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**Dror et al.**

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(54) **MINIATURE TELEPHOTO LENS ASSEMBLY**

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**Related U.S. Application Data**

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(51) **Int. Cl.**

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- G02B 13/18** (2006.01)
- G02B 13/00** (2006.01)
- G02B 13/02** (2006.01)
- G02B 27/00** (2006.01)
- G02B 1/04** (2006.01)
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- H04N 101/00** (2006.01)

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

CPC ..... **G02B 13/0045** (2013.01); **G02B 1/041** (2013.01); **G02B 9/60** (2013.01); **G02B 13/02** (2013.01); **G02B 27/0025** (2013.01); **G02B 27/646** (2013.01); **H04N 2101/00** (2013.01); **Y10T 29/4913** (2015.01)

(58) **Field of Classification Search**

CPC .. **G02B 13/0045**; **G02B 9/60**; **G02B 27/0025**; **G02B 5/005**; **G02B 13/02**; **G02B 1/041**; **G02B 13/002**; **G02B 9/00**; **G02B 27/646**; **H04N 2101/00**; **Y10T 29/4913**  
USPC ..... **359/714**, **739**, **740**, **763**, **764**  
See application file for complete search history.

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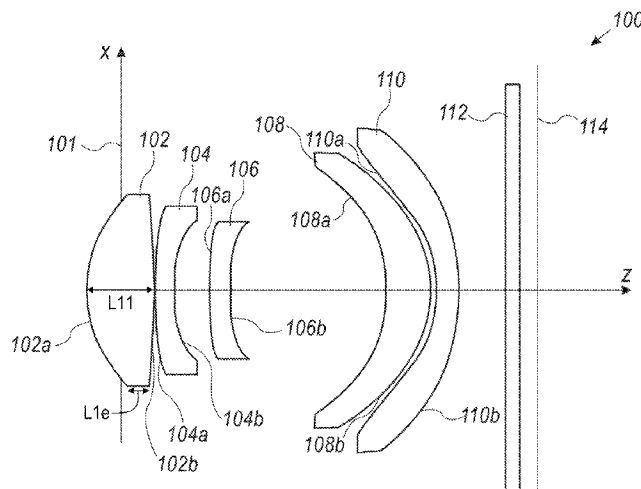
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(57) **ABSTRACT**

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.

**5 Claims, 6 Drawing Sheets**



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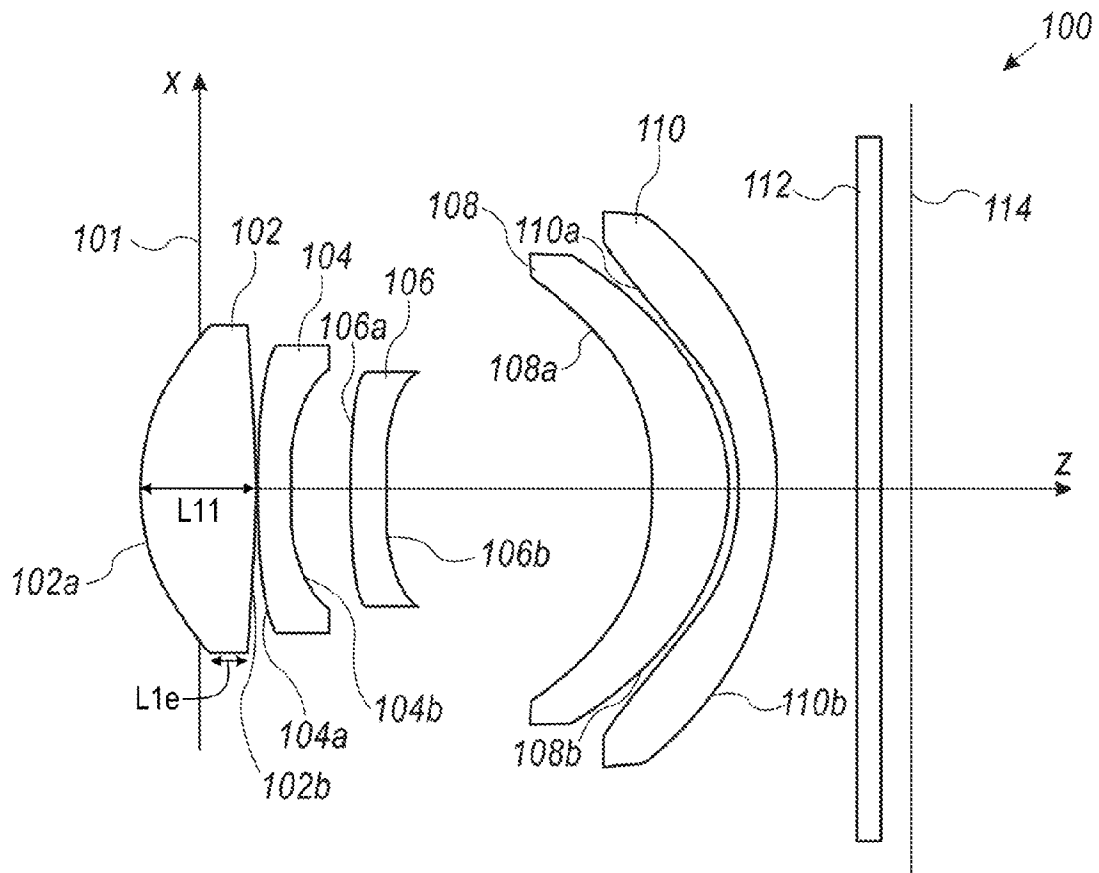
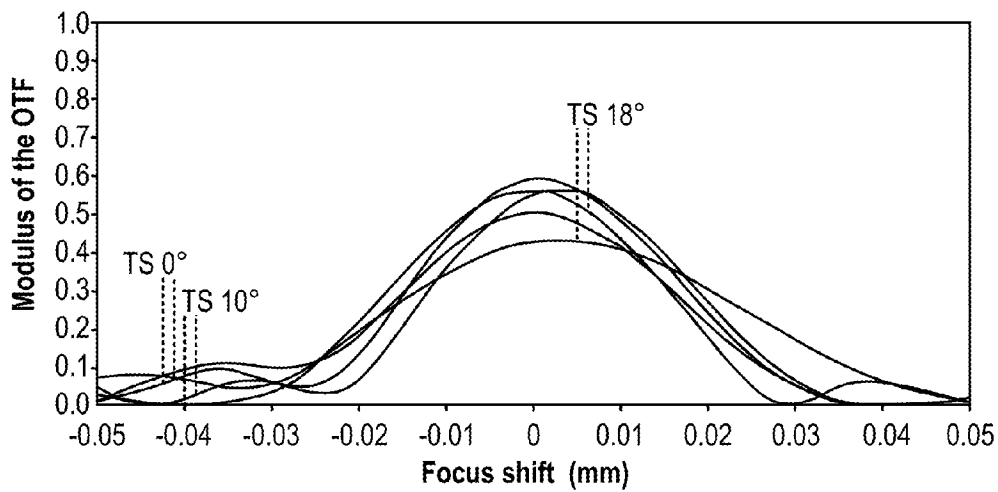
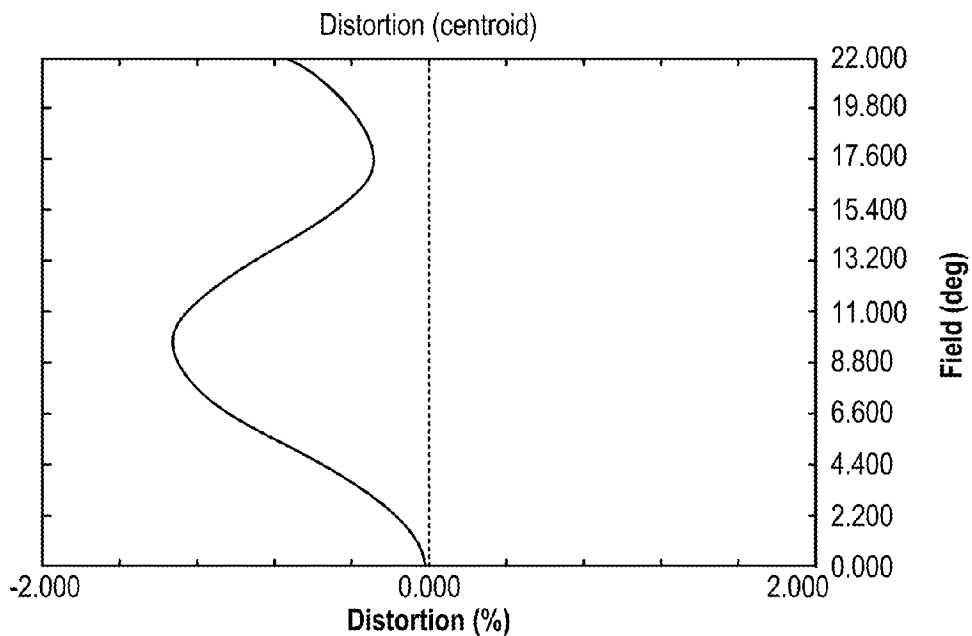


FIG. 1A



Polychromatic Diffraction Through Focus MTF  
Angle 6/2/2013  
Data for 0.4350 to 0.6560  $\mu\text{m}$ .  
Spatial Frequency: 180.0000 cycles/mm.

FIG. 1B



30/06/2013  
Maximum distortion = 1.3%

FIG. 1C

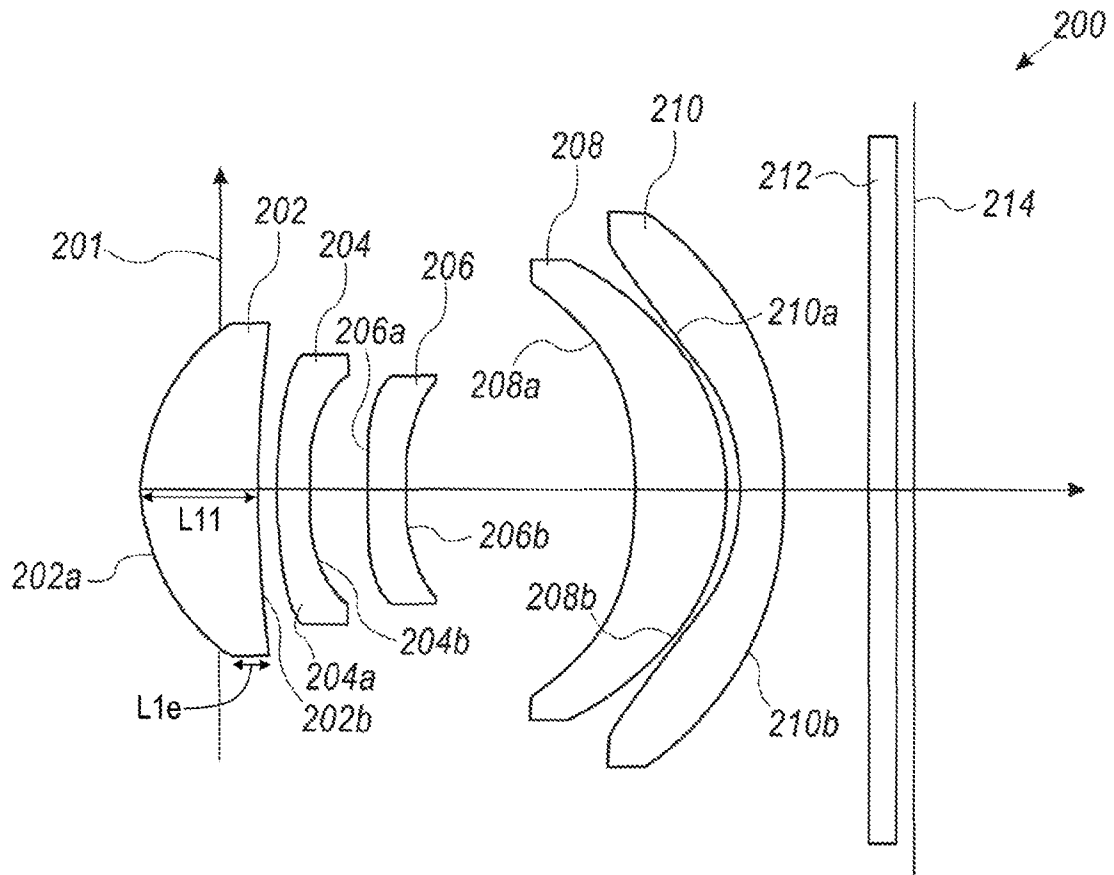


FIG. 2A

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