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(54) Title: FLAT LENS IMAGING DEVICES AND SYSTEMS

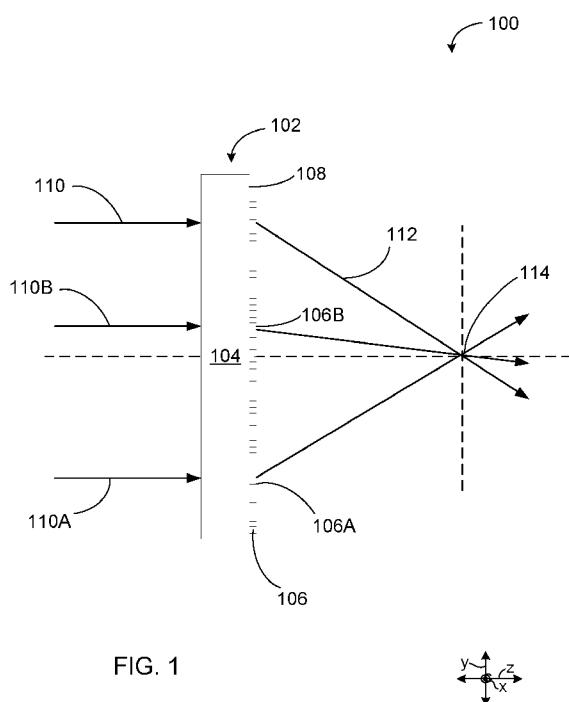


FIG. 1

(57) Abstract: Disclosed herein are electronic devices having flat lenses. The flat lens may be combined with an infrared (IR) emitter, an IR sensor, or an image sensor, and/or one or more additional optical lenses or filters. The flat lens may provide a more compact footprint over a conventional curved optical lens. Additionally, the flat lens may be configured to bend light instantaneously, rather than gradually as the light passes through the lens. This may be advantageous in reducing the number of optical lenses within the electronic device and/or size (e.g., thickness) of the overall lens arrangement (as well as the size of the overall electronic device), therein allowing for a more compact configuration for the electronic device.

Declarations under Rule 4.17:

- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
- *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

Published:

- *with international search report (Art. 21(3))*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

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30 November 2017 (30.11.2017)

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2017/026880

A. CLASSIFICATION OF SUBJECT MATTER
INV. B82Y20/00 G02B1/04 G02B1/00
ADD.

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)
B82Y G02B B29D H01Q

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

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CN 103 094 701 B (KUANG CHI INST ADVANCED TECH; SHENZHEN GUANGQI INNOVATION TE) 16 December 2015 (2015-12-16) paragraph [0001]; figure 1	1
X	DE 10 2011 006106 A1 (UNIV STUTTGART [DE]) 27 September 2012 (2012-09-27)	1-5
Y	paragraphs [0001], [0018]; figure 1 abstract	6
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Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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

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

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

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search

5 October 2017

Date of mailing of the international search report

23/10/2017

Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2017/026880

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Nanfang Yu ET AL: "Flat optics with designer metasurfaces : Nature Materials : Nature Research", Nature, 23 January 2014 (2014-01-23), pages 139-150, XP055389488, Retrieved from the Internet: URL:http://www.nature.com/nmat/journal/v13/n2/full/nmat3839.html [retrieved on 2017-07-10] page 23, paragraph 3 page 5; figure 2a -----	1,3
X	WO 2013/032758 A1 (SMOLYANINOV IGOR I [US]; BAE SYS INF & ELECT SYS INTEG [US]) 7 March 2013 (2013-03-07) page 1, line 24 - line 25; figure 1A -----	1,2
Y	US 2004/070855 A1 (BENITEZ PABLO [ES] ET AL) 15 April 2004 (2004-04-15) figure 3 -----	1,6
X	WO 2009/131780 A1 (RAYTHEON CO [US]; YOUNG ABRAM G [US]; BARKER DELMAR L [US]; OWENS WILL) 29 October 2009 (2009-10-29) paragraphs [0019], [0021], [0025], [0026]; figure 2 -----	7,8,10
X	& SHUANG ZHANG ET AL: "Near-infrared double negative metamaterials", OPTICS EXPRESS, vol. 13, no. 13, 1 January 2005 (2005-01-01), page 4922, XP055050796, ISSN: 1094-4087, DOI: 10.1364/OPEX.13.004922 figure 1 -----	8
X	US 2009/296223 A1 (WERNER DOUGLAS H [US] ET AL) 3 December 2009 (2009-12-03) paragraphs [0010], [0111], [0004], [0009], [0012], [0121] -----	7,9, 11-15

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2017/026880

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☒ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-6

Compact infrared light source

2. claims: 7-15

Infrared Sensor

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2017/026880

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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