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(54) **THIN DUAL-APERTURE ZOOM DIGITAL CAMERA**

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(56) **References Cited**

U.S. PATENT DOCUMENTS

2,354,503 A 7/1944 Cox
2,378,170 A 6/1945 Aklin
(Continued)

FOREIGN PATENT DOCUMENTS

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

OTHER PUBLICATIONS

Extended European Search Report in related EP patent application 17194753.4, dated May 24, 2018, 9 pages.

(Continued)

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(57) **ABSTRACT**

A dual-aperture zoom camera comprising a Wide camera with a respective Wide lens and a Tele camera with a respective Tele lens, the Wide and Tele cameras mounted directly on a single printed circuit board, wherein the Wide and Tele lenses have respective effective focal lengths EFL_W and EFL_T and respective total track lengths TTL_W and TTL_T and wherein $TTL_W/EFL_W > 1.1$ and $TTL_T/EFL_T < 1.0$. Optionally, the dual-aperture zoom camera may further comprise an optical OIS controller configured to provide a compensation lens movement according to a user-defined zoom factor (ZF) and a camera tilt (CT) through $LMV = CT * EFL_{ZF}$, where EFL_{ZF} is a zoom-factor dependent effective focal length.

23 Claims, 9 Drawing Sheets

