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# (12) United States Patent Shabtay et al.

## (54) ZOOM DUAL-APERTURE CAMERA WITH FOLDED LENS

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#### (56) References Cited

#### U.S. PATENT DOCUMENTS

2,106,752 A 2/1938 Land 2,354,503 A 7/1944 Cox (Continued)

#### FOREIGN PATENT DOCUMENTS

CN 101276415 A 10/2008 CN 102739949 A 10/2012 (Continued)

#### OTHER PUBLICATIONS

A compact and cost effective design for cell phone zoom lens, Chang et al., Sep. 2007, 8 pages.

(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.

#### 32 Claims, 15 Drawing Sheets

