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

(54) Title: BANDLIMITING ANTI-NOISE IN PERSONAL AUDIO DEVICES HAVING ADAPTIVE NOISE CANCELLATION (ANC)

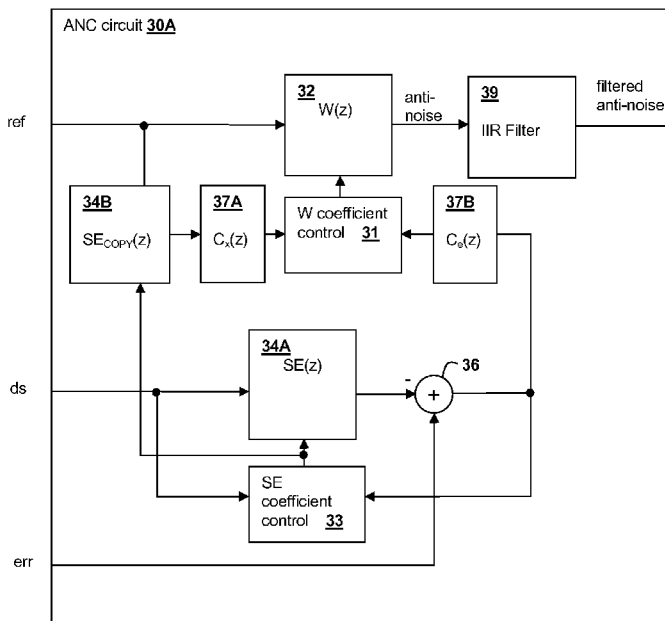


Fig. 3A

(57) Abstract: A personal audio device, such as a wireless telephone, includes noise canceling circuit that adaptively generates an anti-noise signal from a reference microphone signal (ref) and injects the anti-noise signal into the speaker or other transducer output to cause cancellation of ambient audio sounds. An error microphone (err) may also be provided proximate the speaker to measure the output of the transducer in order to control the adaptation of the anti-noise signal and to estimate an electro-acoustical path from the noise canceling circuit through the transducer. A processing circuit (30A) that performs the adaptive noise canceling function also either adjusts (37A) the frequency response of the anti-noise signal with respect to the reference microphone signal, and/or by adjusting (39) the response of the adaptive filter independent of the adaptation provided by the reference microphone signal.

WO 2012/166388 A3



**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:**  
1 August 2013

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

**INTERNATIONAL SEARCH REPORT**

International application No  
PCT/US2012/038512

A. CLASSIFICATION OF SUBJECT MATTER  
INV. G10K11/178  
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)  
G10K

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 2010/014683 A1 (MAEDA TSUYOSHI [JP] ET AL) 21 January 2010 (2010-01-21)  abstract; figures 3A,4,9 paragraphs [0037], [0039], [0082] - [0086]  -----	1,2,11, 12,21, 22,29, 33,37
X	US 2010/166203 A1 (PEISSIG JUERGEN [DE] ET AL) 1 July 2010 (2010-07-01)  abstract; figures 1,4 paragraphs [0004] - [0006], [0024] - [0027], [0031], [0037], [0038], [0040]  -----  -/--	1-4, 9-14, 19-24

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	"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
"E" earlier application or patent but published on or after the international filing date	"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
"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)	"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
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search  4 April 2013	Date of mailing of the international search report  20/06/2013
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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  de Jong, Frank
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# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US2012/038512

## 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.:

1-4, 9-14, 19-24, 29, 33, 37

### 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: 1-4, 9-14, 19-24, 29, 33, 37

Active noise reduction system with adaptive feedforward control and an additional first filter, wherein a second filter prevents the adaptive filter from trying to compensate for frequencies that it cannot control

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2. claims: 5-8, 15-18, 25-28

Active noise reduction system with adaptive feedforward control and an additional first filter, wherein certain problem frequencies are removed from the anti-noise signal

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3. claims: 30, 34, 38

Active noise reduction system with adaptive feedforward control, wherein the adaptive filter is split in two portions, the second portion having a leakage characteristic

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4. claims: 31, 32, 35, 36, 39, 40

Active noise reduction system with adaptive feedforward control, wherein the response of the adaptive filter is adjusted by injecting noise

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5. claims: 41-43

Active noise reduction system with adaptive feedforward control, wherein the adaptive filter has a fixed frequency response and an adjustable gain

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## INTERNATIONAL SEARCH REPORT

International application No  
PCT/US2012/038512

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	<p>US 2010/014685 A1 (WURM MICHAEL [DE]) 21 January 2010 (2010-01-21)</p> <p>abstract; figures 4B,11,12 paragraphs [0006], [0079], [0085], [0124], [0125], [0131]</p> <p>-----</p>	<p>1-4, 10-14, 20-24</p>
X	<p>US 5 815 582 A (CLAYBAUGH DAVID [US] ET AL) 29 September 1998 (1998-09-29)</p> <p>abstract; figure 2 column 2, lines 29-32, 57-65 column 3, lines 7-11,24-26</p> <p>-----</p>	<p>1,11,21</p>

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2012/038512

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2010014683	A1	21-01-2010	JP 2010023534 A
			US 2010014683 A1
			04-02-2010
			21-01-2010
-----			
US 2010166203	A1	01-07-2010	CN 101653014 A
			DE 102007013719 A1
			EP 2138007 A2
			US 2010166203 A1
			WO 2008113822 A2
			17-02-2010
			25-09-2008
			30-12-2009
			01-07-2010
			25-09-2008
-----			
US 2010014685	A1	21-01-2010	EP 2133866 A1
			US 2010014685 A1
			16-12-2009
			21-01-2010
-----			
US 5815582	A	29-09-1998	NONE
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