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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/222,058	07/28/2016	John Daugela	124768	3807

23363 7590 05/17/2017
Lewis Roca Rothgerber Christie LLP
PO BOX 29001
Glendale, CA 91209-9001

EXAMINER

CHERRY, EUNCHA P

ART UNIT	PAPER NUMBER
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2872

NOTIFICATION DATE	DELIVERY MODE
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05/17/2017

ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

pto@lrrc.com
pair_cph@firsttofile.com



UNITED STATES PATENT AND TRADEMARK OFFICE

Commissioner for Patents
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In re Application of	: DECISION ON REQUEST TO
John Daugela	: PARTICIPATE IN THE PATENT
Application No.: 15/222,058	: PROSECUTION HIGHWAY
Filing Date: July 28, 2016	: PROGRAM AND PETITION
Attorney Docket No.: 124768	: TO MAKE SPECIAL UNDER
For: FLAT WEDGE-SHAPED LENS AND	: 37 CFR 1.102(a)
IMAGE PROCESSING METHOD	

This is a decision on the request to participate in the Patent Prosecution Highway (PPH) program and the petition under 37 CFR 1.102(a), filed March 13, 2017, to make the above-identified application special.

The request and petition are **GRANTED**.

DISCUSSION

A grantable request to participate in the PPH pilot program and petition to make special require:

1. The U.S. application for which participation in the Global/IP5 PPH pilot program is requested must have the same earliest date, whether this is the priority date or filing date, as that of a corresponding national or regional application filed with another Global/IP5 PPH participating office or a corresponding PCT international application for which one of the Global/IP5 PPH participating offices was the International Searching Authority (ISA) or the International Preliminary Examining Authority (IPEA).
2. Applicant must:
 - a. Ensure all the claims in the U.S. application must sufficiently correspond or be amended to sufficiently correspond to the allowable/patentable claim(s) in the corresponding (OEE) application and
 - b. Submit a claims correspondence table in English;
3. Examination of the U.S. application has not begun;
4. Applicant must submit:
 - a. Documentation of prior office action:
 - i. a copy of the office action(s) just prior to the “Decision to Grant a Patent” from each of the Global/IP5 PPH participating office application(s) containing the allowable/patentable claim(s) or

Art Unit: OPET

- ii. if the allowable/patentable claims(s) are from a “Notification of Reasons for Refusal” then the Notification of Reasons for Refusal or
 - iii. if the Global/IP5 PPH participating office application is a first action allowance then no office action from the Global/IP5 PPH participating office is necessary should be indicated on the request/petition form or
 - iv. the latest work product in the international phase of the OEE PCT application;
 - b. An English language translation of the Global/IP5 PPH participating office action or work product from (4) (a) (i)-(ii) or (iv) above; and
5. Applicant must submit:
- a. An IDS listing the documents cited by the Global/IP5 PPH participating office examiner in the Global/IP5 PPH participating office action or work product (unless already submitted in this application)
 - b. Copies of the documents except U.S. patents or U.S. patent application publications (unless already submitted in this application).

The request to participate in the PPH pilot program and petition comply with the above requirements. Accordingly, the above-identified application has been accorded “special” status.

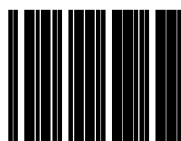
This application will be forwarded to the examiner for action on the merits to commensurate with this decision.

Telephone inquiries concerning this decision should be directed to Jonya Smalls, Paralegal Specialist at (571) 272-1619. All other inquiries concerning the examination or status of the application is accessible in the PAIR system at <http://portal.uspto.gov>.

/Andrea Smith/

Andrea Smith
Lead Paralegal Specialist
Office of Petitions

Office of Petitions: Routing Sheet



4 7 0 0

Application No.

This application is being forwarded to your office for further processing. A decision has been rendered on a petition filed in this application, as indicated below. For details of this decision, please see the document PET.OP.DEC filed on the same date as this document.

☒ **GRANTED**

☐ **DISMISSED**

☐ **DENIED**

Office of Petitions: Decision Count Sheet

Mailing Month

5

Application No.

15222058



For US serial numbers: enter number only, no slashes or commas. Ex: 10123456

For PCT: enter "51+single digit of year of filing+last 5 numbers", Ex. for PCT/US05/12345, enter 51512345

Deciding Official:

Jonya Smalls

Count (1) - Palm Credit

15222058

Decision:

GRANT

FINANCE WORK NEEDED

☐ Select Check Box for YES

Decision Type:

652 - Petition to make special-PPH



Notes:

Count (2)

Decision:

n/a

FINANCE WORK NEEDED

☐ Select Check Box for YES

Decision Type:

NONE

Notes:

Count (3)

Decision:

n/a

FINANCE WORK NEEDED

☐ Select Check Box for YES

Decision Type:

NONE

Notes:

Initials of Approving Official (if required)

If more than 3 decisions, attach
2nd count sheet & mark this box

Printed on:

5/12/2017

**REQUEST FOR PARTICIPATION IN THE PATENT COOPERATION TREATY – PATENT
PROSECUTION HIGHWAY (PCT-PPH) PILOT PROGRAM BETWEEN
THE CANADIAN INTELLECTUAL PROPERTY OFFICE (CIPO) AND THE USPTO**

Application No.:	15/222,058	First Named Inventor:	John Daugela
Filing Date:	July 28, 2016	Attorney Docket No.:	124768
Title of the Invention:	FLAT WEDGE SHAPED LENS AND IMAGE PROCESSING METHOD		

THIS REQUEST FOR PARTICIPATION IN THE PCT-PPH PILOT PROGRAM ALONG WITH THE REQUIRED DOCUMENTS MUST BE SUBMITTED VIA EFS-WEB. INFORMATION REGARDING EFS-WEB IS AVAILABLE AT [HTTP://WWW.USPTO.GOV/PATENTS/PROCESS/FILE/EFS/](http://www.uspto.gov/patents/process/file/efs/).

APPLICANT HEREBY REQUESTS PARTICIPATION IN THE PCT-PPH PILOT PROGRAM AND PETITIONS TO MAKE THE ABOVE-IDENTIFIED APPLICATION SPECIAL UNDER THE PCT-PPH PILOT PROGRAM.

The above-identified application is (1) a national stage entry of the corresponding PCT application, or (2) a national stage entry of another PCT application which claims priority to the corresponding PCT application, or (3) a national application that claims domestic/ foreign priority to the corresponding PCT application, or (4) a national application which forms the basis for the priority claim in the corresponding PCT application, or (5) a continuing application of a U.S. application that satisfies one of (1) to (4) above, or (6) a U.S. application that claims domestic benefit to a U.S. provisional application which forms the basis for the priority claim in the corresponding PCT application.

The corresponding PCT application number(s) is/are: PCT/IB2016/054526

The international filing date of the corresponding PCT application(s) is/are: July 28, 2016

I. List of Required Documents:

- a. **A copy of the latest international work product (WO/ISA, WO/IPEA, or IPER) in the above-identified corresponding PCT application(s)**

☐ is attached.

☒ is not attached because the document is already in the U.S. application.

- b. **A copy of all claims which were indicated as having novelty, inventive step and industrial applicability in the above-identified corresponding PCT application(s)**

☒ is attached.

☐ is not attached because the document is already in the U.S. application.

- c. **English translations of the documents in a. and b. above are attached (if the documents are not in the English language). A statement that the English translation is accurate is attached for the document in b. above.**

- d. **(1) An information disclosure statement listing the documents cited in the international work products (ISR, WO/ISA, WO/IPEA, IPER) of the corresponding PCT application.**

☐ is attached.

☒ has already been filed in the above-identified U.S. application on October 26, 2016

(2) Copies of all documents (except for U.S. patents or U.S. patent application publications)

☐ are attached.

☒ have already been filed in the above-identified U.S. application on October 26, 2016

Application No.:	15/222,058	First Named Inventor:	John Daugela
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[illegible]

Signature <u>/Raymond Tabandeh/</u>	Date <u>Mar. 13, 2017</u>
Name (Print/Typed) <u>Raymond R. Tabandeh</u>	Registration Number <u>43945</u>

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

1 CLAIMS:

1 1. A flat lens system comprising:
a wedge-shaped refractive material having a first surface and a second
surface opposite to the first surface for refracting incident light beams from an object
5 having a width of Y, from the first surface towards the second surface;
a reflective material positioned at the second surface of the wedge-shaped
refractive material for reflecting the refracted light beams at a first angle toward the
first surface, wherein the reflected light beams are refracted from the first surface at
a second angle and having a width of X to be used to form an image of the object
10 and including chromatic aberrations; and
an apparatus for processing the image of the object to reduce said chromatic
aberrations.

15 2. The flat lens system of claim 1, wherein X is smaller than Y to
compress the image of the object.

3. The flat lens system of any of claims 1-2, wherein X is larger than Y to
expand the image of the object.

20 4. The flat lens system of any of claims 1-3, further comprising a focusing
lens to focus the image of the object onto a sensor.

25 5. The flat lens system of any of claims 1-4, further comprising a focusing
lens to focus the image of the object onto an eyepiece for viewing by a human.

6. The flat lens system of any of claims 1-5, wherein the apparatus for
processing the image is an image processing device executing an image processing
programming code to reduce said chromatic aberrations.

30 7. The flat lens system of any of claims 1-6, wherein the apparatus for
processing the image comprises of one or more refractive optical wedges that
together have an achromatic effect to reduce said chromatic aberrations.

35 8. The flat lens system of any of claims 1-7, wherein the apparatus for
processing the image comprises of one or more diffraction gratings that together
have an achromatic effect to reduce said chromatic aberrations.

1 9. The flat lens system of any of claims 1-8, wherein the refractive or
reflective material has one or more coatings at the first or the second surface.

5 10. The flat lens system of any of claims 1-9, wherein the reflective
material is attached to the second surface of the wedge-shaped refractive material.

10 11. The flat lens system of any of claims 1-10, wherein the reflective
material comprises of one or more moving mirrors to reflect the refracted light beams
at varying angles toward the first surface.

12. The flat lens system of claim 11, wherein the one or more moving
mirrors are rotated to reflect the refracted light beams at varying angles.

15 13. The flat lens system of claim 11, wherein the one or more moving
mirrors are tilted to reflect the refracted light beams at varying angles.

20 14. The flat lens system of any of claims 1-13, further comprising an
electric energy source electrically coupled to the wedge-shaped refractive material to
dynamically change a refractive index of the refractive material to refract the incident
light beams at varying angles.

25 15. The flat lens system of any of claims 1-14, further comprising one or
more wedge-shaped refractive material(s) positioned between the wedge-shaped
refractive material and the reflective material.

16. A telescope comprising the flat lens system of claim 2.

17. A microscope comprising the flat lens system of claim 3.

30 18. A binocular comprising the flat lens system of claim 2.

19. A scope comprising the flat lens system of claim 2.

20. A telecentric lens system comprising the flat lens system of claim 2.

Electronic Acknowledgement Receipt

EFS ID:	28608590
Application Number:	15222058
International Application Number:	
Confirmation Number:	3807
Title of Invention:	FLAT WEDGE-SHAPED LENS AND IMAGE PROCESSING METHOD
First Named Inventor/Applicant Name:	John Daugela
Customer Number:	23363
Filer:	Raymond R. Tabandeh/Christina Malinosky
Filer Authorized By:	Raymond R. Tabandeh
Attorney Docket Number:	124768
Receipt Date:	13-MAR-2017
Filing Date:	28-JUL-2016
Time Stamp:	13:11:29
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Petition to make special under Patent Prosecution Hwy	PPH.pdf	343282	no	5
			1239a4e8e28cfb58d3939e104427ebac3ed1c076		

Warnings:

Information:	
Total Files Size (in bytes):	343282
This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503. <u>New Applications Under 35 U.S.C. 111</u> If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application. <u>National Stage of an International Application under 35 U.S.C. 371</u> If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course. <u>New International Application Filed with the USPTO as a Receiving Office</u> If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.	



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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
15/222,058	07/28/2016	John Daugela	124768

CONFIRMATION NO. 3807

PUBLICATION NOTICE



OC000000089102982

23363
Lewis Roca Rothgerber Christie LLP
PO BOX 29001
Glendale, CA 91209-9001

Title: FLAT WEDGE-SHAPED LENS AND IMAGE PROCESSING METHOD

Publication No. US-2017-0038571-A1

Publication Date: 02/09/2017

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently <http://www.uspto.gov/patft/>.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Office of Public Records. The Office of Public Records can be reached by telephone at (571) 272-3150 or (800) 972-6382, by facsimile at (571) 273-3250, by mail addressed to the United States Patent and Trademark Office, Office of Public Records, Alexandria, VA 22313-1450 or via the Internet.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently <http://pair.uspto.gov/>. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (use as many sheets as necessary)	Attorney Docket Number	124768
	Application Number	15/222,058
	Filing Date	July 28, 2016
	Inventor(s)	John Daugela
	Group Art Unit	2872
	Examiner Name	Stephone B. Allen

U.S. PATENT DOCUMENTS				
EXAMINER INITIALS	Cite No. ¹	DOCUMENT NUMBER Number - Kind Code ² (If Known)	PUBLICATION DATE MM-DD-YYYY	NAME OF PATENTEE
		4,623,225	11-18-1986	Forkner
		4,627,690	12-09-1986	Fantone
		4,872,747	10-10-1989	Jalkio et al.
		2006/0291704 A1	12-28-2006	McClurg
		2015/0378186 A1	12-31-2015	Xiong et al.

FOREIGN PATENT DOCUMENTS					
EXAMINER INITIALS	Cite No. ¹	Foreign Patent Document Country Code ³ - Number ⁴ - Kind Code ⁵ (If Known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	T ⁶ (✓)

OTHER DOCUMENTS		
EXAMINER INITIALS	Cite No. ¹	Include name of the author (in CAPITAL LETTERS), title of the article, title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.
		International Search Report and Written Opinion for corresponding International Application No. PCT/IB2016/054526 mailed Oct. 20, 2016, 7pp.

CLM PAS1446362.1-* -10/25/16 5:04 PM

EXAMINER SIGNATURE		DATE CONSIDERED	
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EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. ¹Applicant's unique citation designation number (optional). ²See Kinds Codes of USPTO Patent Documents at www.pto.gov or MPEP 901.4. ³Enter Office that issued the document, by the two-letter code (WIPO standard ST.3). ⁴For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. ⁵Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. ⁶Applicant is to place a check mark here if English Language Translation is attached.

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

To: TABANDEH, RAYMOND c/o Lewis Roca Rothgerber Christie LLP P.O. Box 29001 GLENDALE, California United States of America, 91209

Date of mailing <i>(day/month/year)</i>	20 October 2016 (20-10-2016)
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Applicant's or agent's file reference 124768WO	FOR FURTHER ACTION See paragraph 2 below
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International application No. PCT/IB2016/054526	International filing date <i>(day/month/year)</i> 28 July 2016 (28-07-2016)	Priority date <i>(day/month/year)</i> 05 August 2015 (05-08-2015)
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International Patent Classification (IPC) or both national classification and IPC IPC: G02B 3/02 (2006.01), G02B 21/00 (2006.01), G06T 5/00 (2006.01), G02B 7/04 (2006.01), G02B 23/00 (2006.01)

Applicant SPECTRUM OPTIX INC.

1. This opinion contains indications relating to the following items: <table style="width: 100%;"> <tr> <td style="width: 5%;">☒</td> <td style="width: 15%;">Box No. I</td> <td>Basis of the opinion</td> </tr> <tr> <td>☐</td> <td>Box No. II</td> <td>Priority</td> </tr> <tr> <td>☐</td> <td>Box No. III</td> <td>Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</td> </tr> <tr> <td>☐</td> <td>Box No. IV</td> <td>Lack of unity of invention</td> </tr> <tr> <td>☒</td> <td>Box No. V</td> <td>Reasoned statement under Rule 43<i>bis</i>.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</td> </tr> <tr> <td>☐</td> <td>Box No. VI</td> <td>Certain documents cited</td> </tr> <tr> <td>☐</td> <td>Box No. VII</td> <td>Certain defects in the international application</td> </tr> <tr> <td>☒</td> <td>Box No. VIII</td> <td>Certain observations on the international application</td> </tr> </table> 2. FURTHER ACTION If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1<i>bis</i>(b) that written opinions of this International Searching Authority will not be so considered. If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later. For further options, see Form PCT/ISA/220.	☒	Box No. I	Basis of the opinion	☐	Box No. II	Priority	☐	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability	☐	Box No. IV	Lack of unity of invention	☒	Box No. V	Reasoned statement under Rule 43 <i>bis</i> .1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement	☐	Box No. VI	Certain documents cited	☐	Box No. VII	Certain defects in the international application	☒	Box No. VIII	Certain observations on the international application
☒	Box No. I	Basis of the opinion																						
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☐	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability																						
☐	Box No. IV	Lack of unity of invention																						
☒	Box No. V	Reasoned statement under Rule 43 <i>bis</i> .1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement																						
☐	Box No. VI	Certain documents cited																						
☐	Box No. VII	Certain defects in the international application																						
☒	Box No. VIII	Certain observations on the international application																						

Name and mailing address of the ISA/CA Canadian Intellectual Property Office Place du Portage I, C114 - 1st Floor, Box PCT 50 Victoria Street Gatineau, Quebec K1A 0C9 Facsimile No.: 001-819-953-2476	Date of completion of this opinion 17 October 2016 (17-10-2016)	Authorized officer David E. Green (819) 635-2861
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WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/IB2016/054526

Box No. I

Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of:
 - ☒ the international application in the language in which it was filed.
 - ☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).
2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a))
3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:
 - a. ☐ forming part of the international application as filed:
 - ☐ in the form of an Annex C/ST.25 text file.
 - ☐ on paper or in the form of an image file.
 - b. ☐ furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.
 - c. ☐ furnished subsequent to the international filing date for the purposes of international search only:
 - ☐ in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).
 - ☐ on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).
4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
5. Additional comments:

Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims 1-20	YES
	Claims None	NO
Inventive step (IS)	Claims 1-20	YES
	Claims None	NO
Industrial applicability (IA)	Claims 1-20	YES
	Claims None	NO

2. Citations and explanations:

The inventive concept lies in a flat lens system, in which a wedge shaped refractive body cooperates with a reflective element to alter the width of a light beam coming from an object, and an apparatus is provided for reducing chromatic aberrations in the output light beam.

D1 US2006291704A1, McClurg 28 December 2006 (28-12-2006) (See whole document)

D2 US4623225A, Forkner 18 November 1986 (18-11-1986) (See whole document)

Novelty

Claims 1-20 are novel and therefore comply with PCT Article 33(2). Documents D1 and D2 are considered to represent the closest prior art. Both D1 and D2 disclose various optical prisms which can act to alter the width of a beam of light emitted from an object or an illumination source. However, none of the cited documents discloses the particular optical arrangement as recited in the current claims. As well, both D1 and D2 are silent on the provision of an apparatus for reducing any chromatic aberrations introduced by the wedge-shaped refractive material used in the optical system as currently claimed. Claims 1-20 are therefore novel.

Inventive Step

Claims 1-20 involve an inventive step and therefore comply with PCT Article 33(3). The particular optical arrangement as recited in the current claims and the provision of an apparatus for reducing any chromatic aberrations introduced by the wedge-shaped refractive material used in the optical system would not have been obvious to a person skilled in the art from the cited documents, when taken individually or in any combination. Claims 1-20 therefore involve an inventive step.

Industrial Applicability

The subject matter of claims 1-20 is considered to be industrially applicable in the field of optics, and thus complies with the requirements of PCT Article 33(4).

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

Claims 3, 7, 8 do not comply with PCT Article 6. The claims shall be clear and concise. These are multiply-dependent claims which appear to contradict at least some of the subject matter of one or more claims upon which they are dependent.

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 124768WO	FOR FURTHER ACTION see Form PCT/ISA/220 as well as, where applicable, item 5 below	
International application No. PCT/IB2016/054526	International filing date (<i>day/month/year</i>) 28 July 2016 (28-07-2016)	(Earliest)Priority date (<i>day/month/year</i>) 05 August 2015 (05-08-2015)
Applicant SPECTRUM OPTIX INC.		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 3 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

a. With regard to the **language**, the international search was carried out on the basis of:

☒ the international application in the language in which it was filed.

☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

b. ☐ This international search report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43.6bis(a)).

c. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. ☐ **Certain claims were found unsearchable** (see Box No. II).

3. ☐ **Unity of invention is lacking** (see Box No. III).

4. With regard to the **title**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. With regard to the **drawings**,

a. the figure of the **drawings** to be published with the abstract is Figure No. 2

☒ as suggested by the applicant.

☐ as selected by this Authority, because the applicant failed to suggest a figure.

☐ as selected by this Authority, because this figure better characterizes the invention.

b. ☐ none of the figures is to be published with the abstract.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/IB2016/054526

A. CLASSIFICATION OF SUBJECT MATTER

IPC: **G02B 3/02** (2006.01), **G02B 21/00** (2006.01), **G06T 5/00** (2006.01), **G02B 7/04** (2006.01),
G02B 23/00 (2006.01)

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)

IPC: **G02B 3/02** (2006.01), **G02B 21/00** (2006.01), **G06T 5/00** (2006.01), **G02B 7/04** (2006.01),
G02B 23/00 (2006.01) (in combination with keywords)

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

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

Questel Orbit (keywords flat lens, wedge, chromatic, aberration, refract+, anamorphic prism, compress, expand, magnif+)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US2006291704A1, McClurg 28 December 2006 (28-12-2006) (See whole document)	1-20
A	US4623225A, Forkner 18 November 1986 (18-11-1986) (See whole document)	1-20
A	US2015378186A1, Xiong et al. 31 December 2015 (31-12-2015) (See whole document)	1-20
A	US4627690A, Fantone 09 December 1986 (09-12-1986) (See whole document)	1-20
A	US4872747A, Jalkio et al. 10 October 1989 (10-10-1989) (See whole document)	1-20

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

☒ See patent family annex.

* "A" "E" "L" "O" "P"	Special categories of cited documents: document defining the general state of the art which is not considered to be of particular relevance earlier application or patent but published on or after the international filing date 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) document referring to an oral disclosure, use, exhibition or other means document published prior to the international filing date but later than the priority date claimed	"T" "X" "Y" "&"	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 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 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
14 October 2016 (14/10-2016)

Date of mailing of the international search report
20 October 2016 (20-10-2016)

Name and mailing address of the ISA/CA
Canadian Intellectual Property Office
Place du Portage I, C114 - 1st Floor, Box PCT
50 Victoria Street
Gatineau, Quebec K1A 0C9
Facsimile No.: 819-953-2476

Authorized officer

David E. Green (819) 635-2861

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/IB2016/054526

Patent Document Cited in Search Report	Publication Date	Patent Family Member(s)	Publication Date
US2006291704A1	28 December 2006 (28-12-2006)	US2006291704A1 US7747046B2 US2010322537A1 US7953259B2	28 December 2006 (28-12-2006) 29 June 2010 (29-06-2010) 23 December 2010 (23-12-2010) 31 May 2011 (31-05-2011)
US4623225A	18 November 1986 (18-11-1986)	US4623225A EP0171888A2 EP0171888A3 JPS6163819A	18 November 1986 (18-11-1986) 19 February 1986 (19-02-1986) 30 March 1988 (30-03-1988) 02 April 1986 (02-04-1986)
US2015378186A1	31 December 2015 (31-12-2015)	US2015378186A1 CN105319648A	31 December 2015 (31-12-2015) 10 February 2016 (10-02-2016)
US4627690A	09 December 1986 (09-12-1986)	None	
US4872747A	10 October 1989 (10-10-1989)	None	

Electronic Acknowledgement Receipt

EFS ID:	27328491
Application Number:	15222058
International Application Number:	
Confirmation Number:	3807
Title of Invention:	FLAT WEDGE-SHAPED LENS AND IMAGE PROCESSING METHOD
First Named Inventor/Applicant Name:	John Daugela
Customer Number:	23363
Filer:	Raymond R. Tabandeh/Christina Malinosky
Filer Authorized By:	Raymond R. Tabandeh
Attorney Docket Number:	124768
Receipt Date:	26-OCT-2016
Filing Date:	28-JUL-2016
Time Stamp:	14:48:15
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
------------------------	----

File Listing:

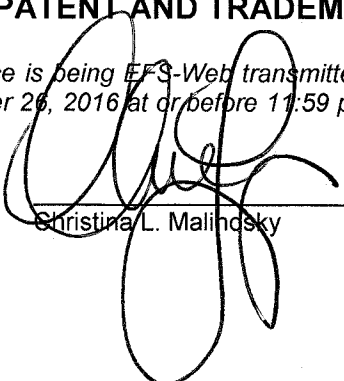
Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		IDS.pdf	277816	yes	3
			45d585b2ab6a0dac280379bed8e2f95b6c40bf72		

	Multipart Description/PDF files in .zip description								
	Document Description		Start	End					
	Transmittal Letter		1	2					
	Information Disclosure Statement (IDS) Form (SB08)		3	3					
Warnings:									
Information:									
2	Other Reference-Patent/App/Search documents	WrittenOpISR.pdf	274786	no	7				
			70eb9c223ed00062915dc68f6f4a3440d91634f0						
Warnings:									
Information:									
Total Files Size (in bytes):			552602						
This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503. <u>New Applications Under 35 U.S.C. 111</u> If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application. <u>National Stage of an International Application under 35 U.S.C. 371</u> If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course. <u>New International Application Filed with the USPTO as a Receiving Office</u> If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.									

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

I hereby certify that this correspondence is being EFS-Web transmitted to the United States Patent and Trademark Office on October 26, 2016 at or before 11:59 p.m. Pacific Time under the Rules of 37 CFR § 1.8.


Christina L. Malinsky

Inventor(s) : John Daugela
Application No. : 15/222,058
Filed : July 28, 2016
Title : FLAT WEDGE SHAPED LENS AND IMAGE PROCESSING METHOD

Confirmation No. 3807

Grp./Div. : 2872
Examiner : Stephone B. Allen

Docket No. : 124768

**INFORMATION DISCLOSURE STATEMENT
37 CFR § 1.97(b)**

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Post Office Box 29001
Glendale, CA 91209-9001
October 26, 2016

Commissioner:

In compliance with the duty of disclosure under 37 CFR §§ 1.56, 1.97 and 1.98, and in accordance with the provisions in the Manual of Patent Examining Procedure §§ 609 and 707.05(b), enclosed is an information disclosure statement listing the references that are known to applicant. A copy of the listed Other Documents reference is enclosed. This filing is timely because it is made during one of the periods described in 37 CFR § 1.97(b).

It is respectfully requested that the listed references be considered in the examination of this application and identified on the list of references cited on the patent issuing for this application. Applicant also requests that an initialed copy of the information disclosure statement be entered in the application file and returned to applicant with the next communication from the Office in accordance with MPEP § 609.

Application No.: 15/222,058

The Commissioner is hereby authorized to charge any fees which may be required by this paper to Deposit Account No. 03-1728. Please show our docket number with any Deposit Account transaction.

Respectfully submitted,

LEWIS ROCA ROTHGERBER CHRISTIE LLP

By



Raymond R. Tabandeh

Reg. No. 43,945

626/795-9900

RRT/clm

Enclosures: Information Disclosure Statement, w/reference

CLM PAS1446363.1-* -10/26/16 10:08 AM



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY. DOCKET NO	TOT CLAIMS	IND CLAIMS
15/222,058	07/28/2016	2872	730	124768	20	1

CONFIRMATION NO. 3807

FILING RECEIPT

23363

Lewis Roca Rothgerber Christie LLP
PO BOX 29001
Glendale, CA 91209-9001



Date Mailed: 08/11/2016

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Inventor(s)

John Daugela, Calgary, CANADA;

Applicant(s)

Spectrum Optix Inc., Calgary, CANADA;

Power of Attorney: The patent practitioners associated with Customer Number 23363

Domestic Priority data as claimed by applicant

This appln claims benefit of 62/201,428 08/05/2015

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see <http://www.uspto.gov> for more information.) - None.

Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 08/10/2016

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 15/222,058**

Projected Publication Date: 02/09/2017

Non-Publication Request: No

Early Publication Request: No

**** SMALL ENTITY ****

Title

FLAT WEDGE-SHAPED LENS AND IMAGE PROCESSING METHOD

Preliminary Class

359

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at <http://www.uspto.gov/web/offices/pac/doc/general/index.html>.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, <http://www.stopfakes.gov>. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

LICENSE FOR FOREIGN FILING UNDER
Title 35, United States Code, Section 184
Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign Assets Control, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

SelectUSA

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop technology, manufacture products, deliver services, and grow your business, visit <http://www.SelectUSA.gov> or call +1-202-482-6800.

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number
15/222,058

APPLICATION AS FILED - PART I

(Column 1)

(Column 2)

SMALL ENTITY

OR

OTHER THAN SMALL ENTITY

FOR	NUMBER FILED	NUMBER EXTRA
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A
SEARCH FEE (37 CFR 1.16(k), (l), or (m))	N/A	N/A
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A
TOTAL CLAIMS (37 CFR 1.16(i))	20 minus 20 =	*
INDEPENDENT CLAIMS (37 CFR 1.16(h))	1 minus 3 =	*
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$310 (\$155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).	
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))		

RATE(\$)	FEE(\$)
N/A	70
N/A	300
N/A	360
x 40 =	0.00
x 210 =	0.00
	0.00
	0.00
TOTAL	730

RATE(\$)	FEE(\$)
N/A	
N/A	
N/A	
TOTAL	

* If the difference in column 1 is less than zero, enter "0" in column 2.

APPLICATION AS AMENDED - PART II

(Column 1)

(Column 2)

(Column 3)

SMALL ENTITY

OR

OTHER THAN SMALL ENTITY

AMENDMENT A		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA
	Total (37 CFR 1.16(i))	*	Minus	**	=
	Independent (37 CFR 1.16(h))	*	Minus	***	=
	Application Size Fee (37 CFR 1.16(s))				
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))				

RATE(\$)	ADDITIONAL FEE(\$)
x =	
x =	
TOTAL ADD'L FEE	

RATE(\$)	ADDITIONAL FEE(\$)
x =	
x =	
TOTAL ADD'L FEE	

(Column 1)

(Column 2)

(Column 3)

AMENDMENT B		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA
	Total (37 CFR 1.16(i))	*	Minus	**	=
	Independent (37 CFR 1.16(h))	*	Minus	***	=
	Application Size Fee (37 CFR 1.16(s))				
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))				

RATE(\$)	ADDITIONAL FEE(\$)
x =	
x =	
TOTAL ADD'L FEE	

RATE(\$)	ADDITIONAL FEE(\$)
x =	
x =	
TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

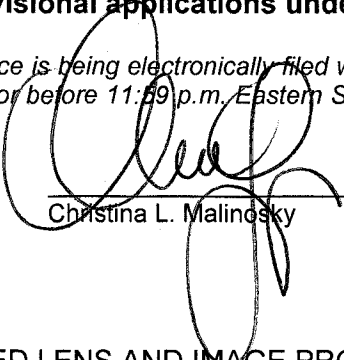
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

UTILITY PATENT APPLICATION TRANSMITTAL
(Only for new nonprovisional applications under 37 CFR 1.53(b))

I hereby certify that this correspondence is being electronically filed with the United States Patent and Trademark Office on July 28, 2016 at or before 11:59 p.m. Eastern Standard Time under the Rules of 37 CFR § 1.10.



Christina L. Malinosky

Docket No. : 124768
Inventor(s) : John Daugela
Title : FLAT WEDGE-SHAPED LENS AND IMAGE PROCESSING METHOD

ADDRESS TO: Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

July 28, 2016

1. ☒ **FEE TRANSMITTAL FORM**

2. **IF A CONTINUING APPLICATION**

_____ This application is a _____ of patent application No. _____.

Prior application information: Examiner _____; Group Art Unit: _____.

☒ This application claims the benefit of Provisional Application No. 62/201,428 pursuant to 35 U.S.C. §119(e) and 37 CFR §1.78(a)(4).

3. **APPLICATION COMPRISED OF**

Specification

15 Specification, claims and Abstract (total pages)

Drawings

5 Sheets of formal drawing(s) (FIGS. 1 to 5)

Inventor's Declaration(s)

☒ Executed Declaration (new or copy from a prior application (37 CFR 1.63(d)) (for continuation and divisional)

_____ Executed Declaration/Assignment (new or copy from a prior application (37 CFR 1.63(d)) (for continuation and divisional)

Power of Attorney by Applicant(s)

☒ Executed (new or copy from a prior application (37 CFR 1.63(d)) (for continuation and divisional) with transmittal

Application Data Sheet

☒ Newly executed ADS

_____ Unexecuted ADS

4. _____ **Microfiche Computer Program (Appendix)**

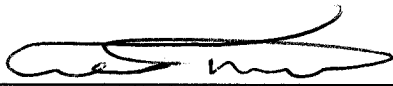
UTILITY PATENT APPLICATION TRANSMITTAL
(Only for new nonprovisional applications under 37 CFR 1.53(b))

Docket No.: 124768

5. _____ **Nucleotide and/or Amino Acid Sequence Submission** *(if applicable, all necessary)*
_____ Computer Readable Copy
_____ Paper Copy (identical to computer copy)
_____ Statement verifying identity of above copies
6. **APPLICANT(S) STATUS UNDER 37 CFR § 1.27 or 1.29**
_____☒ Applicant(s) and any others associated with it/them under § 1.27(a) are a SMALL ENTITY
_____ Applicant(s) and any others associated with it/them under § 1.29(a) are a MICRO ENTITY
_____ Certification of Micro Entity Status (Gross Income Basis)
7. **ALSO ENCLOSED ARE**
_____ Request and Certificate under 35 U.S.C. §122(b)(2)(B)(i) **Request for Non-Publication**
_____ Preliminary Amendment
_____ Includes "Cross-Reference to Related Applications"
_____ A Petition for Extension of Time for the parent application and the required fee are being filed concurrently herewith.
_____ This application is owned by _____ pursuant to an Assignment recorded at Reel _____, Frame _____
_____☒ Information Disclosure Statement (IDS)
_____ Copies of IDS Citations
_____ Certified copy of Priority Document(s) *(paper filing only, if foreign priority is claimed)*
_____ English Translation Document *(if applicable)*
_____ Return Receipt Postcard (MPEP 503) (should be specifically itemized).
_____ Other: _____
8. **DIRECT ALL CORRESPONDENCE TO: CUSTOMER NUMBER 23363**

Respectfully submitted,

LEWIS ROCA ROTHGERBER CHRISTIE LLP

By 
Raymond R. Tabandeh
Reg. No. 43,945
626/795-9900

LEWIS ROCA ROTHGERBER CHRISTIE LLP, P.O. BOX 29001, GLENDALE, CA 91209-9001

FEE TRANSMITTAL UTILITY PATENT APPLICATION

DATE: July 28, 2016

Docket No. : 124768
Inventor(s) : John Daugela
Title : FLAT WEDGE-SHAPED LENS AND IMAGE PROCESSING METHOD

Duplicate

FEE CALCULATION

CLAIMS AS FILED							
	Number Filed	Number Extra	Large Entity Rate	Small Entity Rate	Micro Entity Rate	Fee	
Total Claims	20 – 20	= 0	\$80.00	0 x \$40.00	\$20.00	\$0.00	
Independent Claims	1 – 3	= 0	\$420.00	0 x \$210.00	\$105.00	\$0.00	
Multiple-Dependent Claims Fee			\$780.00	\$390.00	\$195.00	\$0.00	
BASIC FILING, SEARCH, AND EXAMINATION FEES							
			Large Entity Rate	Small Entity Rate	Micro Entity Rate	Fee	
Basic Filing Fee			\$280.00	\$70.00	\$70.00	\$70.00	
Search Fee			\$600.00	\$300.00	\$150.00	\$300.00	
Examination Fee			\$720.00	\$360.00	\$180.00	\$360.00	
APPLICATION SIZE FEE							
EFS Paper Size Equivalent	Total Sheets	Extra Sheets	Number of each additional 50 or fraction thereof (round up to whole number)	Large Entity Rate	Small Entity Rate	Micro Entity Rate	Fee
20 * 75	= 15 – 100	= 0/50	= 0	\$400.00	0 x \$200.00	\$100.00	\$0.00
OTHER							
				Large Entity Rate	Small Entity Rate	Micro Entity Rate	Fee
Late Submission of Oath/Declaration Fee				\$140.00	\$70.00	\$35.00	\$0.00
Non-Electronic Filing Fee				\$400.00	\$200.00	\$200.00	\$0.00
TOTAL AMOUNT OF FEES							\$730.00
List Independent Claims: 1							

METHOD OF PAYMENT

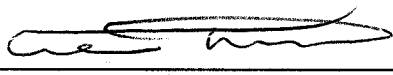
 X Submitted herewith is the fee of \$730.00.

 X The Commissioner is hereby authorized to charge any fees under 37 CFR 1.16 and 1.17 which may be required during the **entire pendency** of the application to Deposit Account No. 03-1728. Please show our docket number with any charge or credit to our Deposit Account.

Respectfully submitted,

LEWIS ROCA ROTHGERBER CHRISTIE LLP

By


Raymond R. Tabandeh
Reg. No. 43,945
626/795-9900

RRT/clm

AIA-SOLE

**INVENTOR'S DECLARATION
FOR PATENT APPLICATION**

PATENT

Title of Invention: FLAT WEDGE-SHAPED LENS AND IMAGE PROCESSING
METHOD
Docket No.: 124768

As a below named inventor, I hereby declare that:

This declaration is directed to the attached application unless the following is checked:

_____ United States Application or PCT International Application Number _____
filed on _____.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor of a claimed invention in the above-identified application.

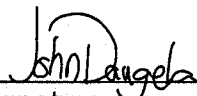
I have reviewed and understand the contents of the above-identified application, including the claims.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 C.F.R. § 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

I acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. § 1001 by fine or imprisonment of not more than five (5) years, or both.

John Daugela
Legal Name of Inventor

28-Jul-2016
Date

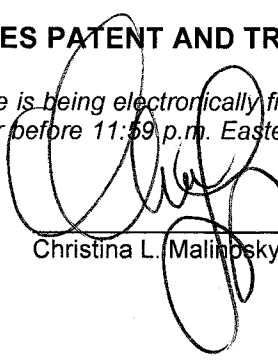

Signature

CLM PAS1430752.1-*07/27/16 3:56 PM

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

I hereby certify that this correspondence is being electronically filed with the United States Patent and Trademark Office on July 28, 2016 at or before 11:59 p.m. Eastern Standard Time under the Rules of 37 CFR § 1.10.


Christina L. Malinsky

Inventor : John Daugela
Application No. : To Be Determined
Filed : July 28, 2016
Title : FLAT WEDGE-SHAPED LENS AND IMAGE PROCESSING METHOD

Grp./Div. : To Be Determined
Examiner : To Be Determined

Docket No. : 124768

**TRANSMITTAL FOR POWER OF ATTORNEY TO ONE OR MORE REGISTERED PRACTITIONERS
IN ACCORDANCE WITH 37 CFR 1.5**

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

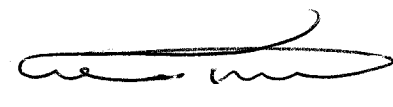
Post Office Box 29001
Glendale, CA 91209-9001
July 28, 2016

Commissioner:

Attached herewith is a General Power of Attorney for the above-identified patent application.

Respectfully submitted,
LEWIS ROCA ROTHGERBER CHRISTIE LLP

By


Raymond R. Tabandeh
Reg. No. 43,945
626/795-9900

RRT/clm

CLM PAS1431885.1-*07/28/16 8:38 AM

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
POWER OF ATTORNEY

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Commissioner:

SPECTRUM OPTIX INC. ("Applicant") is the Applicant by virtue of being the Assignee or Person to Whom the Inventor is Under an Obligation to Assign. Applicant hereby revokes all previous powers of attorney given in the application identified in the attached transmittal letter and appoints the Patent Practitioners associated with

CUSTOMER NUMBER 23363

of the firm LEWIS ROCA ROTHGERBER CHRISTIE LLP, telephone 626/795-9900, as attorneys or agents to transact all business in the United States Patent and Trademark Office for matters connected therewith for the application referenced in the attached transmittal letter.

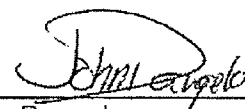
The undersigned representative of Applicant, whose title is supplied below, is authorized to act on behalf of Applicant.

Please direct all correspondence to CUSTOMER NUMBER 23363. Direct all telephone calls to 626/795-9900, LEWIS ROCA ROTHGERBER CHRISTIE LLP, P.O. Box 29001, Glendale, California 91209-9001.

SPECTRUM OPTIX INC.

Date 15-MAR-2016

By



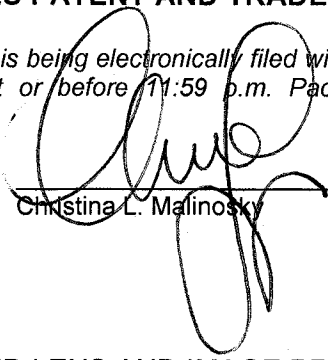
John Daugela
President

RRT/clm

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

I hereby certify that this correspondence is being electronically filed with the United States Patent and Trademark Office on July 28, 2016 at or before 11:59 p.m. Pacific Time under the Rules of 37 CFR § 1.8.


Christina L. Malinosky

Inventor : John Daugela
Application No. : To Be Determined
Filed : July 28, 2016
Title : FLAT WEDGE-SHAPED LENS AND IMAGE PROCESSING METHOD

Grp./Div. : To Be Determined
Examiner : To Be Determined

Docket No. : 124768

**INFORMATION DISCLOSURE STATEMENT
37 CFR § 1.97(b)**

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Post Office Box 29001
Glendale, CA 91209-9001
July 28, 2016

Commissioner:

In compliance with the duty of disclosure under 37 CFR §§ 1.56, 1.97 and 1.98, and in accordance with the provisions in the Manual of Patent Examining Procedure §§ 609 and 707.05(b), enclosed is an information disclosure statement listing the references that are known to applicant. This filing is timely because it is made during one of the periods described in 37 CFR § 1.97(b).

It is respectfully requested that the listed references be considered in the examination of this application and identified on the list of references cited on the patent issuing for this application. Applicant also requests that an initialed copy of the information disclosure statement be entered in the application file and returned to applicant with the next communication from the Office in accordance with MPEP § 609.

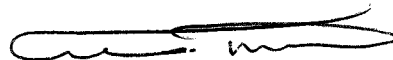
Docket No.: 124768

The Commissioner is hereby authorized to charge any fees which may be required by this paper to Deposit Account No. 03-1728. Please show our docket number with any Deposit Account transaction.

Respectfully submitted,

LEWIS ROCA ROTHGERBER CHRISTIE LLP

By



Raymond R. Tabandeh
Reg. No. 43,945
626/795-9900

RRT/clm

Enclosures: Information Disclosure Statement

CLM PAS1431884.1-*07/28/16 8:37 AM

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (use as many sheets as necessary)	Attorney Docket Number	124768
	Application Number	To Be Determined
	Filing Date	Herewith
	Inventor(s)	John Daugela
	Group Art Unit	To Be Determined
	Examiner Name	To Be Determined

U.S. PATENT DOCUMENTS				
EXAMINER INITIALS	Cite No. ¹	DOCUMENT NUMBER Number - Kind Code ² (If Known)	PUBLICATION DATE MM-DD-YYYY	NAME OF PATENTEE
		4,750,819	06-14-1988	Sugiki
		5,995,284	11-30-1999	Vanderwerf

FOREIGN PATENT DOCUMENTS					
EXAMINER INITIALS	Cite No. ¹	Foreign Patent Document Country Code ³ - Number ⁴ - Kind Code ⁵ (If Known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	T ⁶ (✓)

OTHER DOCUMENTS		
EXAMINER INITIALS	Cite No. ¹	Include name of the author (in CAPITAL LETTERS), title of the article, title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.

CLM PAS1431615.1-*07/26/16 4:14 PM

EXAMINER SIGNATURE		DATE CONSIDERED	
-----------------------	--	--------------------	--

EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. ¹Applicant's unique citation designation number (optional). ²See Kinds Codes of USPTO Patent Documents at www.pto.gov or MPEP 901.4. ³Enter Office that issued the document, by the two-letter code (WIPO standard ST.3). ⁴For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. ⁵Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. ⁶Applicant is to place a check mark here if English Language Translation is attached.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	124768
		Application Number	
Title of Invention	FLAT WEDGE-SHAPED LENS AND IMAGE PROCESSING METHOD		
The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76. This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.			

Secrecy Order 37 CFR 5.2:

☐	Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)
--------------------------	---

Inventor Information:

Inventor	1				Remove
Legal Name					
Prefix	Given Name	Middle Name	Family Name	Suffix	
	John		Daugela		
Residence Information (Select One) US Residency • Non US Residency Active US Military Service					
City	Calgary		Country of Residence ⁱ	CA	
Mailing Address of Inventor:					
Address 1		19 Wentworth Manor SW			
Address 2					
City	Calgary, Alberta		State/Province		
Postal Code	T3H 5K5		Country ⁱ	CA	
All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the Add button.					

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below. For further information see 37 CFR 1.33(a).			
☐ An Address is being provided for the correspondence Information of this application.			
Customer Number	23363		
Email Address	pto@lrrc.com	Add Email	Remove Email

Application Information:

Title of the Invention	FLAT WEDGE-SHAPED LENS AND IMAGE PROCESSING METHOD		
Attorney Docket Number	124768	Small Entity Status Claimed	☒
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	5	Suggested Figure for Publication (if any)	

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	124768
		Application Number	
Title of Invention	FLAT WEDGE-SHAPED LENS AND IMAGE PROCESSING METHOD		

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not be** the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32). Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	☒ Customer Number	☐ US Patent Practitioner	☐ Limited Recognition (37 CFR 11.9)
Customer Number	23363		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.

When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	Pending	Remove	
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	Claims benefit of provisional	62/201428	2015-08-05

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button.

[Add](#)

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	124768
		Application Number	
Title of Invention	FLAT WEDGE-SHAPED LENS AND IMAGE PROCESSING METHOD		

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)ⁱ the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Application Number	Country ⁱ	Filing Date (YYYY-MM-DD)	Access Code ⁱ (if applicable)

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button.

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.

NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	124768
		Application Number	
Title of Invention	FLAT WEDGE-SHAPED LENS AND IMAGE PROCESSING METHOD		

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	124768
		Application Number	
Title of Invention	FLAT WEDGE-SHAPED LENS AND IMAGE PROCESSING METHOD		

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant	1	Remove
------------------	---	------------------------

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

[Clear](#)

☒ Assignee	Legal Representative under 35 U.S.C. 117	Joint Inventor
---	--	----------------

Person to whom the inventor is obligated to assign.	Person who shows sufficient proprietary interest
---	--

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☒

Organization Name	Spectrum Optix Inc.
-------------------	---------------------

Mailing Address Information For Applicant:

Address 1	19 Wentworth Manor SW		
Address 2			
City	Calgary, Alberta	State/Province	
Country	CA	Postal Code	T3H 5K5
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button. [Add](#)

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	124768
		Application Number	
Title of Invention	FLAT WEDGE-SHAPED LENS AND IMAGE PROCESSING METHOD		

Assignee 1				
Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.				
Remove				
If the Assignee or Non-Applicant Assignee is an Organization check here. ☐				
Prefix	Given Name	Middle Name	Family Name	Suffix
Mailing Address Information For Assignee including Non-Applicant Assignee:				
Address 1				
Address 2				
City		State/Province		
Country ⁱ		Postal Code		
Phone Number		Fax Number		
Email Address				
Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button. Add				

Signature:

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). However, if this Application Data Sheet is submitted with the **INITIAL** filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Raymond Tabandeh/		Date (YYYY-MM-DD)	2016-07-28
First Name	Raymond R.	Last Name	Tabandeh	Registration Number
				43945
Additional Signature may be generated within this form by selecting the Add button. Add				

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	124768
		Application Number	
Title of Invention	FLAT WEDGE-SHAPED LENS AND IMAGE PROCESSING METHOD		

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

- 1 The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.
- 2 A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
- 3 A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
- 4 A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
- 5 A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
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- 7 A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
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- 9 A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Patent Application Fee Transmittal

Application Number:

Filing Date:

Title of Invention:

Flat Wedge-Shaped Lens and Image Processing Method

First Named Inventor/Applicant Name:

John Daugela

Filer:

Raymond R. Tabandeh/Christina Malinosky

Attorney Docket Number:

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Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Utility filing Fee (Electronic filing)	4011	1	70	70
Utility Search Fee	2111	1	300	300
Utility Examination Fee	2311	1	360	360

Pages:

Claims:

Miscellaneous-Filing:

Petition:

Patent-Appeals-and-Interference:

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				730

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First Named Inventor/Applicant Name:	John Daugela
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Payment was successfully received in RAM	\$ 730
RAM confirmation Number	798
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1		Specification.pdf	175010	yes	15
			9397571510c319773521da08dc19fa7f523f8737		
	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Specification		1	11	
	Claims		12	14	
	Abstract		15	15	
Warnings:					
Information:					
2	Drawings-only black and white line drawings	Drawings.pdf	152571	no	5
			5dab0f5e2d2eea4e174dad03bcc0733b51e53fef		
Warnings:					
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3		Transmittal.pdf	1092722	yes	9
			1eb0b04d40395c58a7ad74f08241104d0219e9fe		
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	Transmittal of New Application		1	3	
	Oath or Declaration filed		4	4	
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	Transmittal Letter	7	8
	Information Disclosure Statement (IDS) Form (SB08)	9	9

Warnings:

Information:

4	Application Data Sheet	ADS.pdf	1822811	no	8
			884f1e96b403e42a2986be6603372a55013a23f1		

Warnings:

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5	Fee Worksheet (SB06)	fee-info.pdf	34930	no	2
			9184e2ae8df47681d202a9146d7ff1837640f2ea		

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Flat Wedge-Shaped Lens and Image Processing Method

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This Patent Application claims the benefits of U.S. Provisional Patent Application Serial No. 62/201,428, filed on August 5, 2015 and entitled "Flat Wedge Shaped Lens and Image Processing Method," the entire content of which is hereby expressly incorporated by reference.

FIELD OF THE INVENTION

[0002] The disclosed invention generally relates to a flat lens system and correcting aberrations of images from the flat lens system using configuration and image processing techniques.

BACKGROUND

[0003] Anamorphic prism systems are known to compress or expand light beams, but they have not been used for image capture for a variety of reasons. These prism systems are afocal, and do not focus an image onto an image plane, making them unsuitable as an imaging system. Typically, anamorphic prism systems are designed for collimated light from one incident angle and therefore their performance degrades with off axis light, resulting in a lens with a very limited field of view. Many anamorphic prisms have chromatic dispersion resulting in chromatic aberrations making them unsuitable for multi-color images. Accordingly, anamorphic prism systems are almost exclusively used to shape laser beams, often monochromatic, and are generally referred to as beam expanders and beam compressors.

[0004] Achromatic anamorphic prism systems, generally require multiple prisms making them large and heavy. In addition, since the achromatic anamorphic prism systems only compress or expand in one dimension, it would require multiple of these systems to compress equally in two dimensions to maintain the image aspect ratio, which makes the systems even larger and heavier. For these reasons anamorphic prism systems have not been used for image capture.

[0005] Imaging devices such as cameras, microscopes and telescopes can be heavy and large. A large portion of this weight is due to the design of the optical lens elements, which can include heavy curved lenses, and the structure to support these lens separated by long focal distances.

These imaging devices can be large (thick) mainly because in a typical lens system, the opening aperture to system device depth ratio is small. Moreover, to optically improve image resolution with the traditional lens systems, more device depth (longer focal length) is required in order to reduce lens refraction and minimize lens aberrations. The device depth of the imaging device can limit the imaging systems' performance and design. For example, the size and weight constraints of mobile, compact, or weight constrained imaging devices can limit resolution because they constrain the maximum focal length. The disclosed invention can increase the effective focal length in these systems, and improve resolution with the same size and weight constraints.

Additionally, conventional curved lenses have many different types of aberrations that reduce image resolution (spherical, coma, chromatic, and others). To correct these aberrations, conventional curved lenses use extra large pieces of precision glass, adding weight, size and cost to the lens system. The disclosed invention can reduce the size, weight and resulting cost of conventional curved lenses, and in some devices eliminate their use entirely.

SUMMARY OF THE INVENTION

In some embodiments, the disclosed invention is a flat lens system which includes: a wedge-shaped refractive material having a first surface and a second surface opposite to the first surface for refracting incident light beams from an object having a width of Y , from the first surface towards the second surface; a reflective material positioned at the second surface of the wedge-shaped refractive material for reflecting the refracted light beams at a first angle toward the first surface, wherein the reflected light beams are refracted from the first surface at a second angle to compress or expand the light from the object having a width of X and including chromatic aberrations; and an apparatus for forming and processing the image of the object to reduce said chromatic aberrations.

In some embodiments, X is smaller than Y to compress the image of the object for use in a telescope, for instance. In some embodiments, X is larger than Y to expand the image of the object for use in a microscope, for example.

In some embodiments, the reflective material may include one or more moving or rotating mirrors to reflect the refracted light beams at varying angles toward the first surface.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] A more complete appreciation of the disclosed invention, and many of the attendant features and aspects thereof, will become more readily apparent as the disclosed invention becomes better understood by reference to the following detailed description when considered in conjunction with the accompanying drawings in which like reference symbols indicate like components.

[0011] FIG. 1 shows a comparison of a tradition circular curved lens with a flat (wedge) lens, according to some embodiments of the disclosed invention.

[0012] FIG. 2 shows an exemplary configuration of a flat lens system, according to some

[0013] FIG. 2A illustrates a wedge-shaped refractive material, according to some embodiments of the disclosed invention.

[0014] FIG. 3 is an exemplary process flow, according to some embodiments of the disclosed invention.

[0015] FIG. 4 depicts an exemplary flat (wedge) lens with a moving reflective surface, such as one or more moving mirrors, according to some embodiments of the disclosed invention.

[0016] FIG. 5 shows an exemplary flat lens for expanding EM waves, according to some embodiments of the disclosed invention.

DETAILED DESCRIPTION

[0017] Embodiments of the disclosed invention are directed to a flat lens system to obtain a high quality image with a more compact optical lens system and correcting aberrations of images from the flat lens system using configuration and image processing techniques. Increasing the initial surface area of the lens objective (aperture) allows more electromagnetic (EM) wave energy to be collected, and can result in a faster and better image quality. However, increasing the aperture to improve image quality and speed typically results in a proportionally larger size lens system and device depth.

[0018] The flat lens system according to the disclosed invention has an increased initial surface area of the lens objective (aperture), with a decreased corresponding device depth in the lens stack. The flat lens system collects the EM waves, such as visible and nonvisible lights, with a much larger aperture-to-device depth ratio. This means higher quality images can be

captured faster with a smaller device depth. A flat lens system may be very large for telescopes for example, and small for microscopes, and yet maintain a large aperture-to-device depth ratio.

[0019] FIG. 1 shows a comparison of a tradition circular curved lens with a flat (wedge) lens, according to some embodiments of the disclosed invention. The figure shows how a flat lens system with a square light sensor can collect twice as much light as a conventional lens system with circular lens, and a square light sensor. As shown, the area 106 of the rectangular light sensor is $2r^2$, while the area 104 of the circular lens is πr^2 , which is larger. The area 102 is $2r$ by $2r = 4r^2$. As seen, a flat (wedge) lens system captures twice the light in a device with a similar frontal area, and therefore can take higher quality images and do so in a faster manner. This ratio would be even larger for rectangular sensors, which most sensors are.

[0020] In some embodiments, the disclosed invention provides a flat lens system and image processing methods with an increased lens aperture to device depth ratio and corrects aberrations and distortions in the images produced by the lens. In some embodiments, the disclosed invention is capable of optical EM wave compression and/or expansion. Some applications for the flat (wedge) lens of the disclosed invention include both imaging and non-imaging applications. Examples of imaging applications are cameras, microscopes, telescopes, binoculars, scopes, telecentric lenses, and the like. Examples of non-imaging applications are architectural light pipes, which could provide indoor illumination using natural light, and solar concentrators for more efficient solar energy generation.

[0021] FIG. 2 shows an exemplary configuration of a flat lens system, according to some embodiments of the disclosed invention. A wedge shaped refractive material 202 with angles a_1 and a_2 is formed on top of a reflective surface 204 to form a flat lens. The image of an object 201 with a width of Y is reflected from multiple surfaces of the flat (wedge) lens, processed and compressed to form a compressed image 218 of the same object. As shown, light (EM) waves 206a and 208a at the two ends of object 201 are penetrated into the refractive material 202 and reflected from the reflective surface 204 at an angle to form light waves 206b and 208b, respectively. The reflected lights (EM) 206b and 208b are further reflected from the internal surface of the refractive material 202 to form light waves 206c and 208c, respectively. The angle of the light waves 206c (a_4) and 208c (a_3) leaving the refractive material can be designed for specific applications, using conventional optical design methods. Reflected light waves 206c and 208c now form a smaller size X (compressed) image 210 of the original object 201.

[0022] Varying angles a_1 and/or a_2 will vary the size X of the compressed image 210. The size X of compressed image 210 varies with the EM wavelength, angle a_1 and a_2 , and the type of the refractive material 202. Angles a_1 and/or a_2 values can be varied for specific applications, such as the degree of the compression (X) needed. In many typical applications, angles a_1 is
5 between 15 and 25 degrees and a_2 is between 75 to 105 degrees. Exit beam angles of a_3 and a_4 can be modified by varying angles a_1 and/or a_2 until the critical angle is reached which then alters the beam path to total internal reflection.

[0023] Referring back to FIG 2, the compressed image is then directed to an optional focusing lens 212 to focus the compressed image onto light sensor(s) 214 (for example, CCD or
10 CMOS sensor(s)). In some embodiments, the focusing lens 212 focuses the compressed image onto an eyepiece for viewing by a human. An image processor 216 (implemented in software, hardware and/or firmware) corrects for any aberrations resulting from the lens system by using one or more image processing techniques. An example of correcting chromatic aberrations in hardware would be the use of one or more optical wedges and/or diffraction gratings, before the
15 light sensor 214, that together have an achromatic effect for imaging. The refractive properties of the material of the wedge 202 can be changed to assist in controlling chromatic dispersion for imaging applications as well. For example, the refractive index of the wedge can be dynamically changed by applying voltage to current to the wedge comprised of certain material that refract the light differently under electric power.

[0024] If the image processing is performed by an optical device (hardware), the correction
20 is done before the image is received by the sensor. However, if the image processing is performed by software (executed on a processor), the corrections are performed after the image is received by the image sensor, that is, at the output of the sensor.

[0025] In some embodiments, the chromatic dispersion for the output image is dynamically
25 measured (for example, at predetermined intervals) and a corresponding voltage (or current) is applied to the wedge to change its refractive index and/or its beam absorption to compensate for the measured chromatic dispersion. In some embodiments, the amount of the voltage (or current) applied to the wedge is determined from a stored lookup table, taking into account the measured chromatic dispersion and the type of the wedge material.

[0026] Characterizing the chromatic dispersion per device, and applying software algorithms in the image processor 216 to the image, can also be used to assist in controlling chromatic dispersion for imaging

[0027] There are many known image processing techniques to correct for image aberrations.

5 One method is to calculate or measure the aberrations of the system, for example, by creating spot diagrams, which are different for each wavelength of light, and then apply an inverse transfer function to reverse these aberrations.

[0028] The refractive material 202 may be made of any type of glass, plastic, fluids such as water, or similar types of refractive materials. In case of a fluid, such as water, the fluid may
10 also be used to allow cooling of the optics. The reflective surface 204 may be any type of mirror or other material having a reflective surface. Such reflective surface may be attached or coated on such material to form the reflective surface 204.

[0029] The flat lens of the disclosed invention may have any rectangular shape, rather than a square shape, which allows for variable compression ratio and aspect ratio of the image being
15 formed. In some embodiments, the wedge angles a_1 and a_2 can be variable as the specific applications require. For example, using common BK7 glass, a typical wedge angle a_2 may vary between 75 and 105 degrees, in some embodiments. Choosing an angle a_2 closer to 75 degrees will result in higher energy captured and lower chromatic aberration but have lower compression. However, choosing an angle a_2 closer to 105 degrees results in a higher
20 compression of the image at the expense of higher energy losses and larger chromatic aberration. Angle a_1 can be varied to produce similar effects.

[0030] Although FIG. 2 and its description is directed to visible light and an image, those skilled in the art would recognize that the flat lens of the disclosed invention is not limited to visible light. Rather, the disclosed invention is capable of operating on any type of EM wave
25 that can refract, with or without forming an image.

[0031] FIG. 2A illustrates a wedge-shaped refractive material (prism), according to some embodiments of the disclosed invention. As shown a reflective material is coated or attached to the back of the wedge-shaped refractive material. The wedge-shaped prism has a vertex angle α (e.g., between 2 and 25 deg.). If one surface of the prism is reflectorized (by the reflective
30 material), a thin anamorphic beam expander /compressor can be created. In this case, it is shown that the output beam is orthogonal to the input beam. Although FIG. 2A, illustrates a reflecting

wedge anamorphic compressor prism that converts an input beam with an aspect ratio of, for example, 2:1 to an output beam with an aspect ratio of, for example, 4:3, one skilled in the art would recognize that any prism designed for anamorphic compression can be used as an expander by reversing the direction of the input and vice versa. The ray-trace equations of the prism are

$$I_1 = \phi, \quad (1)$$

$$I_1' = \arcsin\left(\frac{\sin I_1}{n}\right), \quad (2)$$

$$I_2 = \alpha + I_1' = I_2', \quad (3)$$

$$I_3 = I_2 + I_2' + I_1 - I_1' - \phi, \quad (4)$$

$$I_3' = \arcsin(n \sin I_3), \quad (5)$$

$$\delta = \phi + I_3'. \quad (6)$$

[0032] Here, $\alpha \approx (I_3 - I_1')/2$ and ϕ is the tilt angle of surface 1 from the vertical. ϕ and α may be adjusted until the desired compression or expansion ratio is obtained. For instance, for a prism of B270 optical crown glass ($n_d = 1.5229$) with $\phi = 16.9$ deg and $\alpha = 14.0$ deg, an anamorphic compression $A'/A = \text{MAG} \approx 0.375$ can be obtained. Typically, two of these reflective wedges, placed orthogonally to maintain the image aspect ratio, would result in a shortening the focal length required of the focusing lens system by 50% or more. This effect may be used to create a more compact device.

[0033] Compressing the image using this technique allows the image to be focused in a shorter distance while maintaining resolution. A shorter focal distance allows for a more compact device. This means higher quality images can be captured faster with a smaller lens system. FIG. 3 is an exemplary process flow, according to some embodiments of the disclosed invention. In block 302, an EM energy (which may or may not contain an image) enters an optical system comprising one or more flat (wedge) lens. The EM energy goes through the medium and bounces off a reflective surface, in block 304. In this example, it is assumed that the EM wave is visible light forming an image. However, as explained above, the disclosed invention is not limited to visible light and images, rather, it is applicable to any EM wave/energy. The reflected EM wave then travels through the medium and exits the optical elements, in block 306, where the EM wave will be compressed or expanded in one or more plane(s). In block 308, the EM wave may then travel through an optional modifying (focusing

and correcting) lens system. In block 310, the EM wave strikes one or more EM sensor(s) or optical element(s) for human eye viewing. Block 302 to block 308 may be repeated multiple times to compress the EM Wave in multiple planes. In the case of imaging, the compressed output aperture from 306 reduces the required focal length which reduces the corresponding device size. In block 312, a processor, such as an image or EM wave processor, receives the information from the EM sensor and modifies/enhances this information, as required by the application of the flat lens. This can also be used to expand/spread the image if the application is directed to a microscopic function, where the sequence is partially reversed.

[0034] In block 314, in the case of imagery application, the (image) processor corrects aberrations from the lens system. The refracting wedge lens can introduce chromatic aberrations, but does not introduce other aberrations usually associated with circular lens systems. The chromatic aberration can be predetermined (by calculation or measurement) for each pixel. A table can be used to offset each color at each pixel to reposition the pixel at the appropriate position in the resolved image.

[0035] Alternatively, or in combination, hardware (optical) processing of the image may be performed by achromatic elements, such as achromatic wedge(s). An anamorphic prism for correcting an anisotropy of a radiation angle of a beam is described in U.S. Pat. No. 4,750,819, the entire contents of which is hereby expressly incorporated by reference. The anamorphic prism is formed as an achromatic structure using a first prism and a second prism. The refractive indexes and refractive index changes as a result of a wavelength fluctuation of the first and second prisms and an incident angle of the beam to the first prism can satisfy a predetermined relationship, where the beam can emerge from the second prism at an exit angle of 0 degree, which corrects the anisotropy of the angle of the beam.

[0036] The flat lens system of the disclosed invention collects the EM waves, such as visible and/or non-visible light, with a much larger aperture-to-device depth ratio. This means higher quality images can be captured faster with a smaller lens system.

[0037] The flat lens system may be very large for telescopes for example, and small for microscopes, and yet maintain a large aperture-to-device depth ratio. The image sensors are often charge coupled devices (CCDs) or CMOS sensors. The disclosed invention is not limited to the above examples of imaging sensor, rather, other types of EM or imaging sensors may be used with the flat lens of the disclosed invention. Human eye viewable optical elements may

also be used. In the case of human eye viewable optical elements, blocks 308 to 314 may not be required because the human eye can focus the image.

[0038] In block 312, one or more processor(s), such as an image or EM wave processor(s), receives the information from the EM sensor(s) and modifies/enhances this information, as required by the application. This can also be used to expand/spread the image if the application is directed to a microscopic function, where the sequence is partially reversed.

[0039] In the case of a three dimensional (3D) imaging, more EM sensors may be required, as known in the art. The invention is not limited to the above examples of imaging sensor, rather, other types of EM or imaging sensors may be used with the flat lens of the disclosed invention.

[0040] FIG. 4 depicts an exemplary flat (wedge) lens with a moving reflective surface, such as one or more moving mirrors, according to some embodiments of the disclosed invention. As shown, the image of an object 401 is reflected from multiple surfaces of the flat (wedge) lens, processed and compressed to form a compressed image 414 of the same object. Light (EM) waves at the two ends of object 401 are penetrated into the refractive material 402 and reflected from moving mirrors 404 at varying angles to form a smaller size (compressed) image 406 of the original object 401.

[0041] The compressed image 406 may optionally get directed to an optional focusing lens 408 to focus the compressed image onto light sensor(s) 410 (for example, CCD or CMOS sensor(s)). An image processor 412 (implemented in software, hardware and/or firmware) corrects for any aberrations resulting from the lens system by using one or more image processing techniques and output a corrected compressed image 414. If the image processing is performed by an optical device (hardware), the correction is done before the image is received by the sensor. However, if the image processing is performed by software (executed on a processor), the corrections are performed after the image is received by the image sensor, that is, at the output of the sensor.

[0042] In these lens systems with moving reflective surface, the quality of the image is increased by reducing the field of view, and stitching many images together. This technique can improve final image resolution. Moving the mirror changes the view of what objects appear in the image. In these embodiments, the mirror is moved in a way that it can captures a series of images, each with a narrow field of view. The system then uses known image processing

techniques to combine or stitch the captured images together into one composite image with a large field of view. For example, known image stitching methods may be used to register, calibrate and blend the images to produce the final image 414. Because the imaging system has a relatively large aperture size with lots of light, images can be captured very quickly. Another reason to move the mirror is to adjust the field of view, or change the compression of one single image, for example, for digital or optical zooming applications.

[0043] There are several different techniques to move the mirror 404. Although mirror 404 is shown as rotating, in some embodiments, it is possible to tilt the reflective surface (e.g., a mirror) about a fulcrum, or rotate about the edge as shown in FIG. 5. In some embodiments, the mirror can be an array of micromirrors. The moving reflective surface(s) of the flat lens system may be combined with the dynamic changing of the refractive index of the refractive wedge-shaped material (as described above) to further enhance the lens system.

[0044] FIG. 5 shows an exemplary flat lens for expanding EM waves, according to some embodiments of the disclosed invention. FIG. 5 described below, illustrates a microscopic function, where the EM paths are reversed with respect to those depicted in the example of FIG. 2. Light leaves a small size (X) object 502, and enters a wedge 504 where it is expanded, and reflected off a reflective surface 506, such as a mirror. The light then exits the wedge into a lens system 510, light sensor 512, and image processor 514. The processed image is an expanded image 516 of the small size image 502. Further expanding the expanded image 516, for example, by varying the angle α_1 and/or α_2 and/or α_3 and/or configuring multiple wedges in series to further expand the small object image 502, the function of a microscope can be realized with a much smaller device and/or enable higher resolution and/or viewable area. In some embodiments, the wedge may include an anti-reflective coating(s) to capture more of the light energy leaving the small object. Similar to flat lens systems of FIG. 4, if the image processing is performed by an optical device (hardware), the correction is done before the image is received by the sensor(s). However, if the image processing is performed by software (executed on a processor), the corrections are performed after the image is received by the image sensor(s), that is, at the output of the sensor(s).

[0045] There are several known image processing methods to correct the image aberration caused by the flat lens. The use of these known methods is dependent upon the application of the flat lens. For example, lookup tables may be used to correct the aberrations as a relatively

simple correction for chromatic aberrations. Moreover, transfer functions may be appropriated when fixing chromatic aberrations in a flat lens application .

[0046] In some applications, there may be a low intensity of EM energy, such as in low light applications (e.g., night vision, or for example Raman Spectroscopy of biological tissue where
5 high power lasers may damage the tissues). In these applications, the large aperture of the lens system of the disclosed invention is capable of collecting a large amount of light energy, and still use a very compact design.

[0047] In some embodiments, the disclosed invention is capable of capturing and optionally process multispectral or hyperspectral imaging, which is used to collect and process information
10 from across the electromagnetic spectrum to obtain the spectrum for each pixel in an image of a scene, with the purpose of finding objects, identifying materials, or detecting processes in the image of the scene.

[0048] In some embodiments, the disclosed invention is scalable and applies to a full range of system sizes including those from small microscopic/nano systems to large telescopic systems
15 greater than, for example, 30m in length or diameter.

[0049] It will be recognized by those skilled in the art that various modifications may be made to the illustrated and other embodiments of the invention described above, without departing from the broad inventive scope thereof. It will be understood therefore that the invention is not limited to the particular embodiments or arrangements disclosed, but is rather
20 intended to cover any changes, adaptations or modifications which are within the scope of the invention as defined by the appended claims and drawings.

CLAIMS:

1. A flat lens system comprising:
a wedge-shaped refractive material having a first surface and a second surface opposite to the first surface for refracting incident light beams from an object having a width of Y, from the first surface towards the second surface;
a reflective material positioned at the second surface of the wedge-shaped refractive material for reflecting the refracted light beams at a first angle toward the first surface, wherein the reflected light beams are refracted from the first surface at a second angle and having a width of X to be used to form an image of the object and including chromatic aberrations; and
an apparatus for processing the image of the object to reduce said chromatic aberrations.
2. The flat lens system of claim 1, wherein X is smaller than Y to compress the image of the object.
3. The flat lens system of claim 1, wherein X is larger than Y to expand the image of the object.
4. The flat lens system of claim 1, further comprising a focusing lens to focus the image of the object onto a sensor.
5. The flat lens system of claim 1, further comprising a focusing lens to focus the image of the object onto an eyepiece for viewing by a human.
6. The flat lens system of claim 1, wherein the apparatus for processing the image is an image processing device executing an image processing programming code to reduce said chromatic aberrations.
7. The flat lens system of claim 1, wherein the apparatus for processing the image comprises of one or more refractive optical wedges that together have an achromatic effect to reduce said chromatic aberrations.

8. The flat lens system of claim 1, wherein the apparatus for processing the image comprises of one or more diffraction gratings that together have an achromatic effect to reduce said chromatic aberrations.

5 9. The flat lens system of claim 1, wherein the refractive or reflective material has one or more coatings at the first or the second surface.

10. The flat lens system of claim 1, wherein the reflective material is attached to the second surface of the wedge-shaped refractive material.

10 11. The flat lens system of claim 1, wherein the reflective material comprises of one or more moving mirrors to reflect the refracted light beams at varying angles toward the first surface.

15 12. The flat lens system of claim 11, wherein the one or more moving mirrors are rotated to reflect the refracted light beams at varying angles.

13. The flat lens system of claim 11, wherein the one or more moving mirrors are tilted to reflect the refracted light beams at varying angles.

20 14. The flat lens system of claim 1, further comprising an electric energy source electrically coupled to the wedge-shaped refractive material to dynamically change a refractive index of the refractive material to refract the incident light beams at varying angles.

25 15. The flat lens system of claim 1, further comprising one or more wedge-shaped refractive material(s) positioned between the wedge-shaped refractive material and the reflective material.

16. A telescope comprising the flat lens system of claim 2.

30 17. A microscope comprising the flat lens system of claim 3.

18. A binocular comprising the flat lens system of claim 2.

19. A scope comprising the flat lens system of claim 2.

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20. A telecentric lens system comprising the flat lens system of claim 2.

Abstract

A flat lens system includes a wedge-shaped refractive material having a first surface and a second surface opposite to the first surface for refracting incident light beams from an object having a width of Y, from the first surface towards the second surface; a reflective material positioned at the second surface of the wedge-shaped refractive material for reflecting the refracted light beams at a first angle toward the first surface, wherein the reflected light beams are refracted from the first surface at a second angle to form an image of the object having a width of X and including chromatic aberrations; and an apparatus for processing the image of the object to reduce said chromatic aberrations.

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FIG. 1

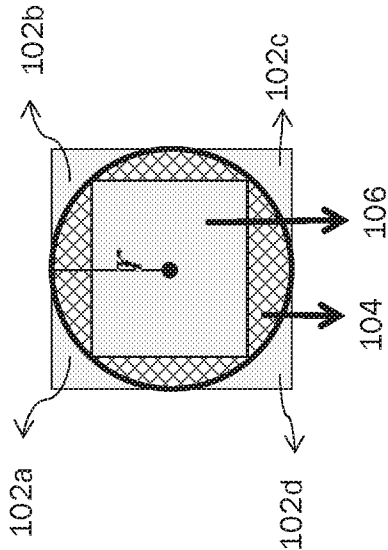


FIG. 2

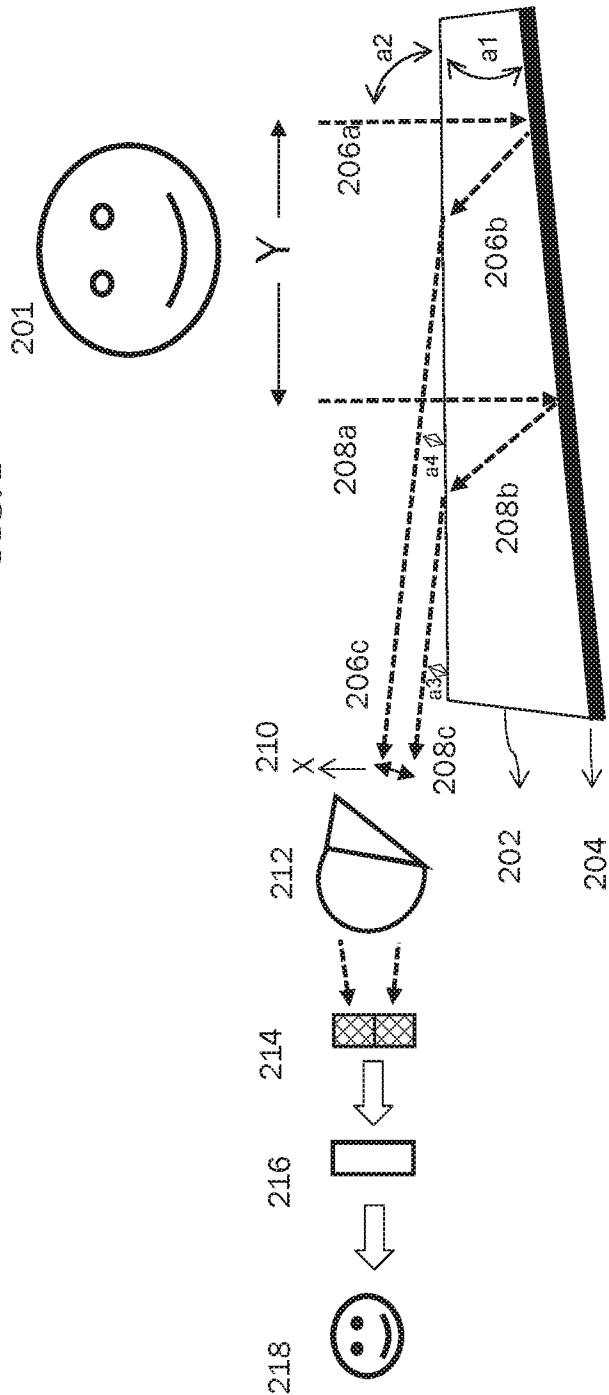


FIG. 2A

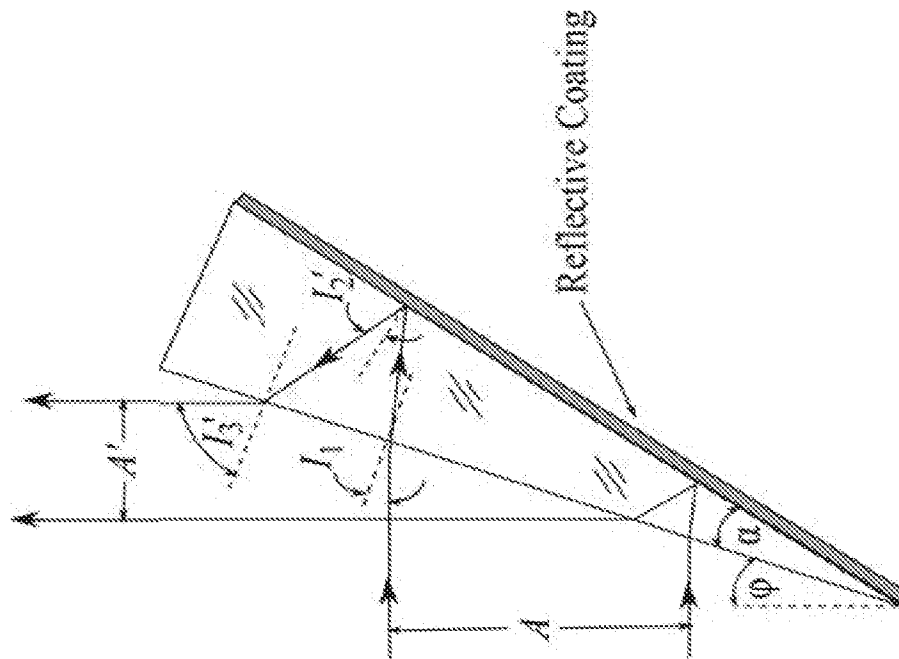


FIG. 3

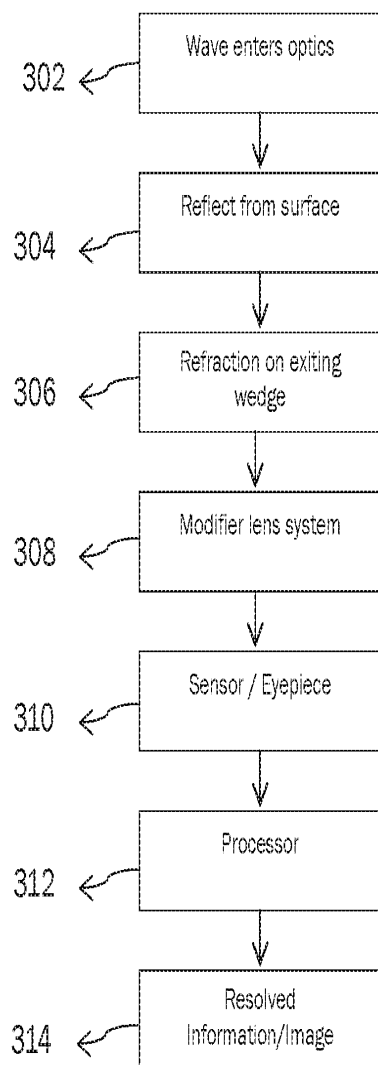


FIG. 4

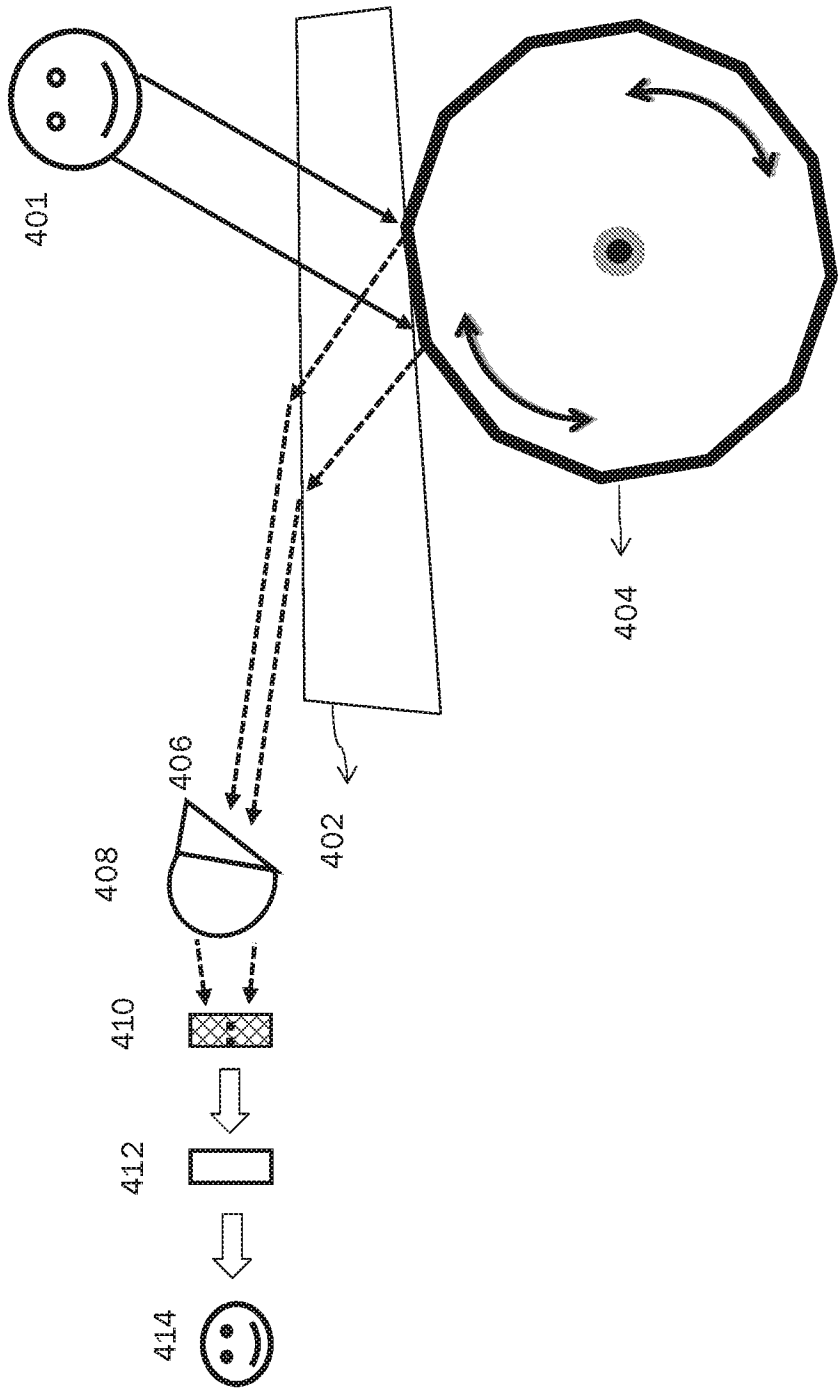
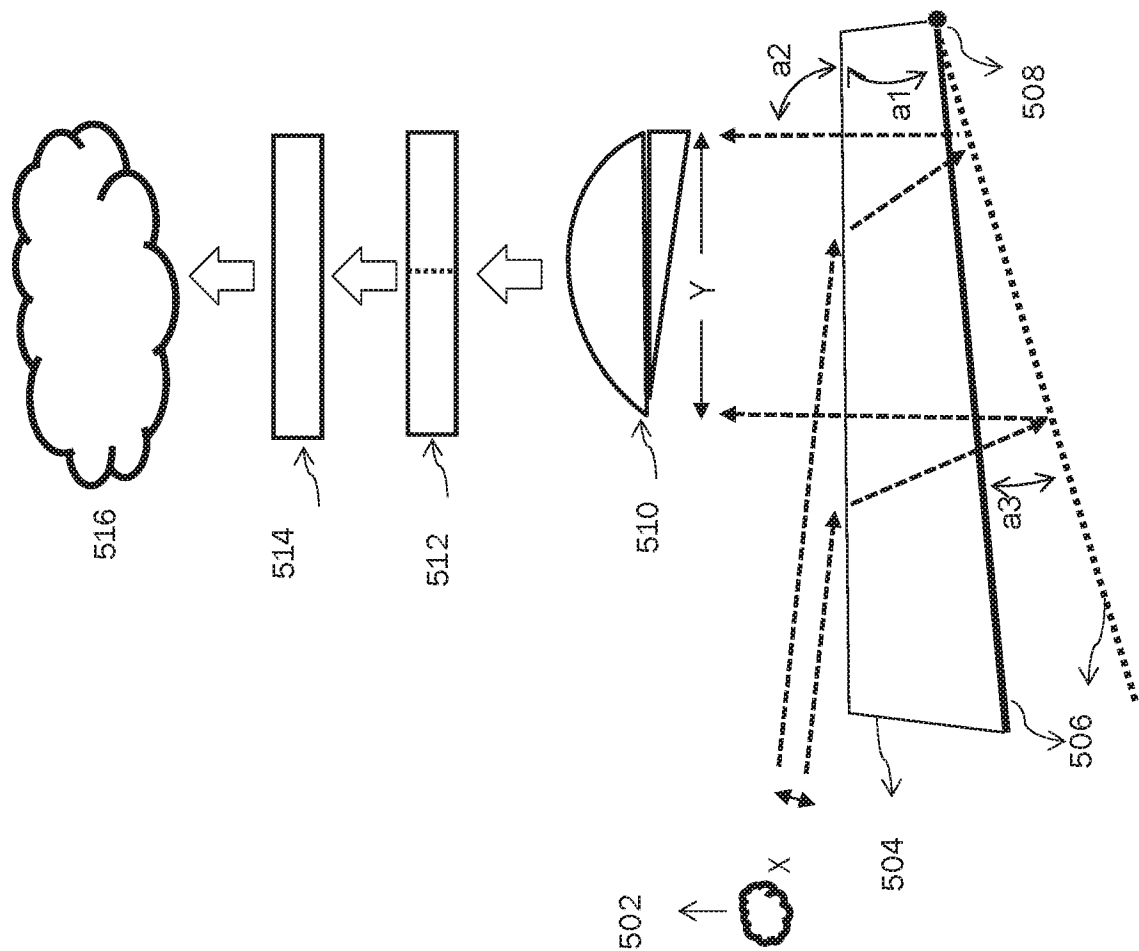


FIG. 5



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