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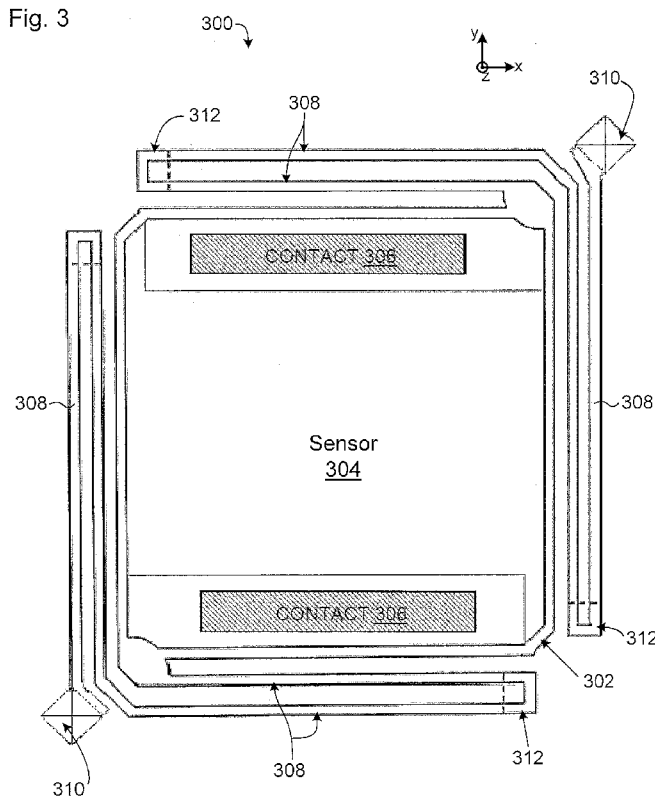
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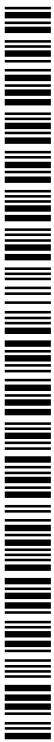
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[Continued on next page]

(54) Title: VERTICAL MICROBOLOMETER CONTACT SYSTEMS AND METHODS



(57) Abstract: Systems and methods are directed to vertical legs for an infrared detector. For example, an infrared imaging device may include a microbolometer array in which each microbolometer includes a bridge and a vertical leg structure that couples the bridge to a substrate such as a readout integrated circuit. The vertical leg structure may run along a path that is parallel to a plane defined by the bridge and may be oriented perpendicularly to the plane. The path may be disposed within, below, or above the plane defined by the bridge.





SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ,
GW, KM, ML, MR, NE, SN, TD, TG).

— 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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INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER
INV. G01J5/02 G01J5/20
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)
G01J

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.
X	US 2011/180713 A1 (NODA TAKAFUMI [JP]) 28 July 2011 (2011-07-28) paragraphs [0060] - [0089], [0152] - [0154] figures 1-3, 14	1-3,8,9, 14,15
X	US 6 046 485 A (COLE BARRETT E [US] ET AL) 4 April 2000 (2000-04-04) column 4, lines 50-64 column 5, lines 7-57 figures 2, 3, 4	1-7

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 14 October 2015	Date of mailing of the international search report 29/01/2016
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Haller, Mirjam
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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2015/039138

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	KIM YOUNG SU ET AL: "Uncooled Microbolometer Arrays With High Responsivity Using Meshed Leg Structure", IEEE PHOTONICS TECHNOLOGY LETTERS, IEEE SERVICE CENTER, PISCATAWAY, NJ, US, vol. 25, no. 21, 1 November 2013 (2013-11-01), pages 2108-2110, XP011529217, ISSN: 1041-1135, DOI: 10.1109/LPT.2013.2281623 [retrieved on 2013-10-09] the whole document	1-7,14,15
A	----- US 2010/171190 A1 (LIGER MATTHIEU [US]) 8 July 2010 (2010-07-08) paragraphs [0039] - [0048] figure 1 -----	1-15

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2015/039138

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2011180713	A1	28-07-2011	CN 102194833 A 21-09-2011
			JP 5644120 B2 24-12-2014
			JP 2011153845 A 11-08-2011
			US 2011180713 A1 28-07-2011

US 6046485	A	04-04-2000	AT 268468 T 15-06-2004
			CA 2368974 A1 12-10-2000
			DE 60011255 D1 08-07-2004
			DE 60011255 T2 07-07-2005
			EP 1166065 A1 02-01-2002
			JP 4700196 B2 15-06-2011
			JP 2002541449 A 03-12-2002
			US 6046485 A 04-04-2000
			WO 0060324 A1 12-10-2000

US 2010171190	A1	08-07-2010	CA 2748969 A1 15-07-2010
			CN 102326255 A 18-01-2012
			EP 2386116 A1 16-11-2011
			JP 2012514753 A 28-06-2012
			KR 20110107366 A 30-09-2011
			US 2010171190 A1 08-07-2010
WO 2010080815 A1 15-07-2010			

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2015/039138

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.:

1-15

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: 1-15

An infrared imaging device comprising a substrate having a plurality of contacts; and a microbolometer array coupled to and disposed above the substrate having a surface that defines a plane, wherein each microbolometer comprises a bridge, a leg structure having at least a first portion that runs non-perpendicularly to the plane and runs between the bridge and at least one of the contacts, wherein the first portion of the leg structure has a first dimension that extends in a direction that is substantially perpendicular to the plane, wherein the first portion of the leg structure has a second dimension that extends in a direction that is substantially parallel to the plane, and wherein the first dimension is greater than the second dimension.

2. claims: 16-33

A method of forming an infrared imaging device, the method comprising providing a device having a bolometer bridge structure formed on a sacrificial layer, optionally depositing an additional sacrificial layer over the sacrificial layer, forming openings in the sacrificial layer or the additional sacrificial layer, forming leg materials on sidewalls of the openings; and removing the sacrificial layer and the additional sacrificial layer to suspend the bolometer bridge structure and the leg materials above a substrate of the infrared imaging device.

3. claims: 34-43

A microbolometer (and manufacturing method), comprising a bridge having a sensor layer having a substantially planar portion and at least one additional portion that extends in a direction that is substantially perpendicular to the planar portion; and at least one leg disposed beneath a portion of the bridge, wherein the at least one additional portion of the sensor layer extends to and contacts a conductive layer of the at least one leg.
