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- (54) **ZOOM DUAL-APERTURE CAMERA WITH FOLDED LENS**
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- (52) **U.S. Cl.**  
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See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,507,558 A	4/1970	Shimizu
6,128,144 A	10/2000	Togino
7,301,576 B2	11/2007	Mihara
7,305,180 B2	12/2007	Labaziewicz et al.
7,382,546 B2	6/2008	Konno
7,453,517 B2	11/2008	Fujimoto et al.
7,561,191 B2	7/2009	May et al.
7,639,938 B2	12/2009	Hsiao et al.
7,676,146 B2	3/2010	Border et al.

(Continued)

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(57) **ABSTRACT**

Zoom digital cameras comprising a Wide sub-camera and a folded fixed Tele sub-camera. The folded Tele sub-camera may be auto-focused by moving either its lens or a reflecting element inserted in an optical path between its lens and a respective image sensor. The folded Tele sub-camera is configured to have a low profile to enable its integration within a portable electronic device.

**19 Claims, 15 Drawing Sheets**

