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[Continued on next page]

(54) Title: AUDIO DEVICES HAVING ELECTROACTIVE POLYMER ACTUATORS

(57) Abstract: Sensory enhanced audio devices containing an electroactive polymer module are disclosed. The electroactive polymer module may be located in, for example, an ear cup of a headphone. The module includes an electroactive polymer actuator array having at least one e!astomeric dielectric element disposed between first and second electrodes. A tray may be configured to receive the electroactive polymer actuator array and a mass coupled to the actuator array. A circuit is electrically coupled to the electroactive polymer actuator array. The circuit is to generate a drive signal to cause the electroactive polymer actuator array to move according to the drive signal. The drive signal is preferably in the frequency range of about 2 Hz to about 200 Hz.

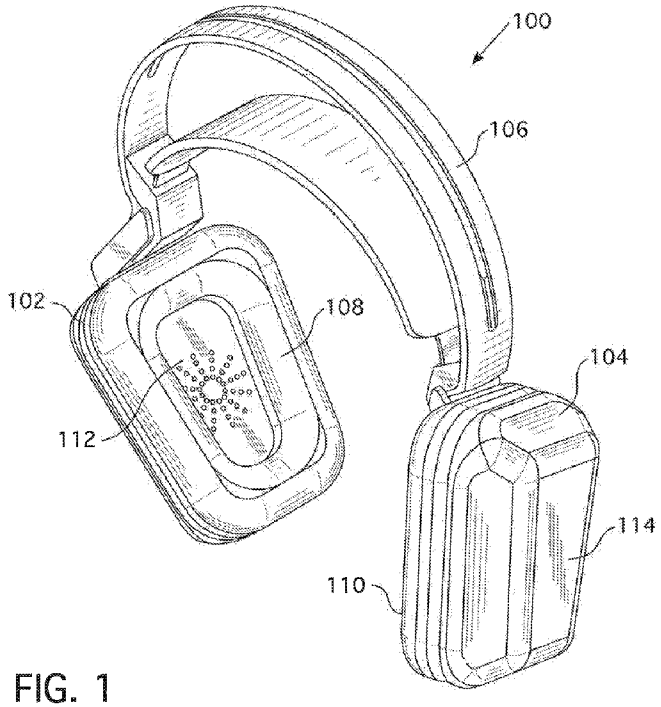

FIG. 1

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LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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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25 April 2013

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2012/026421

A. CLASSIFICATION OF SUBJECT MATTER

H04R 9/02(2006.01)i, H04R 1/10(2006.01)i

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)

H04R 9/02; H04R 25/00; G10K 11/16; H04R 1/24; H04R 9/06; G10K 11/36; H04R 1/10; H04R 5/033; H04R 7/04; H04R 1/20

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

Korean utility models and applications for utility models
Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) & Keywords: sensory enhanced audio deivce, circuit, actuator, electroactive, polymer, drive signal, audio signal, headphone, earphone, mechanical Q factor

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2010-0061582 A1 (TAKIGAWA SOUICHI et al.) 11 March 2010 See paragraphs [0045]-[0061],[0065],[0066],[0137],[0142],[0145] and figures 1-3B.	1-3
Y	US 04829581 A (NIEUWENDIJK; JORIS A. M. et al.) 09 May 1989 See column 3, lines 4-21, column 6, lines 12-51, and figures 1-5b.	1-3
A	US 2009-0226018 A1 (NIELSEN KARSTEN et al.) 10 September 2009 See abstract, paragraphs [0072]-[0080], claim 1 and figures 14-17.	1-3
A	US 2009-0003616 A1 (KLEINSCHMIDT DAVID et al.) 01 January 2009 See abstract, claim 1, and figures 1-5.	1-3
A	EP 2160046 A1 (AKG ACOUSTICS GMBH) 03 March 2010 See paragraphs [0015]-[0020], claim 1, and figures 1-5.	1-3

☐ 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 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	Date of mailing of the international search report
14 FEBRUARY 2013 (14.02.2013)	**18 FEBRUARY 2013 (18.02.2013)**

Name and mailing address of the ISA/KR
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2012/026421

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2010-0061582 A1	11.03.2010	CN 101674509 A	17.03.2010
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		US 2011-0211709 A1	01.09.2011
		WO 2010-022429 A1	04.03.2010

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2012/026421

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.: 10-13, 16
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:

Claims 4-9, 14-15, 17 do not comply with PCT Rule 6.4(a) because multiple dependent claims should not serve as a basis for any other multiple dependent claim. Lack of clairty of the claims arise as a whole, so the dependant claim 10-13, 16 make it difficult to determine the matter for which protection is sought.

3. ☒ Claims Nos.: 4-9, 14-15, 17
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:

1. ☐ As all required addtional 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 fee, this Authority did not invite payment of any additional fee.

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.