



US009568712B2

(12) **United States Patent**
Dror et al.

(10) **Patent No.:** **US 9,568,712 B2**
(45) **Date of Patent:** ***Feb. 14, 2017**

(54) **MINIATURE TELEPHOTO LENS ASSEMBLY**

(71) Applicant: **Corephotonics Ltd.**, Tel-Aviv (IL)

(72) Inventors: **Michael Dror**, Nes Ziona (IL);
Ephraim Goldenberg, Ashdod (IL);
Gal Shabtay, Tel Aviv (IL)

(73) Assignee: **Corephotonics Ltd.**, Tel Aviv (IL)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **15/170,472**

(22) Filed: **Jun. 1, 2016**

(65) **Prior Publication Data**

US 2016/0291293 A1 Oct. 6, 2016

Related U.S. Application Data

(63) Continuation of application No. 14/932,319, filed on Nov. 4, 2015, now Pat. No. 9,402,032, which is a (Continued)

(51) **Int. Cl.**

G02B 13/18 (2006.01)
G02B 9/62 (2006.01)
G02B 13/00 (2006.01)
G02B 9/60 (2006.01)
H04N 5/225 (2006.01)
H04N 5/232 (2006.01)
H04N 9/04 (2006.01)
H04N 9/097 (2006.01)
G02B 13/02 (2006.01)
G02B 1/04 (2006.01)
G02B 27/00 (2006.01)

(Continued)

(52) **U.S. Cl.**

CPC **G02B 13/0045** (2013.01); **G02B 1/041**

(2013.01); **G02B 9/60** (2013.01); **G02B 13/009** (2013.01); **G02B 13/02** (2013.01); **G02B 27/0025** (2013.01); **G02B 27/646** (2013.01); **H04N 5/2254** (2013.01); **H04N 5/2257** (2013.01); **H04N 5/2258** (2013.01); **H04N 5/23296** (2013.01); **H04N 9/045** (2013.01); **H04N 9/097** (2013.01); **G02B 5/005** (2013.01); **G02B 9/12** (2013.01); **G02B 9/62** (2013.01); **G02B 9/64** (2013.01); **G02B 13/00** (2013.01); **G02B 13/004** (2013.01); **G02B 13/18** (2013.01); **H04N 2101/00** (2013.01); **Y10T 29/4913** (2015.01)

(58) **Field of Classification Search**

CPC **G02B 13/0045**; **G02B 9/62**; **G02B 9/60**; **G02B 13/18**; **G02B 13/004**; **G02B 9/64**; **G02B 5/005**; **G02B 13/00**; **G02B 9/12**
USPC **359/713**, **714**, **715-717**, **739**, **740**, **359/745-748**, **754-795**

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

9,402,032 B2* 7/2016 Dror **G02B 9/60**

* cited by examiner

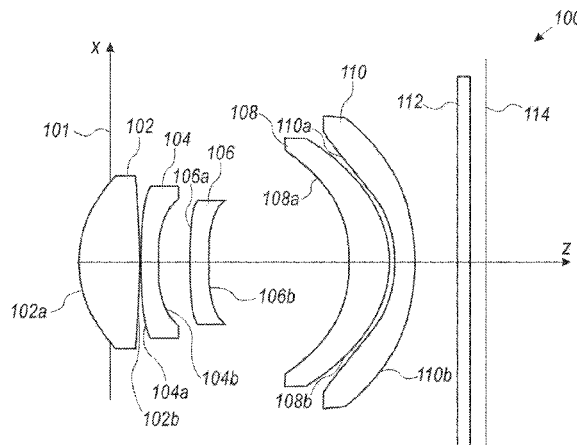
Primary Examiner — Evelyn A Lester

(74) *Attorney, Agent, or Firm* — Nathan & Associates
Patent Agents Ltd.; Menachem Nathan

(57) **ABSTRACT**

An optical lens assembly includes five lens elements and provides a TTL/EFL<1.0. In an embodiment, the focal length of the first lens element $f_1 < TTL/2$, an air gap between first and second lens elements is smaller than half the second lens element thickness, an air gap between the third and fourth lens elements is greater than $TTL/5$ and an air gap between the fourth and fifth lens elements is smaller than about 1.5 times the fifth lens element thickness. All lens elements may be aspheric.

19 Claims, 6 Drawing Sheets



Related U.S. Application Data

continuation of application No. 14/367,924, filed as application No. PCT/IB2014/062465 on Jun. 20, 2014, now abandoned.

(60) Provisional application No. 61/843,987, filed on Jul. 4, 2013.

(51) **Int. Cl.**

<i>G02B 27/64</i>	(2006.01)
<i>G02B 5/00</i>	(2006.01)
<i>G02B 9/64</i>	(2006.01)
<i>G02B 9/12</i>	(2006.01)
<i>H04N 101/00</i>	(2006.01)

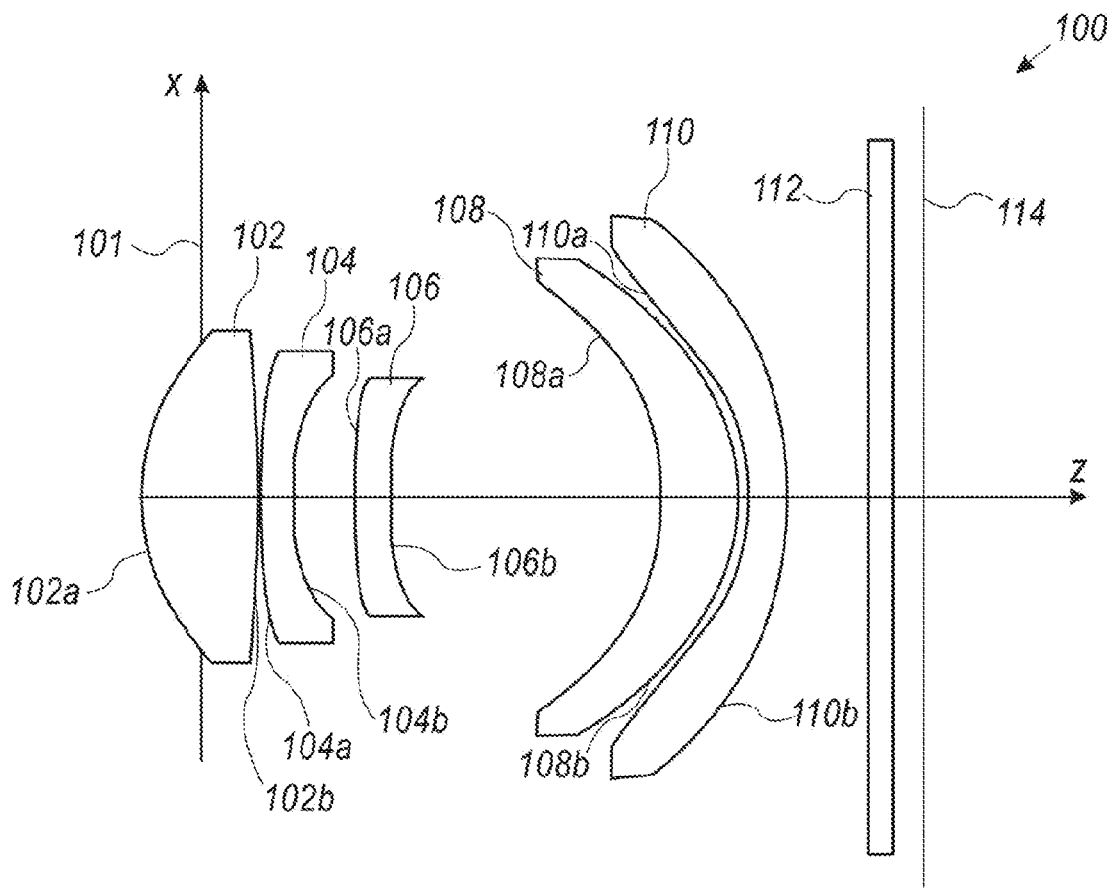
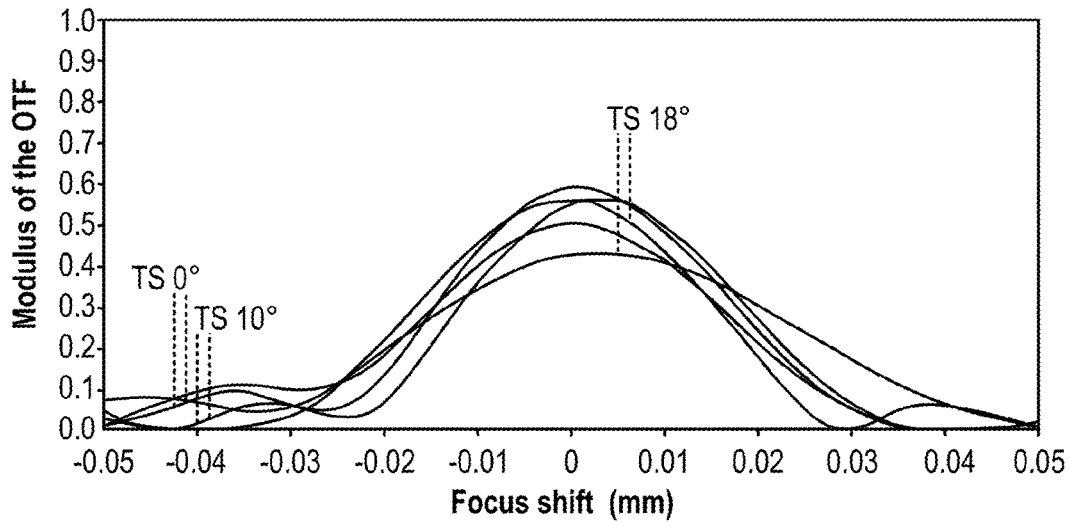


FIG. 1A



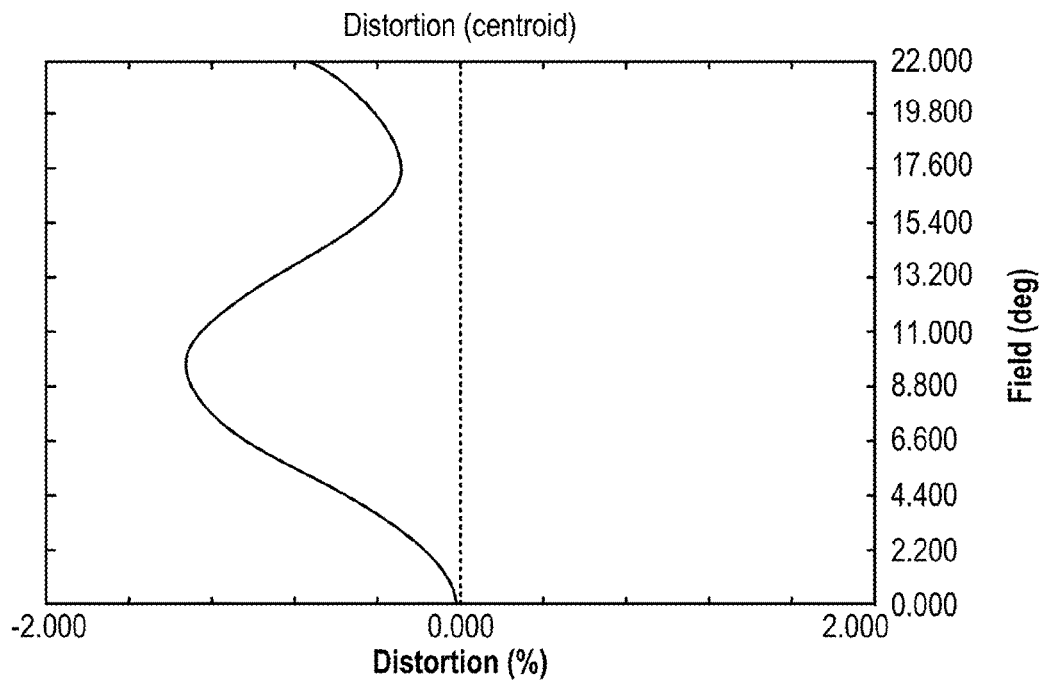
Polychromatic Diffraction Through Focus MTF

Angle 6/2/2013

Data for 0.4350 to 0.6560 μm .

Spatial Frequency: 180.0000 cycles/mm.

FIG. 1B



30/06/2013

Maximum distortion = 1.3%

FIG. 1C

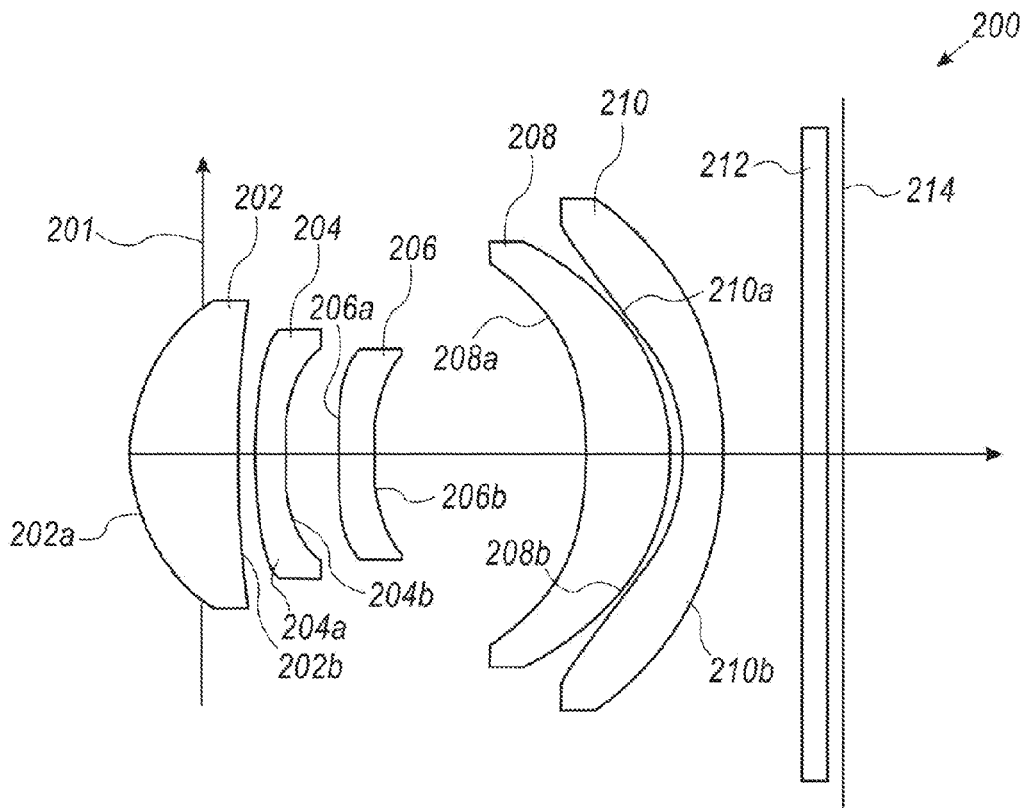


FIG. 2A

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.