

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

(10) **Patent No.:** **US 9,033,494 B2**  
(45) **Date of Patent:** **\*May 19, 2015**

(54) **MULTIFOCAL LENS HAVING A PROGRESSIVE OPTICAL POWER REGION AND A DISCONTINUITY**

351/159.44; 359/652-654

See application file for complete search history.

(75) Inventors: **Ronald D. Blum**, Roanoke, VA (US);  
**William Kokonaski**, Roanoke, VA (US);  
**Venkatramani S. Iyer**, Roanoke, VA (US);  
**Joshua N. Haddock**, Roanoke, VA (US);  
**Mark Mattison-Shupnick**, Petaluma, CA (US)

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,437,642 A 3/1948 Henroleau  
2,576,581 A 11/1951 Edwards

(Continued)

FOREIGN PATENT DOCUMENTS

DE 4223395 1/1994  
EP 0154962 A2 9/1985

(Continued)

OTHER PUBLICATIONS

Thibos et al., "Electronic spectacles for the 21<sup>st</sup> century," Indiana Journal of Optometry, 1999, vol. 2, No. 1, pp. 6-10.

(Continued)

(73) Assignee: **Mitsui Chemicals, Inc.**, Tokyo (JP)

(\* ) 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.: **12/915,819**

(22) Filed: **Oct. 29, 2010**

(65) **Prior Publication Data**

US 2011/0043752 A1 Feb. 24, 2011

**Related U.S. Application Data**

(63) Continuation of application No. 12/839,088, filed on Jul. 19, 2010, now Pat. No. 8,092,016, which is a continuation of application No. 12/059,908, filed on Mar. 31, 2008, now abandoned, which is a

(Continued)

(51) **Int. Cl.**  
**G02C 7/02** (2006.01)  
**G02C 7/06** (2006.01)

(52) **U.S. Cl.**  
CPC **G02C 7/063** (2013.01); **G02C 7/06** (2013.01);  
**G02C 7/061** (2013.01)

(58) **Field of Classification Search**  
CPC ..... G02C 7/061; G02C 7/063; G02C 7/068  
USPC ..... 351/159, 166, 159.57, 159.62, 159.42,

*Primary Examiner* — Jordan Schwartz

(74) *Attorney, Agent, or Firm* — Sterne, Kessler, Goldstein & Fox P.L.L.C.

(57) **ABSTRACT**

Embodiments of the present invention relate to a multifocal lens having a diffractive optical power region and a progressive optical power region. Embodiments of the present invention provide for the proper alignment and positioning of each of these regions, the amount of optical power provided by each of the regions, the optical design of the progressive optical power region, and the size and shape of each of the regions. The combination of these design parameters allows for an optical design having less unwanted astigmatism and distortion as well as both a wider channel width and a shorter channel length compared to conventional PALs. Embodiments of the present invention may also provide a new, inventive far-intermediate distance zone and may further provide for increased vertical stability of vision within a zone of the lens.

**13 Claims, 23 Drawing Sheets**

