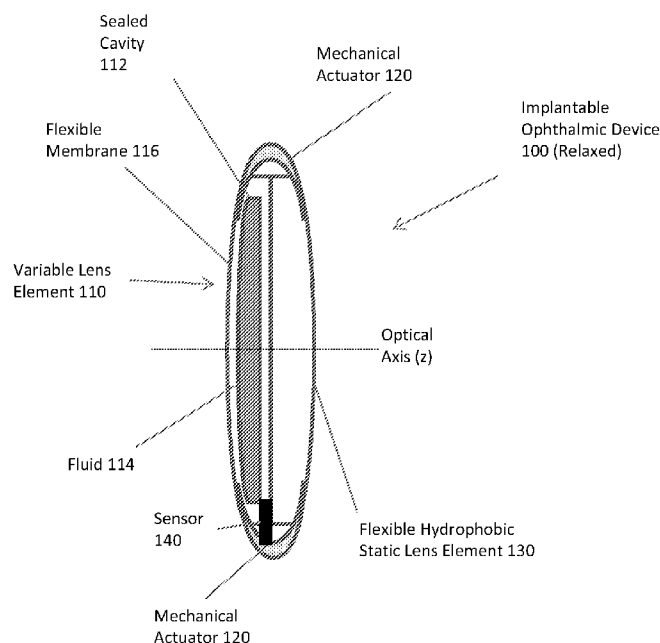




- (51) **International Patent Classification:**
A61F 2/16 (2006.01)
- (21) **International Application Number:**
PCT/US2011/060556
- (22) **International Filing Date:**
14 November 2011 (14.11.2011)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:**
61/413,542 15 November 2010 (15.11.2010) US
61/428,064 29 December 2010 (29.12.2010) US
61/428,079 29 December 2010 (29.12.2010) US
- (71) **Applicant** (for all designated States except US):
ELENZA, INC. [US/US]; 5238 Valleypointe Parkway,
Suite 6, Roanoke, VA 24019 (US).
- (72) **Inventors; and**
- (75) **Inventors/Applicants** (for US only): **BLUM, Ronald David** [US/US]; 5320 Silver Fox Road, Roanoke, Virginia
- 24014 (US). **MAZZOCCHI, Rudy** [US/US]; 2982 Bellwind Circle, Rockledge, Florida 32955 (US).
- (74) **Agents:** **RAWLINS, Andrew E.** et al.; Foley & Lardner LLP, 3000 K Street, NW, Suite 600, Washington, District of Columbia 20007 (US).
- (81) **Designated States** (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.
- (84) **Designated States** (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU,

[Continued on next page]

(54) **Title:** ADAPTIVE INTRAOCULAR LENS



(57) **Abstract:** An implantable ophthalmic device with flexible, fluid-filled membranes provide dynamically variable optical power to restore lost accommodation in individuals suffering from presbyopia or aphakia without moving parts or reducing the amount of transmitted light. Actuating the device causes the fluid-filled membrane to change curvature, which produces a corresponding change in optical power. For instance, squeezing the edge of the membrane causes the center of the membrane to bulge by an amount proportional to the squeezing force. Alternatively, heating or applying a voltage to the membrane may cause the liquid in the membrane to undergo a phase transition accompanied by a corresponding change in volume that causes the membrane to inflate so as to change the optical power of the device.

FIG. 1A



TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

(88) Date of publication of the international search report:

21 November 2013

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 11/60556

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - A61F 2/16 (2012.01)

USPC - 623/6.13

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

USPC: 623/6.13

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

IPC(8): A61F2/00, 2/02, 2/14, 2/16 (2012.01)

USPC: 623/4.1, 6.11, 6.13, 6.22, 6.37, 6.56

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PubWEST and Google: Intraocular, lens, ophthalmic, implant, electromagnetic, magnetically, MEMS, microelectromechanical, flexible, elastic/icity/omer/omeric, power, focal length, optical, dioptric, refractive, focusing, convergence, fluid, liquid, mercury, phase, change, transition, capsule, chamber, cavity, reservoir, sensor, modulus, temperat

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2009/0264998 A1 (Mentak et al) 22 October 2009 (22.10.2009), entire document, especially para [0010], [0017], [0022], [0050]-[0054], [0060]-[0063], [0072], [0081]-[0085]; Fig. 1, 3 and 6-9	1-2, 6-12, 23-25, 27 and 39-45
---		---
Y		3-5, 13-22, 26, 28-38 and 46
Y	US 6,935,743 B2 (Shaddock) 30 August 2005 (30.08.2005), entire document, especially col 7, ln 51-61; col 7, ln 62 to col 8, ln 20; col 14, ln 9-22	3-4
Y	US 6,423,001 B1 (Abreu) 23 July 2002 (23.07.2002), entire document, especially col 51, ln 66 to col 52, ln 3; col 61, ln 30-34	5
Y	US 2010/0228344 A1 (Shaddock) 09 September 2010 (09.09.2010), entire document, especially para [0017], [0068], [0077], [0092], [0102], [0105]; Fig. 20A-B	13-22, 29-38 and 46
Y	US 2007/0260307 A1 (Azar) 08 November 2007 (08.11.2007), entire document, especially para [0022], [0026], [0028], [0031], [0042], and [0048]-[0049]	14, 26 and 28
Y	US 4,731,078 A (Stoy et al) 15 March 1988 (15.03.1988), entire document, especially col 10, ln 12-42	14 and 30
Y	US 2005/0143814 A1 (Esch et al) 30 June 2005 (30.06.2005), entire document, especially para [0037]-[0043], [0057]-[0090]	1-46
Y	US 2008/0306589 A1 (Donitzky et al) 11 December 2008 (11.12.2008), entire document, especially para [0032] - [0046]	1-46

☐ Further documents are listed in the continuation of Box C.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

20 February 2012 (20.02.2012)

Date of mailing of the international search report

28 FEB 2012

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US, Commissioner for Patents
P.O. Box 1450, Alexandria, Virginia 22313-1450

Facsimile No. 571-273-3201

Authorized officer:

Lee W. Young

PCT Helpdesk: 571-272-4300
PCT OSP: 571-272-7774