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Whiteman et al.

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(54) **SECURITY DEVICE**

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(58) **Field of Classification Search**

CPC B42D 2033/12; B42D 2033/26; B42D 25/324

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

1,901,049	A	3/1933	von Heinrich
2,009,185	A	7/1935	McCorkindale
4,186,943	A	2/1980	Lee
6,337,131	B1	1/2002	Rupaner et al.
2004/0131799	A1	7/2004	Arsenault et al.
2004/0253443	A1	12/2004	Anselmann et al.

(Continued)

FOREIGN PATENT DOCUMENTS

DE	10 2006 051 524	A1	4/2008
EP	0 435 029	A2	7/1991

(Continued)

OTHER PUBLICATIONS

Pursiainen et al., "Nanoparticle-tuned structural color from polymer opals," Optics Express, Jul. 23, 2007, pp. 9553-9561, vol. 15-No. 15.

(Continued)

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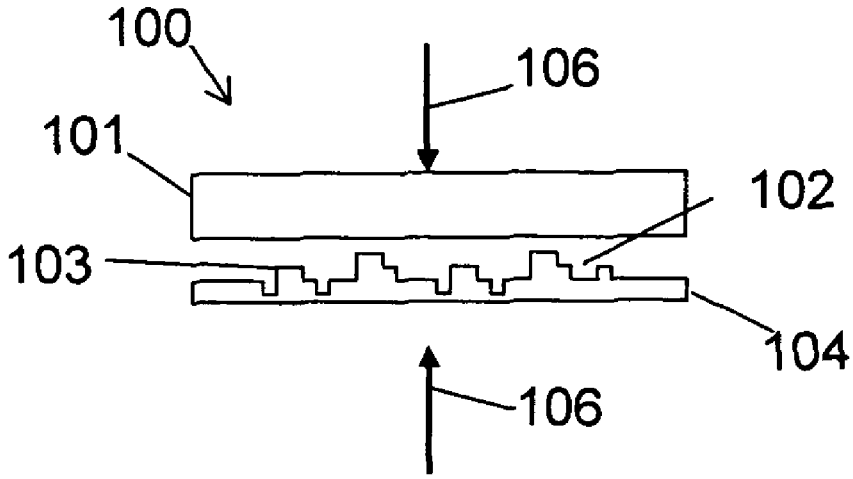
(57) **ABSTRACT**

A security device is disclosed having a region of piezochromic material and an integrated relief structure. The security device is arranged such that when a stress is generated in the piezochromic material and relief structure, an optical effect is generated in the piezochromic material.

33 Claims, 6 Drawing Sheets