

(43) International Publication Date
30 September 2010 (30.09.2010)(10) International Publication Number
WO 2010/109363 A3

(51) International Patent Classification:

G01N 33/00 (2006.01) G01N 29/024 (2006.01)
G01N 33/497 (2006.01) B06B 1/02 (2006.01)
G01N 29/02 (2006.01)

(21) International Application Number:

PCT/IB2010/051043

(22) International Filing Date:

10 March 2010 (10.03.2010)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

61/162,361 23 March 2009 (23.03.2009) US

(71) Applicant (for all designated States except US): **KONINKLIJKE PHILIPS ELECTRONICS, N.V.** [NL/NL]; High Tech Campus Building 44, NL-5656 AE Eindhoven (NL).

(71) Applicant (for AE only): **U.S. PHILIPS CORPORATION** [US/US]; 3000 Minuteman Road Building 1, MS 109, Andover, Massachusetts 01810 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **SCHELLEKENS, Martijn** [NL/NL]; High Tech Campus Building 44, NL-5656 AE Eindhoven (NL). **KAHLMAN, Josephus, Arnoldus, Henricus, Maria** [NL/NL]; High Tech Campus Building 44, NL-5656 AE Eindhoven (NL). **VAN DER MARK, Martinus, Bernardus** [NL/NL]; High

Tech Campus Building 44, NL-5656 AE Eindhoven (NL). **DIRKSEN, Peter** [NL/NL]; High Tech Campus Building 44, NL-5656 AE Eindhoven (NL). **VAN KESTEREN, Hans, Willem** [NL/NL]; High Tech Campus Building 44, NL-5656 AE Eindhoven (NL).

(74) Agent: **DAMEN, Daniel, M.**; Philips Intellectual Property & Standards, High Tech Campus 44, P.O. Box 220, NL-5600 AE Eindhoven (NL).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: GAS SENSING USING ULTRASOUND

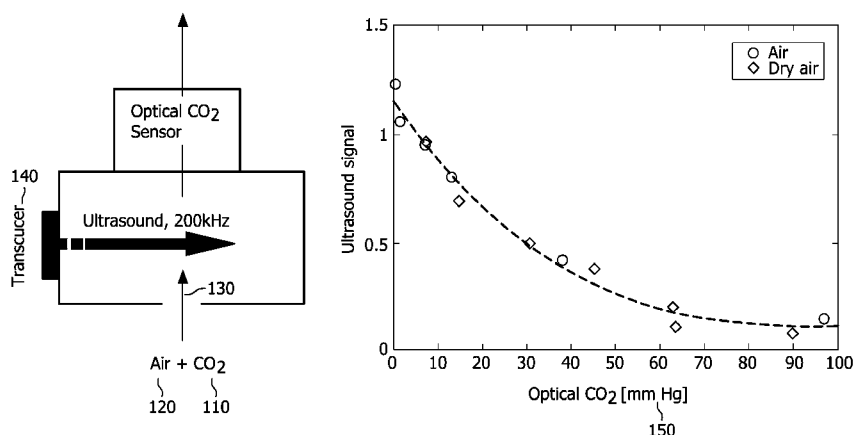


FIG. 1

(57) Abstract: A sensor chip (1030) for gas has cells (200) for emitting and receiving ultrasound and is configured for a sufficiently large frequency range and for measuring concentration of at least one of the gas components based on at least two responses within the range. The frequency range can be achieved by varying the size of cell membranes (230), varying bias voltages, and/or varying air pressure for an array (205) of cMUTs or MEMS microphones. The sensor chip can be applied in, for example, capnography. A measurement air chamber (515) is implemented in the respiratory pathway (400), and it and/or the pathway may be designed to reduce turbulence in the exhaled breath (120) subject to ultrasound interrogation. The chip (1030) can be implemented as self-contained in the monitoring of parameters, obviating the need for off-chip sensors.

**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))*
- *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))*

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

18 November 2010

Published:

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

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2010/051043

A. CLASSIFICATION OF SUBJECT MATTER

INV. G01N33/00 G01N33/497 G01N29/02 G01N29/024 B06B1/02

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)

G01N B06B

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 practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 3 981 176 A (JACOBS JOHN E) 21 September 1976 (1976-09-21)	25
A	column 3, line 63 - column 4, line 2	1-18,26
X	US 2005/146247 A1 (FISHER RAYETTE A [US] ET AL FISHER RAYETTE A [US] ET AL) 7 July 2005 (2005-07-07)	1-18,26
Y	paragraph [0001] paragraph [0038]	25
X	US 5 982 709 A (LADABAUM IGAL [US] ET AL) 9 November 1999 (1999-11-09)	1-18,26
A	column 3, line 5 - line 9	25
X	US 2005/075572 A1 (MILLS DAVID M [US] ET AL) 7 April 2005 (2005-04-07)	1-18,26
A	paragraph [0035]	25
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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 document but published on or after the international filing date

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"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

12 July 2010

Date of mailing of the international search report

14/09/2010

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

Baranski, Jörg

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2010/051043

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2007/164631 A1 (ADACHI HIDEO [JP] ET AL) 19 July 2007 (2007-07-19)	1-18,26
A	paragraph [0035] paragraph [0090]; figures -----	25
A	US 2002/026937 A1 (MAULT JAMES R [US]) 7 March 2002 (2002-03-07) paragraph [0068] figures -----	1-18,25, 26
A	PARK K ET AL: "Capacitive micromachined ultrasonic transducers for chemical detection in nitrogen" APPLIED PHYSICS LETTERS, AIP, AMERICAN INSTITUTE OF PHYSICS, MELVILLE, NY, US LNKD- DOI:10.1063/1.2776348, vol. 91, no. 9, 28 August 2007 (2007-08-28), pages 94102-94102, XP012100971 ISSN: 0003-6951 pages 094102-2, left-hand column, paragraph 3 - right-hand column, paragraph 1 -----	1-18,25, 26

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2010/051043

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.:

1-18, 25, 26

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: 1-18, 25, 26

sensor array chip for ultrasonic gas sensor, multiple frequencies

2. claims: 19-24

plurality of ultrasonic transducers for an ultrasonic gas sensor in a measurement air chamber, reynolds number smaller than 2400

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2010/051043

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
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US 2007164631	A1	19-07-2007	EP 1779784 A1 WO 2005120355 A1	02-05-2007 22-12-2005
US 2002026937	A1	07-03-2002	NONE	