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(54) Series of security documents provided with a watermark in the form of a bar code

(57) The invention relates to a series of security documents, preferably bank notes, comprising several denominations each representing a different value, provided with a watermark in the form of a bar code (2), the bars for each denomination being at another angle to an axis.

Additionally the invention relates to a device for detecting and reading a watermark in the form of a bar code, provided with at least two recording elements, two recording elements being sensitive in different wavelength ranges in the infrared range.

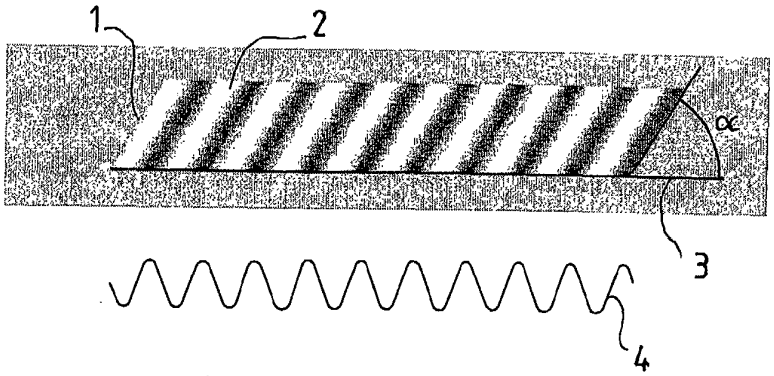


FIG. 1

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Description

[0001] The invention relates to a series of security documents, preferably bank notes, comprising several denominations each representing a different value, provided with a watermark in the form of a bar code.

[0002] It is known to provide security documents, for instance bank notes, with a watermark, particularly a watermark in the form of a bar code. For instance from among others WO-A-00/45344 a watermark in the form of a bar code is generally known.

[0003] From EP-A-509916 security documents are know provided with a watermark in the form of a bar code. The bars of the bar code are at an angle that is not perpendicular to the strips that are in a graphic image. Said strips in turn are symmetric with respect to an axis of symmetry of the security document. However, the watermark is combined here with the print on the security document. Additionally denomination recognition takes place based on the print.

[0004] Because the watermark is combined with a printed characteristic it is designed relatively large, to meet production tolerances.

[0005] It is an object of the invention to at least partially overcome said drawbacks.

[0006] To that end the invention provides a series of security documents, preferably bank notes, comprising several denominations each representing a different value, provided with a watermark in the form of a bar code, the bars for each denomination being at another angle to an axis.

[0007] By choosing bars that for each denomination are at a different/another angle, a better security is offered. As a result mechanical authenticity recognition is possible. Such a characteristic can furthermore offer an extra aid to for instance sort bank notes in denominations. For a receiver of a security document, the public in general for instance as well, it will moreover be relatively easy to check whether the watermark is correct and corresponds to the other visual characteristics of a security document. The term "periodical(ly)" is used in this text in the mathematical sense of the word.

[0008] The term "brightness" in connection with a watermarks should be understood to be a variation in translucency as is usual in watermarks, that become visible when light falls through. It therefore is in fact the intensity of the transmitted light.

[0009] Preferably the invention relates to a series of security documents, the axis being formed by the longitudinal axis of the bar code, or a series of security documents, the axis being formed by a side of the security document. In this way the angle can easily be checked. It is of course also possible to arrange a special watermark on the security document or to use a characteristic that is already present for defining the axis.

[0010] Preferably the bars are substantially parallel one to the other. As a result the angle can be easily and unambiguously checked by a user. The bars can also be grouped, the bars within a group being parallel to one another.

[0011] Preferably the brightness variation along the longitudinal axis at least partially deviates from a sinusoidal course. A brightness variation that is simple to realise and arrange is substantially sinusoidal. However, by deviating from it an extra coding and security possibility is offered. Preferably the brightness variation along the longitudinal axis is saw tooth-shaped, triangular, block-shaped, pulse-shaped, or a combination thereof. Thus an additional security level that is easy to notice is offered. The intensity variation can for instance also be adapted per denomination or per year. A part of the bars can also have an intensity or brightness variation according to a first periodical function and another part according to another periodical function. Such an additional security level can generally only be seen by an expert.

[0012] Another additional security possibility is a brightness variation along the longitudinal axis that changes periodically, the period not being constant. For instance the period or frequency may for a part of the bars take a first value, and for a second part a second value. The frequency may also linearly increase or decrease, or another function is possible. Such variations may be arranged such that they can easily and unambiguously be noticed. However it is possible to arrange this and the aforementioned extra security possibilities such that they can only be noticed mechanically or by means of image analysis.

[0013] A possibility that is visually simple to distinguish, is the period along the longitudinal axis taking at least two constant values, or being different for each denomination.

[0014] Additionally the invention relates to a security document provided with a watermark in the form of a bar code, the brightness variation of the bars along the longitudinal axis of the bar code at least partially deviating from a sinusoidal course. As a result an extra security level can be arranged. This can be noticed visually, but also such that it can only be detected by means of for instance image analysis of an electronic, digital image that has been taken from the watermark.

[0015] A result that can be visually noticed, is among others created when the brightness variation of the bars along the longitudinal axis is saw tooth-shaped, triangular, block-shaped, pulse-shaped, or a combination thereof. By means of variation in the brightness variation several aspects can be changed. For instance the value of a denomination can be changed, but also a relation with a production year, the serial number, the country (in case of Euros) or another characteristic that may or may not be visually present.

[0016] Additionally the invention relates to a security document provided with a watermark in the form of a bar code, the period of the brightness variation of the bars along the longitudinal axis of the bar code not being constant. This was discussed above in combination with

the angle, but may, just like the wave form, also serve as extra characteristic, in the same manner as the wave form. Additionally at least two groups of bars can be formed, the bars within a group being parallel to one another.

[0017] Additionally the invention relates to a security document provided with a watermark in the form of a bar code, the bars being parallel to one another and being at an angle that is different from 90° to the lower edge of the watermark, and with a visual indication, the angle being distinctive for the visual indication.

[0018] Additionally the invention relates to a device for detecting and reading a watermark, provided with at least two recording elements, two recording elements being sensitive in different wavelength ranges in the infrared range. More in general a device for detecting a security characteristic, provided with at least two recording elements, two recording elements being sensitive in different wavelength ranges in the infrared range.

[0019] In practice it appeared that a watermark that is well visible in the infrared range can be forged. However, experience has taught that it is almost impossible to have a forgery be perfect for all wavelengths.

[0020] Preferably the device is provided with a first detector, sensitive in the near infrared, and a second detector, sensitive in the infrared range having a wavelength larger than the wavelength in which the first detector is sensitive.

[0021] Moreover or additionally it is preferred that the first detector is sensitive in a wavelength range of approximately 900 to 1200 nm and a second detector being sensitive in a wavelength range of approximately 1500 to 1900 nm. From experiments and research it has namely appeared that it is hard to let the forgery resemble the original in those two ranges.

[0022] Preferably the device further comprises a third detector, sensitive in a wavelength range of over 2500 nm, particularly round about 3000 nm.

[0023] An even better verification appeared possible when the first detector is a diode array. As a result for instance a background level can be established, dimensions can be taken and checked, and other characteristics mentioned above can be detected.

[0024] Additionally the invention relates to a device as described, suitable for either detecting or reading out a watermark in the form of a bar code as described above.

[0025] Additionally the invention regards a security document apparently belonging to the series of security documents as described.

[0026] The invention will be further elucidated on the basis of an exemplary embodiment, in which a watermark in the form of a bar code according to the invention is shown, in which:

Figure 1 shows a watermark in the form of a bar code; and

Figure 2 shows a watermark in the form of a bar code, having a deviating brightness variation and period.

[0027] Figure 1 shows an example of a watermark in the form of a bar code 1. In this figure the bars 2 have been arranged at a regular distance from each other, and the bars are at an angle α to the lower edge 3 of the watermark, which here runs parallel to the longitudinal axis of the watermark, the angle being different from 90°. In this example the angle for instance is 70°. In practice the angle can be varied from approximately 45-135 degrees. In cross-section 4 the intensity or brightness variation along the longitudinal axis looks like as shown and here is sinusoidal. The bar code may for instance be parallel to a side of a security document, but not necessarily so. In this example the lower side or lower edge 3 of the bar code is straight and parallel to the longitudinal axis or main axis of the watermark in the form of a bar code.

[0028] In figure 2 as well, a watermark in the form of a bar code 1 is shown. In this case the angle α of the bars 2 to the lower edge 3 of the watermark is 110°. Under the watermark it is indicated that the intensity or brightness variation seen in cross-section 4 is triangular. Additionally it can be seen that the frequency of the bars from left to right becomes lower. In figure 2 two periods or frequencies occur, and a more or less direct transition from the one value to the other value. In practice many variations are possible. For instance the period may take a first value, and some periods later a second value, and yet some periods later again a third value. Said transition can be sudden, or fluent. The wave form can also change gradually, for instance from sinusoidal to triangular. It is of course also possible that the wave form, the period or the angle of the bars is characterising for the denomination. If so desired, those variations can also be combined.

[0029] The size of the bar code is, as is the bar code of figure 1, approximately 30 mm x 8 mm.

[0030] The (groups of) bars can be more or less equidistant, but the distance one to the other or the width of each bar may also vary, as is usual in bar codes.

[0031] For that matter detection or reading out of the bar code usually takes place in the infrared range. Preferably a detector provided with an array of photo diodes or a suitable CCD element is used to that end. This has the advantage that deviations in the production and the transport past the detector can be taken. Preferably the detector has a recording element, for instance an array of photo diodes or the CCD, positioned behind a slit between the recording element and the security document with watermark, that is guided past the slit. The slit is here substantially perpendicularly oriented with respect to the direction of displacement of the security document. Preferably the slit is wider than the bar code so that variations in the path and the bar code itself can be taken. Additionally, when the recording element is used

as mentioned, it is possible to determine a reference level from the ranges adjacent to the bar code when the projection of the recording element on the security document is wider than the bar code. Because the reference level can be established, the watermark in the form of a bar code can also be arranged under a different characteristic with infrared influencing properties.

[0032] Another aspect is that the security characteristics can also be developed by means of automated methods and a security document can also be designed in an automated manner by means of computer simulations. To that end various security characteristics can be arranged on a security document in an electronic manner, and the result can be shown on a display screen. It can also be calculated whether the characteristics can be noticed by means of detection equipment. The ageing of a security document can also be simulated, for instance by superposing the artificially produced bar code image with the image, taken from actually circulated and aged bank notes. The software can in this way simulate a security document provided with security characteristics.

[0033] Additionally or supplementary the software can simulate the detection of the security characteristics. In this way it is possible to develop a bar code and detector in an early stage that are well adjusted to each other, also for recognising circulated and dirty security documents provided with a watermark in the form of a bar code. The results can be shown on a display device, for instance a display screen.

Claims

1. Series of security documents, preferably bank notes, comprising several denominations each representing a different value, provided with a watermark in the form of a bar code, the bars for each denomination being at another angle to an axis.

2. Series of security documents according to claim 1, the axis being formed by the longitudinal axis of the bar code.

3. Series of security documents according to claim 1, the axis being formed by a side of the security document.

4. Series of security documents according to claim 1-3, the bars being substantially parallel one to the other.

5. Series of security documents according to one or more of the preceding claims, the brightness variation along the longitudinal axis at least partially deviating from a sinusoidal course.

6. Series of security documents according to one or more of the preceding claims, the brightness variation along the longitudinal axis being saw tooth-shaped, triangular, block-shaped, pulse-shaped, or a combination thereof.

7. Series of security documents according to one or more of the preceding claims, the brightness variation along the longitudinal axis changing periodically, the period not being constant.

8. Series of security documents according to claim 7, the period along the longitudinal axis taking at least two constant values.

9. Series of security documents according to claims 1-6, the period for each denomination being different.

10. Series of security documents according to claims 1-6, the waveform of the brightness variation along the longitudinal axis being different for each denomination.

11. Security document provided with a watermark in the form of a bar code, the brightness variation of the bars along the longitudinal axis of the bar code at least partially deviating from a sinusoidal course.

12. Security document according to claim 11, the brightness variation of the bars along the longitudinal axis being saw tooth-shaped, triangular, block-shaped, pulse-shaped, or a combination thereof.

13. Security document provided with a watermark in the form of a bar code, the period of the brightness variation of the bars along the longitudinal axis of the bar code not being constant.

14. Security document provided with a watermark in the form of a bar code, the bars being parallel one to the other and being at an angle that does not equal 90° to the lower edge of the watermark, and with a visual indication, the angle being distinctive for the visual indication.

15. Device for detecting and reading a security characteristic, such as a watermark, particularly in the form of a bar code, provided with at least two recording elements, two recording elements being sensitive in different wavelength ranges in the infrared range.

16. Device according to claim 15, the device being provided with a first detector, sensitive in the near infrared, and a second detector, sensitive in the infrared range having a wavelength larger than the wavelength in which the first detector is sensitive.

17. Device according to claim 16, the first detector be-

ing sensitive in a wavelength range of approximately 900 to 1200 nm and a second detector being sensitive in a wavelength range of approximately 1500 to 1900 nm.

18. Device according to any one of the claims 15-17, further comprising a third detector, sensitive in a wavelength range of over 2500 nm, particularly round about 3000 nm.

19. Device according to any one of the claims 15-18, the first detector being a diode array.

20. Device according to any one of the claims 15-18, suitable for either detecting or reading out a watermark in the form of a bar code according to any one of the claims 1-14.

21. Security document, apparently belonging to the series of security documents according to claims 1-10.

22. Device comprising one or more of the characterizing measures described in the description and/or shown in the drawings.

23. Method comprising one or more of the characterizing measures described in the description and/or shown in the drawings.

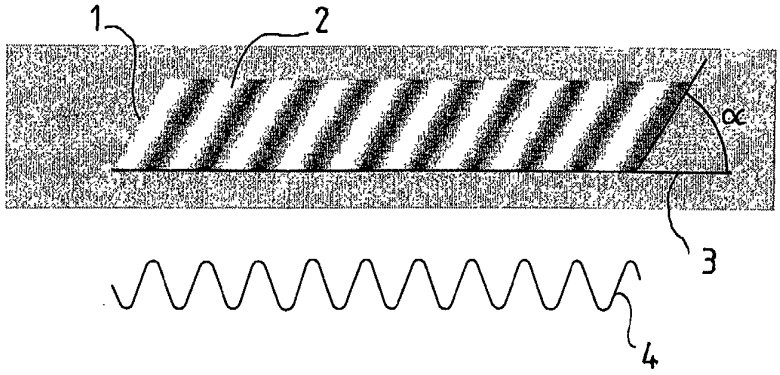


FIG. 1

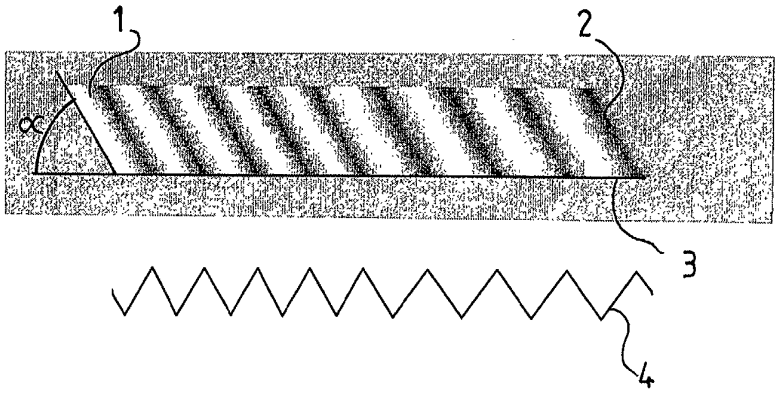


FIG. 2