one of both circular polarized light components; that means that within a determined wavelength range, light having a determined circular polarization state (left- or right-handed, depending on the polymer) is predominantly reflected.

Cholesteric liquid crystal materials are characterized by an internal helical supramolecular texture, which causes a periodic modulation of the refractive index, wherein the periodicity is comparable with the wavelength of visible light. As a consequence, such materials act as optical diffraction gratings and reflect light of particular wavelengths, appearing colored to the eye. The helical sense of the texture (right or left) causes light of one circular polarization state to be predominantly reflected (cf. J. L. Fergason, "Cholesteric Structure - I Optical Properties", in "Molecular Crystals", VoI 1, pp 293-307 (1966)). Cholesteric liquid crystal materials have been proposed as coloring means in US Pat. No. 3,766,061.

To achieve color properties which are stable in time and independent of the temperature, it is advantageous to "freeze" the cholesteric helical texture by chemical cross-linking, i.e. by polymerizing the liquid crystal material in the desired state, hereby obtaining a cholesteric liquid crystal polymer (CLCP). Photo-polymerized cholesteric liquid crystal materials have been disclosed in GB2166755A. Pigments made of cholesteric liquid crystal polymer are disclosed in EP 0 601 483 Al; such pigments can be used in coating compositions and as a security marking. WO 94/22976 Al and WO 95/08786 Al are particularly directed to such coatings and security markings. Further documents relevant in this context are DE 44 18 490 Al, EP 0 685 749 Al, WO 97/30136 Al, US 6,597,426, EP 0 887 398 Al, US 6,570,648, WO

00/47694 ~~A1,~~ A1, DE 199 22 158 A1, US 6,641,874, WO 2005/105473 A1, and WO 2006/063926 A1.

An authentication device for the machine-detection of security-markings comprising cholesteric liquid crystal material is disclosed in DE 102 11 310 A1. According to this document, the marking is illuminated using one or several spectrally restricted light sources, e.g. "color' light emitting diodes, and the light reflected by the marking is checked by a detecting unit for the presence of circular polarization. The device is not enabled, however, for the visual authentication of cholesteric liquid crystal markings.

According to the prior art, the visual authentication of a circular polarizing security marking on a document or item is performed under "ambient light" with the help of left- and right-circular polarizing filters, comparing the respective aspects of the marking as seen through the left- and through the right-circular polarizing filter, respectively. This method gives satisfactory results only as long as the illuminating light is of good spectral quality. In many circumstances the ambient light level is furthermore low (less than 50 lux, e.g. at night outdoors events, nocturnal identity controls, etc.), which does not facilitate the authentication operation.

Summary of the invention

The present invention discloses an authentication device for the easy visual authentication of a document or item comprising a circular polarizing security marking.

In an important aspect of the present invention, the authentication device comprises a special light source, able to emit left- and right- circular polarized light. This

and 'color'-LEDs are currently proposed by number of suppliers (Philips, Nichia, etc...) as high efficiency light sources for portable applications. White LEDs emit light all over the visible spectral domain (i.e. 400nm - 700nm). 'Color' -LEDs emit light in a particular, narrow wavelength range - about 50nm large - in the UV, visible or IR spectral domain.

LED efficiencies can be as high as 150 lumen/W of electric power, i.e. more than 10 times the efficiency of an incandescent lamp. This results in a 10 times increased autonomy, compared to a light bulb, which is an essential advantage for portable application, where autonomy is required. Typical operating conditions for white LEDs in flashlights and light torches vary from 20 mA at 3~~,~~.2 to 3~~,~~.6 V (for 25 to 30 cd light output) to up to ~~IA~~ 1 A (for more than 100 lumen light output).

The choice of a LED in the present invention allows thus to obtain an important advantage over the prior art, because i) the light source, and hence the illumination conditions of the marking, are precisely defined and remain the same for all authentications made with the device, and ii) the autonomy of the authentication device at continuous use can be up to one week, compared to less than one day for an incandescent lamp, using a set of classic commercial AAA batteries.

In a first embodiment of the authentication device, with reference to Fig. 1, a split right / left circular polarizing filter (FL, FR), composed of two semicircular filter plates, and disposed in front of a single white light source Ll, is used to obtain two adjacent beams of light of

Claims

1. A visual ~~Authentication~~ authentication device for the visual authentication of a document or item ~~comprising~~ having a circular polarizing security marking, said device comprising:

at least one light source~~,~~ and at least one circular polarizing filter structured and arranged to ~~, characterized in that said device~~ emit~~s~~ left- and right-circular polarized light onto the document for the illumination of the said marking ~~on said document~~, wherein either:

two beams of light of ~~the~~ opposite circular polarizations are produced to simultaneously illuminate ~~a document or item comprising a circular polarizing~~ said marking~~, preferably in adjacent zones, thereby allowing a user to visually judge the light reflected by said marking and authenticate said document or item.~~; or

a single beam of light of alternating opposite circular polarization is produced to illuminate said marking,

which thereby allows a user to visually observe with the naked eye the appearance/change of appearance of the marking under illumination by each type of polarized light.

2. The visual ~~Authentication~~ authentication device according to claim 1, ~~characterized in that~~wherein the circular polarizing filter is selected from the group consisting of the left-circular and the right-circular fixed polarizing filters, and of the mechanical and the electro-optic variable circular polarizing filters.

3. The visual ~~Authentication~~ authentication device according to claim 1 ~~or 2~~, ~~characterized in that~~wherein the light source is selected from the group consisting

of the white Light-Emitting Diodes (white-LEDs) and the 'color' Light-Emitting Diode (color-LEDs).

4. The visual ~~Authentication~~ authentication device according to ~~one of claims 1 to 3~~claim 1, ~~characterized in that~~wherein a positive lens or Fresnel lens is used to concentrate the light of the light source onto the document or item.

5. The visual ~~Authentication~~ authentication device according to ~~one of claims 1 to 4~~claim 1, ~~characterized in that~~wherein the illumination strength at working distance on the marking (M) is not less than 50 Lux, more preferably not less than 500 Lux.

~~6. Authentication device according to one of claims 1 to 5, characterized in that the authentication device is made from a material of the group consisting of the plastic materials, the stainless steels, aluminum and the aluminum alloys.~~

~~7~~6. The visual ~~Authentication~~ authentication device according to ~~one of claims 1 to 6~~claim 1, ~~characterized in that~~wherein the authentication device has the shape of a cylinder or a bar.

~~8. Authentication device according to one of claims 1 to 7, characterized in that the device additionally comprises a photoelectric cell chosen from the group consisting of the photocells and the color sensors, a microprocessor (µP), and a display (D), for the automated determination and evaluation of the intensity and color of the light reflected by the marking.~~

~~9~~7. A method of visually authenticating, with the visual ~~Use of an~~ authentication device according to ~~one of claims 1 to 8~~claim 1, ~~for the authentication of~~

currency, value papers, vouchers, identity documents, access documents, event tickets, transportation tickets, tear-tapes, product labels, or packaging materials.

~~10~~8. A ~~Method~~ method of visual~~ly~~ ~~authentication~~ authenticating ~~of~~ a document or item ~~comprising~~ having a circular polarizing security marking, said method ~~being characterized by the steps of~~comprising:

~~a)~~ illuminating said marking on said document ~~using a device according to one of the claims 1 to 8, emitting~~ with left- and right-circular polarized light from the visual authenticating device according to claim 1; and

~~b)~~ visually judging with the naked eye the light reflected by the ~~said~~ illuminated marking~~, hereby authenticating~~ in order to authenticate the document or item.

~~11. Method according to claim 10, wherein the light source is selected from the group consisting of the white Light-Emitting Diodes (white-LEDs) and the 'color' Light-Emitting Diode (color-LEDs).~~

9. The visual authentication device according to claim 1, wherein the two beams of light of opposite circular polarizations are produced in adjacent zones of the document or item.