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Dror et al.

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(54) **MINIATURE TELEPHOTO LENS ASSEMBLY**

H04N 9/097 (2013.01); *G02B 5/005* (2013.01);
G02B 9/12 (2013.01); *G02B 9/62* (2013.01);

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(Continued)

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(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

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

See application file for complete search history.

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

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(21) Appl. No.: **14/932,319**

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(Continued)

(65) **Prior Publication Data**

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Related U.S. Application Data

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International Search Report and Written Opinion issued in related PCT patent application PCT/IB2014/062465, dated Oct. 29, 2014, 8 pages.

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(51) **Int. Cl.**

G02B 13/18 (2006.01)
G02B 3/02 (2006.01)

(Continued)

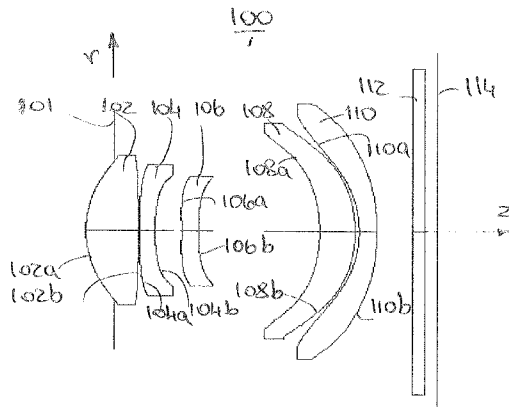
(57) **ABSTRACT**

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.

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

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20 Claims, 6 Drawing Sheets



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- H04N 5/232* (2006.01)
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- H04N 9/097* (2006.01)
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- G02B 27/00* (2006.01)
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- G02B 9/62* (2006.01)
- G02B 5/00* (2006.01)
- G02B 9/64* (2006.01)
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- (52) **U.S. Cl.**
- CPC *G02B 9/64* (2013.01); *G02B 13/00*
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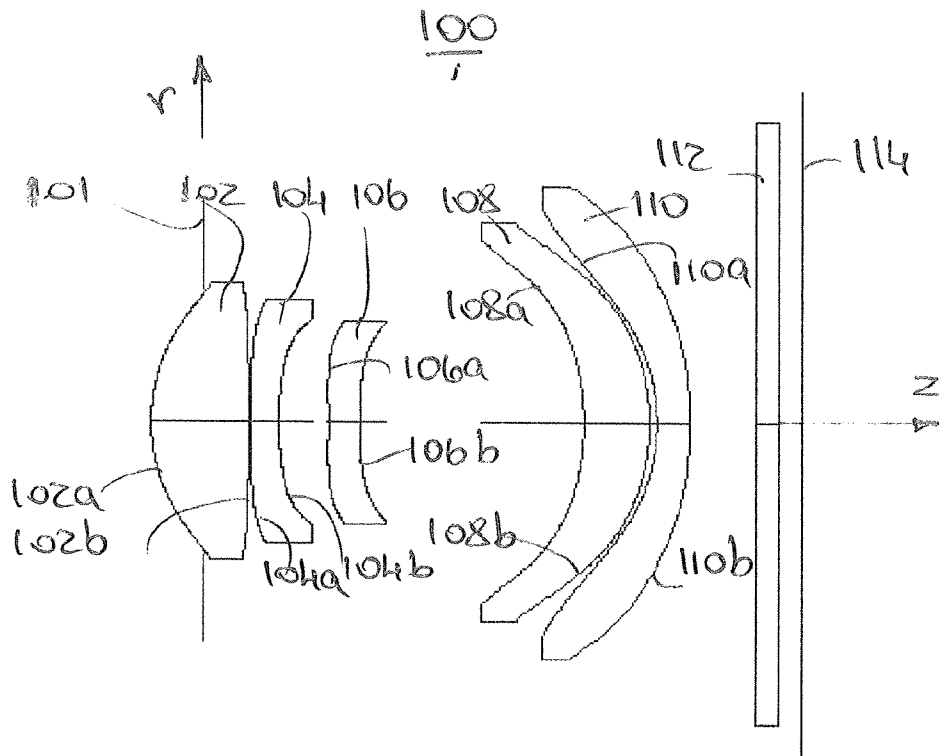


FIG. 1A

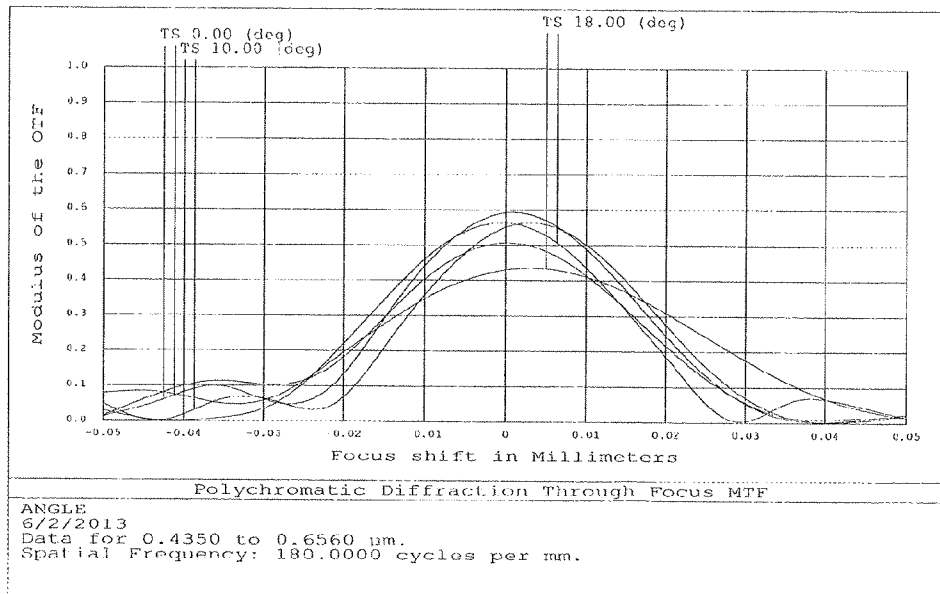


FIG. 1B

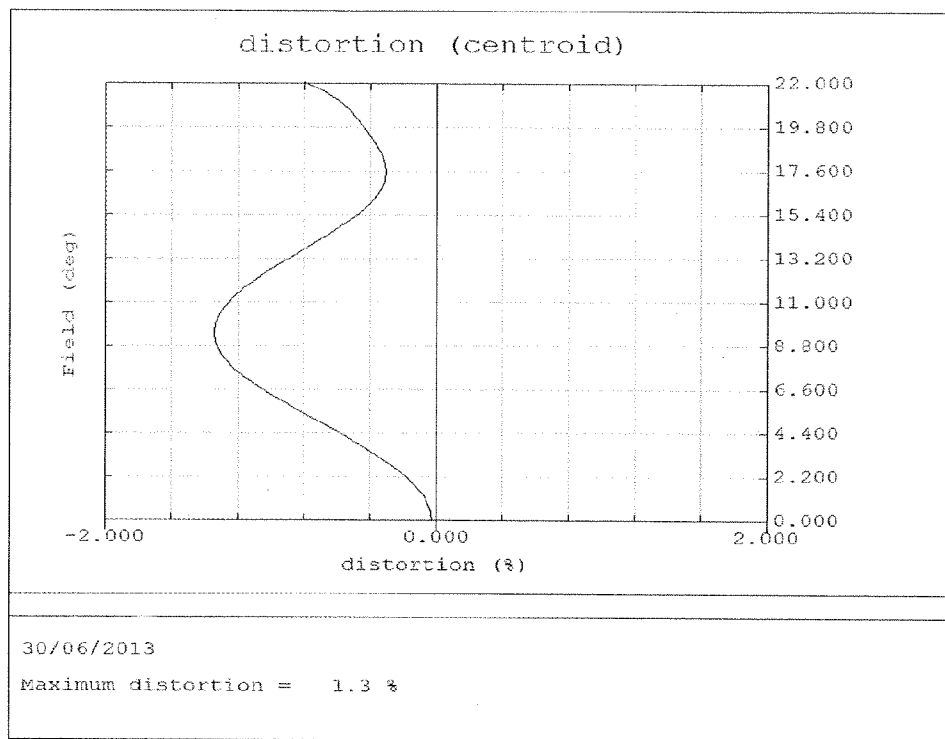


FIG. 1C

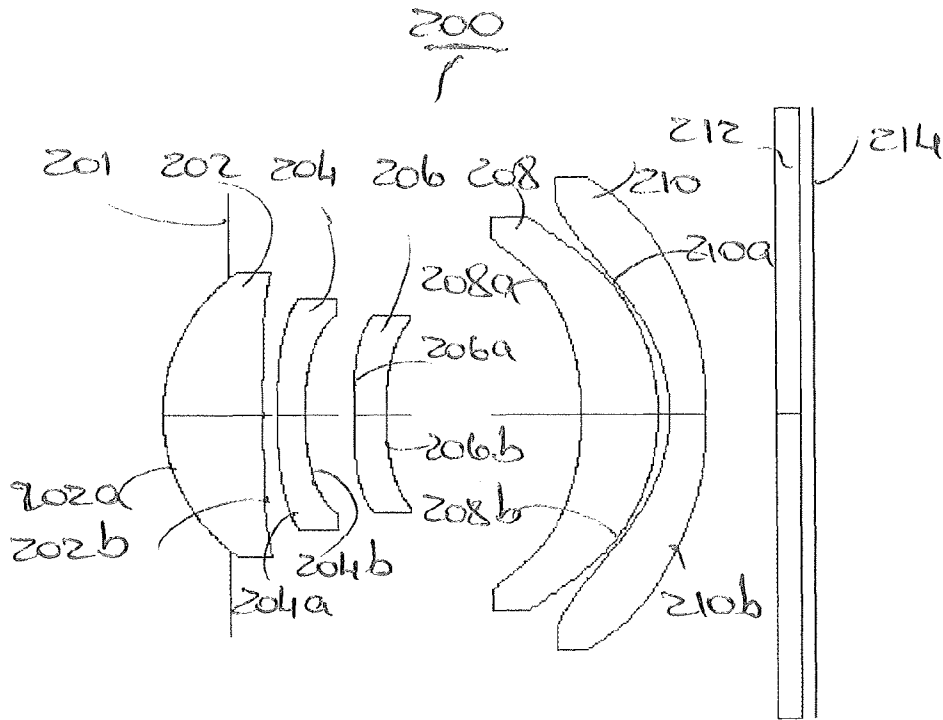


FIG. 2A

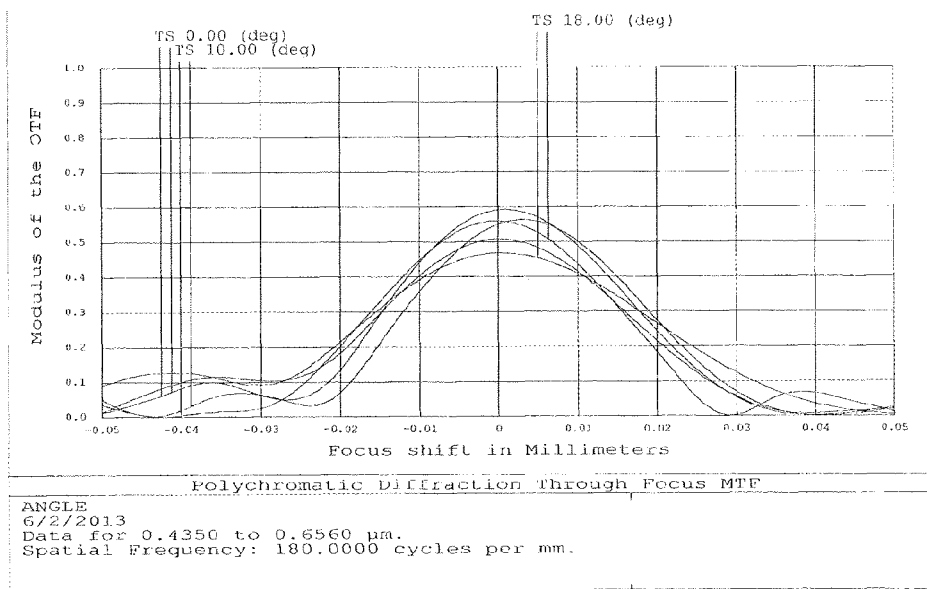


FIG.2B

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