of the refraction index). The station 9 includes, first, means of support for the reel 6 and a reel 10, initially empty, which serves to recover the protective strip 2A of the film 2 as it is progressively consumed. The station 9 also includes a unwinding support for a reel 11 of film of material P, and a winding support for a reel 12, initially empty, which serves to receive the protective film 12A of the film 11A of material P. After separation from their respective protective films, the films 2 and 11A are brought into contact between two heated pressure rollers 13, 14.

The heating of these rollers 13, 14 produces a multilayer film constituted by the two materials M and P welded together and laminated between two protective films (polyester, for example) which constitute their supports, the layers M and P of course being in mutual contact.

The station 9 is followed by a "buffer unit" 15 of known design which can receive a variable length of laminate output from station 9. This device 15 is necessary, since at the following stations, described below, the advance of the laminated film may be continuous or discontinuous, depending on the station considered, whereas the advance of the film in station 9 before and

just after the rollers 13 and 14 must necessarily be continuous to ensure good lamination of the materials M and P, and it must also be continuous in the thermal chamber of the first following station, and during the lamination of the adhesive in the second following station. On the other hand, the advance of the film is discontinuous in the personalization station and during placing of the hologram on the identity document. The buffer unit 15 and the following buffer units, described below, enable these requirements to be met.

The buffer unit 15 is followed by a station 16 which personalizes the holographic mirrors. The station 16 includes a UV personalization device 17 followed by a buffer unit 18 and a thermal chamber 19. In this station 16, the material P that is part of the multilayer film 20 from the station 9 is inhibited according to a pattern representing an information item from the identity document. This inhibition consists in making more-or-less chemically inactive the material P in the zones corresponding to the darker areas of said pattern, by exposure to the ultraviolet rays produced by the device 17. The copy of the pattern in question is made in a known manner using a spatial light modulator (or a light deflection device using mirrors or micro-mirrors) projecting the pattern to be reproduced. According to the preferred embodiment, said modification of the fringe distance according to a pattern is made by proportional transformation of the pattern, but of course other functions could be implemented: stereoscopic transformation, local modifications of the pattern, encryption, etc. Whatever copying device is used, it is controlled in real time by a processor 21 supervising the machine 8. In a variant, the material P is first exposed then laminated with the material M.

After printing of the pattern in the device 17, and passing through the buffer unit 18, the holographic mirror personalized in a latent manner is developed in the thermal chamber 19 for about 5 minutes to 2 hours, at a temperature of about 120°C to 160°C, depending on the color required for the final hologram. Following this heat treatment, the personalized holographic mirror

is at least constituted by one two-color image: the original color of the mirror in the zones where the material P has been inhibited (no modification of the original fringe distance), and a second color in the areas where this fringe distance has been modified by exposure to ultraviolet rays to reproduce the pattern used. At the outlet from the thermal chamber 19, the composite film 19A is constituted by a layer containing a series of personalized holograms, protected on each of its two faces by a protective sheet, for example of polyester, these sheets being the support sheets of the films 2 and 11A.

At the next station 22, the film 19A is delaminated by removing one of its protective sheets, which is recovered by a receiving reel 23. Immediately afterwards, an adhesive film 24 is applied to the exposed face of the film 19A in order to be able to affix it later on the identity document to be security-protected. For this purpose, a reel 25 of adhesive film 26 is used, this film being itself protected by a protective film, for example of polyester. The protected adhesive film 26 is delaminated by removing its protective film 27 in contact with the surface that will be applied to the film 19A. This film 27 is recovered on a receiving reel 28. After this delamination, the adhesive film 24 is applied to the film 19A as the two films pass between two heated pressure rollers 29, 30.

The film 31 thus produced passes through a buffer unit 32 before arriving in a device 33 that fixes the holograms on the identity documents. To ensure that the right holograms are applied to the right identity documents, according to the invention a distinctive marking, for example a bar-code, is attached to each holographic mirror during its personalization in the device 17. This marking is made in the material P in a similar manner to that used to make the personalization pattern, under the control of the processor 21. For example, near the spatial light modulator (or mirror deflector) in the device 17 it is possible to place another spatial modulator to project said distinctive marking on the composite film 20 which is then developed is the same manner as the personalized pattern; moreover, a single spatial modulator

could serve for both markings. This marking is made just next to the corresponding holographic mirror on a free area of the composite film (the holographic mirrors do not occupy the whole surface of the film, as shown in figure 2). The processor 21 of course prints the same code on the corresponding identity document, as explained below.

In parallel to the production of the personalization holographic thumbnails, the identity documents are printed in a station 34. The blank identity documents, which could be individual sheets, are stacked in the feed cassette 35 of a printer 36. This printer 36, which is controlled by the processor 21, prints on these blank documents the various information required (holder's photograph, personal details, etc.) and the marking (bar-code) identical to the one printed on the film 15A in the device 17. The printed documents are stored in the outfeed cassette 37 of the printer 36. From here the printed documents are fed, synchronously with the arrival of the film 31, into the device 33 in which the thumbnails are cut and affixed on the corresponding documents. The support film remaining after cutting out the thumbnails is collected on a receiving reel 38. The device 33 includes means of reading bar-codes and means of comparison of the codes read respectively on the film 31 and on the documents coming from the outfeed cassette 37. It also includes means enabling the holographic thumbnails to be placed face-to-face with the corresponding printed documents, to be cut from their support film and to be affixed on the documents.

The documents in a strip, now carrying their respective thumbnails, are moved to a lamination station 39 where heated pressure rollers 40, 41 apply to each face a protective film advantageously equipped with appropriate securities (known protection against attempted falsification of the documents by removing the protective films) and fed respectively from reels 42, 43. The security-protected documents are cut from the strip and provisionally stored in an outfeed cassette 44.

CLAIMS

1. Process for series production of objects security-protected by at least one hologram, characterized in that it consists in prerecording for each object at least one holographic mirror (7) in a photosensitive material (2), in personalizing the holographic mirror by locally modifying the fringe distance according to a specific pattern representing at least part of the information specific to the object and/or the person(s) authorized to hold the object, in security-protecting the object by attaching to it the corresponding personalized mirror(s), and in protecting at least part of the assembly using protective means to prevent falsification.

2. Process according to claim 1, characterized in that said object is an identification document, said specific pattern is a characteristic element of the document and its holder, and the document assembled with its hologram(s) is protected by a protective film preventing falsification.

3. Process according to claim 1 or 2, characterized in that said personalization of said holographic mirror is achieved by attaching to the holographic mirror a film of photosensitive material (11A) that is exposed (17) to a pattern representing information specific to the object and its holder, the mirror and the material then being developed in a thermal chamber (19).

4. Process according to claim 3, characterized in that said exposure is made using a spatial light modulator.

5. Process according to claim 3, characterized in that said exposure is made using a scanning system with a mobile mirror.

6. Process according to claim 3, characterized in that said exposure is made using a system of micro-mirrors.

7. Process according to one of the previous claims, characterized in that to ensure that said personalized mirror(s) are paired with the right object

before assembling them, each object and each corresponding mirror during its personalization is provided with a specific identification code which, just before assembling each object with its personalized mirror(s), are compared to verify that they are the same.

8. Machine for series production of documents security-protected by holograms, characterized in that it includes a first station (9) with means of storage and unreeling of strips (6) of holographic mirrors and strips (11) of photosensitive material, a station (16) for personalizing the holographic mirrors, including an exposure module (17) and a thermal chamber (19), a station (22) for assembling the documents with their corresponding personalized mirror(s), including an assembly and cutting module (33), a document printing station (36), a document lamination station (39), and a control and supervision processor (21).

9. Machine according to claim 8, characterized in that said assembly station (22) includes means of comparing identification codes.

10. Machine according to claim 8 or 9, characterized in that it includes a buffer unit (15) between said first station (9) and said personalization station (16), a buffer unit (18) in said personalization station between said exposure module and said thermal chamber, and a buffer unit (32) in said assembly station, upstream of said assembly and cutting module (33).