



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
[www.uspto.gov](http://www.uspto.gov)

| APPLICATION NO. | ISSUE DATE | PATENT NO. | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|-----------------|------------|------------|---------------------|------------------|
| 13/959,708      | 09/14/2021 | 11122357   | 122174-10134        | 5622             |

21125 7590 08/25/2021  
NUTTER MCCLENNEN & FISH LLP  
SEAPORT WEST  
155 SEAPORT BOULEVARD  
BOSTON, MA 02210-2604

## ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

### **Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)** (application filed on or after May 29, 2000)

The Patent Term Adjustment is 0 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (<http://pair.uspto.gov>).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site <http://pair.uspto.gov> for additional applicants):

Gregory C. Burnett, Dodge Center, MN;  
Jawbone Innovations, LLC, Marshall, TX;

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The USA offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to encourage and facilitate business investment. To learn more about why the USA is the best country in the world to develop technology, manufacture products, and grow your business, visit [SelectUSA.gov](http://SelectUSA.gov).

Best Available Copy

## PART B-FEE(S) TRANSMITTAL

Complete and send this form, together with the applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

By fax, send to: (571) 273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

21125 7590 08/02/2021  
NUTTER MCCLENNEN & FISH LLP  
Seaport West  
155 Seaport Boulevard  
Boston, Massachusetts 02210-2604



Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

## Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

|                               |                         |
|-------------------------------|-------------------------|
| Jeffrey T. Klayman            | (Typed or printed name) |
| /Jeffrey T. Klayman, #39,250/ | (Signature)             |
| August 12, 2021               | (Date)                  |

| APPLICATION NO | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO | CONFIRMATION NO |
|----------------|-------------|----------------------|--------------------|-----------------|
| 13/959,708     | 08/05/2013  | Gregory C. Burnett   | 122174-10134       | 5622            |

TITLE OF INVENTION: FORMING VIRTUAL MICROPHONE ARRAYS USING DUAL OMNIDIRECTIONAL MICROPHONE ARRAY (DOMA)

| APPLN. TYPE    | ENTITY STATUS | ISSUE FEE DUE | PUBLICATION FEE DUE | PREV. PAID ISSUE FEE | TOTAL FEE(S) DUE | DATE DUE   |
|----------------|---------------|---------------|---------------------|----------------------|------------------|------------|
| nonprovisional | SMALL         | \$600         | \$0.00              | \$480.00             | \$120            | 11/02/2021 |

| EXAMINER                 | ART UNIT | CLASS-SUBCLASS |
|--------------------------|----------|----------------|
| PIZZARO CRESPO, MARCOS D | 2814     | 381-092000     |

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363)

- ☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.  
☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. Use of a Customer Number is required.

2. For printing on the patent front page, list

- (1) The names of up to 3 registered patent attorneys or agents OR, alternatively,  
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1. Nutter McClennen & Fish LLP

2.  
3.

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

Jawbone Innovations, LLC

(B) RESIDENCE: (CITY and STATE or COUNTRY)

Marshall, Texas

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. Fees Submitted: ☒ Issue Fee ☐ Publication Fee (if required) ☐ Advance Order - # of Copies \_\_\_\_\_

4b. Method of Payment (Please first reapply any previously paid fee shown above):

☒ Electronic Payment via EFS-Web ☐ Enclosed check ☐ Non-electronic payment by credit card (Attach form PTO-2038)

☒ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. 141449

5. Change of Entity Status (from status indicated above)

- ☐ Applicant certifying micro entity status. See 37 CFR 1.29.  
☐ Applicant asserting small entity status. See 37 CFR 1.27.  
☐ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid Certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.  
NOTE: If the application was previously under micro entity status, checking this box will be taken as a notification of loss of entitlement to micro entity status.  
NOTE: Checking this box will be taken as a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature

/Jeffrey T. Klayman, #39,250/

Date August 12, 2021

Typed or printed name

Jeffrey T. Klayman

Registration No.

39,250



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## NOTICE OF ALLOWANCE AND FEE(S) DUE

21125 7590 08/02/2021  
NUTTER MCCLENNEN & FISH LLP  
SEAPORT WEST  
155 SEAPORT BOULEVARD  
BOSTON, MA 02210-2604

EXAMINER  
PIZARRO CRESPO, MARCOS D

ART UNIT PAPER NUMBER  
2814

DATE MAILED: 08/02/2021

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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|----------------|---------------|---------------|---------------------|----------------------|------------------|------------|
| nonprovisional | SMALL         | \$600         | \$0.00              | \$480.00             | \$120            | 11/02/2021 |

**THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.**

**THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.**

### HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

**IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at [www.uspto.gov/PatentMaintenanceFees](http://www.uspto.gov/PatentMaintenanceFees).**

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|                         |
|-------------------------|
| (Typed or printed name) |
| (Signature)             |
| (Date)                  |

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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| PIZARRO CRESPO, MARCOS D | 2814     | 381-092000     |

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1 \_\_\_\_\_

2 \_\_\_\_\_

3 \_\_\_\_\_

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Authorized Signature \_\_\_\_\_

Date \_\_\_\_\_

Typed or printed name \_\_\_\_\_

Registration No. \_\_\_\_\_



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| APPLICATION NO.                                                                                                       | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO.                  | CONFIRMATION NO. |
|-----------------------------------------------------------------------------------------------------------------------|-------------|----------------------|--------------------------------------|------------------|
| 13/959,708                                                                                                            | 08/05/2013  | Gregory C. Burnett   | 122174-10134                         | 5622             |
| 21125 7590 08/02/2021<br>NUTTER MCLENNEN & FISH LLP<br>SEAPORT WEST<br>155 SEAPORT BOULEVARD<br>BOSTON, MA 02210-2604 |             |                      | EXAMINER<br>PIZARRO CRESPO, MARCOS D |                  |
|                                                                                                                       |             |                      | ART UNIT<br>2814                     | PAPER NUMBER     |
| DATE MAILED: 08/02/2021                                                                                               |             |                      |                                      |                  |

## Determination of Patent Term Adjustment under 35 U.S.C. 154 (b) (Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

## OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

### Privacy Act Statement

**The Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

|                               |                                      |                                            |                                |
|-------------------------------|--------------------------------------|--------------------------------------------|--------------------------------|
| <b>Notice of Allowability</b> | <b>Application No.</b><br>13/959,708 | <b>Applicant(s)</b><br>Burnett, Gregory C. |                                |
|                               | <b>Examiner</b><br>MARCOS D PIZARRO  | <b>Art Unit</b><br>2814                    | <b>AIA (FITF) Status</b><br>No |

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--**

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to the submission filed on 11/9/2020.  
☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on \_\_\_\_\_.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on \_\_\_\_\_; the restriction requirement and election have been incorporated into this action.

3. ☒ The allowed claim(s) is/are 2-21. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see [http://www.uspto.gov/patents/init\\_events/pph/index.jsp](http://www.uspto.gov/patents/init_events/pph/index.jsp) or send an inquiry to [PPHfeedback@uspto.gov](mailto:PPHfeedback@uspto.gov).

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

**Certified copies:**

a) ☐ All      b) ☐ Some      \*c) ☐ None of the:

1. ☐ Certified copies of the priority documents have been received.

2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.

3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

\* Certified copies not received: \_\_\_\_\_.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.  
**THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.**

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.  
☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date \_\_\_\_\_.

**Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).**

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

**Attachment(s)**

|                                                                                                                   |                                                                           |
|-------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|
| 1. <input type="checkbox"/> Notice of References Cited (PTO-892)                                                  | 5. <input checked="" type="checkbox"/> Examiner's Amendment/Comment       |
| 2. <input type="checkbox"/> Information Disclosure Statements (PTO/SB/08),<br>Paper No./Mail Date _____.          | 6. <input type="checkbox"/> Examiner's Statement of Reasons for Allowance |
| 3. <input type="checkbox"/> Examiner's Comment Regarding Requirement for Deposit<br>of Biological Material _____. | 7. <input type="checkbox"/> Other _____.                                  |
| 4. <input type="checkbox"/> Interview Summary (PTO-413),<br>Paper No./Mail Date. _____.                           |                                                                           |

|                                                        |  |
|--------------------------------------------------------|--|
| /Marcos D. Pizarro/<br>Primary Examiner, Art Unit 2814 |  |
|--------------------------------------------------------|--|

Attorney's Docket Number: ALI-050ACON1  
Filing Date: 8/5/2013  
Applicant: Burnett

Examiner: Marcos D. Pizarro

**Detailed Action / Examiner's Comment**

This Office action responds to the submission filed on 11/9/2020.

***Notice of Pre-AIA or AIA Status***

1. The present application is being examined under the pre-AIA first to invent provisions. In the event the determination of the status of the application as subject to pre-AIA is incorrect, any correction of the statutory basis for a rejection, as subject to AIA instead, will not be considered a new ground of rejection if the prior art relied upon, and the rationale supporting the rejection, would be the same under either status.

***Terminal Disclaimer***

2. The terminal disclaimers filed on 11/2/2015 disclaiming the terminal portion of any patent granted on this application, which would extend beyond the expiration date of U.S. Patent No. 8,494,177 and any patent issued on U.S. Application No. 13/948,160 has been reviewed and is accepted.

***Reasons for Allowance***

3. Claims 2-21 are allowed.

4. Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Allowance."

***Conclusion***

5. Papers related to this application may be submitted directly to Art Unit 2814 by facsimile transmission. The faxing of such papers must conform with the notice published in the Official Gazette, 1096 OG 30 (15 November 1989). The Art Unit 2814 Fax Center number is (571) 273-8300. The Art Unit 2814 Fax Center is to be used only for papers related to Art Unit 2814 applications.

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Marcos D. Pizarro at (571) 272-1716 and between the hours of 7:00 AM to 3:00 PM (Eastern Standard Time) Monday through Friday or by e-mail via Marcos.Pizarro@USPTO.gov. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy, can be reached on 571-272-1705. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either private PAIR or public PAIR. Status information for unpublished applications is available through private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

/Marcos D. Pizarro/  
Primary Examiner, Art Unit 2814

MP/mp  
26 July 2021



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
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| APPLICATION NO.                                              | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO.                  | CONFIRMATION NO.            |
|--------------------------------------------------------------|-------------|----------------------|--------------------------------------|-----------------------------|
| 13/959,708                                                   | 08/05/2013  | Gregory C. Burnett   | 2064-0001                            | 5622                        |
| 150413                                                       | 7590        | 07/13/2021           |                                      |                             |
| Hard IP LLC (JAWB)<br>48 Speir Dr.<br>South Orange, NJ 07079 |             |                      | EXAMINER<br>PIZARRO CRESPO, MARCOS D |                             |
|                                                              |             |                      | ART UNIT<br>2814                     | PAPER NUMBER                |
|                                                              |             |                      | NOTIFICATION DATE<br>07/13/2021      | DELIVERY MODE<br>ELECTRONIC |

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

USPTO@dockettrak.com  
ip@remotedocket.com  
kinza@hard-ip.net



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In re Application of :  
Burnett, Gregory, C. :  
Application No. 13/959,708 :  
Filed: August 5, 2013 : DECISION GRANTING PETITION  
Attorney Docket NO. 2064-0001 : UNDER 37 CFR 1.313(c)(2)  
For: FORMING VIRTUAL :  
MICROPHONE ARRAYS USING DUAL :  
OMNIDIRECTIONAL MICROPHONE :  
ARRAY (DOMA) :

This is a decision on the petition under 37 CFR 1.313(c)(2), filed November 9, 2020, to withdraw the above-identified application from issue after payment of the issue fee.

The petition is **GRANTED**.

The above-identified application is withdrawn from issue for consideration of a submission under 37 CFR 1.114 (request for continued examination). *See* 37 CFR 1.313(c)(2).

***Petitioner is advised that the issue fee paid on August 10, 2020 cannot be refunded. If, however, this application is again allowed, petitioner may request that it be applied towards the issue fee required by the new Notice of Allowance.<sup>1</sup>***

This application is being referred to Technology Center Art Unit 2814 for processing of the request for continued examination under 37 CFR 1.114 and for consideration of the request to change applicant's name by way of application data sheet (ADS) filed and the substitute statement in lieu of the inventor's oath or declaration.

Telephone inquiries regarding this decision should be directed to undersigned at (571) 272-1642.

---

<sup>1</sup> The request to apply the issue fee to the new Notice may be satisfied by completing and returning the new Part B – Fee(s) Transmittal Form (along with any balance due at the time of submission). Petitioner is advised that the Issue Fee Transmittal Form **must** be completed and timely submitted to avoid abandonment of the application.

All other inquiries regarding the examination of this application should be directed to the Technology Center at their customer service line (571) 272-2815.

/April M. Wise/  
Paralegal Specialist, Office of Petitions



# UNITED STATES PATENT AND TRADEMARK OFFICE

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Alexandria, Virginia 22313-1450  
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| APPLICATION NO.        | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO.      | CONFIRMATION NO. |
|------------------------|-------------|----------------------|--------------------------|------------------|
| 13/959,708             | 08/05/2013  | Gregory C. Burnett   | 2064-0001                | 5622             |
| 150413                 | 7590        | 06/15/2021           | EXAMINER                 |                  |
| Hard IP LLC (JAWB)     |             |                      | PIZARRO CRESPO, MARCOS D |                  |
| 48 Speir Dr.           |             |                      |                          |                  |
| South Orange, NJ 07079 |             |                      |                          |                  |
|                        |             |                      | ART UNIT                 | PAPER NUMBER     |
|                        |             |                      | 2814                     |                  |
|                        |             |                      | NOTIFICATION DATE        | DELIVERY MODE    |
|                        |             |                      | 06/15/2021               | ELECTRONIC       |

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

USPTO@dockettrak.com  
ip@remotedocket.com  
kinza@hard-ip.net



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Alexandria, VA 22313-1450  
[www.uspto.gov](http://www.uspto.gov)

In re Application of :  
Burnett, Gregory, C. :  
Application No. 13/959,708 : DECISION ON PETITION  
Filed: 5 Aug 2013 :  
Attorney Dkt. No.: 2064-0001 :

The above-identified application has been directed to the Office of Petitions for consideration of the petition to revive under 37 CFR 1.137(a), filed March 30, 2021.

The application became abandoned February 22, 2017 for to timely submit an executed oath or declaration for each inventor on or prior to submission of the issue fee in accordance with 37 CFR 1.53(f)(3)(H). Notice of Abandonment was mailed March 10, 2017.

A grantable petition pursuant to 37 C.F.R. § 1.137(a) must be accompanied by: (1) the required reply to the outstanding Office action or notice, unless previously filed; (2) the petition fee as set forth in 37 C.F.R. § 1.17(m); (3) a statement that the entire delay in filing the required reply from the due date for the reply until the filing of a grantable petition pursuant to 37 C.F.R. § 1.137(b) was unintentional; and (4) any terminal disclaimer (and fee set forth in 37 C.F.R. § 1.20(d)) required pursuant to 37 C.F.R. § 1.137(c).

The instant petition has been carefully considered and found in compliance with the requirements above. The required reply has been submitted. Receipt is acknowledged of the required petition fee. Lastly, a proper statement and explanation of unintentional delay have been submitted.

In view thereof, the petition to revive under 37 CFR 1.137(a) is hereby **GRANTED**.

Telephone inquiries concerning this matter may be directed to the undersigned at (571) 272-3205.

/ALESIA M. BROWN/

Alesia M. Brown  
Attorney Advisor  
Office of Petitions

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

Inventor(s): Gregory C. Burnett

Application No.: 13/959,708

Filed: 08-05-2013

Title: FORMING VIRTUAL MICROPHONE  
ARRAYS USING DUAL  
OMNIDIRECTIONAL MICROPHONE  
ARRAY (DOMA)

Confirmation No.: 5622

Examiner: PIZARRO CRESPO, MARCOS D.

Group Art Unit: 2814

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

**RENEWED PETITION UNDER 37 CFR 1.137(A)**

Sir:

In response to the Decision on Petition mailed December 31, 2020 (hereinafter “Decision”), this renewed petition under 37 CFR 1.137(a) is respectfully submitted.

The Decision states:

A grantable petition under 37 CFR 1.137(a) must be accompanied by ... (3) a statement that the entire delay in filing the required reply from the due date for the reply until the filing of a grantable petition pursuant to 37 CFR 1.137(a) was unintentional ... See, MPEP 711.03(c)(II)(C) and (D) ...

The USPTO requires additional information concerning whether a delay in seeking the revival of an abandoned application was unintentional where the petition to revive was filed more than two years after the date the application became abandoned ... Therefore, additional information that provides an explanation of the circumstances surrounding the delay that establishes the entire delay was unintentional is required.

The USPTO is concerned with three periods of delay. Petitioner is reminded the burden of proof to establish that the delay from the due date for the reply until the filing of a grantable petition was unintentional within the meaning of 35 U.S.C. 27 and 37 CFR 1.137 rests with the petitioner. See, MPEP 711.03(c)(II)(F).

The first period of delay petitioner must address on renewed petition is the delay in filing the reply that originally resulted in the abandonment of this application. Petitioner must explain the delay between when the reply was due and when the reply was filed.

The second period of delay petitioner must address on renewed petition is the delay in filing the initial petition pursuant to 37 CFR 1.137(a). Petitioner must explain why this petition was not filed until August 10, 2020. It is noted that the record fails to reflect that petitioners herein timely sought further consideration of the matter of abandonment subsequent to the mailing of the petition decision mailed February 12, 2019 until August 10, 2020.

The third period of delay petitioner must address on renewed petition is the delay in filing a grantable petition pursuant to 37 CFR 1.137(a).  
(Decision, pgs. 1-2)

Submitted herewith are affidavits of Michael Luna (“Luna affidavit”) and Daniel Setton (“Setton affidavit”). The Luna and Setton affidavits provide details regarding any delays. Specifically, the Luna affidavit states that the above-referenced patent application originally went abandoned on February 22, 2017 due to unavailable funds. The Luna affidavit further states that the original assignee ALIPHCOM (based on the assignment from the inventor to ALIPHCOM that was recorded with the USPTO’s assignment branch and accorded reel/frame no. 035352/0324) “was shut down and an assignment for the benefit of creditors was initiated in June 2017,” (Luna affidavit, pg. 1).

The Setton affidavit states that JAWB ACQUISITION LLC is the current assignee (the assignment from ALIPHCOM (ASSIGNMENT FOR THE BENEFIT OF CREDITORS), LLC to JAWB ACQUISITION LLC was recorded with the USPTO’s assignment branch and accorded reel/frame no. 043746/0693). The Setton affidavit further provides details regarding “the second period of delay” mentioned above.

With respect to “the third period of delay” mentioned above, the following details are provided. It is respectfully submitted that the Decision was mailed on December 31, 2020. On January 15, 2021, I received Michael Luna’s signed affidavit.

After receiving that affidavit, I made attempts to obtain another affidavit from an officer at JAWB ACQUISITION LLC detailing the events that happened after Michael Luna was no longer involved. Ultimately, I obtained the affidavit of Daniel Setton who is the CEO of JAWB ACQUISITION LLC. The Setton affidavit was executed on March 29, 2021. Thus, it is respectfully submitted that the third period’s delay detailed above was unintentional.

As detailed in the Luna and Setton affidavits and in view of the information provided above, it is respectfully submitted that the delay in filing the required reply from the due date for the reply until the filing of a grantable petition pursuant to 37 CFR 1.137(a) is unintentional.

The petition to revive fee (code 2453) amounting to \$1000 for a small-entity was previously submitted. If, however, additional fees are required, the Commissioner is

hereby authorized to charge any additional fees or credit any overpayment to Deposit Account 60-0366.

Date: March 30, 2021

Respectfully submitted,

Hard IP LLC

/Kinza Hecht/

Kinza Hecht

Patent Agent

Reg. No. 62,325

Phone No.: 212 321 0598

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

Inventor(s): Gregory C. Burnett

Application No.: 13/959,708

Filed: 08-05-2013

Title: FORMING VIRTUAL MICROPHONE  
ARRAYS USING DUAL  
OMNIDIRECTIONAL MICROPHONE  
ARRAY (DOMA)

Confirmation No.: 5622

Examiner: PIZARRO CRESPO, MARCOS D.

Group Art Unit: 2814

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

**AFFIDAVIT**

Dear Sir:

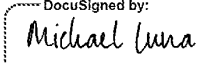
I, Michael Luna, hereby declare:

1. I am over eighteen (18) years of age, and have personal knowledge of the facts stated herein.
2. The above-identified patent application was originally owned by ALIPHCOM.
3. An assignment from the inventor to ALIPHCOM was recorded on April 7, 2015 with the United States Patent and Trademark Office (USPTO) and accorded reel/frame number: 035352/0324.
4. I was the Chief Technology Officer (CTO) of ALIPHCOM from December 2007 until it was shut down and an assignment for the benefit of creditors was initiated in June 2017. During my tenure I was responsible for management of ALIPHCOM's intellectual property portfolio.

5. Kokka and Backus, LLC was the law firm tasked with handling our patent portfolio including the above-identified patent application.
6. Between 2015 and 2017 ALIPHCOM suffered funding/financial issues.
7. I instructed Kokka and Backus, LLC and CPA Global to employ procedures to ensure that patent applications (including the above-identified application) were, on a timely basis, diligently prosecuted and that fees were paid. Such procedures continued until funds were no longer available to ALIPHCOM to pay Kokka and Backus, LLC and CPA Global for their fees.
8. As a result, on February 22, 2017, the above-identified patent application went abandoned.
9. At no point did I intend to allow the above-referenced patent application to go abandoned.
10. On information and belief, these statements are believed to be true; and these statements are made with knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Respectfully submitted,

Dated: 1/15/2021 | 15:41 PST

DocuSigned by:  
  
\_\_\_\_\_  
Michael Luna

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

Inventor(s): Gregory C. Burnett

Application No.: 13/959,708

Filed: 08-05-2013

Title: FORMING VIRTUAL MICROPHONE  
ARRAYS USING DUAL  
OMNIDIRECTIONAL MICROPHONE  
ARRAY (DOMA)

Confirmation No.: 5622

Examiner: PIZARRO CRESPO, MARCOS D.

Group Art Unit: 2814

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

**AFFIDAVIT**

Dear Sir:

I, Daniel Setton, hereby declare:

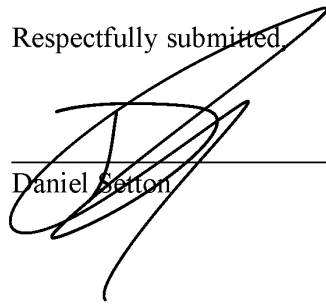
1. I am over eighteen (18) years of age, and have personal knowledge of the facts stated herein.
2. An assignment from the sole inventor to ALIPHCOM was recorded on April 7, 2015 with the United States Patent and Trademark Office (USPTO) and accorded reel/frame number: 035352/0324.
3. An assignment from ALIPHCOM to ALIPHCOM (assignment for the benefit of credits), LLC was recorded on August 29, 2017 with the USPTO and accorded reel/frame number: 043711/0001.
4. An assignment from ALIPHCOM (assignment for the benefit of credits), LLC to JAWB ACQUISITION LLC was recorded on September 1, 2017 with the USPTO and accorded reel/frame number: 043746/0693.

5. I became the CEO of JAWB ACQUISITION LLC around July 2017. As CEO, I am responsible for management of JAWB ACQUISITION LLC's intellectual property portfolio.
6. I became aware that the above-referenced patent application went abandoned around Q2 2018.
7. I had engaged CSC Global and the following law firms to assess JAWB ACQUISITION LLC's very robust patent portfolio: Envision IP, Dallal Firm and Myers Wolin. I had tasked Envision IP to handle JAWB ACQUISITION LLC's patent portfolio and to revive various abandoned patent applications including the above-identified patent application.
8. I retained Envision IP around Q2 of 2018 and instructed Envision IP to revive various abandoned patent applications including the above-identified patent application around Q4/2018 to Q1/2019.
9. However, the above-identified patent application was not revived, and the inventor's oath/declaration document was not filed.
10. In February of 2019, I instructed Myers and Wolin to retain power of attorney for the above-referenced patent application. However, accordingly to the file history of the above-referenced patent application, it appears that the request to obtain power of attorney was denied on April 17, 2019.
11. On June 3, 2020, I retained Hard IP LLC to revive the above-referenced patent application.

12. After making efforts to obtain the inventor's signature for the declaration document, Hard IP LLC filed either a substitute statements for the inventor in August of 2020. Hard IP LLC filed a petition to revive the abandoned application on August 10, 2020.
13. The petition to revive was dismissed on December 31, 2020. I am filing this affidavit to detail the timeline of events.
14. At no point did I intend to allow the above-referenced patent application to stay abandoned. It was my intention to revive the above-identified application.
15. On information and belief, these statements are believed to be true; and these statements are made with knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Respectfully submitted,

Dated: March 29, 2021

  
\_\_\_\_\_  
Daniel Setton



# UNITED STATES PATENT AND TRADEMARK OFFICE

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| APPLICATION NO.                                              | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO.                  | CONFIRMATION NO.            |
|--------------------------------------------------------------|-------------|----------------------|--------------------------------------|-----------------------------|
| 13/959,708                                                   | 08/05/2013  | Gregory C. Burnett   | 2064-0001                            | 5622                        |
| 150413                                                       | 7590        | 12/31/2020           |                                      |                             |
| Hard IP LLC (JAWB)<br>48 Speir Dr.<br>South Orange, NJ 07079 |             |                      | EXAMINER<br>PIZARRO CRESPO, MARCOS D |                             |
|                                                              |             |                      | ART UNIT<br>2814                     | PAPER NUMBER                |
|                                                              |             |                      | NOTIFICATION DATE<br>12/31/2020      | DELIVERY MODE<br>ELECTRONIC |

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

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ip@remotedocket.com  
kinza@hard-ip.net



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[www.uspto.gov](http://www.uspto.gov)

In re Application of :  
Burnett, Gregory, C. :  
Application No. 13/959,708 :  
Filed: 5 Aug 2013 : DECISION ON PETITION  
For: FORMING VIRTUAL :  
MICROPHONE ARRAYS USING DUAL :  
OMNIDIRECTIONAL MICROPHONE :  
ARRAY (DOMA) :

The above-identified application has been directed to the Office of Petitions for consideration of the petition to revive under 37 CFR 1.137(a), filed November 9, 2020.

The application became abandoned February 22, 2017 for to timely submit an executed oath or declaration for each inventor on or prior to submission of the issue fee in accordance with 37 CFR 1.53(f)(3)(ii). Notice of Abandonment was mailed March 10, 2017.

A grantable petition under 37 CFR 1.137(a) must be accompanied by: (1) the required reply, unless previously filed; (2) required the petition fee; (3) a statement that the entire delay in filing the required reply from the due date for the reply until the filing of a grantable petition pursuant to 37 CFR 1.137(a) was unintentional; and (4) any terminal disclaimer (and fee as set forth in 37 CFR 1.20(d)) required by 37 CFR 1.137(d). Where there is a question as to whether either the abandonment or the delay in filing a petition under 37 CFR 1.137 was unintentional, the Director may require additional information. See, MPEP 711.03(c)(II)(C) and (D).

Further consideration of the petition to revive reflects that the instant petition fails to satisfy requirement (3) set forth above as the petition does not satisfy 37 CFR 1.137(b)(4). Petitioner submitted the required statement of unintentional delay. However, this petition to revive the abandoned application under 37 CFR 1.137(a) was filed more than two years after the date of abandonment.

The statement accompanying the instant petition is insufficient to establish that the entire period of time, from the time that a reply to the Notice was due until the filing of a grantable petition, was unintentional.

The USPTO requires additional information concerning whether a delay in seeking the revival of an abandoned application was unintentional where the petition to revive was filed more than two

years after the date the application became abandoned. See, Clarification of the Practice for Requiring Additional Information in Petitions Filed in Patent Applications and Patents Based on Unintentional Delay, 85 FR 12222 (March 2, 2020). Therefore, additional information that provides an explanation of the circumstances surrounding the delay that establishes the entire delay was unintentional is required.

The USPTO is concerned with three periods of delay. Petitioner is reminded the burden of proof to establish that the delay from the due date for the reply until the filing of a grantable petition was unintentional within the meaning of 35 U.S.C. 27 and 37 CFR 1.137 rests with the petitioner. See, MPEP 711.03(c)(II)(F).

The first period of delay petitioner must address on renewed petition is the delay in filing the reply that originally resulted in the abandonment of this application. Petitioner must explain the delay between when the reply was due and when the reply was filed.

The second period of delay petitioner must address on renewed petition is the delay in filing the initial petition pursuant to 37 CFR 1.137(a). Petitioner must explain why the petition was not filed until August 10, 2020. It is noted that the record fails to reflect that petitioners herein timely sought further consideration of the matter of abandonment subsequent to the mailing of the petition decision mailed February 12, 2019 until August 10, 2020.

The third period of delay petitioner must address on renewed petition is the delay in filing a *grantable* petition pursuant to 37 CFR 1.137(a).

When addressing each of these three periods of delay, petitioner is reminded that where the petitioner deliberately permits an application to become abandoned (*e.g.*, due to a conclusion the claims are unpatentable, a rejection in an Office action cannot be overcome, or the invention lacks sufficient commercial value to justify continued prosecution), the abandonment of such application is considered to be a deliberately chosen course of action, and the resulting delay cannot be considered as “unintentional” within the meaning of 37 CFR 1.137. See, In re Application of G, 11 USPQ2d 1378, 1380 (Comm’r Pat. 1989). Similarly, an intentional course of action is not rendered unintentional when, upon reconsideration, the applicant changes his or her mind as to the course of action that should have been taken. See, In re Maldague, 10 USPQ2d 1477, 1478 (Comm’r Pat. 1988). Petitioner’s failure to carry the burden of proof to establish that the “entire” delay was “unintentional” may lead to the denial of a petition under 37 CFR 1.137, regardless of the circumstances that originally resulted in the abandonment of the application.

Petitioner should note that the party whose delay is relevant is the party having the right or authority to file the response in the above identified application. When the applicant assigns the entire right, title, and interest in an invention to a third party (and thus does not retain any legal or equitable interest in the invention), the applicant’s delay is irrelevant in evaluating whether the delay was unintentional. See, Kim v. Quigg, 718 F. Supp. 1280, 1284, 12 USPQ2d 1604, 1607-08 (E.D. Va. 1989). See, MPEP 711.03(c)(II)(C)-(F) for additional guidance on the information required to establish that the entire delay was unintentional.

Please note that a renewed petition fee is not required to seek reconsideration of this decision.

Accordingly, the petition is **DISMISSED**.

Any request for reconsideration of this decision must be submitted within **TWO (2) MONTHS** from mail date of this decision. Extensions of time under 37 CFR 1.136(a) are permitted. The reconsideration request should include a cover letter entitled "Renewed Petition under 37 CFR 1.137(a)." This is not a final agency decision.

Further correspondence with respect to this matter should be addressed as follows:

|                   |                                                                                                                                                  |
|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| By mail:          | <b>Mail Stop Petition</b><br>Commissioner for Patents<br>P.O. Box 1450<br>Alexandria, VA 22313-1450                                              |
| By facsimile:     | (571) 273-8300                                                                                                                                   |
| By hand delivery: | U.S. Patent and Trademark Office<br>Customer Window, <b>Mail Stop Petition</b><br>Randolph Building<br>401 Dulany Street<br>Alexandria, VA 22314 |

Via EFS

Telephone inquiries concerning this matter may be directed to the undersigned at (571) 272-3205.

*/ALESIA M. BROWN/*

Alesia M. Brown  
Attorney Advisor  
Office of Petitions

**IN THE UNITED STATES  
PATENT AND TRADEMARK OFFICE**

Application No. : 13/959,708 Confirmation No. 5622  
Inventor : Gregory C. Burnett  
Filed : 08-05-2013  
Docket No. : 2064-0001

Title : FORMING VIRTUAL MICROPHONE ARRAYS USING  
DUAL OMNIDIRECTIONAL MICROPHONE ARRAY  
(DOMA)

**Mail Stop Petition**

Commissioner for Patents  
PO Box 1450  
Alexandria, Virginia 22313-1450.

**Renewed Petition under 37 CFR 1.137(a) and  
Petition to Withdraw from Issue Under 37 CFR 1.313(c) Accompanied by a Request  
for Continued Examination**

Sir:

A petition to revive the above-referenced patent application has been dismissed for the following reason:

A grantable petition under 37 CFR 1.137(a) must be accompanied by: (1) the required reply, unless previously filed; (2) required the petition fee; (3) a statement that the entire delay in filing

...

The instant petition fails to satisfy requirement (1) set forth above. While a substitute statement accompanies the instant petition, the substitute statement cannot be entered as the applicant was changed subsequent to the payment of the issue fee on January 30, 2019.

Be advised that further consideration of the matter of the substitute statement would require withdrawal from issue per 37 CFR 1.313(c) and a request for continued examination, including fee and submission in the form of re-submission of the substitute statement, per 37 CFR 1.114, as amendments, i.e., including amending of applicant, are not subject to entry subsequent to the payment of the issue fee.

(Dismissed petition, 9/9/2020, pg. 2.).

To satisfy requirement (1) provided above, this petition is submitted in accordance with 37 CFR 1.313(c)(2). Specifically, this petition is submitted to withdraw the above-referenced patent application from issuance because a request for continued examination (RCE) in compliance with § 1.114 is filed herewith.

In addition, filed herewith please find:

- 1) A substitute statement in lieu of an oath or declaration for a utility application for the sole inventor Gregory C. Burnett (substitute statement) signed by an officer of JAWB Acquisition LLC;
- 2) Power of Attorney;
- 3) Assignee showing ownership per 37 CFR 3.73 and
- 4) Corrected ADS

In view of the RCE and above documents, it is respectfully submitted that a change of the applicant to JAWB Acquisition LLC be recognized.

In conclusion, it is respectfully submitted that (A) the patent application be withdrawn from issuance, (B) the substitute statement be accepted and (C) the patent application be revived and no longer abandoned. It is further respectfully submitted that a Notice of Allowance be issued thereafter.

Attorney Advisor Alesia M. Brown is requested to call the undersigned at (212) 312-0598 if there remain any issues with this patent application.

**Deposit Account Authorization**

Authorization is hereby given to charge Deposit Account No. 60-0366 for any charges or shortages in fees that may be due.

Date: November 9, 2020

Respectfully submitted,

Hard IP LLC  
/Kinza Hecht/  
Kinza Hecht  
Patent Agent  
Reg. No. 62,325  
Phone: (212) 321-0598  
Email: kinza@hard-ip.net

Doc code: RCEX

Doc description: Request for Continued Examination (RCE)

PTO/SB/30EFS (02-18)

Approved for use through 11/30/2020. OMB 0651-0031

U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

# **REQUEST FOR CONTINUED EXAMINATION(RCE)TRANSMITTAL** **(Submitted Only via EFS-Web)**

|                      |                    |             |            |                               |                           |          |      |
|----------------------|--------------------|-------------|------------|-------------------------------|---------------------------|----------|------|
| Application Number   | 13/959,708         | Filing Date | 2013-08-15 | Docket Number (if applicable) | 2064-0001                 | Art Unit | 2814 |
| First Named Inventor | Gregory C. Burnett |             |            | Examiner Name                 | PIZARRO CRESPO, MARCOS D. |          |      |

**This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.**

Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. The Instruction Sheet for this form is located at WWW.USPTO.GOV

## **SUBMISSION REQUIRED UNDER 37 CFR 1.114**

Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).

☐ Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.

☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on \_\_\_\_\_

☐ Other \_\_\_\_\_

☒ Enclosed

☐ Amendment/Reply

☐ Information Disclosure Statement (IDS)

☒ Affidavit(s)/ Declaration(s)

☒ Other Petition for withdrawal from issue under 1.313(c)(2) and Renewed Petition under 37 CFR 1.137(a), substitute statement, power of attorney, assignee showing ownership per 37 CFR 3.73 and corrected ADS

## **MISCELLANEOUS**

☐ Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of months \_\_\_\_\_ (Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)

☐ Other \_\_\_\_\_

## **FEES**

**The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.**

☒ The Director is hereby authorized to charge any underpayment of fees, or credit any overpayments, to Deposit Account No 600366

## **SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED**

☒ Patent Practitioner Signature

Applicant Signature

Doc code: RCEX

Doc description: Request for Continued Examination (RCE)

PTO/SB/30EFS (02-18)

Approved for use through 11/30/2020. OMB 0651-0031

U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

| Signature of Registered U.S. Patent Practitioner |              |                     |            |
|--------------------------------------------------|--------------|---------------------|------------|
| Signature                                        | Kinza Hecht/ | Date (YYYY-MM-DD)   | 2020-11-09 |
| Name                                             | Kinza Hecht  | Registration Number | 62325      |

This collection of information is required by 37 CFR 1.114. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450.

*If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.*

## Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Doc Code: PET.OP

Document Description: Petition for Review by the Office of Petitions

PTO/SB/64 (01-18)

Approved for use through 11/30/2020. OMB 0651-0031  
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                              |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|
| <b>PETITION FOR REVIVAL OF AN APPLICATION FOR PATENT<br/>ABANDONED UNINTENTIONALLY UNDER 37 CFR 1.137(a)</b><br><br>Page 1 of 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Docket Number (Optional)<br><b>2064-0001</b> |
| <div style="border-bottom: 1px solid black; margin-bottom: 5px;">First named inventor: <u>Gregory C. Burnett</u></div> <div style="display: flex; justify-content: space-between; border-bottom: 1px solid black; margin-bottom: 5px;"><div>Application No.: <u>13/959,708</u></div><div>Art Unit: <u>2814</u></div></div> <div style="display: flex; justify-content: space-between; border-bottom: 1px solid black; margin-bottom: 5px;"><div>Filed: <u>August 5, 2013</u></div><div>Examiner: <u>PIZARRO CRESPO, MARCOS D</u></div></div> <div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">Title: <b>FORMING VIRTUAL MICROPHONE ARRAYS USING DUAL OMNIDIRECTIONAL MICROPHONE ARRAY (DOMA)</b></div> <div style="font-size: small; margin-bottom: 5px;">Attention: Office of Petitions<br/><b>Mail Stop Petition</b><br/>Commissioner for Patents<br/>P.O. Box 1450<br/>Alexandria, VA 22313-1450<br/>FAX (571) 273-8300</div> <div style="font-size: x-small; margin-bottom: 5px;">NOTE: If information or assistance is needed in completing this form, please contact the Office of Petitions at (571) 272-3282.</div> <div style="font-size: x-small; margin-bottom: 5px;">The above-identified application became abandoned for failure to file a timely and proper reply to a notice or action by the United States Patent and Trademark Office. The date of abandonment is the day after the expiration date of the period set for reply in the Office notice or action plus any extensions of time actually obtained.</div> <div style="font-weight: bold; margin-bottom: 5px;">APPLICANT HEREBY PETITIONS FOR REVIVAL OF THIS APPLICATION.</div> <div style="font-size: x-small; margin-bottom: 5px;">NOTE: A grantable petition requires the following items:</div> <div style="font-size: x-small; margin-bottom: 5px;">(1) Petition fee;<br/>(2) Reply and/or issue fee;<br/>(3) Terminal disclaimer with disclaimer fee – required for all utility and plant applications filed before June 8, 1995, and for all design applications; and<br/>(4) Statement that the entire delay was unintentional.</div> <div style="font-weight: bold; margin-bottom: 5px;">1. Petition fee</div> <div style="margin-bottom: 5px;"><input checked="" type="checkbox"/> Small entity fee \$ <u>1000</u> (37 CFR 1.17(m)). Applicant asserts small entity status. See 37 CFR 1.27.</div> <div style="margin-bottom: 5px;"><input type="checkbox"/> Micro entity fee \$ _____ (37 CFR 1.17(m)). Applicant certifies micro entity status. See 37 CFR 1.29. Form PTO/SB/15A or B or equivalent must either be enclosed or have been submitted previously.</div> <div style="margin-bottom: 5px;"><input type="checkbox"/> Undiscounted fee \$ _____ (37 CFR 1.17(m)).</div> <div style="font-weight: bold; margin-bottom: 5px;">2. Reply and/or fee</div> <div style="margin-bottom: 5px;">A The reply and/or fee to the above-noted Office notice or action in the form of<br/><u>Oath or Declaration</u> (identify the type of reply):<div style="margin-left: 20px;"><input type="checkbox"/> has been filed previously on _____.</div><div style="margin-left: 20px;"><input checked="" type="checkbox"/> is enclosed herewith.</div></div> <div style="margin-bottom: 5px;">B The issue fee and publication fee (if applicable) of \$ <u>480</u><div style="margin-left: 20px;"><input checked="" type="checkbox"/> has been paid previously on <u>January 30, 2019</u>.</div><div style="margin-left: 20px;"><input type="checkbox"/> is enclosed herewith.</div></div> |                                              |

This collection of information is required by 37 CFR 1.137(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11, 1.14 and 41.6. This collection is estimated to take 1 hour to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Mail Stop Petition, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

*If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.*

Doc Code: PET.OP

Document Description: Petition for Review by the Office of Petitions

PTO/SB/64 (01-18)

Approved for use through 11/30/2020. OMB 0651-0031

U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

**PETITION FOR REVIVAL OF AN APPLICATION FOR PATENT  
ABANDONED UNINTENTIONALLY UNDER 37 CFR 1.137(a)**

Page 2 of 2

**3. Terminal disclaimer with disclaimer fee**

- ☐ Since this utility/plant application was filed on or after June 8, 1995, no terminal disclaimer is required.
- ☐ A terminal disclaimer (and disclaimer fee (37 CFR 1.20(d)) of \$ \_\_\_\_\_) disclaiming the required period of time is enclosed herewith (see PTO/SB/63).

**4. STATEMENT:** The entire delay in filing the required reply from the due date for the required reply until the filing of a grantable petition under 37 CFR 1.137(a) was unintentional. [NOTE: The United States Patent and Trademark Office may require additional information if there is a question as to whether either the abandonment or the delay in filing a petition under 37 CFR 1.137(a) was unintentional (MPEP 711.03(c), subsections (III)(C) and (D)).]

**WARNING:**

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

/Kinza Hecht/

Signature

Kinza Hecht

Typed or Printed Name

Hard IP LLC

Address

48 Speir Drive, South Orange, NJ 07079

Address

August 10, 2020

Date

62,325

Registration Number, if applicable

212-837-8074

Telephone Number

**Enclosures:**

- ☒ Fee Payment
- ☒ Reply
- ☐ Terminal Disclaimer Form
- ☐ Additional sheet(s) containing statements establishing unintentional delay
- ☐ Other: \_\_\_\_\_

**CERTIFICATE OF MAILING OR TRANSMISSION [37 CFR 1.8(a)]**

I hereby certify that this correspondence is being:

- ☐ Deposited with the United States Postal Service on the date shown below with sufficient postage as first class mail in an envelope addressed to: Mail Stop Petition, Commissioner for Patents, P. O. Box 1450, Alexandria, VA 22313-1450.
- ☐ Transmitted by facsimile on the date shown below to the United States Patent and Trademark Office at (571) 273-8300.

Date

Signature

Typed or printed name of person signing certificate

## Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
**United States Patent and Trademark Office**  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

| APPLICATION NO.                                                                  | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO.      | CONFIRMATION NO. |
|----------------------------------------------------------------------------------|-------------|----------------------|--------------------------|------------------|
| 13/959,708                                                                       | 08/05/2013  | Gregory C. Burnett   | JAL-050ACON1             | 5622             |
| 15516                                                                            | 7590        | 02/15/2019           | EXAMINER                 |                  |
| Kokka & Backus, PC<br>550 S. California Ave.<br>Suite 300<br>Palo Alto, CA 94306 |             |                      | PIZARRO CRESPO, MARCOS D |                  |
|                                                                                  |             |                      | ART UNIT                 | PAPER NUMBER     |
|                                                                                  |             |                      | 2814                     |                  |
|                                                                                  |             |                      | NOTIFICATION DATE        | DELIVERY MODE    |
|                                                                                  |             |                      | 02/15/2019               | ELECTRONIC       |

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

docketing@kokkalaw.com  
kcleland@kokkalaw.com  
skokka@kokkalaw.com



UNITED STATES PATENT AND TRADEMARK OFFICE

Commissioner for Patents  
United States Patent and Trademark Office  
P.O. Box 1450  
Alexandria, VA 22313-1450  
[www.uspto.gov](http://www.uspto.gov)

In re application of :  
Gregory C. Burnett :  
Application No. 13/959,708 : NOTICE VACATING PETITION  
Filed: August 5, 2013 :  
Attorney Docket No. JAL-050ACON1 :

The purpose of this notice is to advise you that the decision automatically granted by Electronic Filing System (EFS) on January 30, 2019, is hereby **VACATED** for the reasons indicated below:

The record discloses the following:

- A Notice of Allowance and Fee(s) Due was mailed on November 21, 2016, which set a Non-Extendable Statutory Period for reply of three (3) months.
- A Notice Requiring Inventor's Oath or Declaration was mailed November 21, 2016, which set a Non-Extendable Statutory Period for a reply no later than the date on which the issue fee was paid.
- A Notice of Abandonment was mailed on March 10, 2017.
- On January 30, 2019, a Petition for Revival Of An Application For Patent Abandoned Unintentionally Under 37 CFR 1.137(a) was filed by EFS and automatically granted by EFS on January 30, 2019. The petition was accompanied by the issue fee payment of \$480 and the petition fee of (\$1,000).

However, the applicant failed to submit a proper oath and declaration for the inventor in the application. The oath and declaration filed on January 30, 2019, does not include the required statement that "This application was made or authorized to be made by me". See 37 CFR 1.63(a)(4).

In view of the above, the petition automatically granted by EFS on January 30, 2019, is vacated and the application remains ABANDONED.

A response to this letter must be submitted within **TWO (2) MONTHS** from the mail date of this decision. Extensions of time under 37 CFR 1.136(a) are permitted. The petition should include a cover letter entitled "Renewed Petition under 37 CFR 1.137(a)." This is not a final agency action within the meaning of 5 U.S.C. § 704.

Further correspondence with respect to this matter should be delivered through one of the following mediums:

By mail:                Mail Stop PETITIONS  
                              Commissioner for Patents  
                              Post Office Box 1450  
                              Alexandria, VA 22313-1450

By hand:                Customer Service Window  
                              Mail Stop Petitions  
                              Randolph Building  
                              401 Dulany Street  
                              Alexandria, VA 22314

By fax:                 (571) 273-8300  
                              ATTN: Office of Petitions

By internet:            EFS-Web  
                              [www.uspto.gov/ebc/efs\\_help.html](http://www.uspto.gov/ebc/efs_help.html)  
                              (for help using EFS-Web call the  
                              Patent Electronic Business Center  
                              at (866) 217-9197)

Any questions concerning this matter may be directed to the undersigned at (571) 272-4618.

/KIMBERLY A INABINET/  
Paralegal Specialist, OPET

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                      |                                                                         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|
| Doc Code: PET.AUTO<br>Document Description: Petition automatically granted by EFS-Web                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                      | PTO/SB/64<br>U.S. Patent and Trademark Office<br>Department of Commerce |
| Electronic Petition Request                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | PETITION FOR REVIVAL OF AN APPLICATION FOR PATENT ABANDONED<br>UNINTENTIONALLY UNDER 37 CFR 1.137(a) |                                                                         |
| Application Number                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 13959708                                                                                             |                                                                         |
| Filing Date                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 05-Aug-2013                                                                                          |                                                                         |
| First Named Inventor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Gregory Burnett                                                                                      |                                                                         |
| Art Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 2814                                                                                                 |                                                                         |
| Examiner Name                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | MARCOS PIZARRO CRESPO                                                                                |                                                                         |
| Attorney Docket Number                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | JAL-050ACON1                                                                                         |                                                                         |
| Title                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | FORMING VIRTUAL MICROPHONE ARRAYS USING DUAL OMNIDIRECTIONAL<br>MICROPHONE ARRAY (DOMA)              |                                                                         |
| <p>The above-identified application became abandoned for failure to file a timely and proper reply to a notice or action by the United States Patent and Trademark Office. The date of abandonment is the day after the expiration date of the period set for reply in the office notice or action plus any extensions of time actually obtained.</p> <p>APPLICANT HEREBY PETITIONS FOR REVIVAL OF THIS APPLICATION</p> <p>NOTE: A grantable petition requires the following items:</p> <ul style="list-style-type: none"> <li>(1) Petition fee;</li> <li>(2) Reply and/or issue fee;</li> <li>(3) Terminal disclaimer with disclaimer fee – required for all utility and plant applications filed before June 8, 1995; and for all design applications;</li> <li>(4) Statement that the entire delay was unintentional.</li> </ul> |                                                                                                      |                                                                         |
| <b>Petition Fee</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                      |                                                                         |
| <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px;"> <input checked="" type="radio"/> Small Entity       </div> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px;"> <input type="radio"/> Micro Entity       </div> <div style="border: 1px solid black; padding: 2px;"> <input type="radio"/> Regular Undiscounted       </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                      |                                                                         |
| <b>Issue Fee and Publication Fee :</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                      |                                                                         |
| Issue Fee and Publication Fee are not due.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                      |                                                                         |
| <input checked="" type="checkbox"/> Issue Fee Transmittal is attached                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                      |                                                                         |
| <b>Drawing corrections and/ or other deficiencies.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                      |                                                                         |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |               |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| <p><input checked="" type="radio"/> Drawing corrections and/ or other deficiencies are not required</p> <p><input type="radio"/> I certify, in accordance with 37 CFR 1.4(d)(4), that drawing corrections and/ or other deficiencies have previously been filed on</p> <p><input type="radio"/> Drawing corrections and/ or other deficiencies are attached.</p> <p>STATEMENT: The entire delay in filing the required reply from the due date for the required reply until the filing of a <input checked="" type="checkbox"/> grantable petition under 37 CFR 1.137(a) was unintentional.</p>                                                                                                                                                                                                                         |               |
| <p>THIS PORTION MUST BE COMPLETED BY THE SIGNATORY OR SIGNATORIES</p> <p>I certify, in accordance with 37 CFR 1.4(d)(4) that I am:</p> <p><input type="radio"/> An attorney or agent registered to practice before the Patent and Trademark Office who has been given power of attorney in this application.</p> <p><input checked="" type="radio"/> An attorney or agent registered to practice before the Patent and Trademark Office, acting in a representative capacity.</p> <p><input type="radio"/> A sole inventor</p> <p><input type="radio"/> A joint inventor; I certify that I am authorized to sign this submission on behalf of all of the inventors as evidenced by the power of attorney in the application</p> <p><input type="radio"/> A joint inventor; all of whom are signing this e-petition.</p> |               |
| Signature                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | /Maulin Shah/ |
| Name                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Maulin Shah   |
| Registration Number                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 56587         |



## UNITED STATES PATENT AND TRADEMARK OFFICE

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Commissioner for Patents  
United States Patent and Trademark Office  
P.O. Box 1450  
Alexandria, VA 22313-1450  
[www.uspto.gov](http://www.uspto.gov)

Decision Date : January 30, 2019

In re Application of :

DECISION ON PETITION

Gregory Burnett

UNDER CFR 1.137(a)

Application No : 13959708

Filed : 05-Aug-2013

Attorney Docket No : JAL-050ACON1

This is an electronic decision on the petition under 37 CFR 1.137(a), filed January 30, 2019 , to revive the above-identified application.

The petition is **GRANTED**.

The above-identified application became abandoned for failure to reply in a timely manner to the Notice of Allowance and Issue Fee(s) Due. The date of abandonment is the day after the expiration date of the period set for reply in the Notice.

The electronic petition satisfies the conditions for revival pursuant to the provisions of 37 CFR 1.137(a) in that (1) the reply in the form of payment of the Issue Fee and the Publication Fee (if necessary); (2) the petition fee as set forth in 37 CFR 1.17 (m); (3) the drawing correction and/or other deficiencies (if necessary); and (4) the required statement of unintentional delay have been received. Accordingly, the Issue Fee payment is accepted as having been unintentionally delayed.

It is not apparent whether the person signing the statement of unintentional delay was in a position to have firsthand or direct knowledge of the facts and circumstances of the delay at issue. Nevertheless, such statement is being treated as having been made as the result of a reasonable inquiry into the facts and circumstances of such delay. See 37 CFR 10.18(b) and Changes to Patent Practice and Procedure; Final Rule Notice, 62 Fed. Reg. 53131, 53178 (October 10, 1997), 1203 Off. Gaz. Pat. Office 63, 103 (October 21, 1997). In the event that such an inquiry has not been made, petitioner must make such an inquiry. If such inquiry results in the discovery that it is not correct that the entire delay in filing the required reply from the due date for the reply until the filing of a grantable petition pursuant to 37 CFR 1.137(a) was unintentional, petitioner must notify the Office.

Telephone inquiries concerning this decision should be directed to the Patent Electronic Business Center (EBC) at 866-217-9197.

This application file is being directed to the Office of Data Management.

Office of Petitions



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
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P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

|                                                                                                  |             |                      |                                      |                             |
|--------------------------------------------------------------------------------------------------|-------------|----------------------|--------------------------------------|-----------------------------|
| APPLICATION NO.                                                                                  | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO.                  | CONFIRMATION NO.            |
| 13/959,708                                                                                       | 08/05/2013  | Gregory C. Burnett   | ALI-050ACON1                         | 5622                        |
| 7590<br>Kokka & Backus, PC<br>1 Embarcadero Center<br>Suite 4150<br>San Francisco, CA 94111-3740 |             |                      | EXAMINER<br>PIZARRO CRESPO, MARCOS D |                             |
|                                                                                                  |             |                      | ART UNIT<br>2814                     | PAPER NUMBER                |
|                                                                                                  |             |                      | NOTIFICATION DATE<br>03/10/2017      | DELIVERY MODE<br>ELECTRONIC |

## Notice of Abandonment

This application is abandoned in view of:

1. ☐ The applicant's failure to timely file a proper reply to the Office letter mailed on \_\_\_\_\_.
  - (a) ☐ A reply was received on \_\_\_\_\_ (with a Certificate of Mailing or Transmission date \_\_\_\_\_), which is after the expiration of the period for reply (including a total extension of \_\_\_\_\_ month(s)) which expired on \_\_\_\_\_.
  - (b) ☐ No reply has been received.
2. ☒ Applicant's failure to timely pay the required issue fee and publication fee, if applicable, within the statutory period of three months from the mailing date of the Notice of Allowance (PTOL-85).
  - (a) ☐ The issue fee and publication fee, if applicable, was received on \_\_\_\_\_ (with a Certificate of Mailing or Transmission date \_\_\_\_\_), which is after the expiration of the statutory period for payment of the issue fee (and publication fee) set in the Notice of Allowance (PTOL-85).
  - (b) ☐ The submitted fee of \$\_\_\_\_\_ is insufficient. A balance of \$\_\_\_\_\_ is due.  
The issue fee required by 37 CFR 1.18 is \$\_\_\_\_\_.  
The publication fee, if required by 37 CFR 1.18(d), is \$\_\_\_\_\_.
  - (c) ☒ The issue fee and publication fee, if applicable, has not been received.
3. ☐ Applicant's failure to timely file corrected drawings as required by, and within the three-month period set in, the Notice of Allowability (PTO-37).
  - (a) ☐ Proposed corrected drawings were received on \_\_\_\_\_ (with a Certificate of Mailing or Transmission dated \_\_\_\_\_), which is after the expiration of the period for reply.
  - (b) ☐ No corrected drawing have been received.
4. ☒ Applicant's failure to timely file the inventor's oath or declaration no later than the date on which the issue fee was paid as required by the Notice Requiring Inventor's Oath or Declaration (PTO-2306).
  - (a) ☐ An inventor's oath or declaration was received on \_\_\_\_\_ (with a Certificate of Mailing or Transmission date \_\_\_\_\_), which is after the date on which the issue fee was paid.
  - (b) ☐ While an oath or declaration (or substitute statement) for one or more inventors was received, an oath or declaration (or substitute statement) for at least one other inventor has not been received.
  - (c) ☒ No inventor's oath or declaration has been received.
5. ☐ Drawings received on \_\_\_\_\_ were disapproved by examiner. See examiner's response dated \_\_\_\_\_.
6. ☐ Corrected drawings were received on \_\_\_\_\_, which is after the expiration of the one-month period for reply set in examiner's response dated \_\_\_\_\_.
7. ☐ No corrected drawings have been received in reply to one-month period set in examiner's response dated \_\_\_\_\_.
8. ☐ The reason(s) below:

Petitions to revive under 37 CFR 1.137(a) or (b), or request to withdraw the holding of abandonment under 37 CFR 1.181, should be promptly filed to minimize any negative effects on patent term.

*Brand Kelly for*  
(571)-272-4200 or 1(888)-786-0101  
Patent Publication Branch  
Office of Data Management

FORM PTO-ABN0 (Rev. 06/09)



# UNITED STATES PATENT AND TRADEMARK OFFICE

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P.O. Box 1450  
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## NOTICE OF ALLOWANCE AND FEE(S) DUE

15516 7590 11/21/2016  
Kokka & Backus, PC  
1 Embarcadero Center  
Suite 4150  
San Francisco, CA 94111-3740

EXAMINER

PIZARRO CRESPO, MARCOS D

ART UNIT PAPER NUMBER

2814

DATE MAILED: 11/21/2016

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|-----------------|-------------|----------------------|---------------------|------------------|
|-----------------|-------------|----------------------|---------------------|------------------|

13/959,708 08/05/2013 Gregory C. Burnett ALI-050ACON1 5622

TITLE OF INVENTION: FORMING VIRTUAL MICROPHONE ARRAYS USING DUAL OMNIDIRECTIONAL MICROPHONE ARRAY (DOMA)

| APPLN. TYPE    | ENTITY STATUS | ISSUE FEE DUE | PUBLICATION FEE DUE | PREV. PAID ISSUE FEE | TOTAL FEE(S) DUE | DATE DUE   |
|----------------|---------------|---------------|---------------------|----------------------|------------------|------------|
| nonprovisional | UNDISCOUNTED  | \$960         | \$0                 | \$0                  | \$960            | 02/21/2017 |

**THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.**

**THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.**

### HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

**IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.**

# **PART B - FEE(S) TRANSMITTAL**

**Complete and send this form, together with applicable fee(s), to:** **Mail** **Mail Stop ISSUE FEE**  
**Commissioner for Patents**  
**P.O. Box 1450**  
**Alexandria, Virginia 22313-1450**  
**or Fax** **(571)-273-2885**

**INSTRUCTIONS:** This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

15516 7590 11/21/2016  
**Kokka & Backus, PC**  
**1 Embarcadero Center**  
**Suite 4150**  
**San Francisco, CA 94111-3740**

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

## **Certificate of Mailing or Transmission**

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

|                    |
|--------------------|
| (Depositor's name) |
| (Signature)        |
| (Date)             |

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|-----------------|-------------|----------------------|---------------------|------------------|
| 13/959,708      | 08/05/2013  | Gregory C. Burnett   | ALI-050ACON1        | 5622             |

TITLE OF INVENTION: FORMING VIRTUAL MICROPHONE ARRAYS USING DUAL OMNIDIRECTIONAL MICROPHONE ARRAY (DOMA)

| APPLN. TYPE    | ENTITY STATUS | ISSUE FEE DUE | PUBLICATION FEE DUE | PREV. PAID ISSUE FEE | TOTAL FEE(S) DUE | DATE DUE   |
|----------------|---------------|---------------|---------------------|----------------------|------------------|------------|
| nonprovisional | UNDISCOUNTED  | \$960         | \$0                 | \$0                  | \$960            | 02/21/2017 |

| EXAMINER                 | ART UNIT | CLASS-SUBCLASS |
|--------------------------|----------|----------------|
| PIZARRO CRESPO, MARCOS D | 2814     | 381-092000     |

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

- ☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
- ☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

- (1) The names of up to 3 registered patent attorneys or agents OR, alternatively, 1 \_\_\_\_\_
- (2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed. 2 \_\_\_\_\_
- 3 \_\_\_\_\_

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☐ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:

- ☐ Issue Fee
- ☐ Publication Fee (No small entity discount permitted)
- ☐ Advance Order - # of Copies \_\_\_\_\_

4b. Payment of Fee(s): (Please first reapply any previously paid issue fee shown above)

- ☐ A check is enclosed.
- ☐ Payment by credit card. Form PTO-2038 is attached.
- ☐ The director is hereby authorized to charge the required fee(s), any deficiency, or credits any overpayment, to Deposit Account Number \_\_\_\_\_ (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)

- ☐ Applicant certifying micro entity status. See 37 CFR 1.29
- ☐ Applicant asserting small entity status. See 37 CFR 1.27
- ☐ Applicant changing to regular undiscounted fee status.

**NOTE:** Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

**NOTE:** If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

**NOTE:** Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

**NOTE:** This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature \_\_\_\_\_ Date \_\_\_\_\_

Typed or printed name \_\_\_\_\_ Registration No. \_\_\_\_\_



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
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|                                                                                          |             |                      |                          |                  |
|------------------------------------------------------------------------------------------|-------------|----------------------|--------------------------|------------------|
| APPLICATION NO.                                                                          | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO.      | CONFIRMATION NO. |
| 13/959,708                                                                               | 08/05/2013  | Gregory C. Burnett   | ALI-050ACON1             | 5622             |
| 15516                                                                                    | 7590        | 11/21/2016           | EXAMINER                 |                  |
| Kokka & Backus, PC<br>1 Embarcadero Center<br>Suite 4150<br>San Francisco, CA 94111-3740 |             |                      | PIZARRO CRESPO, MARCOS D |                  |
|                                                                                          |             |                      | ART UNIT                 | PAPER NUMBER     |
|                                                                                          |             |                      | 2814                     |                  |

DATE MAILED: 11/21/2016

## Determination of Patent Term Adjustment under 35 U.S.C. 154 (b) (Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

|                                                               |                                         |                                    |  |
|---------------------------------------------------------------|-----------------------------------------|------------------------------------|--|
| <b><i>Notice Requiring Inventor's Oath or Declaration</i></b> | Application No.<br>13/959,708           | Applicant(s)<br>Gregory C. Burnett |  |
|                                                               | Examiner<br>PIZARRO CRESPO, MARCOS<br>D | Art Unit<br>2814                   |  |

This notice is an attachment to the Notice of Allowability (PTOL-37), or the Notice of Allowability For A Design Application (PTOL-37D).

An inventor's oath or declaration in compliance with 37 CFR 1.63 or 1.64 executed by or with respect to each inventor has not yet been submitted.

An oath or declaration in compliance with 37 CFR 1.63, or a substitute statement in compliance with 37 CFR 1.64, executed by or with respect to each inventor (for any inventor for which a compliant oath, declaration, or substitute statement has not yet been submitted) **MUST** be filed no later than the date on which the issue fee is paid. See 35 U.S.C. 115(f). Failure to timely comply will result in ABANDONMENT of this application.

A properly executed inventor's oath to declaration has not been received for the following inventor(s):

If applicant previously filed one or more oaths, declarations, or substitute statements, applicant may have received an informational notice regarding deficiencies therein.

The following deficiencies are noted:

#### INFORMAL ACTION PROBLEMS

- A properly executed inventor's oath or declaration has not been received for the following inventor(s):  
**Gregory C. Burnett.**

Applicant may submit the inventor's oath or declaration at any time before the Notice of Allowance and Fee(s) Due, PTOL-85, is mailed.

Questions relating to this Notice should be directed to the Application Assistance Unit at 571-272-4200.

## OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

### Privacy Act Statement

**The Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

|                               |                                      |                                            |                                                  |
|-------------------------------|--------------------------------------|--------------------------------------------|--------------------------------------------------|
| <b>Notice of Allowability</b> | <b>Application No.</b><br>13/959,708 | <b>Applicant(s)</b><br>BURNETT, GREGORY C. |                                                  |
|                               | <b>Examiner</b><br>Marcos D. Pizarro | <b>Art Unit</b><br>2814                    | <b>AIA (First Inventor to File) Status</b><br>No |

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--**

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to the submission filed on 4/19/2016.  
☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on \_\_\_\_\_.
2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on \_\_\_\_\_; the restriction requirement and election have been incorporated into this action.
3. ☒ The allowed claim(s) is/are 2-21. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see [http://www.uspto.gov/patents/init\\_events/pph/index.jsp](http://www.uspto.gov/patents/init_events/pph/index.jsp) or send an inquiry to [PPHfeedback@uspto.gov](mailto:PPHfeedback@uspto.gov).
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

**Certified copies:**

- a) ☐ All    b) ☐ Some    \*c) ☐ None of the:
  1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

\* Certified copies not received: \_\_\_\_\_.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.

**THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.**

5. ☐ CORRECTED DRAWINGS ( as "replacement sheets") must be submitted.  
☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date \_\_\_\_\_.  
**Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).**
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

**Attachment(s)**

- |                                                                                                                               |                                                                           |
|-------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|
| 1. <input type="checkbox"/> Notice of References Cited (PTO-892)                                                              | 5. <input checked="" type="checkbox"/> Examiner's Amendment/Comment       |
| 2. <input checked="" type="checkbox"/> Information Disclosure Statements (PTO/SB/08),<br>Paper No./Mail Date <u>4/19/2016</u> | 6. <input type="checkbox"/> Examiner's Statement of Reasons for Allowance |
| 3. <input type="checkbox"/> Examiner's Comment Regarding Requirement for Deposit of Biological Material                       | 7. <input type="checkbox"/> Other _____.                                  |
| 4. <input type="checkbox"/> Interview Summary (PTO-413),<br>Paper No./Mail Date _____.                                        |                                                                           |

Attorney's Docket Number: ALI-050ACON1

Filing Date: 8/5/2013

Claimed Foreign Priority Date: none

Applicant(s): Burnett

Examiner: Marcos D. Pizarro

**Detailed Action / Examiner's Comment**

This Office action responds to the submission filed on 4/19/2016.

***Notice of Pre-AIA or AIA Status***

1. The present application is being examined under the pre-AIA first to invent provisions. In the event the determination of the status of the application as subject to pre-AIA is incorrect, any correction of the statutory basis for a rejection, as subject to AIA instead, will not be considered a new ground of rejection if the prior art relied upon, and the rationale supporting the rejection, would be the same under either status.

***Terminal Disclaimer***

2. The terminal disclaimers filed on 11/2/2015 disclaiming the terminal portion of any patent granted on this application which would extend beyond the expiration date of U.S. Patent No. 8,494,177 and any patent issued on U.S. Application No. 13/948,160 has been reviewed and is accepted.

***Reasons for Allowance***

3. Claims 2-21 are allowed.

4. Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably

accompany the issue fee. Such submissions should be clearly labeled "Comments on Allowance."

***Conclusion***

5. Papers related to this application may be submitted directly to Art Unit 2814 by facsimile transmission. The faxing of such papers must conform with the notice published in the Official Gazette, 1096 OG 30 (15 November 1989). The Art Unit 2814 Fax Center number is (571) 273-8300. The Art Unit 2814 Fax Center is to be used only for papers related to Art Unit 2814 applications.

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Marcos D. Pizarro at (571) 272-1716 and between the hours of 7:00 AM to 3:00 PM (Eastern Standard Time) Monday through Friday or by e-mail via Marcos.Pizarro@USPTO.gov. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy, can be reached on 571-272-1705. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either private PAIR or public PAIR. Status information for unpublished applications is available through private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

MP/mp  
16 November 2016

/Marcos D. Pizarro/  
Primary Examiner  
Art Unit 2814

Doc code: RCEX

Doc description: Request for Continued Examination (RCE)

PTO/SB/30EFS (07-09)

Approved for use through 07/31/2012. OMB 0651-0031

U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

# **REQUEST FOR CONTINUED EXAMINATION(RCE)TRANSMITTAL** **(Submitted Only via EFS-Web)**

|                      |                    |             |            |                               |               |          |      |
|----------------------|--------------------|-------------|------------|-------------------------------|---------------|----------|------|
| Application Number   | 13/959,708         | Filing Date | 2008-06-13 | Docket Number (if applicable) | ALI-050ACON1  | Art Unit | 2814 |
| First Named Inventor | Gregory C. Burnett |             |            | Examiner Name                 | WEISS, Howard |          |      |

**This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.**

Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. The Instruction Sheet for this form is located at [WWW.USPTO.GOV](http://WWW.USPTO.GOV)

## **SUBMISSION REQUIRED UNDER 37 CFR 1.114**

Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).

☐ Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.

☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on \_\_\_\_\_

☐ Other \_\_\_\_\_

☒ Enclosed

☐ Amendment/Reply

☒ Information Disclosure Statement (IDS)

☐ Affidavit(s)/ Declaration(s)

☐ Other \_\_\_\_\_

## **MISCELLANEOUS**

☐ Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of months \_\_\_\_\_.  
 (Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)

☐ Other \_\_\_\_\_

## **FEES**

☐ **The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.**

☐ The Director is hereby authorized to charge any underpayment of fees, or credit any overpayments, to Deposit Account No \_\_\_\_\_

## **SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED**

☒ Patent Practitioner Signature

☐ Applicant Signature

Doc code: RCEX

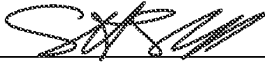
Doc description: Request for Continued Examination (RCE)

PTO/SB/30EFS (07-09)

Approved for use through 07/31/2012. OMB 0651-0031

U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

| Signature of Registered U.S. Patent Practitioner |                                                                                   |                     |            |
|--------------------------------------------------|-----------------------------------------------------------------------------------|---------------------|------------|
| Signature                                        |  | Date (YYYY-MM-DD)   | 2016-04-19 |
| Name                                             | Scott S. Kokka                                                                    | Registration Number | 51893      |

This collection of information is required by 37 CFR 1.114. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450.

*If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.*



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
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Alexandria, Virginia 22313-1450  
www.uspto.gov

| APPLICATION NO.                                              | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO.       | CONFIRMATION NO. |
|--------------------------------------------------------------|-------------|----------------------|---------------------------|------------------|
| 13/959,708                                                   | 08/05/2013  | Gregory C. Burnett   | ALI-050ACON1              | 5622             |
| 15516                                                        | 7590        | 01/26/2016           |                           |                  |
| Kokka & Backus, PC<br>703 High Street<br>Palo Alto, CA 94301 |             |                      | EXAMINER<br>WEISS, HOWARD |                  |
|                                                              |             |                      | ART UNIT                  | PAPER NUMBER     |
|                                                              |             |                      | 2814                      |                  |
|                                                              |             |                      | MAIL DATE                 | DELIVERY MODE    |
|                                                              |             |                      | 01/26/2016                | PAPER            |

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.



UNITED STATES PATENT AND TRADEMARK OFFICE

Commissioner for Patents  
United States Patent and Trademark Office  
P.O. Box 1450  
Alexandria, VA 22313-1450  
www.uspto.gov

Application No. : 13959708  
Applicant : Burnett  
Filing Date : 08/05/2013  
Date Mailed : 01/27/2016

## NOTICE TO FILE CORRECTED APPLICATION PAPERS

### *Notice of Allowance Mailed*

This application has been accorded an Allowance Date and is being prepared for issuance. The application, however, is incomplete for the reasons below.

**Applicant is given two (2) months from the mail date of this Notice within which to respond. This time period for reply is extendable under 37 CFR 1.136(a) for only TWO additional MONTHS.**

The application is not in compliance with 37 CFR 1.78, as indicated in the attachment. The consequences of failure to respond within the above-identified time period are set forth in the attachment.

Even if the Office has recognized a benefit claim and has entered it into the Office's database and included it on applicant's filing receipt, the benefit claim is not a proper benefit claim unless the reference in compliance with 37 CFR 1.78 is included, depending upon the application's filing date and as indicated in the attachment, in an application data sheet or in the first sentence(s) of the specification and all other requirements are met.

**See attachment.**

*A copy of this notice MUST be returned with the reply. Please address response to  
"Mail Stop Issue Fee, Commissioner for Patents,  
P.O. Box 1450, Alexandria, VA 22313-1450".*

/Kam Sin/  
Publication Branch  
Office of Data Management  
(571) 272-4200

**APPLICATION FILED ON OR AFTER MARCH 16, 2013,  
NOT IN COMPLIANCE WITH 37 CFR 1.78**

- ☐ The 37 CFR 1.78(c)(2) reference on the application data sheet does not indicate the relationship (continuation, division, continuation-in-part) to the prior U.S. nonprovisional application or international application designating the U.S. See document coded dated , listing application number(s) .
- ☐ The 37 CFR 1.78(c)(2) reference on the application data sheet does not provide the U.S. nonprovisional application number (series code and serial number) or, with respect to an international PCT application designating the U.S., it provides the international application number or international filing date but not both. See document coded dated , in which the following is missing: .
- ☒ The 37 CFR 1.78(c)(2) reference on the application data sheet shows an incorrect, incomplete, or illegible U.S. nonprovisional application number, international PCT application number, or international PCT filing date. See document coded ADS dated 11/02/2015, in which the following error was made: 12/139355 is incorrect.
- ☐ The 37 CFR 1.78(c)(2) reference to the prior U.S. nonprovisional application or international application designating the U.S. is not present on an application data sheet, thus removing the validating link under 35 U.S.C. 119(a)-(d) to a prior foreign application or under 35 U.S.C. 119(e) to a prior U.S. provisional application.
- ☐ The 37 CFR 1.78(c)(2) reference to the prior U.S. nonprovisional application or international application designating the U.S. is not present on an application data sheet.
- ☐ The 37 CFR 1.78(a)(3) reference to the prior U.S. provisional application is not present on an application data sheet.
- ☐ The 37 CFR 1.78(a)(3) reference to the prior U.S. provisional application on an application data sheet does not provide the provisional application number (series code and serial number). See document coded dated , in which the following is missing: .
- ☐ The 37 CFR 1.78(a)(3) reference to the prior U.S. provisional application on an application data sheet shows an incorrect, incomplete, or illegible U.S. provisional application number. See document coded dated , in which the following error was made: .
- ☐ Other: .

**HOW TO RESPOND**

A proper response to this notice would include: (1) a corrected Application Data Sheet (ADS) pursuant to 37 CFR 1.76(c) which provides the benefit information from the attached filing receipt which would make the benefit information comply with 37 CFR 1.78(c)(2) or 37 CFR 1.78(a)(3) or (2) a petition filed pursuant to the provisions of 37 CFR 1.78(b) or 37 CFR 1.78(d) if the benefit information from the attached filing receipt does not accurately reflect the benefits under 35 U.S.C. 119(e), 120, 121 or 365(c) as claimed by applicant (a grantable petition would include a corrected ADS as required by 37 CFR 1.78(b)(1) or 37 CFR 1.78(d)(1)).

**WARNING:** If Applicant fails to timely submit a proper response, the benefit information will be deleted and the patent will be printed without the benefit information present.



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www.uspto.gov

| APPLICATION NO.                                              | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO.       | CONFIRMATION NO. |
|--------------------------------------------------------------|-------------|----------------------|---------------------------|------------------|
| 13/959,708                                                   | 08/05/2013  | Gregory C. Burnett   | ALI-050ACON1              | 5622             |
| 15516                                                        | 7590        | 01/26/2016           |                           |                  |
| Kokka & Backus, PC<br>703 High Street<br>Palo Alto, CA 94301 |             |                      | EXAMINER<br>WEISS, HOWARD |                  |
|                                                              |             |                      | ART UNIT                  | PAPER NUMBER     |
|                                                              |             |                      | 2814                      |                  |
|                                                              |             |                      | MAIL DATE                 | DELIVERY MODE    |
|                                                              |             |                      | 01/26/2016                | PAPER            |

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P.O. Box 1450  
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www.uspto.gov

Application No. : 13959708  
Applicant : Burnett  
Filing Date : 08/05/2013  
Date Mailed : 01/27/2016

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**See attachment.**

*A copy of this notice **MUST** be returned with the reply. Please address response to  
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/Kam Sin/  
Publication Branch  
Office of Data Management  
(571) 272-4200

**APPLICATION FILED ON OR AFTER MARCH 16, 2013,  
NOT IN COMPLIANCE WITH 37 CFR 1.78**

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- ☐ The 37 CFR 1.78(a)(3) reference to the prior U.S. provisional application on an application data sheet does not provide the provisional application number (series code and serial number). See document coded dated , in which the following is missing: .
- ☐ The 37 CFR 1.78(a)(3) reference to the prior U.S. provisional application on an application data sheet shows an incorrect, incomplete, or illegible U.S. provisional application number. See document coded dated , in which the following error was made: .
- ☐ Other: .

**HOW TO RESPOND**

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**WARNING:** If Applicant fails to timely submit a proper response, the benefit information will be deleted and the patent will be printed without the benefit information present.



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## NOTICE OF ALLOWANCE AND FEE(S) DUE

15516 7590 01/19/2016  
Kokka & Backus, PC  
703 High Street  
Palo Alto, CA 94301

EXAMINER

WEISS, HOWARD

ART UNIT

PAPER NUMBER

2814

DATE MAILED: 01/19/2016

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|-----------------|-------------|----------------------|---------------------|------------------|
| 13/959,708      | 08/05/2013  | Gregory C. Burnett   | ALI-050ACON1        | 5622             |

TITLE OF INVENTION: FORMING VIRTUAL MICROPHONE ARRAYS USING DUAL OMNIDIRECTIONAL MICROPHONE ARRAY (DOMA)

| APPLN. TYPE    | ENTITY STATUS | ISSUE FEE DUE | PUBLICATION FEE DUE | PREV. PAID ISSUE FEE | TOTAL FEE(S) DUE | DATE DUE   |
|----------------|---------------|---------------|---------------------|----------------------|------------------|------------|
| nonprovisional | UNDISCOUNTED  | \$960         | \$0                 | \$0                  | \$960            | 04/19/2016 |

**THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.**

**THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.**

### HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

**IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.**

**PART B - FEE(S) TRANSMITTAL**

**Complete and send this form, together with applicable fee(s), to: Mail Mail Stop ISSUE FEE  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
or Fax (571)-273-2885**

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

15516 7590 01/19/2016  
Kokka & Backus, PC  
703 High Street  
Palo Alto, CA 94301

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

**Certificate of Mailing or Transmission**

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

|                    |
|--------------------|
| (Depositor's name) |
| (Signature)        |
| (Date)             |

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|-----------------|-------------|----------------------|---------------------|------------------|
| 13/959,708      | 08/05/2013  | Gregory C. Burnett   | ALI-050ACON1        | 5622             |

TITLE OF INVENTION: FORMING VIRTUAL MICROPHONE ARRAYS USING DUAL OMNIDIRECTIONAL MICROPHONE ARRAY (DOMA)

| APPLN. TYPE    | ENTITY STATUS | ISSUE FEE DUE | PUBLICATION FEE DUE | PREV. PAID ISSUE FEE | TOTAL FEE(S) DUE | DATE DUE   |
|----------------|---------------|---------------|---------------------|----------------------|------------------|------------|
| nonprovisional | UNDISCOUNTED  | \$960         | \$0                 | \$0                  | \$960            | 04/19/2016 |

| EXAMINER      | ART UNIT | CLASS-SUBCLASS |
|---------------|----------|----------------|
| WEISS, HOWARD | 2814     | 381-092000     |

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

- ☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
- ☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

- (1) The names of up to 3 registered patent attorneys or agents OR, alternatively, 1 \_\_\_\_\_
- (2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed. 2 \_\_\_\_\_
- 3 \_\_\_\_\_

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☐ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:

- ☐ Issue Fee
- ☐ Publication Fee (No small entity discount permitted)
- ☐ Advance Order - # of Copies \_\_\_\_\_

4b. Payment of Fee(s): (Please first reapply any previously paid issue fee shown above)

- ☐ A check is enclosed.
- ☐ Payment by credit card. Form PTO-2038 is attached.
- ☐ The director is hereby authorized to charge the required fee(s), any deficiency, or credits any overpayment, to Deposit Account Number \_\_\_\_\_ (enclose an extra copy of this form).

5. Change in Entity Status (from status indicated above)

- ☐ Applicant certifying micro entity status. See 37 CFR 1.29
- ☐ Applicant asserting small entity status. See 37 CFR 1.27
- ☐ Applicant changing to regular undiscounted fee status.

**NOTE:** Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

**NOTE:** If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

**NOTE:** Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature \_\_\_\_\_

Date \_\_\_\_\_

Typed or printed name \_\_\_\_\_

Registration No. \_\_\_\_\_



# UNITED STATES PATENT AND TRADEMARK OFFICE

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|                                                              |             |                      |                     |                  |
|--------------------------------------------------------------|-------------|----------------------|---------------------|------------------|
| APPLICATION NO.                                              | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
| 13/959,708                                                   | 08/05/2013  | Gregory C. Burnett   | ALI-050ACON1        | 5622             |
| 15516                                                        | 7590        | 01/19/2016           | EXAMINER            |                  |
| Kokka & Backus, PC<br>703 High Street<br>Palo Alto, CA 94301 |             |                      | WEISS, HOWARD       |                  |
|                                                              |             |                      | ART UNIT            | PAPER NUMBER     |
|                                                              |             |                      | 2814                |                  |

DATE MAILED: 01/19/2016

## Determination of Patent Term Adjustment under 35 U.S.C. 154 (b) (Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

|                                                               |                               |                                    |  |
|---------------------------------------------------------------|-------------------------------|------------------------------------|--|
| <b><i>Notice Requiring Inventor's Oath or Declaration</i></b> | Application No.<br>13/959,708 | Applicant(s)<br>Gregory C. Burnett |  |
|                                                               | Examiner<br>WEISS, HOWARD     | Art Unit<br>2814                   |  |

This notice is an attachment to the Notice of Allowability (PTOL-37), or the Notice of Allowability For A Design Application (PTOL-37D).

An inventor's oath or declaration in compliance with 37 CFR 1.63 or 1.64 executed by or with respect to each inventor has not yet been submitted.

An oath or declaration in compliance with 37 CFR 1.63, or a substitute statement in compliance with 37 CFR 1.64, executed by or with respect to each inventor (for any inventor for which a compliant oath, declaration, or substitute statement has not yet been submitted) **MUST** be filed no later than the date on which the issue fee is paid. See 35 U.S.C. 115(f). Failure to timely comply will result in ABANDONMENT of this application.

A properly executed inventor's oath to declaration has not been received for the following inventor(s):

If applicant previously filed one or more oaths, declarations, or substitute statements, applicant may have received an informational notice regarding deficiencies therein.

The following deficiencies are noted:

**INFORMAL ACTION PROBLEMS**

- A properly executed inventor's oath or declaration has not been received for the following inventor(s):  
**Gregory C. Burnett.**

Applicant may submit the inventor's oath or declaration at any time before the Notice of Allowance and Fee(s) Due, PTOL-85, is mailed.

Questions relating to this Notice should be directed to the Application Assistance Unit at 571-272-4200.

## OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

### Privacy Act Statement

**The Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

|                               |                                      |                                            |                                                  |
|-------------------------------|--------------------------------------|--------------------------------------------|--------------------------------------------------|
| <b>Notice of Allowability</b> | <b>Application No.</b><br>13/959,708 | <b>Applicant(s)</b><br>BURNETT, GREGORY C. |                                                  |
|                               | <b>Examiner</b><br>/HOWARD WEISS/    | <b>Art Unit</b><br>2814                    | <b>AIA (First Inventor to File) Status</b><br>No |

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--**

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to a reply filed 11/2/2015.  
☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on \_\_\_\_\_.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on \_\_\_\_\_; the restriction requirement and election have been incorporated into this action.

3. ☒ The allowed claim(s) is/are 2-21. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see [http://www.uspto.gov/patents/init\\_events/pph/index.jsp](http://www.uspto.gov/patents/init_events/pph/index.jsp) or send an inquiry to [PPHfeedback@uspto.gov](mailto:PPHfeedback@uspto.gov).

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
**Certified copies:**  
a) ☐ All    b) ☐ Some    \*c) ☐ None of the:  
1. ☐ Certified copies of the priority documents have been received.  
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).  
\* Certified copies not received: \_\_\_\_\_.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.  
**THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.**

5. ☐ CORRECTED DRAWINGS ( as "replacement sheets") must be submitted.  
☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date \_\_\_\_\_.  
**Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).**

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

**Attachment(s)**

|                                                                                                            |                                                                                      |
|------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| 1. <input type="checkbox"/> Notice of References Cited (PTO-892)                                           | 5. <input type="checkbox"/> Examiner's Amendment/Comment                             |
| 2. <input type="checkbox"/> Information Disclosure Statements (PTO/SB/08),<br>Paper No./Mail Date _____    | 6. <input checked="" type="checkbox"/> Examiner's Statement of Reasons for Allowance |
| 3. <input type="checkbox"/> Examiner's Comment Regarding Requirement for Deposit<br>of Biological Material | 7. <input type="checkbox"/> Other _____                                              |
| 4. <input type="checkbox"/> Interview Summary (PTO-413),<br>Paper No./Mail Date _____                      |                                                                                      |

Attorney's Docket Number: ALI-050ACON1

Filing Date: 8/5/2013

Continuing Data: a continuation of 12/139,333 (06/13/2008 now U. S. Patent No. 8,503,691) which claims benefit of 60/934,551 (06/13/2007) and claims benefit of 60/953,444 (08/01/2007) and claims benefit of 60/954,712 (08/08/2007) and claims benefit of 61/045,377 (04/16/2008); RCE established 4/21/2015

Claimed Foreign Priority Date: none

Applicant(s): Burnett

Examiner: Howard Weiss

***Notice of Pre-AIA or AIA Status***

1. The present application is being examined under the pre-AIA first to invent provisions.

***Terminal Disclaimer***

2. The terminal disclaimers filed on 11/2/2015 disclaiming the terminal portion of any patent granted on this application which would extend beyond the expiration date of U.S. Patent No. 8,494,177 and any patent issued on U.S. Application No. 13/948,160 has been reviewed and is accepted.

***Reasons for Allowance***

3. The following is an examiner's statement of reasons for allowance: the filing of the TDs on 11/2/215.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

***Conclusion***

4. Papers related to this application may be submitted directly to Art Unit 2814 by facsimile transmission. The faxing of such papers must conform with the notice published in the Official Gazette, 1096 OG 30 (15 November 1989). The Art Unit 2814 Fax Center number is **(571) 273-8300**. The Art Unit 2814 Fax Center is to be used only for papers related to Art Unit 2814 applications.
5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Howard Weiss at **(571) 272-1720** and between the hours of 7:00 AM to 3:00 PM (Eastern Standard Time) Monday through Friday or by e-mail via [Howard.Weiss@uspto.gov](mailto:Howard.Weiss@uspto.gov). If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy, can be reached on **(571) 272-1705**.
6. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at **866-217-9197** (toll-free).

7. The following list is the Examiner's field of search for the present Office Action:

| Field of Search                                                             | Date           |
|-----------------------------------------------------------------------------|----------------|
| U.S. Class / Subclass(es): H04R 3/005, 2410/05; G10L<br>2021/02165, 21/0208 | Thru 1/13/2016 |
| Other Documentation: none                                                   |                |
| Electronic Database(s): EAST                                                | Thru 1/13/2016 |

HW/hw  
14 January 2016

/Howard Weiss/  
Primary Examiner  
Art Unit 2814

|                                                                                                                |                                              |                                                                       |  |
|----------------------------------------------------------------------------------------------------------------|----------------------------------------------|-----------------------------------------------------------------------|--|
| <b>Application Number</b><br> | <b>Application/Control No.</b><br>13/959,708 | <b>Applicant(s)/Patent under Reexamination</b><br>BURNETT, GREGORY C. |  |
| <b>Document Code - DISQ</b>                                                                                    |                                              | <b>Internal Document – DO NOT MAIL</b>                                |  |

|                                |                                                                |                                             |
|--------------------------------|----------------------------------------------------------------|---------------------------------------------|
| <b>TERMINAL<br/>DISCLAIMER</b> | <input checked="" type="checkbox"/> <b>APPROVED</b>            | <input type="checkbox"/> <b>DISAPPROVED</b> |
| Date Filed : 11/2/15           | <b>This patent is subject<br/>to a Terminal<br/>Disclaimer</b> |                                             |

**Approved/Disapproved by:**

ANDRE ROBINSON  
2 TDS WERE APPRVD.



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| APPLICATION NUMBER | FILING OR 371(C) DATE | FIRST NAMED APPLICANT | ATTY. DOCKET NO./TITLE |
|--------------------|-----------------------|-----------------------|------------------------|
| 13/959,708         | 08/05/2013            | Gregory C. Burnett    | ALI-050ACON1           |

**CONFIRMATION NO. 5622**

**POA ACCEPTANCE LETTER**



\*OC000000078564857\*

15516  
Kokka & Backus, PC  
703 High Street  
Palo Alto, CA 94301

Date Mailed: 11/09/2015

**NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY**

This is in response to the Power of Attorney filed 11/02/2015.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at (571) 272-4000 or (571) 272-4200 or 1-888-786-0101.

/mbeyene/

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of:

Gregory C. Burnett

Application Serial No.: 13/959,708

Filing Date: August 5, 2013

For: FORMING VIRTUAL MICROPHONE  
ARRAYS USING DUAL  
OMNIDIRECTIONAL MICROPHONE  
ARRAY (DOMA)

Examiner: WEISS, Howard

Group Art Unit: 2814

Confirmation No.: 5622

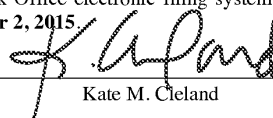
Transmission Date: November 2, 2015

Atty. Docket No.: ALI-050ACON1

CERTIFICATE OF EFS-WEB TRANSMISSION

I hereby certify that this correspondence is being transmitted via the U.S. Patent and Trademark Office electronic filing system (EFS-Web) to the USPTO on **November 2, 2015**.

Signed: \_\_\_\_\_



Kate M. Cleland

**RESPONSE TO OFFICE ACTION**

Dear Sir or Madam:

In response to the *Non-Final Office Action*, mailed May 1, 2015, Applicant respectfully submits herewith a complete claim listing and remarks as well as (1) a *Terminal Disclaimer under 37 C.F.R. § 1.321(c) to Obviate an Obviousness-Type Double Patenting Rejection* and (2) a *Terminal Disclaimer Under 37 C.F.R § 1.321 to Obviate a Provisional Obviousness-Type Double Patenting Rejection*. Please also find enclosed (3) an *Application Data Sheet* (corrected), (4) a *Statement Under 37 C.F.R. § 3.73(c)*, and (5) a *Power of Attorney* (Form PTO/SB/80).

**CLAIM LISTING**

1. (Cancelled)
2. (Previously presented) A device, comprising:
  - a first virtual microphone comprising a first combination of a first microphone signal and a second microphone signal, wherein the first microphone signal is generated by a first physical microphone and the second microphone signal is generated by a second physical microphone;
  - a second virtual microphone comprising a second combination of the first microphone signal and the second microphone signal, wherein the second combination is different from the first combination, wherein the first virtual microphone and the second virtual microphone are distinct virtual directional microphones with substantially similar responses to noise and substantially dissimilar responses to speech; and
  - a signal processor coupled with the first and second microphone signals and operative to combine the first and second microphone signals by filtering and summing in the time domain, to apply a varying linear transfer function between the first and second microphone signals, and to generate an output signal having noise content that is attenuated with respect to speech content.
3. (Previously presented) The device of Claim 2, wherein the signal processor comprises one or more digital signal processors (DSPs).
4. (Previously presented) The device of Claim 2, wherein the noise content comprises acoustic noise and the speech content comprises human speech.

5. (Previously presented) The device of Claim 2, wherein the signal processor is operative to add a delay to the first microphone signals.
6. (Previously presented) The device of Claim 5, wherein the signal processor is operative to raise the delay to a power that is proportional to a time difference between arrival of the speech at the first virtual microphone and arrival of the speech at the second virtual microphone.
7. (Previously presented) The device of Claim 5, wherein the signal processor is operative to raise the delay to a power that is proportional to a sampling frequency multiplied by a quantity equal to a third distance subtracted from a fourth distance, the third distance being between the first physical microphone and a speech source of the speech and the fourth distance being between the second physical microphone and the speech source.
8. (Previously presented) The device of Claim 2, wherein the first and second physical microphones comprise omnidirectional microphones.
9. (Previously presented) The device of Claim 2, wherein the first and second physical microphones are included in a microphone array.
10. (Previously presented) The device of Claim 2, wherein the first physical microphone and the second physical microphones are disposed along an axis and are separated from each other by a first distance.

11. (Previously presented) The device of Claim 10, wherein a midpoint of the axis is a second distance from a speech source that generates the speech, wherein the speech source is located in a direction defined by an angle relative to the midpoint.
12. (Previously presented) The device of Claim 11, wherein the first virtual microphone is formed by subtracting the second microphone signal from the first microphone signal.
13. (Previously presented) The device of Claim 11, wherein the second virtual microphone is formed by subtracting the first microphone signal from the second microphone signal.
14. (Previously presented) The device of Claim 2, wherein the first virtual microphone is formed by subtracting the second microphone signal from a delayed version of the first microphone signal.
15. (Previously presented) The device of Claim 2, wherein the second virtual microphone is formed by subtracting the first microphone signal from a delayed version of the second microphone signal.

16. (Previously presented) A device, comprising:

a first virtual microphone comprising a first combination of a first microphone signal and a second microphone signal, wherein the first microphone signal is generated by a first physical microphone and the second microphone signal is generated by a second physical microphone;

a second virtual microphone comprising a second combination of the first microphone signal and the second microphone signal, wherein the second combination is different from the first combination, wherein the first virtual microphone and the second virtual microphone are distinct virtual directional microphones with substantially similar responses to noise and substantially dissimilar responses to speech;

a virtual microphone array including the first and second virtual microphones and having a single null oriented in a direction toward a source of speech; and

a signal processor coupled with the first and second microphone signals and operative to combine the first and second microphone signals by filtering and summing in the time domain, to apply a varying linear transfer function between the first and second microphone signals, and to generate an output signal having noise content that is attenuated with respect to speech content.

17. (Previously presented) The device of Claim 16, wherein the source of speech comprises human speech.

18. (Previously presented) The device of Claim 16, wherein the second virtual microphone includes a second linear response to speech and the single null comprises a region of the second linear response to speech having a measured response level that is lower than a measured response level of any other region of the second linear response to speech.

19. (Previously presented) The device of Claim 16, wherein the first virtual microphone is formed by subtracting the second microphone signal from a delayed version of the first microphone signal.

20. (Previously presented) The device of Claim 16, wherein the second virtual microphone is formed by subtracting the first microphone signal from a delayed version of the second microphone signal.

21. (Previously presented) The device of Claim 16, wherein the first and second physical microphones are included in a microphone array.

**REMARKS**

Claims 2-21 remain pending.

The Examiner has rejected claims 2-21 on the ground of non-statutory double patenting as being unpatentable over claims 1-51 of U.S. Patent No. 8,494,177. Additionally, the Examiner has provisionally rejected claims 2-21 on the ground of non-statutory double patenting as being unpatentable over claims 2-21 of copending U.S. Patent Application No. 13/948,160.

The Examiner has set forth the non-statutory double patenting rejections as set forth above. Applicant respectfully submits the enclosed *Terminal Disclaimer under 37 C.F.R. § 1.321(c) to Obviate an Obviousness-Type Double Patenting Rejection* and *Terminal Disclaimer Under 37 C.F.R § 1.321 to Obviate a Provisional Obviousness-Type Double Patenting Rejection* to overcome the Examiner's non-statutory double patenting rejections.

Additionally, Applicant respectfully requests to update the Applicant information in accordance with 37 C.F.R. § 1.46(c), and submits herewith (1) an *Application Data Sheet* (corrected) (Exhibit A), (2) a *Statement Under 37 C.F.R. § 3.73(c)* (Exhibit B), and (3) a *Power of Attorney* (Form PTO/SB/80) (Exhibit C).

Reconsideration of the application and allowance of all claims are respectfully requested based on the preceding remarks. If at any time the Examiner believes that an interview would be helpful, please contact the undersigned.

Respectfully submitted,

A handwritten signature in black ink, appearing to read 'S. Kokka', with a stylized flourish at the end.

Scott S. Kokka  
Reg. No. 51,893

KOKKA & BACKUS, PC  
703 High Street  
Palo Alto, CA 94301-2447  
Tel: (650) 566-9921  
Fax: (650) 566-9922

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of:

Gregory C. Burnett

Application Serial No.: 13/959,708

Filing Date: August 5, 2013

For: FORMING VIRTUAL MICROPHONE  
ARRAYS USING DUAL  
OMNIDIRECTIONAL MICROPHONE  
ARRAY (DOMA)

Examiner: WEISS, Howard

Group Art Unit: 2814

Confirmation No.: 5622

Transmission Date: November 2, 2015

Atty. Docket No.: ALI-050ACON1

CERTIFICATE OF EFS-WEB TRANSMISSION

I hereby certify that this correspondence is being transmitted via the U.S. Patent and Trademark Office electronic filing system (EFS-Web) to the USPTO on **November 2, 2015**.

Signed: \_\_\_\_\_

Kate M. Cleland

**TERMINAL DISCLAIMER UNDER 37 C.F.R. § 1.321(c) TO OBVIATE AN  
OBVIOUSNESS-TYPE DOUBLE PATENTING REJECTION**

Commissioner for Patents  
PO Box 1450  
Alexandria, VA 22313-1450

Dear Sir or Madam:

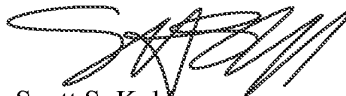
The owner(s), AliphCom (Assignee), of the entire interest in the above-identified application hereby disclaims, except as provided below, the terminal part of the statutory term of any patent granted on the above-identified application (hereafter "instant application"), which would extend beyond the expiration date of the full statutory term, as defined in 35 U.S.C. §§ 154 and 173, of prior United States Patent No. 8,494,177 (hereafter "prior patent"), as presently

shortened by any terminal disclaimer. The owner hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and the prior patent are commonly owned. This agreement runs with any patent granted on the instant application and is binding upon the grantee, its successors or assigns.

In making the above disclaimer, the owner does not disclaim the terminal part of any patent granted on the instant application that would extend to the expiration date of the full statutory term, as defined in 35 U.S.C. §§ 154 and 173, of the prior patent, as presently shortened by any terminal disclaimer, in the event that it later: expires for failure to pay a maintenance fee, is held unenforceable, is found invalid by a court of competent jurisdiction, is statutorily disclaimed in whole or terminally disclaimed under 37 CFR § 1.321, has all claims canceled by a reexamination certificate, is reissued, or is in any manner terminated prior to the expiration of its full statutory term as presently shortened by any terminal disclaimer.

We hereby submit the amount of \$160.00 to cover the statutory disclaimer fees for undiscounted entity. If any questions arise regarding this statutory disclaimer, please contact the undersigned attorney or agent of record.

Respectfully submitted,



Scott S. Kokka  
Reg. No. 51,893

Date: November 2, 2015

KOKKA & BACKUS, PC  
703 High Street  
Palo Alto, CA 94301-2447  
Tel: (650) 566-9921  
Fax: (650) 566-9922

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of:

Gregory C. Burnett

Application Serial No.: 13/959,708

Filing Date: August 5, 2013

For: FORMING VIRTUAL MICROPHONE  
ARRAYS USING DUAL  
OMNIDIRECTIONAL MICROPHONE  
ARRAY (DOMA)

Examiner: WEISS, Howard

Group Art Unit: 2814

Confirmation No.: 5622

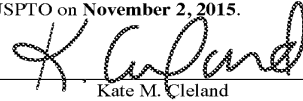
Transmission Date: November 2, 2015

Atty. Docket No.: ALI-050ACON1

CERTIFICATE OF EFS-WEB TRANSMISSION

I hereby certify that this correspondence is being transmitted via the U.S. Patent and Trademark Office electronic filing system (EFS-Web) to the USPTO on **November 2, 2015**.

Signed: \_\_\_\_\_

  
Kate M. Cleland

**TERMINAL DISCLAIMER UNDER 37 C.F.R. § 1.321**  
**TO OBVIATE A PROVISIONAL OBVIOUSNESS-TYPE DOUBLE PATENTING**  
**REJECTION**

Commissioner for Patents  
PO Box 1450  
Alexandria, VA 22313-1450

Dear Sir or Madam:

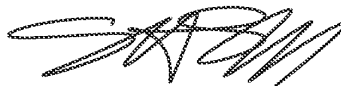
The owner(s), AliphCom (Assignee), of the entire interest in the above-identified application hereby disclaims, except as provided below, the terminal part of the statutory term of any patent granted on the above-identified application (hereafter "instant application"), which would extend beyond the expiration date of the full statutory term defined in 35 U.S.C. 154 and 173 of any patent granted on pending reference Application Number 13/948,160, filed on July

22, 2013 (hereafter "reference patent application"), as the term of any patent granted on said reference patent application may be shortened by any terminal disclaimer filed prior to the grant of any patent on the reference patent application. The owner(s) hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and any patent granted on the reference patent application are commonly owned. This agreement runs with any patent granted on the instant application and is binding upon the grantee, its successors or assigns.

In making the above disclaimer, the owner does not disclaim the terminal part of any patent granted on the above-identified application that would extend to the expiration date of the full statutory term as defined in 35 U.S.C. 154 and 173 of any patent(s) granted on said reference patent application, as the term of any patent(s) granted on said reference patent application may be shortened by any terminal disclaimer filed prior to the grant of any patent(s) on the pending reference application, in the event that it later: expires for failure to pay a maintenance fee, is held unenforceable, is found invalid by a court of competent jurisdiction, is statutorily disclaimed in whole or terminally disclaimed under 37 CFR 1.321, has all claims canceled by a reexamination certificate, is reissued or is in any matter terminated prior to the expiration of its full statutory term as presently shortened by any terminal disclaimer.

We hereby submit the amount of \$160.00 to cover the statutory disclaimer fees for undiscounted entity. If any questions arise regarding this statutory disclaimer, please contact the undersigned attorney or agent of record.

Respectfully submitted,



Scott S. Kokka  
Reg. No. 51,893

Date: November 2, 2015

KOKKA & BACKUS, PC  
703 High Street  
Palo Alto, CA 94301-2447  
Tel: (650) 566-9921  
Fax: (650) 566-9922



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

| APPLICATION NO.                                              | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|--------------------------------------------------------------|-------------|----------------------|---------------------|------------------|
| 13/959,708                                                   | 08/05/2013  | Gregory C. Burnett   | ALI-050ACON1        | 5622             |
| 15516                                                        | 7590        | 05/01/2015           | EXAMINER            |                  |
| Kokka & Backus, PC<br>703 High Street<br>Palo Alto, CA 94301 |             |                      | WEISS, HOWARD       |                  |
|                                                              |             |                      | ART UNIT            | PAPER NUMBER     |
|                                                              |             |                      | 2814                |                  |
|                                                              |             |                      | MAIL DATE           | DELIVERY MODE    |
|                                                              |             |                      | 05/01/2015          | PAPER            |

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

|                              |                                      |                                            |                                                  |
|------------------------------|--------------------------------------|--------------------------------------------|--------------------------------------------------|
| <b>Office Action Summary</b> | <b>Application No.</b><br>13/959,708 | <b>Applicant(s)</b><br>BURNETT, GREGORY C. |                                                  |
|                              | <b>Examiner</b><br>HOWARD WEISS      | <b>Art Unit</b><br>2814                    | <b>AIA (First Inventor to File) Status</b><br>No |

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --**

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 4/27/2015.  
☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on \_\_\_\_.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on \_\_\_\_; the restriction requirement and election have been incorporated into this action.
- 4) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims\***

- 5) ☒ Claim(s) 2-21 is/are pending in the application.  
5a) Of the above claim(s) \_\_\_\_ is/are withdrawn from consideration.
- 6) ☐ Claim(s) \_\_\_\_ is/are allowed.
- 7) ☒ Claim(s) 2-21 is/are rejected.
- 8) ☐ Claim(s) \_\_\_\_ is/are objected to.
- 9) ☐ Claim(s) \_\_\_\_ are subject to restriction and/or election requirement.

\* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see [http://www.uspto.gov/patents/init\\_events/pph/index.jsp](http://www.uspto.gov/patents/init_events/pph/index.jsp) or send an inquiry to [PPHfeedback@uspto.gov](mailto:PPHfeedback@uspto.gov).

**Application Papers**

- 10) ☐ The specification is objected to by the Examiner.
- 11) ☐ The drawing(s) filed on \_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

**Certified copies:**

- a) ☐ All    b) ☐ Some\*\*    c) ☐ None of the:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\*\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |                                                                                                |                                                         |
|------------------------------------------------------------------------------------------------|---------------------------------------------------------|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)                               | 3) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) | Paper No(s)/Mail Date. ____.                            |
| Paper No(s)/Mail Date ____.                                                                    | 4) <input type="checkbox"/> Other: ____.                |

Attorney's Docket Number: ALI-050ACON1

Filing Date: 8/5/2013

Continuing Data: a continuation of 12/139,333 (06/13/2008 now U. S. Patent No. 8,503,691) which claims benefit of 60/934,551 (06/13/2007) and claims benefit of 60/953,444 (08/01/2007) and claims benefit of 60/954,712 (08/08/2007) and claims benefit of 61/045,377 (04/16/2008); RCE established 4/21/2015

Claimed Foreign Priority Date: none

Applicant(s): Burnett

Examiner: Howard Weiss

***Notice of Pre-AIA or AIA Status***

1. The present application is being examined under the pre-AIA first to invent provisions.

***Double Patenting***

2. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory double patenting rejection is appropriate where the claims at issue are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the reference application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement. A terminal disclaimer must be signed in compliance with 37 CFR 1.321(b).

The USPTO internet Web site contains terminal disclaimer forms which may be used. Please visit <http://www.uspto.gov/forms/>. The filing date of the application will determine what form should be used. A web-based eTerminal Disclaimer may be filled out completely online using web-screens. An eTerminal Disclaimer that meets all requirements is auto-processed and approved immediately upon submission. For more information about eTerminal Disclaimers, refer to <http://www.uspto.gov/patents/process/file/efs/guidance/eTD-info-l.jsp>.

3. Claims 2 to 21 rejected on the ground of nonstatutory double patenting as being unpatentable over Claims 1 to 51 of U.S. Patent No. 8,494,177. Although the claims at issue are not identical, they are not patentably distinct from each other because both claim a first virtual microphone comprising a first combination of a first microphone signal and a second microphone signal, wherein the first microphone signal is generated by a first physical microphone and the second microphone signal is generated by a second physical microphone, a second virtual microphone comprising a second combination of the first microphone signal and the second microphone signal, wherein the second combination is different from the first combination, wherein the first virtual microphone and the second virtual microphone are distinct virtual directional microphones with substantially similar responses to noise and substantially dissimilar responses to speech, a virtual microphone array including the first and second virtual microphones and having a single null oriented in a direction toward a source of speech, a signal processor coupled with the first and second microphone signals and operative to combine the first and second microphone signals by filtering and summing in the time domain, to apply a varying linear transfer function between the first and second microphone signals, and to generate an output signal having noise content that is attenuated with respect to speech content.
4. Claims 2 to 21 are provisionally rejected on the ground of nonstatutory double patenting as being unpatentable over Claims 2 to 21 of copending Application No. 13/948,160. Although the claims at issue are not identical, they are not patentably distinct from each other because both claim a first virtual microphone comprising a

first combination of a first microphone signal and a second microphone signal, wherein the first microphone signal is generated by a first physical microphone and the second microphone signal is generated by a second physical microphone, a second virtual microphone comprising a second combination of the first microphone signal and the second microphone signal, wherein the second combination is different from the first combination, wherein the first virtual microphone and the second virtual microphone are distinct virtual directional microphones with substantially similar responses to noise and substantially dissimilar responses to speech, a virtual microphone array including the first and second virtual microphones and having a single null oriented in a direction toward a source of speech, a signal processor coupled with the first and second microphone signals and operative to combine the first and second microphone signals by filtering and summing in the time domain, to apply a varying linear transfer function between the first and second microphone signals, and to generate an output signal having noise content that is attenuated with respect to speech content.

This is a provisional nonstatutory double patenting rejection because the patentably indistinct claims have not in fact been patented.

***Terminal Disclaimer***

5. The terminal disclaimers filed on 4/21/2015 disclaiming the terminal portion of any patent granted on this application which would extend beyond the expiration date of U.S. Patent No. 8,494,177 and any patent issued on U.S. Application No. 13/948,160 has been reviewed and is NOT accepted.
6. The terminal disclaimers do not comply with 37 CFR 1.321 because:  
This application was filed on or after September 16, 2012. The party identified in the terminal disclaimers is not the applicant of record. A request to change the applicant under 37 CFR 1.46(c) must be filed and must include an application data sheet specifying the applicant in the applicant information section and comply with 37 CFR

3.71 and 3.73. To be reconsidered, the terminal disclaimers must be filed with the request under 37 CFR 1.46(c).

7. Below is what needs to be done by Applicant to remedy the defects:

- A request under 37 CFR 1.46(c) to change the applicant needs to be filed, which is:
  - 1) A request, signed by a 1.33(b) party.
  - 2) A corrected ADS (37 CFR 1.76(c)) that identifies the "NEW" Applicant in the applicant information, and is Underlined since its new.
  - 3) A 3.73(c) statement showing chain of title to the New Applicant.
  - 4) A POA that gives power to the attorney who is signing the TDs.
- Resubmit TDs with these papers, NO Fee is required.

### ***Conclusion***

8. Papers related to this application may be submitted directly to Art Unit 2814 by facsimile transmission. The faxing of such papers must conform with the notice published in the Official Gazette, 1096 OG 30 (15 November 1989). The Art Unit 2814 Fax Center number is **(571) 273-8300**. The Art Unit 2814 Fax Center is to be used only for papers related to Art Unit 2814 applications.

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Howard Weiss at **(571) 272-1720** and between the hours of 7:00 AM to 3:00 PM (Eastern Standard Time) Monday through Friday or by e-mail via [Howard.Weiss@uspto.gov](mailto:Howard.Weiss@uspto.gov). If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy, can be reached on **(571) 272-1705**.

10. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published

applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at **866-217-9197** (toll-free).

11. The following list is the Examiner's field of search for the present Office Action:

| Field of Search                                                          | Date           |
|--------------------------------------------------------------------------|----------------|
| U.S. Class / Subclass(es): H04R 3/005, 2410/05; G10L 2021/02165, 21/0208 | Thru 4/30/2015 |
| Other Documentation: none                                                |                |
| Electronic Database(s): EAST                                             | Thru 4/30/2015 |

HW/hw  
1 May 2015

/Howard Weiss/  
Primary Examiner  
Art Unit 2814

|                                                                                                                |                                              |                                                                       |  |
|----------------------------------------------------------------------------------------------------------------|----------------------------------------------|-----------------------------------------------------------------------|--|
| <b>Application Number</b><br> | <b>Application/Control No.</b><br>13/959,708 | <b>Applicant(s)/Patent under Reexamination</b><br>BURNETT, GREGORY C. |  |
| <b>Document Code - DISQ</b>                                                                                    |                                              | <b>Internal Document – DO NOT MAIL</b>                                |  |

|                            |                                                                                      |                                                 |
|----------------------------|--------------------------------------------------------------------------------------|-------------------------------------------------|
| <b>TERMINAL DISCLAIMER</b> | <input type="checkbox"/> APPROVED                                                    | <input checked="" type="checkbox"/> DISAPPROVED |
| Date Filed : 4/21/15       | <p align="center"><b>This patent is subject<br/>to a Terminal<br/>Disclaimer</b></p> |                                                 |

**Approved/Disapproved by:**

2/Tds disapproved.

Td identifies a party who is not the applicant (for applications filed on/after 9/16/12), see FP 14.26.10.

Below is what needs to be done by Applicant to remedy the defects:

A request under 37 CFR 1.46(c) to change the applicant needs to be filed, which is:

1. A request, signed by a 1.33(b) party,
2. A corrected ADS (37 CFR 1.76(c) that identifies the "NEW" Applicant in the applicant information, and is Underlined since its new, and,
3. A 3.73(c) statement showing chain of title to the New Applicant.
4. We need a POA that gives power to the attorney who is signing the Td.

Also resubmit Td with these papers, NO Fee is required.

Lawana Hixon

Doc code: RCEX

Doc description: Request for Continued Examination (RCE)

PTO/SB/30EFS (07-09)

Approved for use through 07/31/2012. OMB 0651-0031

U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

## REQUEST FOR CONTINUED EXAMINATION(RCE)TRANSMITTAL (Submitted Only via EFS-Web)

|                      |                    |             |            |                               |               |          |      |
|----------------------|--------------------|-------------|------------|-------------------------------|---------------|----------|------|
| Application Number   | 13959708           | Filing Date | 2013-08-05 | Docket Number (if applicable) | ALI-050ACON1  | Art Unit | 2814 |
| First Named Inventor | Gregory C. Burnett |             |            | Examiner Name                 | WEISS, Howard |          |      |

**This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.**

Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. The Instruction Sheet for this form is located at [WWW.USPTO.GOV](http://WWW.USPTO.GOV)

### SUBMISSION REQUIRED UNDER 37 CFR 1.114

Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).

☐ Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.

☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on \_\_\_\_\_

☐ Other \_\_\_\_\_

☒ Enclosed

☒ Amendment/Reply

☐ Information Disclosure Statement (IDS)

☐ Affidavit(s)/ Declaration(s)

☐ Other \_\_\_\_\_

### MISCELLANEOUS

☐ Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of months \_\_\_\_\_. (Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)

☐ Other \_\_\_\_\_

### FEES

**The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.**

☐ The Director is hereby authorized to charge any underpayment of fees, or credit any overpayments, to Deposit Account No \_\_\_\_\_

### SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

☒ Patent Practitioner Signature

☐ Applicant Signature

Doc code: RCEX

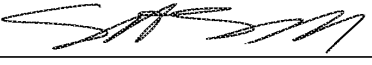
Doc description: Request for Continued Examination (RCE)

PTO/SB/30EFS (07-09)

Approved for use through 07/31/2012. OMB 0651-0031

U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

| Signature of Registered U.S. Patent Practitioner |                                                                                   |                     |            |
|--------------------------------------------------|-----------------------------------------------------------------------------------|---------------------|------------|
| Signature                                        |  | Date (YYYY-MM-DD)   | 2014-04-21 |
| Name                                             | Scott S. Kokka                                                                    | Registration Number | 51893      |

This collection of information is required by 37 CFR 1.114. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450.

*If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.*

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of:

Gregory C. Burnett

Application Serial No.: 13/959,708

Filing Date: August 5, 2013

For: FORMING VIRTUAL MICROPHONE  
ARRAYS USING DUAL  
OMNIDIRECTIONAL MICROPHONE  
ARRAY (DOMA)

Examiner: WEISS, Howard

Confirmation No.: 5622

Group Art Unit: 2814

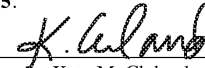
Transmission Date: April 21, 2015

Atty. Docket No.: ALI-050ACON1

CERTIFICATE OF EFS-WEB TRANSMISSION

I hereby certify that this correspondence is being transmitted via the U.S. Patent and Trademark Office electronic filing system (EFS-Web) to the USPTO on **April 21, 2015**.

Signed: \_\_\_\_\_

  
Kate M. Cleland

**RESPONSE**

Dear Sir or Madam:

In response to the *Final Office Action* mailed October 21, 2014, please find enclosed a complete, updated claim listing and remarks as well as 1) *Terminal Disclaimer under 37 C.F.R. §1.321 to Obviate an Obviousness-Type Double Patenting Rejection* and 2) *Terminal Disclaimer under 37 C.F.R. §1.321 to Obviate a Provisional Obviousness-Type Double*. Applicant hereby submits the \$320 fee to cover the statutory disclaimer fees for undiscounted entity as well as a 3-month extension of time fee of \$1,400.

CLAIM LISTING

1. (Cancelled)

2. (Previously presented) A device, comprising:

a first virtual microphone comprising a first combination of a first microphone signal and a second microphone signal, wherein the first microphone signal is generated by a first physical microphone and the second microphone signal is generated by a second physical microphone;

a second virtual microphone comprising a second combination of the first microphone signal and the second microphone signal, wherein the second combination is different from the first combination, wherein the first virtual microphone and the second virtual microphone are distinct virtual directional microphones with substantially similar responses to noise and substantially dissimilar responses to speech; and

a signal processor coupled with the first and second microphone signals and operative to combine the first and second microphone signals by filtering and summing in the time domain, to apply a varying linear transfer function between the first and second microphone signals, and to generate an output signal having noise content that is attenuated with respect to speech content.

3. (Previously presented) The device of Claim 2, wherein the signal processor comprises one or more digital signal processors (DSPs).

4. (Previously presented) The device of Claim 2, wherein the noise content comprises acoustic noise and the speech content comprises human speech.
5. (Previously presented) The device of Claim 2, wherein the signal processor is operative to add a delay to the first microphone signals.
6. (Previously presented) The device of Claim 5, wherein the signal processor is operative to raise the delay to a power that is proportional to a time difference between arrival of the speech at the first virtual microphone and arrival of the speech at the second virtual microphone.
7. (Previously presented) The device of Claim 5, wherein the signal processor is operative to raise the delay to a power that is proportional to a sampling frequency multiplied by a quantity equal to a third distance subtracted from a fourth distance, the third distance being between the first physical microphone and a speech source of the speech and the fourth distance being between the second physical microphone and the speech source.
8. (Previously presented) The device of Claim 2, wherein the first and second physical microphones comprise omnidirectional microphones.
9. (Previously presented) The device of Claim 2, wherein the first and second physical microphones are included in a microphone array.

10. (Previously presented) The device of Claim 2, wherein the first physical microphone and the second physical microphones are disposed along an axis and are separated from each other by a first distance.
11. (Previously presented) The device of Claim 10, wherein a midpoint of the axis is a second distance from a speech source that generates the speech, wherein the speech source is located in a direction defined by an angle relative to the midpoint.
12. (Previously presented) The device of Claim 11, wherein the first virtual microphone is formed by subtracting the second microphone signal from the first microphone signal.
13. (Previously presented) The device of Claim 11, wherein the second virtual microphone is formed by subtracting the first microphone signal from the second microphone signal.
14. (Previously presented) The device of Claim 2, wherein the first virtual microphone is formed by subtracting the second microphone signal from a delayed version of the first microphone signal.
15. (Previously presented) The device of Claim 2, wherein the second virtual microphone is formed by subtracting the first microphone signal from a delayed version of the second microphone signal.

16. (Previously presented) A device, comprising:

a first virtual microphone comprising a first combination of a first microphone signal and a second microphone signal, wherein the first microphone signal is generated by a first physical microphone and the second microphone signal is generated by a second physical microphone;

a second virtual microphone comprising a second combination of the first microphone signal and the second microphone signal, wherein the second combination is different from the first combination, wherein the first virtual microphone and the second virtual microphone are distinct virtual directional microphones with substantially similar responses to noise and substantially dissimilar responses to speech;

a virtual microphone array including the first and second virtual microphones and having a single null oriented in a direction toward a source of speech; and

a signal processor coupled with the first and second microphone signals and operative to combine the first and second microphone signals by filtering and summing in the time domain, to apply a varying linear transfer function between the first and second microphone signals, and to generate an output signal having noise content that is attenuated with respect to speech content.

17. (Previously presented) The device of Claim 16, wherein the source of speech comprises human speech.

18. (Previously presented) The device of Claim 16, wherein the second virtual microphone includes a second linear response to speech and the single null comprises a region of the second linear response to speech having a measured response level that is lower than a measured response level of any other region of the second linear response to speech.

19. (Previously presented) The device of Claim 16, wherein the first virtual microphone is formed by subtracting the second microphone signal from a delayed version of the first microphone signal.

20. (Previously presented) The device of Claim 16, wherein the second virtual microphone is formed by subtracting the first microphone signal from a delayed version of the second microphone signal.

21. (Previously presented) The device of Claim 16, wherein the first and second physical microphones are included in a microphone array.

**REMARKS**

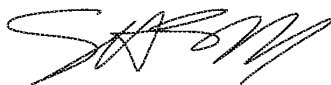
Claims 2-21 remain pending.

The Examiner has rejected claims 2 to 21 on the ground of non-statutory double patenting as being unpatentable over claims 1 to 51 of U.S. Patent No. 8,494,177. The Examiner has provisionally rejected Claims 2 to 21 on the ground of non-statutory double patenting as being unpatentable over Claims 2 to 21 of copending Application No. 13/948,160.

Applicant respectfully submits the enclosed 1) *Terminal Disclaimer under 37 C.F.R. §1.321 to Obviate an Obviousness-Type Double Patenting Rejection* and 2) *Terminal Disclaimer under 37 C.F.R. §1.321 to Obviate a Provisional Obviousness-Type Double Patenting Rejection* to overcome the Examiner's nonstatutory double patenting rejections.

Reconsideration of the application and allowance of all claims are respectfully requested based on the preceding remarks. If at any time the Examiner believes that an interview would be helpful, please contact the undersigned.

Respectfully submitted,



Scott S. Kokka  
Reg. No. 51,893

KOKKA & BACKUS, PC  
703 High Street  
Palo Alto, CA 94301-2447  
Tel: (650) 566-9921  
Fax: (650) 566-9922

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re Application of:  
Gregory C. Burnett

Application No.: 13/959,708

Filed: August 5, 2013

For: FORMING VIRTUAL  
MICROPHONE ARRAYS USING  
DUAL OMNIDIRECTIONAL  
MICROPHONE ARRAY (DOMA)

Confirmation No.: 5622

Examiner: WEISS, Howard

Group Art Unit: 2814

Date: April 21, 2015

Atty. Docket No.: ALI-050ACON1

CERTIFICATE OF EFS-WEB TRANSMISSION

I hereby certify that this correspondence is being transmitted via the U.S. Patent and Trademark Office electronic filing system (EFS-Web) to the USPTO on **April 21, 2015**.

Signed: \_\_\_\_\_

  
Kate M. Cleland

**TERMINAL DISCLAIMER UNDER 37 C.F.R. § 1.321**  
**TO OBVIATE A PROVISIONAL OBVIOUSNESS-TYPE DOUBLE**  
**PATENTING REJECTION**

Commissioner for Patents  
PO Box 1450  
Alexandria, VA 22313-1450

Dear Sir or Madam:

The owner(s), AliphCom (Assignee), of the entire interest in the above-identified application hereby disclaims, except as provided below, the terminal part of the statutory term of any patent granted on the above-identified application (hereafter "instant application"), which would extend beyond the expiration date of the full statutory term defined in 35 U.S.C. 154 and 173 of any patent granted on pending reference Application Number 13/948,160, filed on July 22, 2013 (hereafter "reference patent application"), as the term of any patent granted on said reference patent application may be shortened by any terminal disclaimer filed prior to the grant of any patent on the reference patent application. The owner(s) hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and any patent granted on the reference

patent application are commonly owned. This agreement runs with any patent granted on the instant application and is binding upon the grantee, its successors or assigns.

In making the above disclaimer, the owner does not disclaim the terminal part of any patent granted on the above-identified application that would extend to the expiration date of the full statutory term as defined in 35 U.S.C. 154 and 173 of any patent(s) granted on said reference patent application, as the term of any patent(s) granted on said reference patent application may be shortened by any terminal disclaimer filed prior to the grant of any patent(s) on the pending reference application, in the event that it later: expires for failure to pay a maintenance fee, is held unenforceable, is found invalid by a court of competent jurisdiction, is statutorily disclaimed in whole or terminally disclaimed under 37 CFR 1.321, has all claims canceled by a reexamination certificate, is reissued or is in any matter terminated prior to the expiration of its full statutory term as presently shortened by any terminal disclaimer.

We hereby submit the amount of \$160.00 to cover the statutory disclaimer fees for undiscounted entity. If any questions arise regarding this statutory disclaimer, please contact the undersigned attorney or agent of record.

Respectfully submitted,



Scott S. Kokka  
Reg. No. 51,893

Date: April 21, 2015

Kokka & Backus, PC  
703 High Street  
Palo Alto, CA 94301  
Tel: (650) 566-9921  
Fax: (650) 566-9922

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re Application of:  
Gregory C. Burnett

Application No.: 13/959,708

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For: FORMING VIRTUAL  
MICROPHONE ARRAYS USING  
DUAL OMNIDIRECTIONAL  
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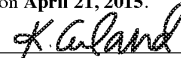
Date: April 21, 2015

Atty. Docket No.: ALI-050ACON1

CERTIFICATE OF EFS-WEB TRANSMISSION

I hereby certify that this correspondence is being transmitted via the U.S. Patent and Trademark Office electronic filing system (EFS-Web) to the USPTO on **April 21, 2015**.

Signed: \_\_\_\_\_

  
Kate M. Cleland

**TERMINAL DISCLAIMER UNDER 37 C.F.R. § 1.321(c) TO OBVIATE AN  
OBVIOUSNESS-TYPE DOUBLE PATENTING REJECTION**

Dear Sir:

The owner, AliphCom (Assignee), of the entire interest in the above-identified application hereby disclaims, except as provided below, the terminal part of the statutory term of any patent granted on the above-identified application (hereafter “instant application”), which would extend beyond the expiration date of the full statutory term, as defined in 35 U.S.C. §§ 154 and 173, of prior United States Patent No. 8,494,177 (hereafter “prior patent”), as presently shortened by any terminal disclaimer. The owner hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and the prior patent are commonly owned. This agreement runs with any patent granted on the instant application and is binding upon the grantee, its successors or assigns.

In making the above disclaimer, the owner does not disclaim the terminal part of any patent granted on the instant application that would extend to the expiration date of the full statutory term, as defined in 35 U.S.C. §§ 154 and 173, of the prior patent, as presently

shortened by any terminal disclaimer, in the event that it later: expires for failure to pay a maintenance fee, is held unenforceable, is found invalid by a court of competent jurisdiction, is statutorily disclaimed in whole or terminally disclaimed under 37 CFR § 1.321, has all claims canceled by a reexamination certificate, is reissued, or is in any manner terminated prior to the expiration of its full statutory term as presently shortened by any terminal disclaimer.

We hereby submit the amount of \$160.00 to cover the statutory disclaimer fee for undiscounted entity. If any questions arise regarding this statutory disclaimer, please contact the undersigned attorney or agent of record.

Respectfully submitted,



Scott S. Kokka  
Reg. No. 51,893

Date: April 21, 2015

Kokka & Backus, PC  
703 High Street  
Palo Alto, CA 94301-2447  
Tel: (650) 566-9921  
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# UNITED STATES PATENT AND TRADEMARK OFFICE

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| APPLICATION NO.                                              | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|--------------------------------------------------------------|-------------|----------------------|---------------------|------------------|
| 13/959,708                                                   | 08/05/2013  | Gregory C. Burnett   | ALI-050ACON1        | 5622             |
| 15516                                                        | 7590        | 10/21/2014           | EXAMINER            |                  |
| Kokka & Backus, PC<br>703 High Street<br>Palo Alto, CA 94301 |             |                      | WEISS, HOWARD       |                  |
|                                                              |             |                      | ART UNIT            | PAPER NUMBER     |
|                                                              |             |                      | 2814                |                  |
|                                                              |             |                      | MAIL DATE           | DELIVERY MODE    |
|                                                              |             |                      | 10/21/2014          | PAPER            |

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

|                              |                                      |                                            |                                                  |
|------------------------------|--------------------------------------|--------------------------------------------|--------------------------------------------------|
| <b>Office Action Summary</b> | <b>Application No.</b><br>13/959,708 | <b>Applicant(s)</b><br>BURNETT, GREGORY C. |                                                  |
|                              | <b>Examiner</b><br>HOWARD WEISS      | <b>Art Unit</b><br>2814                    | <b>AIA (First Inventor to File) Status</b><br>No |

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --**

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 8/12/2014.  
☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on \_\_\_\_.
- 2a) ☒ This action is **FINAL**.                      2b) ☐ This action is non-final.
- 3) ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on \_\_\_\_; the restriction requirement and election have been incorporated into this action.
- 4) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims\***

- 5) ☒ Claim(s) 2-21 is/are pending in the application.  
5a) Of the above claim(s) \_\_\_\_ is/are withdrawn from consideration.
- 6) ☐ Claim(s) \_\_\_\_ is/are allowed.
- 7) ☒ Claim(s) 2-21 is/are rejected.
- 8) ☐ Claim(s) \_\_\_\_ is/are objected to.
- 9) ☐ Claim(s) \_\_\_\_ are subject to restriction and/or election requirement.

\* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see [http://www.uspto.gov/patents/init\\_events/pph/index.jsp](http://www.uspto.gov/patents/init_events/pph/index.jsp) or send an inquiry to [PPHfeedback@uspto.gov](mailto:PPHfeedback@uspto.gov).

**Application Papers**

- 10) ☐ The specification is objected to by the Examiner.
- 11) ☐ The drawing(s) filed on \_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

**Certified copies:**

- a) ☐ All    b) ☐ Some\*\* c) ☐ None of the:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\*\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |                                                                                                |                                                         |
|------------------------------------------------------------------------------------------------|---------------------------------------------------------|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)                               | 3) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) | Paper No(s)/Mail Date. ____.                            |
| Paper No(s)/Mail Date ____.                                                                    | 4) <input type="checkbox"/> Other: ____.                |

Attorney's Docket Number: ALI-050ACON1

Filing Date: 8/5/2013

Continuing Data: a continuation of 12/139,333 (06/13/2008 now U. S. Patent No. 8,503,691) which claims benefit of 60/934,551 (06/13/2007) and claims benefit of 60/953,444 (08/01/2007) and claims benefit of 60/954,712 (08/08/2007) and claims benefit of 61/045,377 (04/16/2008)

Claimed Foreign Priority Date: none

Applicant(s): Burnett

Examiner: Howard Weiss

***Notice of Pre-AIA or AIA Status***

1. The present application is being examined under the pre-AIA first to invent provisions.

***Double Patenting***

2. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory double patenting rejection is appropriate where the claims at issue are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the reference application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement. A terminal disclaimer must be signed in compliance with 37 CFR 1.321(b).

The USPTO internet Web site contains terminal disclaimer forms which may be used. Please visit <http://www.uspto.gov/forms/>. The filing date of the application will

determine what form should be used. A web-based eTerminal Disclaimer may be filled out completely online using web-screens. An eTerminal Disclaimer that meets all requirements is auto-processed and approved immediately upon submission. For more information about eTerminal Disclaimers, refer to <http://www.uspto.gov/patents/process/file/efs/guidance/eTD-info-I.jsp>.

3. Claims 2 to 21 rejected on the ground of nonstatutory double patenting as being unpatentable over Claims 1 to 51 of U.S. Patent No. 8,494,177. Although the claims at issue are not identical, they are not patentably distinct from each other because both claim a first virtual microphone comprising a first combination of a first microphone signal and a second microphone signal, wherein the first microphone signal is generated by a first physical microphone and the second microphone signal is generated by a second physical microphone, a second virtual microphone comprising a second combination of the first microphone signal and the second microphone signal, wherein the second combination is different from the first combination, wherein the first virtual microphone and the second virtual microphone are distinct virtual directional microphones with substantially similar responses to noise and substantially dissimilar responses to speech, a virtual microphone array including the first and second virtual microphones and having a single null oriented in a direction toward a source of speech, a signal processor coupled with the first and second microphone signals and operative to combine the first and second microphone signals by filtering and summing in the time domain, to apply a varying linear transfer function between the first and second microphone signals, and to generate an output signal having noise content that is attenuated with respect to speech content.
4. Claims 2 to 21 are provisionally rejected on the ground of nonstatutory double patenting as being unpatentable over Claims 2 to 21 of copending Application No. 13/948,160. Although the claims at issue are not identical, they are not patentably distinct from each other because both claim a first virtual microphone comprising a first combination of a first microphone signal and a second microphone signal,

wherein the first microphone signal is generated by a first physical microphone and the second microphone signal is generated by a second physical microphone, a second virtual microphone comprising a second combination of the first microphone signal and the second microphone signal, wherein the second combination is different from the first combination, wherein the first virtual microphone and the second virtual microphone are distinct virtual directional microphones with substantially similar responses to noise and substantially dissimilar responses to speech, a virtual microphone array including the first and second virtual microphones and having a single null oriented in a direction toward a source of speech, a signal processor coupled with the first and second microphone signals and operative to combine the first and second microphone signals by filtering and summing in the time domain, to apply a varying linear transfer function between the first and second microphone signals, and to generate an output signal having noise content that is attenuated with respect to speech content.

This is a provisional nonstatutory double patenting rejection because the patentably indistinct claims have not in fact been patented.

#### ***Response to Arguments***

5. Applicant's arguments with respect to Claims 2 to 21 have been considered but are moot because the arguments do not apply to any of the references being used in the current rejection.

#### ***Conclusion***

6. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

7. Papers related to this application may be submitted directly to Art Unit 2814 by facsimile transmission. The faxing of such papers must conform with the notice published in the Official Gazette, 1096 OG 30 (15 November 1989). The Art Unit 2814 Fax Center number is **(571) 273-8300**. The Art Unit 2814 Fax Center is to be used only for papers related to Art Unit 2814 applications.
8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Howard Weiss at **(571) 272-1720** and between the hours of 7:00 AM to 3:00 PM (Eastern Standard Time) Monday through Friday or by e-mail via [Howard.Weiss@uspto.gov](mailto:Howard.Weiss@uspto.gov). If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy, can be reached on **(571) 272-1705**.
9. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at **866-217-9197** (toll-free).

10. The following list is the Examiner's field of search for the present Office Action:

| Field of Search                                                                                              | Date            |
|--------------------------------------------------------------------------------------------------------------|-----------------|
| U.S. Class / Subclass(es): 381/ 92,94.7; 704/ 233, E21.004;<br>H04R 3/005, 2410/05; G10L 2021/02165, 21/0208 | Thru 10/14/2014 |
| Other Documentation: none                                                                                    |                 |
| Electronic Database(s): EAST                                                                                 | Thru 10/14/2014 |

HW/hw  
20 October 2014

/Howard Weiss/  
Primary Examiner  
Art Unit 2814

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re the Application of:

**Gregory C. Burnett**

Application Serial No.: **13/959,708**

Filing Date: **August 5, 2013**

For: **Forming Virtual Microphone Arrays  
Using Dual Omnidirectional  
Microphone Array (DOMA)**

Examiner: **WEISS, Howard**

Confirmation No.: **5622**

Group Art Unit: **2814**

Transmission Date: **August 12, 2014**

Atty. Docket No.: **ALI-050ACON1**

**CERTIFICATE OF TRANSMISSION**

I hereby certify that this correspondence is being transmitted via the U.S. Patent and Trademark Office electronic filing system (**EFS-Web**) to the **USPTO** on **August 12, 2014**.

Signed:   
**Heather N. Erwin**

**AMENDMENT A**

Dear Sir or Madam:

Please find enclosed the following items:

1. Amendments to the Specification;
2. a complete, updated claim listing and remarks in response to the **Non-Final Office Action** mailed **May 12, 2014**, and;
3. Supplemental Application Data Sheet.

**AMENDMENTS TO THE SPECIFICATION**

a. Kindly replace paragraph **[0001]** of the present application as filed with the replacement paragraph as indicated below.

**[0001]** This application is a continuation of U.S. Nonprovisional Patent Application No. 12/139,333, filed June 13, 2008, **now U.S. Patent No. 8,503,691,** entitled “Forming Virtual Microphone Arrays Using Dual Omnidirectional Microphone Array (DOMA),” which claims the benefit of U.S. Provisional Patent Application No. 60/934,551, filed June 13, 2007, U.S. Provisional Patent Application No. 60/953,444, filed August 1, 2007, U.S. Provisional Patent Application No. 60/954,712, filed August 8, 2007, and U.S. Provisional Patent Application No. 61/045,377, filed April 16, 2008, all of which are incorporated by reference herein in their entirety for all purposes.

**AMENDMENTS TO THE CLAIMS:** This listing of claims will replace all prior versions, and listings, of claims in the application.

**Listing of Claims:**

1. (Cancelled)

2. (New) A device, comprising:

a first virtual microphone comprising a first combination of a first microphone signal and a second microphone signal, wherein the first microphone signal is generated by a first physical microphone and the second microphone signal is generated by a second physical microphone;

a second virtual microphone comprising a second combination of the first microphone signal and the second microphone signal, wherein the second combination is different from the first combination, wherein the first virtual microphone and the second virtual microphone are distinct virtual directional microphones with substantially similar responses to noise and substantially dissimilar responses to speech; and

a signal processor coupled with the first and second microphone signals and operative to combine the first and second microphone signals by filtering and summing in the time domain, to apply a varying linear transfer function between the first and second microphone signals, and to generate an output signal having noise content that is attenuated with respect to speech content.

3.     **(New)**         The device of Claim 2, wherein the signal processor comprises one or more digital signal processors (DSPs).
4.     **(New)**         The device of Claim 2, wherein the noise content comprises acoustic noise and the speech content comprises human speech.
5.     **(New)**         The device of Claim 2, wherein the signal processor is operative to add a delay to the first microphone signals.
6.     **(New)**         The device of Claim 5, wherein the signal processor is operative to raise the delay to a power that is proportional to a time difference between arrival of the speech at the first virtual microphone and arrival of the speech at the second virtual microphone.
7.     **(New)**         The device of Claim 5, wherein the signal processor is operative to raise the delay to a power that is proportional to a sampling frequency multiplied by a quantity equal to a third distance subtracted from a fourth distance, the third distance being between the first physical microphone and a speech source of the speech and the fourth distance being between the second physical microphone and the speech source.
8.     **(New)**         The device of Claim 2, wherein the first and second physical microphones comprise omnidirectional microphones.

9.     **(New)**         The device of Claim 2, wherein the first and second physical microphones are included in a microphone array.
10.   **(New)**         The device of Claim 2, wherein the first physical microphone and the second physical microphones are disposed along an axis and are separated from each other by a first distance.
11.   **(New)**         The device of Claim 10, wherein a midpoint of the axis is a second distance from a speech source that generates the speech, wherein the speech source is located in a direction defined by an angle relative to the midpoint.
12.   **(New)**         The device of Claim 11, wherein the first virtual microphone is formed by subtracting the second microphone signal from the first microphone signal.
13.   **(New)**         The device of Claim 11, wherein the second virtual microphone is formed by subtracting the first microphone signal from the second microphone signal.
14.   **(New)**         The device of Claim 2, wherein the first virtual microphone is formed by subtracting the second microphone signal from a delayed version of the first microphone signal.
15.   **(New)**         The device of Claim 2, wherein the second virtual microphone is formed by subtracting the first microphone signal from a delayed version of the second microphone signal.

16. **(New)** A device, comprising:

a first virtual microphone comprising a first combination of a first microphone signal and a second microphone signal, wherein the first microphone signal is generated by a first physical microphone and the second microphone signal is generated by a second physical microphone;

a second virtual microphone comprising a second combination of the first microphone signal and the second microphone signal, wherein the second combination is different from the first combination, wherein the first virtual microphone and the second virtual microphone are distinct virtual directional microphones with substantially similar responses to noise and substantially dissimilar responses to speech;

a virtual microphone array including the first and second virtual microphones and having a single null oriented in a direction toward a source of speech; and

a signal processor coupled with the first and second microphone signals and operative to combine the first and second microphone signals by filtering and summing in the time domain, to apply a varying linear transfer function between the first and second microphone signals, and to generate an output signal having noise content that is attenuated with respect to speech content.

17. **(New)** The device of Claim 16, wherein the source of speech comprises human speech.

18. **(New)** The device of Claim 16, wherein the second virtual microphone includes a second linear response to speech and the single null comprises a region of the second linear response to speech having a measured response level that is lower than a measured response level of any other region of the second linear response to speech.

19. **(New)** The device of Claim 16, wherein the first virtual microphone is formed by subtracting the second microphone signal from a delayed version of the first microphone signal.

20. **(New)** The device of Claim 16, wherein the second virtual microphone is formed by subtracting the first microphone signal from a delayed version of the second microphone signal.

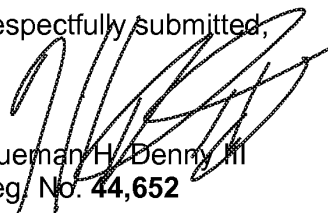
21. **(New)** The device of Claim 16, wherein the first and second physical microphones are included in a microphone array.

**REMARKS**

The status of the claims is as follows: **Claim 1** is **Cancelled**; and **New Claims 2 – 21** have been **Added** herein. Paragraph **[0001]** of the **Specification** has been amended herein by replacement paragraph to overcome the Examiner's objections to the disclosure. The Examiner has rejected **Claim 1** under **pre-AIA 35 U.S.C. §102(e)** as being anticipated by U.S. Patent No. **8,068,619** to *Zhang* and on grounds of **Non-Statutory Double Patenting** in view of Claims 1, 25, 29, 45 and 51 of U.S. Patent No. **8,494,177** and Claims 27, 29 and 41 of U.S. Patent No. **8,503,691**. The rejections are respectfully traversed. The **pre-AIA 35 U.S.C. §102(e)** and the **Non-Statutory Double Patenting** rejections of **Claim 1** are mooted by the cancellation herein of independent **Claim 1**. New **Claims 2 – 21** are patentably distinct, are non-obvious, and are not anticipated by the cited sections of *Zhang*.

Reconsideration of the application and allowance of all claims are respectfully requested based on the preceding remarks. If at any time the Examiner believes that an interview would be helpful, please contact the undersigned.

Respectfully submitted,

  
Trueman H. Denny III  
Reg. No. **44,652**

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# UNITED STATES PATENT AND TRADEMARK OFFICE

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| APPLICATION NO.                                              | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|--------------------------------------------------------------|-------------|----------------------|---------------------|------------------|
| 13/959,708                                                   | 08/05/2013  | Gregory C. Burnett   | ALI-050ACON1        | 5622             |
| 15516                                                        | 7590        | 05/12/2014           | EXAMINER            |                  |
| Kokka & Backus, PC<br>703 High Street<br>Palo Alto, CA 94301 |             |                      | WEISS, HOWARD       |                  |
|                                                              |             |                      | ART UNIT            | PAPER NUMBER     |
|                                                              |             |                      | 2814                |                  |
|                                                              |             |                      | MAIL DATE           | DELIVERY MODE    |
|                                                              |             |                      | 05/12/2014          | PAPER            |

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

|                              |                                      |                                            |                                                  |
|------------------------------|--------------------------------------|--------------------------------------------|--------------------------------------------------|
| <b>Office Action Summary</b> | <b>Application No.</b><br>13/959,708 | <b>Applicant(s)</b><br>BURNETT, GREGORY C. |                                                  |
|                              | <b>Examiner</b><br>HOWARD WEISS      | <b>Art Unit</b><br>2814                    | <b>AIA (First Inventor to File) Status</b><br>No |

**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --**

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 8/5/2013.  
☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on \_\_\_\_.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on \_\_\_\_; the restriction requirement and election have been incorporated into this action.
- 4) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims\***

- 5) ☒ Claim(s) 1 is/are pending in the application.  
5a) Of the above claim(s) \_\_\_\_ is/are withdrawn from consideration.
- 6) ☐ Claim(s) \_\_\_\_ is/are allowed.
- 7) ☒ Claim(s) 1 is/are rejected.
- 8) ☐ Claim(s) \_\_\_\_ is/are objected to.
- 9) ☐ Claim(s) \_\_\_\_ are subject to restriction and/or election requirement.

\* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see [http://www.uspto.gov/patents/init\\_events/pph/index.jsp](http://www.uspto.gov/patents/init_events/pph/index.jsp) or send an inquiry to [PPHfeedback@uspto.gov](mailto:PPHfeedback@uspto.gov).

**Application Papers**

- 10) ☒ The specification is objected to by the Examiner.
- 11) ☒ The drawing(s) filed on 8/5/2013 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

**Certified copies:**

- a) ☐ All    b) ☐ Some\*\*    c) ☐ None of the:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\*\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b)  
Paper No(s)/Mail Date \_\_\_\_.
- 3) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_.
- 4) ☐ Other: \_\_\_\_.

Application/Control Number: 13/959,708

Page 2

Art Unit: 2814

Attorney's Docket Number: ALI-050ACON1

Filing Date: 8/5/2013

Continuing Data: a continuation of 12/139,333 (06/13/2008 now U. S. Patent No. 8,503,691) which claims benefit of 60/934,551 (06/13/2007) and claims benefit of 60/953,444 (08/01/2007) and claims benefit of 60/954,712 (08/08/2007) and claims benefit of 61/045,377 (04/16/2008)

Claimed Foreign Priority Date: none

Applicant(s): Burnett

Examiner: Howard Weiss

***Notice of Pre-AIA or AIA Status***

1. The present application is being examined under the pre-AIA first to invent provisions.
2. In the event the determination of the status of the application as subject to AIA 35 U.S.C. 102 and 103 (or as subject to pre-AIA 35 U.S.C. 102 and 103) is incorrect, any correction of the statutory basis for the rejection will not be considered a new ground of rejection if the prior art relied upon, and the rationale supporting the rejection, would be the same under either status.

***Specification***

3. The disclosure is objected to because of the following informalities: --now U. S. Patent No. 8,503,691—should be inserted after “2008” in Line 2 of Paragraph [0001]. Appropriate correction is required.

***Claim Rejections - 35 USC § 102***

4. The following is a quotation of the appropriate paragraphs of pre-AIA 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section

Art Unit: 2814

351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

5. Claim 1 is rejected under pre-AIA 35 U.S.C. 102(e) as being anticipated by Zhang et al. (U. S. Patent No. 8,068,619).

Zhang et al. show all aspects of the instant invention (e.g. Figure 2) including:

- a first virtual microphone  **$b_1(n)$**  comprising a first combination of a first microphone signal  **$s_1(n)$**  and a second microphone signal  **$a(n)$** , wherein the first microphone signal is generated by a first physical microphone **212a** and the second microphone signal is generated by a second physical microphone **212b**
- a second virtual microphone  **$r_1(n)$**  comprising a second combination of the first microphone signal and the second microphone signal, wherein the second combination is different from the first combination, wherein the first virtual microphone and the second virtual microphone are distinct virtual directional microphones with substantially similar responses to noise and substantially dissimilar responses to speech

### ***Double Patenting***

6. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the “right to exclude” granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory double patenting rejection is appropriate where the claims at issue are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the reference application or patent either is shown

to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement. A terminal disclaimer must be signed in compliance with 37 CFR 1.321(b).

The USPTO internet Web site contains terminal disclaimer forms which may be used. Please visit <http://www.uspto.gov/forms/>. The filing date of the application will determine what form should be used. A web-based eTerminal Disclaimer may be filled out completely online using web-screens. An eTerminal Disclaimer that meets all requirements is auto-processed and approved immediately upon submission. For more information about eTerminal Disclaimers, refer to <http://www.uspto.gov/patents/process/file/efs/guidance/eTD-info-I.jsp>.

7. Claim 1 is rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1, 25, 29, 45 and 51 of U.S. Patent No. 8,494,177. Although the claims at issue are not identical, they are not patentably distinct from each other because both claim a first virtual microphone comprising a first combination of a first microphone signal and a second microphone signal, wherein the first microphone signal is generated by a first physical microphone and the second microphone signal is generated by a second physical microphone, a second virtual microphone comprising a second combination of the first microphone signal and the second microphone signal, wherein the second combination is different from the first combination, wherein the first virtual microphone and the second virtual microphone are distinct virtual directional microphones with substantially similar responses to noise and substantially dissimilar responses to speech. The instant invention is a broader statement of the invention of U.S. Patent No. 8,494,177.
8. Claim 1 is rejected on the ground of nonstatutory double patenting as being unpatentable over claims 27, 29 and 41 of U.S. Patent No. 8,503,691. Although the claims at issue are not identical, they are not patentably distinct from each other because both claim a first virtual microphone comprising a first combination of a first microphone signal and a second microphone signal, wherein the first microphone signal is generated by a first physical microphone and the second microphone signal is generated by a second physical microphone, a second virtual microphone

comprising a second combination of the first microphone signal and the second microphone signal, wherein the second combination is different from the first combination, wherein the first virtual microphone and the second virtual microphone are distinct virtual directional microphones with substantially similar responses to noise and substantially dissimilar responses to speech. The instant invention is a broader statement of the invention of U.S. Patent No. 8,503,691.

### ***Conclusion***

9. Papers related to this application may be submitted directly to Art Unit 2814 by facsimile transmission. The faxing of such papers must conform with the notice published in the Official Gazette, 1096 OG 30 (15 November 1989). The Art Unit 2814 Fax Center number is **(571) 273-8300**. The Art Unit 2814 Fax Center is to be used only for papers related to Art Unit 2814 applications.
10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Howard Weiss at **(571) 272-1720** and between the hours of 7:00 AM to 3:00 PM (Eastern Standard Time) Monday through Friday or by e-mail via [Howard.Weiss@uspto.gov](mailto:Howard.Weiss@uspto.gov). If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy, can be reached on **(571) 272-1705**.
11. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at **866-217-9197** (toll-free).

Art Unit: 2814

12. The following list is the Examiner's field of search for the present Office Action:

| Field of Search                                                                                              | Date     |
|--------------------------------------------------------------------------------------------------------------|----------|
| U.S. Class / Subclass(es): 381/ 92,94.7; 704/ 233, E21.004;<br>H04R 3/005, 2410/05; G10L 2021/02165, 21/0208 | 5/7/2014 |
| Other Documentation: Search from 12/139,333 and 13/948,160                                                   | 5/7/2014 |
| Electronic Database(s): EAST                                                                                 | 5/7/2014 |

HW/hw  
9 May 2014

/Howard Weiss/  
Primary Examiner  
Art Unit 2814

|                                   |                                       |                                                                   |             |
|-----------------------------------|---------------------------------------|-------------------------------------------------------------------|-------------|
| <b>Notice of References Cited</b> | Application/Control No.<br>13/959,708 | Applicant(s)/Patent Under<br>Reexamination<br>BURNETT, GREGORY C. |             |
|                                   | Examiner<br>HOWARD WEISS              | Art Unit<br>2814                                                  | Page 1 of 1 |

**U.S. PATENT DOCUMENTS**

| * |   | Document Number<br>Country Code-Number-Kind Code | Date<br>MM-YYYY | Name         | Classification |
|---|---|--------------------------------------------------|-----------------|--------------|----------------|
| * | A | US-8,503,691                                     | 08-2013         | Burnett      | 381/92         |
| * | B | US-8,494,177                                     | 07-2013         | Burnett      | 381/92         |
| * | C | US-8,068,619                                     | 11-2011         | Zhang et al. | 381/92         |
|   | D | US-                                              |                 |              |                |
|   | E | US-                                              |                 |              |                |
|   | F | US-                                              |                 |              |                |
|   | G | US-                                              |                 |              |                |
|   | H | US-                                              |                 |              |                |
|   | I | US-                                              |                 |              |                |
|   | J | US-                                              |                 |              |                |
|   | K | US-                                              |                 |              |                |
|   | L | US-                                              |                 |              |                |
|   | M | US-                                              |                 |              |                |

**FOREIGN PATENT DOCUMENTS**

| * |   | Document Number<br>Country Code-Number-Kind Code | Date<br>MM-YYYY | Country | Name | Classification |
|---|---|--------------------------------------------------|-----------------|---------|------|----------------|
|   | N |                                                  |                 |         |      |                |
|   | O |                                                  |                 |         |      |                |
|   | P |                                                  |                 |         |      |                |
|   | Q |                                                  |                 |         |      |                |
|   | R |                                                  |                 |         |      |                |
|   | S |                                                  |                 |         |      |                |
|   | T |                                                  |                 |         |      |                |

**NON-PATENT DOCUMENTS**

| * |   | Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages) |
|---|---|-------------------------------------------------------------------------------------------|
|   | U |                                                                                           |
|   | V |                                                                                           |
|   | W |                                                                                           |
|   | X |                                                                                           |

\*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)  
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.



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| APPLICATION<br>NUMBER | FILING or<br>371(c) DATE | GRP ART<br>UNIT | FIL FEE REC'D | ATTY. DOCKET NO | TOT CLAIMS | IND CLAIMS |
|-----------------------|--------------------------|-----------------|---------------|-----------------|------------|------------|
| 13/959,708            | 08/05/2013               | 2654            | 0.00          | ALI-050ACON1    | 1          | 1          |

CONFIRMATION NO. 5622

FILING RECEIPT



\*OC000000063342389\*

15516  
Kokka & Backus, PC  
703 High Street  
Palo Alto, CA 94301

Date Mailed: 08/21/2013

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Inventor(s)

Gregory C. Burnett, Dodge Center, MN;

Applicant(s)

Gregory C. Burnett, Dodge Center, MN;

Power of Attorney: None

Domestic Priority data as claimed by applicant

This application is a CON of 12/139,333 06/13/2008 PAT 8503691  
which claims benefit of 60/934,551 06/13/2007  
and claims benefit of 60/953,444 08/01/2007  
and claims benefit of 60/954,712 08/08/2007  
and claims benefit of 61/045,377 04/16/2008

**Foreign Applications** for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see <http://www.uspto.gov> for more information.) - None.

*Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.*

**If Required, Foreign Filing License Granted:** 08/20/2013

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 13/959,708**

**Projected Publication Date:** To Be Determined - pending completion of Missing Parts

**Non-Publication Request:** No

**Early Publication Request:** No

**\*\* SMALL ENTITY \*\***

**Title**

FORMING VIRTUAL MICROPHONE ARRAYS USING DUAL OMNIDIRECTIONAL MICROPHONE  
ARRAY (DOMA)

**Preliminary Class**

381

**Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications:** No

**PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES**

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at <http://www.uspto.gov/web/offices/pac/doc/general/index.html>.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, <http://www.stopfakes.gov>. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

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**Title 37, Code of Federal Regulations, 5.11 & 5.15**

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This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign Assets Control, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

**NOT GRANTED**

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                   |      |  |  |  |         |  |  |  |      |       |          |  |         |           |       |  |
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| <b>UTILITY<br/>PATENT APPLICATION<br/>TRANSMITTAL</b><br><br><small>(Only for new nonprovisional applications under 37 CFR 1.53(b))</small>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |           | Attorney Docket No.<br>First Named Inventor<br>Title<br>Express Mail Label No.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | ALI-050ACON1<br>Gregory C. Burnett<br>FORMING VIRTUAL MICROPHONE ARRAYS...<br>N/A |      |  |  |  |         |  |  |  |      |       |          |  |         |           |       |  |
| <b>APPLICATION ELEMENTS</b><br><small>See MPEP chapter 600 concerning utility patent application contents.</small>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |           | <b>ADDRESS TO:</b> Commissioner for Patents<br>P.O. Box 1450<br>Alexandria, VA 22313-1450                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                   |      |  |  |  |         |  |  |  |      |       |          |  |         |           |       |  |
| 1. <input type="checkbox"/> <b>Fee Transmittal Form</b><br><small>(PTO/SB/17 or equivalent)</small><br>2. <input checked="" type="checkbox"/> <b>Applicant asserts small entity status.</b><br><small>See 37 CFR 1.27</small><br>3. <input type="checkbox"/> <b>Applicant certifies micro entity status.</b> See 37 CFR 1.29.<br><small>Applicant must attach form PTO/SB/15A or B or equivalent.</small><br>4. <input checked="" type="checkbox"/> <b>Specification</b> [Total Pages <u>54</u> ]<br><small>Both the claims and abstract must start on a new page.<br/>         (See MPEP § 608.01(a) for information on the preferred arrangement)</small><br>5. <input checked="" type="checkbox"/> <b>Drawing(s)</b> (35 U.S.C. 113) [Total Sheets <u>17</u> ]<br>6. <input checked="" type="checkbox"/> <b>Inventor's Oath or Declaration</b> [Total Pages _____]<br><small>(including substitute statements under 37 CFR 1.64 and assignments<br/>         serving as an oath or declaration under 37 CFR 1.63(e))</small><br>a. <input type="checkbox"/> Newly executed (original or copy)<br>b. <input type="checkbox"/> A copy from a prior application (37 CFR 1.63(d))<br>7. <input checked="" type="checkbox"/> <b>Application Data Sheet</b> * See note below.<br><small>See 37 CFR 1.76 (PTO/AIA/14 or equivalent)</small><br>8. <input type="checkbox"/> <b>CD-ROM or CD-R</b><br><small>in duplicate, large table, or Computer Program (Appendix)</small><br><input type="checkbox"/> Landscape Table on CD<br>9. <b>Nucleotide and/or Amino Acid Sequence Submission</b><br><small>(if applicable, items a. -- c. are required)</small><br>a. <input type="checkbox"/> Computer Readable Form (CRF)<br>b. <input type="checkbox"/> Specification Sequence Listing on:<br>i. <input type="checkbox"/> CD-ROM or CD-R (2 copies); or<br>ii. <input type="checkbox"/> Paper<br>c. <input type="checkbox"/> Statements verifying identity of above copies |           | <b>ACCOMPANYING APPLICATION PAPERS</b><br>10. <input type="checkbox"/> <b>Assignment Papers</b><br><small>(cover sheet &amp; document(s))</small><br>Name of Assignee _____<br>11. <input type="checkbox"/> <b>37 CFR 3.73(c) Statement</b> <input type="checkbox"/> <b>Power of Attorney</b><br><small>(when there is an assignee)</small><br>12. <input type="checkbox"/> <b>English Translation Document</b><br><small>(if applicable)</small><br>13. <input type="checkbox"/> <b>Information Disclosure Statement</b><br><small>(PTO/SB/08 or PTO-1449)</small><br><input type="checkbox"/> Copies of citations attached<br>14. <input type="checkbox"/> <b>Preliminary Amendment</b><br>15. <input type="checkbox"/> <b>Return Receipt Postcard</b><br><small>(MPEP § 503) (Should be specifically itemized)</small><br>16. <input type="checkbox"/> <b>Certified Copy of Priority Document(s)</b><br><small>(if foreign priority is claimed)</small><br>17. <input type="checkbox"/> <b>Nonpublication Request</b><br><small>Under 35 U.S.C. 122(b)(2)(B)(i). Applicant must attach form PTO/SB/35<br/>         or equivalent.</small><br>18. <input type="checkbox"/> <b>Other:</b> _____<br>_____<br>_____<br>_____ |                                                                                   |      |  |  |  |         |  |  |  |      |       |          |  |         |           |       |  |
| <p>*Note: (1) Benefit claims under 37 CFR 1.78 and foreign priority claims under 1.55 must be included in an Application Data Sheet (ADS).<br/>         (2) For applications filed under 35 U.S.C. 111, the application must contain an ADS specifying the applicant if the applicant is an assignee, person to whom the inventor is under an obligation to assign, or person who otherwise shows sufficient proprietary interest in the matter. See 37 CFR 1.46(b).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                   |      |  |  |  |         |  |  |  |      |       |          |  |         |           |       |  |
| <b>19. CORRESPONDENCE ADDRESS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                   |      |  |  |  |         |  |  |  |      |       |          |  |         |           |       |  |
| <input checked="" type="checkbox"/> The address associated with Customer Number: <u>15516</u> OR <input type="checkbox"/> Correspondence address below                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                   |      |  |  |  |         |  |  |  |      |       |          |  |         |           |       |  |
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| Signature                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |           | Date <b>August 5, 2013</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                   |      |  |  |  |         |  |  |  |      |       |          |  |         |           |       |  |
| Name (Print/Type) <b>Scott S. Kokka</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |           | Registration No. (Attorney/Agent) <b>51,893</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                   |      |  |  |  |         |  |  |  |      |       |          |  |         |           |       |  |

This collection of information is required by 37 CFR 1.53(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

## **Application Data Sheet**

### **Cross-Reference to Related Applications**

This application is a continuation of U.S. Nonprovisional Patent Application No. 12/139,333, filed June 13, 2008, entitled "Forming Virtual Microphone Arrays Using Dual Omnidirectional Microphone Array (DOMA)," which claims the benefit of U.S. Provisional Patent Application No. 60/934,551, filed June 13, 2007, U.S. Provisional Patent Application No. 60/953,444, filed August 1, 2007, U.S. Provisional Patent Application No. 60/954,712, filed August 8, 2007, and U.S. Provisional Patent Application No. 61/045,377, filed April 16, 2008, all of which are incorporated by reference herein in their entirety for all purposes.

### **Application Information**

|                                         |                                                                                            |
|-----------------------------------------|--------------------------------------------------------------------------------------------|
| <b>Filing Date::</b>                    | August 5, 2013                                                                             |
| <b>Application Type::</b>               | Continuation                                                                               |
| <b>Subject Matter::</b>                 | Utility                                                                                    |
| <b>Suggested Group Art Unit::</b>       | None                                                                                       |
| <b>CD-ROM or CD-R?::</b>                | None                                                                                       |
| <b>Title::</b>                          | FORMING VIRTUAL MICROPHONE<br>ARRAYS USING DUAL OMNIDIRECTIONAL<br>MICROPHONE ARRAY (DOMA) |
| <b>Attorney Docket Number::</b>         | ALI-050ACON1                                                                               |
| <b>Request for Early Publication?::</b> | No                                                                                         |
| <b>Request for Non-Publication?::</b>   | No                                                                                         |
| <b>Suggested Drawing Figure::</b>       | FIG. 1                                                                                     |
| <b>Total Drawing Sheets::</b>           | 17                                                                                         |
| <b>Small Entity::</b>                   | Yes                                                                                        |
| <b>Petition included?::</b>             | No                                                                                         |
| <b>Secrecy Order in Parent Appl.?::</b> | No                                                                                         |
|                                         | 1                                                                                          |

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Representative Customer Number:: 15516

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| Primary                         | 51,893                | Scott S. Kokka |

## Signature



Scott S. Kokka

Reg. No. 51,893



Date

**APPLICATION FOR UNITED STATES PATENT**

**FORMING VIRTUAL MICROPHONE ARRAYS USING DUAL**

**OMNIDIRECTIONAL MICROPHONE ARRAY (DOMA)**

By Inventor:

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## **FORMING VIRTUAL MICROPHONE ARRAYS USING DUAL OMNIDIRECTIONAL MICROPHONE ARRAY (DOMA)**

### **CROSS-REFERENCE TO RELATED APPLICATIONS**

[0001] This application is a continuation of U.S. Nonprovisional Patent Application No. 12/139,333, filed June 13, 2008, entitled "Forming Virtual Microphone Arrays Using Dual Omnidirectional Microphone Array (DOMA)," which claims the benefit of U.S. Provisional Patent Application No. 60/934,551, filed June 13, 2007, U.S. Provisional Patent Application No. 60/953,444, filed August 1, 2007, U.S. Provisional Patent Application No. 60/954,712, filed August 8, 2007, and U.S. Provisional Patent Application No. 61/045,377, filed April 16, 2008, all of which are incorporated by reference herein in their entirety for all purposes.

### **TECHNICAL FIELD**

[0002] The disclosure herein relates generally to noise suppression. In particular, this disclosure relates to noise suppression systems, devices, and methods for use in acoustic applications.

### **BACKGROUND**

[0003] Conventional adaptive noise suppression algorithms have been around for some time. These conventional algorithms have used two or more microphones to sample both an (unwanted) acoustic noise field and the (desired) speech of a user. 20 The noise relationship between the microphones is then determined using an adaptive filter (such as Least-Mean-Squares as described in Haykin & Widrow, ISBN# 0471215708, Wiley, 2002, but any adaptive or stationary system identification algorithm may be used) and that relationship used to filter the noise from the desired signal.

[0004] Most conventional noise suppression systems currently in use for speech communication systems are based on a single-microphone spectral subtraction technique first develop in the 1970's and described, for example, by S. F. Boll in "Suppression of Acoustic Noise in Speech using Spectral Subtraction," IEEE Trans. on ASSP, pp. 113-120, 1979. These

techniques have been refined over the years, 30 but the basic principles of operation have remained the same. See, for example, US Patent Number 5,687,243 of McLaughlin, et al., and US Patent Number 4,811,404 of Vilmur, et al. There have also been several attempts at multi-microphone noise suppression systems, such as those outlined in US Patent Number 5,406,622 of Silverberg et al. and US Patent Number 5,463,694 of Bradley et al. Multi-microphone systems have not been very successful for a variety of reasons, the most compelling being poor noise cancellation performance and/or significant speech distortion. Primarily, conventional multi-microphone systems attempt to increase the SNR of the user's speech by "steering" the nulls of the system to the strongest noise sources. This approach is limited in the number of noise sources removed by the number of available nulls.

[0005] The Jawbone earpiece (referred to as the "Jawbone"), introduced in December 2006 by AliphCom of San Francisco, California, was the first known commercial 10 product to use a pair of physical directional microphones (instead of omnidirectional microphones) to reduce environmental acoustic noise. The technology supporting the Jawbone is currently described under one or more of US Patent Number 7,246,058 by Burnett and/or US Patent Application Numbers 10/400,282, 10/667,207, and/or 10/769,302. Generally, multi-microphone techniques make use of an acoustic-based Voice Activity Detector (VAD) to determine the background noise characteristics, where "voice" is generally understood to include human voiced speech, unvoiced speech, or a combination of voiced and unvoiced speech. The Jawbone improved on this by using a microphone-based sensor to construct a VAD signal using directly detected speech vibrations in the user's cheek. This allowed the Jawbone to aggressively remove noise when the user was not producing speech. However, the Jawbone uses a directional microphone array.

#### **INCORPORATION BY REFERENCE**

[0006] Each patent, patent application, and/or publication mentioned in this specification is herein incorporated by reference in its entirety to the same extent as if each individual patent, patent application, and/or publication was specifically and individually indicated to be incorporated by reference.

### **BRIEF DESCRIPTION OF THE DRAWINGS**

- [0007] **Figure 1** is a two-microphone adaptive noise suppression system, under an embodiment.
- [0008] **Figure 2** is an array and speech source (S) configuration, under an embodiment. The microphones are separated by a distance approximately equal to  $2d_0$ , and the speech source is located a distance  $d_s$  away from the midpoint of the array at an angle  $\theta$ . The system is axially symmetric so only  $d_s$  and  $\theta$  need be specified.
- [0009] **Figure 3** is a block diagram for a first order gradient microphone using two omnidirectional elements  $O_1$  and  $O_2$ , under an embodiment.
- [0010] **Figure 4** is a block diagram for a DOMA including two physical microphones configured to form two virtual microphones  $V_1$  and  $V_2$ , under an embodiment.
- [0011] **Figure 5** is a block diagram for a DOMA including two physical microphones configured to form  $N$  virtual microphones  $V_1$  through  $V_N$ , where  $N$  is any number greater than one, under an embodiment.
- [0012] **Figure 6** is an example of a headset or head-worn device that includes the DOMA, as described herein, under an embodiment.
- [0013] **Figure 7** is a flow diagram for denoising acoustic signals using the DOMA, under an embodiment.
- [0014] **Figure 8** is a flow diagram for forming the DOMA, under an embodiment.
- [0015] **Figure 9** is a plot of linear response of virtual microphone  $V_2$  to a 1 kHz speech source at a distance of 0.1 m, under an embodiment. The null is at 0 degrees, where the speech is normally located.
- [0016] **Figure 10** is a plot of linear response of virtual microphone  $V_2$  to a 1 kHz noise source at a distance of 1.0 m, under an embodiment. There is no null and all noise sources are detected.
- [0017] **Figure 11** is a plot of linear response of virtual microphone  $V_1$  to a 1 kHz speech source at a distance of 0.1 m, under an embodiment. There is no null and the response for speech is greater than that shown in Figure 9.

[0018] **Figure 12** is a plot of linear response of virtual microphone  $V_1$  to a 1 kHz noise source at a distance of 1.0 m, under an embodiment. There is no null and the response is very similar to  $V_2$  shown in Figure 10.

[0019] **Figure 13** is a plot of linear response of virtual microphone  $V_1$  to a speech source at a distance of 0.1 m for frequencies of 100, 500, 1000, 2000, 3000, and 4000 Hz, under an embodiment.

[0020] **Figure 14** is a plot showing comparison of frequency responses for speech for the array of an embodiment and for a conventional cardioid microphone.

[0021] **Figure 15** is a plot showing speech response for  $V_1$  (top, dashed) and  $V_2$  (bottom, solid) versus  $B$  with  $d_s$  assumed to be 0.1 m, under an embodiment. The spatial null in  $V_2$  is relatively broad.

[0022] **Figure 16** is a plot showing a ratio of  $V_1/V_2$  speech responses shown in Figure 10 versus  $B$ , under an embodiment. The ratio is above 10 dB for all  $0.8 < B < 1.1$ . This means that the physical  $\beta$  of the system need not be exactly modeled for good performance.

[0023] **Figure 17** is a plot of  $B$  versus actual  $d_s$  assuming that  $d_s = 10$  cm and  $\theta = 0$ , under an embodiment.

[0024] **Figure 18** is a plot of  $B$  versus  $\theta$  with  $d_s = 10$  cm and assuming  $d_s = 10$  cm, under an embodiment.

[0025] **Figure 19** is a plot of amplitude (top) and phase (bottom) response of  $N(s)$  with  $B = 1$  and  $D = -7.2$   $\mu\text{sec}$ , under an embodiment. The resulting phase difference clearly affects high frequencies more than low.

[0026] **Figure 20** is a plot of amplitude (top) and phase (bottom) response of  $N(s)$  with  $B = 1.2$  and  $D = -7.2$   $\mu\text{sec}$ , under an embodiment. Non-unity  $B$  affects the entire frequency range.

[0027] **Figure 21** is a plot of amplitude (top) and phase (bottom) response of the effect on the speech cancellation in  $V_2$  due to a mistake in the location of the speech source with  $q_1 = 0$  degrees and  $q_2 = 30$  degrees, under an embodiment. The cancellation remains below -10 dB for frequencies below 6 kHz.

[0028] **Figure 22** is a plot of amplitude (top) and phase (bottom) response of the effect on the speech cancellation in  $V_2$  due to a mistake in the location of the speech source with  $q_1 = 0$  degrees and  $q_2 = 45$  degrees, under an embodiment. The cancellation is below -10 dB only for frequencies below about 2.8 kHz and a reduction in performance is expected.

[0029] **Figure 23** shows experimental results for a  $2d_0 = 19$  mm array using a linear  $\beta$  of 0.83 on a Bruel and Kjaer Head and Torso Simulator (HATS) in very loud ( ~85 dBA) music/speech noise environment, under an embodiment. The noise has been reduced by about 25 dB and the speech hardly affected, with no noticeable distortion.

### SUMMARY OF THE INVENTION

[0030] The present invention provides for dual omnidirectional microphone array devices systems and methods.

[0031] In accordance with on embodiment, a microphone array is formed with a first virtual microphone that includes a first combination of a first microphone signal and a second microphone signal, wherein the first microphone signal is generated by a first physical microphone and the second microphone signal is generated by a second physical microphone; and a second virtual microphone that includes a second combination of the first microphone signal and the second microphone signal, wherein the second combination is different from the first combination. The first virtual microphone and the second virtual microphone are distinct virtual directional microphones with substantially similar responses to noise and substantially dissimilar responses to speech.

[0032] In accordance with another embodiment, a microphone array is formed with a first virtual microphone formed from a first combination of a first microphone signal and a second microphone signal, wherein the first microphone signal is generated by a first omnidirectional microphone and the second microphone signal is generated by a second omnidirectional microphone; and a second virtual microphone formed from a second combination of the first microphone signal and the second microphone signal, wherein the second combination is different from the first combination. The first virtual microphone has a first linear response to speech that has a single null oriented in a direction toward a source of the speech, wherein the speech is human speech.

[0033] In accordance with another embodiment, a device includes a first microphone outputting a first microphone signal and a second microphone outputting a second microphone signal; and a processing component coupled to the first microphone signal and the second microphone signal, the processing component generating a virtual microphone array comprising a first virtual microphone and a second virtual microphone, wherein the first virtual microphone

comprises a first combination of the first microphone signal and the second microphone signal, and wherein the second virtual microphone comprises a second combination of the first microphone signal and the second microphone signal. The second virtual microphone have substantially similar responses to noise and substantially dissimilar responses to speech.

**[0034]** In accordance with another embodiment, a device includes a first microphone outputting a first microphone signal and a second microphone outputting a second microphone signal, wherein the first microphone and the second microphone are omnidirectional microphones; and a virtual microphone array comprising a first virtual microphone and a second virtual microphone, wherein the first virtual microphone comprises a first combination of the first microphone signal and the second microphone signal, and the second virtual microphone comprises a second combination of the first microphone signal and the second microphone signal. The second combination is different from the first combination, and the first virtual microphone and the second virtual microphone are distinct virtual directional microphones.

**[0035]** In accordance with another embodiment, a device includes a first physical microphone generating a first microphone signal; a second physical microphone generating a second microphone signal; and a processing component coupled to the first microphone signal and the second microphone signal, the processing component generating a virtual microphone array comprising a first virtual microphone and a second virtual microphone. The first virtual microphone comprises the second microphone signal subtracted from a delayed version of the first microphone signal, and the second virtual microphone comprises a delayed version of the first microphone signal subtracted from the second microphone signal.

**[0036]** In accordance with another embodiment, a sensor includes a physical microphone array including a first physical microphone and a second physical microphone, the first physical microphone outputting a first microphone signal and the second physical microphone outputting a second microphone signal; and a virtual microphone array comprising a first virtual microphone and a second virtual microphone, the first virtual microphone comprising a first combination of the first microphone signal and the second microphone signal, the second virtual microphone comprising a second combination of the first microphone signal and the second microphone signal. The second combination is different from the first combination, and the virtual microphone array includes a single null oriented in a direction toward a source of speech of a human speaker.

### **DETAILED DESCRIPTION**

[0037] A dual omnidirectional microphone array (DOMA) that provides improved noise suppression is described herein. Compared to conventional arrays and algorithms, which seek to reduce noise by nulling out noise sources, the array of an embodiment is used to form two distinct virtual directional microphones which are configured to have very similar noise responses and very dissimilar speech responses. The only null formed by the DOMA is one used to remove the speech of the user from  $V_2$ . The two virtual microphones of an embodiment can be paired with an adaptive filter algorithm and/or VAD algorithm to significantly reduce the noise without distorting the speech, significantly improving the SNR of the desired speech over conventional noise suppression systems. The embodiments described herein are stable in operation, flexible with respect to virtual microphone pattern choice, and have proven to be robust with respect to speech source-to-array distance and orientation as well as temperature and calibration techniques. In the following description, numerous specific details are introduced to provide a thorough understanding of, and enabling description for, embodiments of the DOMA. One skilled in the relevant art, however, will recognize that these embodiments can be practiced without one or more of the specific details, or with other components, systems, etc. In other instances, well-known structures or operations are not shown, or are not described in detail, to avoid obscuring aspects of the disclosed embodiments.

[0038] Unless otherwise specified, the following terms have the corresponding meanings in addition to any meaning or understanding they may convey to one skilled in the art.

[0039] The term "bleedthrough" means the undesired presence of noise during speech.

[0040] The term "denoising" means removing unwanted noise from Mic1, and also refers to the amount of reduction of noise energy in a signal in decibels (dB).

[0041] The term "devoicing" means removing/distorting the desired speech from Mic1.

[0042] The term "directional microphone (DM)" means a physical directional microphone that is vented on both sides of the sensing diaphragm.

[0043] The term "Mic1 (M1)" means a general designation for an adaptive noise suppression system microphone that usually contains more speech than noise.

[0044] The term "Mic2 (M2)" means a general designation for an adaptive noise suppression system microphone that usually contains more noise than speech.

[0045] The term "noise" means unwanted environmental acoustic noise.

- [0046] The term "null" means a zero or minima in the spatial response of a physical or virtual directional microphone.
- [0047] The term "O<sub>1</sub>" means a first physical omnidirectional microphone used to form a microphone array.
- [0048] The term "O<sub>2</sub>" means a second physical omnidirectional microphone used to form a microphone array.
- [0049] The term "speech" means desired speech of the user.
- [0050] The term "Skin Surface Microphone (SSM)" is a microphone used in an earpiece (e.g., the Jawbone earpiece available from Aliph of San Francisco, California) to detect speech vibrations on the user's skin.
- [0051] The term "V<sub>1</sub>" means the virtual directional "speech" microphone, which has no nulls.
- [0052] The term "V<sub>2</sub>" means the virtual directional "noise" microphone, which has a null for the user's speech.
- [0053] The term "Voice Activity Detection (VAD) signal" means a signal indicating when user speech is detected.
- [0054] The term "virtual microphones (VM)" or "virtual directional microphones" means a microphone constructed using two or more omnidirectional microphones and associated signal processing.
- [0055] **Figure 1** is a two-microphone adaptive noise suppression system 100, under an embodiment. The two-microphone system 100 including the combination of physical microphones MIC 1 and MIC 2 along with the processing or circuitry components to which the microphones couple (described in detail below, but not shown in this figure) is referred to herein as the dual omnidirectional microphone array (DOMA) 110, but the embodiment is not so limited. Referring to Figure 1, in analyzing the single noise source 101 and the direct path to the microphones, the total acoustic information coming into MIC 1 (102, which can be an physical or 5 virtual microphone) is denoted by  $m_1(n)$ . The total acoustic information coming into MIC 2 (103, which can also be an physical or virtual microphone) is similarly labeled  $m_2(n)$ . In the  $z$  (digital frequency) domain, these are represented as  $M_1(z)$  and  $M_2(z)$ . Then,

$$M_1(z) = S(z) + N_2(z)$$

$$M_2(z) = N(z) + S_2(z),$$

with

$$\begin{aligned} N_2(z) &= N(z)H_1(z) \\ S_2(z) &= S(z)H_2(z), \end{aligned}$$

so that

$$\begin{aligned} M_1(z) &= S(z) + N(z)H_1(z) \\ M_2(z) &= N(z) + S(z)H_2(z). \end{aligned} \tag{Eq. 1}$$

This is the general case for all two microphone systems. Equation 1 has four unknowns and only two known relationships and therefore cannot be solved explicitly.

[0056] However, there is another way to solve for some of the unknowns in Equation 1. The analysis starts with an examination of the case where the speech is not being generated, that is, where a signal from the VAD subsystem 104 (optional) equals zero. In this case,  $s(n) = S(z) = 0$ , and Equation 1 reduces to

$$\begin{aligned} M_{1N}(z) &= N(z)H_1(z) \\ M_{2N}(z) &= N(z), \end{aligned}$$

where the N subscript on the M variables indicate that only noise is being received.

This leads to

$$\begin{aligned} M_{1N}(z) &= M_{2N}(z)H_1(z) \\ H_1(z) &= \frac{M_{1N}(z)}{M_{2N}(z)}. \end{aligned} \tag{Eq. 2}$$

The function  $H_1(z)$  can be calculated using any of the available system identification algorithms and the microphone outputs when the system is certain that only noise is being received. The calculation can be done adaptively, so that the system can react to changes in the noise.

[0057] A solution is now available for  $H_1(z)$ , one of the unknowns in Equation 1. The final unknown,  $H_2(z)$ , can be determined by using the instances where speech is being produced and the VAD equals one. When this is occurring, but the recent (perhaps less than 1 second) history

of the microphones indicate low levels of 10 noise, it can be assumed that  $n(s) = N(z) \sim 0$ . Then Equation 1 reduces to

$$\begin{aligned} M_{1s}(z) &= S(z) \\ M_{2s}(z) &= S(z)H_2(z), \end{aligned}$$

which in turn leads to

$$\begin{aligned} M_{2s}(z) &= M_{1s}(z)H_2(z) \\ H_2(z) &= \frac{M_{2s}(z)}{M_{1s}(z)}, \end{aligned}$$

which is the inverse of the  $H_1(z)$  calculation. However, it is noted that different inputs are being used (now only the speech is occurring whereas before only the noise was occurring). While calculating  $H_2(z)$ , the values calculated for  $H_1(z)$  are held constant (and vice versa) and it is assumed that the noise level is not high enough to cause errors in the  $H_2(z)$  calculation.

**[0058]** After calculating  $H_1(z)$  and  $H_2(z)$ , they are used to remove the noise from the signal.

If Equation 1 is rewritten as

$$\begin{aligned} S(z) &= M_1(z) - N(z)H_1(z) \\ N(z) &= M_2(z) - S(z)H_2(z) \\ S(z) &= M_1(z) - [M_2(z) - S(z)H_2(z)]H_1(z) \\ S(z)[1 - H_2(z)H_1(z)] &= M_1(z) - M_2(z)H_1(z), \end{aligned}$$

then  $N(z)$  may be substituted as shown to solve for  $S(z)$  as

$$S(z) = \frac{M_1(z) - M_2(z)H_1(z)}{1 - H_1(z)H_2(z)}. \quad \text{Eq. 3}$$

**[0059]** If the transfer functions  $H_1(z)$  and  $H_2(z)$  can be described with sufficient accuracy, then the noise can be completely removed and the original signal recovered. This remains true without respect to the amplitude or spectral characteristics of the noise. If there is very little or no leakage from the speech source into  $M_2$ , then  $H_2(z) \sim 0$  and Equation 3 reduces to

$$S(z) \approx M_1(z) - M_2(z)H_1(z). \quad \text{Eq. 4}$$

**[0060]** Equation 4 is much simpler to implement and is very stable, assuming  $H_1(z)$  is stable. However, if significant speech energy is in  $M_2(Z)$ , devoicing can occur. In order to construct a well-performing system and use Equation 4, consideration is given to the following conditions:

R1. Availability of a perfect (or at least very good) VAD in noisy conditions

R2. Sufficiently accurate  $H_1(z)$

R3. Very small (ideally zero)  $H_2(Z)$ .

R4. During speech production,  $H_1(z)$  cannot change substantially.

R5. During noise,  $H_2(z)$  cannot change substantially.

**[0061]** Condition R1 is easy to satisfy if the SNR of the desired speech to the unwanted noise is high enough. "Enough" means different things depending on the method of VAD generation. If a VAD vibration sensor is used, as in Burnett 7,256,048, accurate VAD in very low SNRs (-10 dB or less) is possible. Acoustic- only methods using information from  $O_1$  and  $O_2$  can also return accurate VADs, but are limited to SNRs of ~3 dB or greater for adequate performance.

**[0062]** Condition R5 is normally simple to satisfy because for most applications the microphones will not change position with respect to the user's mouth very often or rapidly. In those applications where it may happen (such as hands-free conferencing systems) it can be satisfied by configuring Mic2 so that  $H_2(z) \approx 0$ .

**[0063]** Satisfying conditions R2, R3, and R4 are more difficult but are possible given the right combination of  $V_1$  and  $V_2$ . Methods are examined below that have proven to be effective in satisfying the above, resulting in excellent noise suppression performance and minimal speech removal and distortion in an embodiment.

**[0064]** The DOMA, in various embodiments, can be used with the Pathfinder system as the adaptive filter system or noise removal. The Pathfinder system, available from AliphCom, San Francisco, CA, is described in detail in other patents and patent applications referenced herein. Alternatively, any adaptive filter or noise removal algorithm can be used with the DOMA in one or more various alternative embodiments or configurations.

**[0065]** When the DOMA is used with the Pathfinder system, the Pathfinder system generally provides adaptive noise cancellation by combining the two microphone signals (e.g., Mic1, Mic2)

by filtering and summing in the time domain. The adaptive filter generally uses the signal received from a first microphone of the DOMA to remove noise from the speech received from at least one other microphone of the DOMA, which relies on a slowly varying linear transfer function between the two microphones for sources of noise. Following processing of the two channels of the DOMA, an output signal is generated in which the noise content is attenuated with respect to the speech content, as described in detail below.

**[0066]** **Figure 2** is a generalized two-microphone array (DOMA) including an array 201/202 and speech source S configuration, under an embodiment. **Figure 3** is a system 300 for generating or producing a first order gradient microphone V using two omnidirectional elements  $O_1$  and  $O_2$ , under an embodiment. The array of an embodiment includes two physical microphones 201 and 202 (e.g., omnidirectional microphones) placed a distance  $2d_0$  apart and a speech source 200 is located a distance  $d_s$  away at an angle of  $\theta$ . This array is axially symmetric (at least in free space), so no other angle is needed. The output from each microphone 201 and 202 can be delayed ( $Z_1$  and  $Z_2$ ), multiplied by a gain ( $A_1$  and  $A_2$ ), and then summed with the other as demonstrated in Figure 3. The output of the array is or forms at least one virtual microphone, as described in detail below. This operation can be over any frequency range desired. By varying the magnitude and sign of the delays and gains, a wide variety of virtual microphones (VMs), also referred to herein as virtual directional microphones, can be realized. There are other methods known to those skilled in the art for constructing VMs but this is a common one and will be used in the enablement below.

**[0067]** As an example, **Figure 4** is a block diagram for a DOMA 400 including two physical microphones configured to form two virtual microphones  $V_1$  and  $V_2$ , under an embodiment. The DOMA includes two first order gradient microphones  $V_1$  and  $V_2$  formed using the outputs of two microphones or elements  $O_1$  and  $O_2$  (201 and 202), under an embodiment. The DOMA of an embodiment includes two physical microphones 201 and 202 that are omnidirectional microphones, as described above with reference to Figures 2 and 3. The output from each microphone is coupled to a processing component 402, or circuitry, and the processing component outputs signals representing or corresponding to the virtual microphones  $V_1$  and  $V_2$ .

**[0068]** In this example system 400, the output of physical microphone 201 is coupled to processing component 402 that includes a first processing path that includes application of a first delay  $Z_{11}$  and a first gain  $A_{11}$  and a second processing path that includes application of a second

delay  $Z_{12}$  and a second gain  $A_{12}$ . The output of physical microphone 202 is coupled to a third processing path of the processing component 402 that includes application of a third delay  $Z_{21}$  and a third gain  $A_{21}$  and a fourth processing path that includes application of a fourth delay  $Z_{22}$  and a fourth gain  $A_{22}$ . The output of the first and third processing paths is summed to form virtual microphone  $V_1$ , and the output of the second and fourth processing paths is summed to form virtual microphone  $V_2$ .

[0069] As described in detail below, varying the magnitude and sign of the delays and gains of the processing paths leads to a wide variety of virtual microphones (VMs), also referred to herein as virtual directional microphones, can be realized. While the processing component 402 described in this example includes four processing paths generating two virtual microphones or microphone signals, the embodiment is not so limited. For example, Figure 5 is a block diagram for a DOMA 500 including two physical microphones configured to form  $N$  virtual microphones  $V_1$  through  $V_N$ , where  $N$  is any number greater than one, under an embodiment. Thus, the DOMA can include a processing component 502 having any number of processing paths as appropriate to form a number  $N$  of virtual microphones.

[0070] The DOMA of an embodiment can be coupled or connected to one or more remote devices. In a system configuration, the DOMA outputs signals to the 5 remote devices. The remote devices include, but are not limited to, at least one of cellular telephones, satellite telephones, portable telephones, wireline telephones, Internet telephones, wireless transceivers, wireless communication radios, personal digital assistants (PDAs), personal computers (PCs), headset devices, head-worn devices, and earpieces.

[0071] Furthermore, the DOMA of an embodiment can be a component or subsystem integrated with a host device. In this system configuration, the DOMA outputs signals to components or subsystems of the host device. The host device includes, but is not limited to, at least one of cellular telephones, satellite telephones, portable telephones, wireline telephones, Internet telephones, wireless transceivers, wireless communication radios, personal digital assistants (PDAs), personal computers (PCs), headset devices, head-worn devices, and earpieces.

[0072] As an example, **Figure 6** is an example of a headset or head-worn device 600 that includes the DOMA, as described herein, under an embodiment. The headset 600 of an embodiment includes a housing having two areas or receptacles (not shown) that receive and hold two microphones (e.g.,  $O_1$  and  $O_2$ ). The headset 600 is generally a device that can be worn

by a speaker 602, for example, a headset or earpiece that positions or holds the microphones in the vicinity of the speaker's mouth. The headset 600 of an embodiment places a first physical microphone (e.g., physical microphone  $O_1$ ) in a vicinity of a speaker's lips. A second physical microphone (e.g., physical microphone  $O_2$ ) is placed a distance behind the first physical microphone. The distance of an embodiment is in a range of a few centimeters behind the first physical microphone or as described herein (e.g., described with reference to Figures 1-5). The DOMA is symmetric and is used in the same configuration or manner as a single close-talk microphone, but is not so limited.

**[0073]** **Figure 7** is a flow diagram for denoising 700 acoustic signals using the DOMA, under an embodiment. The denoising 700 begins by receiving 702 acoustic signals at a first physical microphone and a second physical microphone. In response to the acoustic signals, a first microphone signal is output from the first physical microphone and a second microphone signal is output from the second physical microphone 704. A first virtual microphone is formed 706 by generating a first combination of the first microphone signal and the second microphone signal. A second virtual microphone is formed 708 by generating a second combination of the first microphone signal and the second microphone signal, and the second combination is different from the first combination. The first virtual microphone and the second virtual microphone are distinct virtual directional microphones with substantially similar responses to noise and substantially dissimilar responses to speech. The denoising 700 generates 710 output signals by combining signals from the first virtual microphone and the second virtual microphone, and the output signals include less acoustic noise than the acoustic signals.

**[0074]** **Figure 8** is a flow diagram for forming 800 the DOMA, under an embodiment. Formation 800 of the DOMA includes forming 802 a physical microphone array including a first physical microphone and a second physical microphone. The first physical microphone outputs a first microphone signal and the second physical microphone outputs a second microphone signal. A virtual microphone array is formed 804 comprising a first virtual microphone and a second virtual microphone. The first virtual microphone comprises a first combination of the first microphone signal and the second microphone signal. The second virtual microphone comprises a second combination of the first microphone signal and the second microphone signal, and the second combination is different from the first combination. The virtual microphone array including a single null oriented in a direction toward a source of speech of a human speaker.

[0075] The construction of VMs for the adaptive noise suppression system of an embodiment includes substantially similar noise response in  $V_1$  and  $V_2$ . Substantially similar noise response as used herein means that  $H_1(z)$  is simple to model and will not change much during speech, satisfying conditions R2 and R4 described above and allowing strong denoising and minimized bleedthrough.

[0076] The construction of VMs for the adaptive noise suppression system of an embodiment includes relatively small speech response for  $V_2$ . The relatively small speech response for  $V_2$  means that  $H_2(z) \approx 0$ , which will satisfy conditions R3 and R5 described above.

[0077] The construction of VMs for the adaptive noise suppression system of an embodiment further includes sufficient speech response for  $V_1$  so that the cleaned speech will have significantly higher SNR than the original speech captured by  $O_1$ .

[0078] The description that follows assumes that the responses of the omnidirectional microphones  $O_1$  and  $O_2$  to an identical acoustic source have been normalized so that they have exactly the same response (amplitude and phase) to that source. This can be accomplished using standard microphone array methods (such as frequency-based calibration) well known to those versed in the art.

[0079] Referring to the condition that construction of VMs for the adaptive noise suppression system of an embodiment includes relatively small speech response for  $V_2$ , it is seen that for discrete systems  $V_2(z)$  can be represented as:

$$V_2(z) = O_2(z) - z^{-\gamma} \beta O_1(z)$$

where

$$\beta = \frac{d_1}{d_2}$$

$$\gamma = \frac{d_2 - d_1}{c} \cdot f_s \text{ (samples)}$$

$$d_1 = \sqrt{d_s^2 - 2d_{s1}d_0 \cos(\theta) + d_0^2}$$

$$d_2 = \sqrt{d_s^2 + 2d_s d_0 \cos(\theta) + d_0^2}$$

[0080] The distances  $d_1$  and  $d_2$  are the distance from  $O_1$  and  $O_2$  to the speech source (see Figure 2), respectively, and  $\gamma$  is their difference divided by  $c$ , the speed of sound, and multiplied by the sampling frequency  $f_s$ . Thus  $\gamma$  is in samples, but need not be an integer. For non-integer  $\gamma$ , fractional-delay filters (well known to those versed in the art) may be used.

[0081] It is important to note that the  $\beta$  above is not the conventional  $\beta$  used to denote the mixing of VMs in adaptive beamforming; it is a physical variable of the system that depends on the intra-microphone distance  $d_0$  (which is fixed) and the distance  $d_s$  and angle  $\theta$ , which can vary. As shown below, for properly calibrated microphones, it is not necessary for the system to be programmed with the exact  $\beta$  of the array. Errors of approximately 10-15% in the actual  $\beta$  (i.e. the  $\beta$  used by the algorithm is not the  $\beta$  of the physical array) have been used with very little degradation in quality. The algorithmic value of  $\beta$  may be calculated and set for a particular user or may be calculated adaptively during speech production when little or no noise is present. However, adaptation during use is not required for nominal performance.

[0082] **Figure 9** is a plot of linear response of virtual microphone  $V_2$  with  $\beta = 0.8$  to a 1 kHz speech source at a distance of 0.1 m, under an embodiment. The null in the linear response of virtual microphone  $V_2$  to speech is located at 0 degrees, where the speech is typically expected to be located. **Figure 10** is a plot of linear response of virtual microphone  $V_2$  with  $\beta = 0.8$  to a 1 kHz noise source at a distance of 1.0 m, under an embodiment. The linear response of  $V_2$  to noise is devoid of or includes no null, meaning all noise sources are detected.

[0083] The above formulation for  $V_2(z)$  has a null at the speech location and will therefore exhibit minimal response to the speech. This is shown in **Figure 9** for an array with  $d_0 = 10.7$  mm and a speech source on the axis of the array ( $\theta = 0$ ) at 10 cm ( $\beta = 0.8$ ). Note that the speech null at zero degrees is not present for noise in the far field for the same microphone, as shown in **Figure 10** with a noise source distance of approximately 1 meter. This insures that noise in front of the user will be detected so that it can be removed. This differs from conventional systems that can have difficulty removing noise in the direction of the mouth of the user.

The  $V_1(z)$  can be formulated using the general form for  $V_1(z)$ :

$$V_1(z) = \alpha_A O_1(z) \cdot z^{-d_A} - \alpha_B O_2(z) \cdot z^{-d_B}$$

Since

$$V_2(z) = O_2(z) - z^{-\gamma} \beta O_1(z)$$

and, since for noise in the forward direction

$$O_{2N}(z) = O_{1N}(z) \cdot z^{-\gamma},$$

Then

$$\begin{aligned} V_{2N}(z) &= O_{1N}(z) \cdot z^{-\gamma} - z^{-\gamma} \beta O_{1N}(z) \\ V_{2N}(z) &= (1 - \beta)(O_{1N}(z) \cdot z^{-\gamma}) \end{aligned}$$

If this is then set equal to  $V_1(z)$  above, the result is

$$V_{IN}(z) = \alpha_A O_{1N}(z) \cdot z^{-d_A} - \alpha_B O_{1N}(z) \cdot z^{-\gamma} \cdot z^{-d_B} = (1 - \beta)(O_{1N}(z) \cdot z^{-\gamma})$$

thus we may set

$$\begin{aligned} d_A &= \gamma \\ d_B &= 0 \\ \alpha_A &= 1 \\ \alpha_B &= \beta \end{aligned}$$

to get

$$V_1(z) = O_1(z) \cdot z^{-\gamma} - \beta O_2(z)$$

The definitions for  $V_1$  and  $V_2$  above mean that for noise  $H_1(z)$  is:

$$H_1(z) = \frac{V_1(z)}{V_2(z)} = \frac{\beta O_2(z) + O_1(z) \cdot z^{-\gamma}}{O_2(z) - z^{-\gamma} \beta O_1(z)}$$

which, if the amplitude noise responses are about the same, has the form of an allpass filter. This has the advantage of being easily and accurately modeled, especially in magnitude response, satisfying R2.

This formulation assures that the noise response will be as similar as possible and that the speech response will be proportional to  $(1 - \beta^2)$ . Since  $\beta$  is the ratio of the distances from  $O_1$  and  $O_2$  to the speech source, it is affected by the size of the array and the distance from the array to the speech source.

[0084] **Figure 11** is a plot of linear response of virtual microphone  $V_1$  with  $\beta = 0.8$  to a 1 kHz speech source at a distance of 0.1 m, under an embodiment. The linear response of virtual microphone  $V_1$  to speech is devoid of or includes no null and the response for speech is greater than that shown in **Figure 4**.

[0085] **Figure 12** is a plot of linear response of virtual microphone  $V_1$  with  $\beta = 0.8$  to a 1 kHz noise source at a distance of 1.0 m, under an embodiment. The linear response of virtual microphone  $V_1$  to noise is devoid of or includes no null and the response is very similar to  $V_2$  shown in **Figure 5**.

[0086] **Figure 13** is a plot of linear response of virtual microphone  $V_1$  with  $\beta = 0.8$  to a speech source at a distance of 0.1 m for frequencies of 100, 500, 1000, 2000, 3000, and 4000 Hz, under an embodiment. **Figure 14** is a plot showing comparison of frequency responses for speech for the array of an embodiment and for a conventional cardioid microphone.

[0087] The response of  $V_1$  to speech is shown in **Figure 11**, and the response to noise in **Figure 12**. Note the difference in speech response compared to  $V_2$  shown in **Figure 9** and the similarity of noise response shown in **Figure 10**. Also note that the orientation of the speech response for  $V_1$  shown in **Figure 11** is completely opposite the orientation of conventional systems, where the main lobe of response is normally oriented toward the speech source. The orientation of an embodiment, in which the main lobe of the speech response of  $V_1$  is oriented away from the speech source, means that the speech sensitivity of  $V_1$  is lower than a normal directional microphone but is flat for all frequencies within approximately  $\pm 30$  degrees of the axis of the array, as shown in **Figure 13**. This flatness of response for speech means that no shaping postfilter is needed to restore omnidirectional frequency response. This does come at a price - as shown in **Figure 14**, which shows the speech response of  $V_1$  with  $\beta = 0.8$  and the

speech response of a cardioid microphone. The speech response of  $V_1$  is approximately 0 to ~ 13 dB less than a normal directional microphone between approximately 500 and 7500 Hz and approximately 0 to 10+ dB greater than a directional microphone below approximately 500 Hz and above 7500 Hz for a sampling frequency of approximately 16000 Hz. However, the superior noise suppression made possible using this system more than compensates for the initially poorer SNR.

[0088] It should be noted that **Figures 9-12** assume the speech is located at approximately 0 degrees and approximately 10 cm,  $\beta = 0.8$ , and the noise at all angles is located approximately 1.0 meter away from the midpoint of the array. Generally, the noise distance is not required to be 1 m or more, but the denoising is the best for those distances. For distances less than approximately 1 m, denoising will not be as effective due to the greater dissimilarity in the noise responses of  $V_1$  and  $V_2$ . This has not proven to be an impediment in practical use - in fact, it can be seen as a feature. Any "noise" source that is ~10 cm away from the earpiece is likely to be desired to be captured and transmitted.

[0089] The speech null of  $V_2$  means that the VAD signal is no longer a critical component. The VAD's purpose was to ensure that the system would not train on speech and then subsequently remove it, resulting in speech distortion. If, however,  $V_2$  contains no speech, the adaptive system cannot train on the speech and cannot remove it. As a result, the system can denoise all the time without fear of devoicing, and the resulting clean audio can then be used to generate a VAD signal for use in subsequent single-channel noise suppression algorithms such as spectral subtraction. In addition, constraints on the absolute value of  $H_1(z)$  (i.e. restricting it to absolute values less than two) can keep the system from fully training on speech even if it is detected. In reality, though, speech can be present due to a mis-located  $V_2$  null and/or echoes or other phenomena, and a VAD sensor or other acoustic-only VAD is recommended to minimize speech distortion.

[0090] Depending on the application,  $\beta$  and  $\gamma$  may be fixed in the noise suppression algorithm or they can be estimated when the algorithm indicates that speech production is taking place in the presence of little or no noise. In either case, there may be an error in the estimate of the actual  $\beta$  and  $\gamma$  of the system. The following description examines these errors and their effect on the performance of the system. As above, "good performance" of the system indicates that there is sufficient denoising and minimal devoicing.

[0091] The effect of an incorrect  $\beta$  and  $\gamma$  on the response of  $V_1$  and  $V_2$  can be seen by examining the definitions above:

$$\begin{aligned} V_1(z) &= O_1(z) \cdot z^{-\gamma_T} - \beta_T O_2(z) \\ V_2(z) &= O_2(z) \cdot z^{-\gamma_T} \beta_T O_1(z) \end{aligned}$$

where  $\beta_T$  and  $\gamma_T$  denote the theoretical estimates of  $\beta$  and  $\gamma$  used in the noise suppression algorithm. In reality, the speech response of  $O_2$  is

$$O_{2S}(z) = \beta_R O_{1S}(z) \cdot z^{-\gamma_R}$$

where  $\beta_R$  and  $\gamma_R$  denote the real  $\beta$  and  $\gamma$  of the physical system. The differences between the theoretical and actual values of  $\beta$  and  $\gamma$  can be due to mis-location of the speech source (it is not where it is assumed to be) and/or a change in air temperature (which changes the speed of sound). Inserting the actual response of  $O_2$  for speech into the above equations for  $V_1$  and  $V_2$  yields

$$\begin{aligned} V_{1S}(z) &= O_{1S}(z)[z^{-\gamma_T} - \beta_T \beta_R z^{-\gamma_R}] \\ V_{2S}(z) &= O_{1S}(z)[\beta_R z^{-\gamma_R} - \beta_T z^{-\gamma_T}] \end{aligned}$$

If the difference in phase is represented by

$$\gamma_R = \gamma_T + \gamma_D$$

And the difference in amplitude as

$$\beta_R = B\beta_T$$

then

$$\begin{aligned} V_{1S}(z) &= O_{1S}(z)z^{-\gamma_T}[1 - B\beta_T^2 z^{-\gamma_D}] \\ V_{2S}(z) &= \beta_T O_{1S}(z)z^{-\gamma_T}[Bz^{-\gamma_D} - 1] \end{aligned}$$

[0092] The speech cancellation in  $V_2$  (which directly affects the degree of devoicing) and the speech response of  $V_1$  will be dependent on both  $B$  and  $D$ . An examination of the case where  $D = 0$  follows. **Figure 15** is a plot showing speech response for  $V_1$  (top, dashed) and  $V_2$  (bottom, solid) versus  $B$  with  $d_s$  assumed to be 0.1 m, under an embodiment. This plot shows the spatial null in  $V_2$  to be relatively broad. **Figure 16** is a plot showing a ratio of  $V_1/V_2$  speech responses shown in **Figure 10** versus  $B$ , under an embodiment. The ratio of  $V_1/V_2$  is above 10 dB for all  $0.8 < B < 1.1$ , and this means that the physical  $\beta$  of the system need not be exactly modeled for good performance. **Figure 17** is a plot of  $B$  versus actual  $d_s$  assuming that  $d_s = 10$  cm and  $\theta = 0$ , under an embodiment. **Figure 18** is a plot of  $B$  versus  $\theta$  with  $d_s = 10$  cm and assuming  $d_s = 10$  cm, under an embodiment.

[0093] In **Figure 15**, the speech response for  $V_1$  (upper, dashed) and  $V_2$  (lower, solid) compared to  $O_1$  is shown versus  $B$  when  $d_s$  is thought to be approximately 10 cm and  $\theta = 0$ . When  $B = 1$ , the speech is absent from  $V_2$ . In **Figure 16**, the ratio of the speech responses in **Figure 10** is shown. When  $0.8 < B < 1.1$ , the  $V_1/V_2$  ratio is above approximately 10 dB - enough for good performance. Clearly, if  $D = 0$ ,  $B$  can vary significantly without adversely affecting the performance of the system. Again, this assumes that calibration of the microphones so that both their amplitude and phase response is the same for an identical source has been performed.

[0094] The  $B$  factor can be non-unity for a variety of reasons. Either the distance to the speech source or the relative orientation of the array axis and the speech source or both can be different than expected. If both distance and angle mismatches are included for  $B$ , then

$$B = \frac{\beta_R \sqrt{d_{SR}^2 - 2d_{SR}d_0 \cos(\theta_R) + d_0^2}}{\beta_T \sqrt{d_{SR}^2 + 2d_{SR}d_0 \cos(\theta_R) + d_0^2}} \cdot \frac{\sqrt{d_{ST}^2 + 2d_{ST}d_0 \cos(\theta_T) + d_0^2}}{\sqrt{d_{ST}^2 - 2d_{ST}d_0 \cos(\theta_T) + d_0^2}}$$

where again the T subscripts indicate the theorized values and R the actual values.

In **Figure 17**, the factor  $B$  is plotted with respect to the actual  $d_s$  with the assumption that  $d_s = 10$  cm and  $\theta = 0$ . So, if the speech source is on-axis of the array, the actual distance can vary from approximately 5 cm to 18 cm without significantly affecting performance - a significant amount. Similarly, **Figure 18** shows what happens if the speech source is located at a distance of approximately 10 cm but not on the axis of the array. In this case, the angle can vary up to

approximately  $\pm 55$  degrees and still result in a B less than 1.1, assuring good performance. This is a significant amount of allowable angular deviation. If there is both angular and distance errors, the equation above may be used to determine if the deviations will result in adequate performance. Of course, if the value for  $\beta_T$  is allowed to update during speech, essentially tracking the speech source, then B can be kept near unity for almost all configurations.

[0095] An examination follows of the case where B is unity but D is nonzero. This can happen if the speech source is not where it is thought to be or if the speed of sound is different from what it is believed to be. From Equation 5 above, it can be seen that the factor that weakens the speech null in  $V_2$  for speech is

$$N(z) = Bz^{-YD} - 1$$

or in the continuous s domain

$$N(s) = Be^{-Ds} - 1$$

Since  $\gamma$  is the time difference between arrival of speech at  $V_1$  compared to  $V_2$ , it can be errors in estimation of the angular location of the speech source with respect to the axis of the array and/or by temperature changes. Examining the temperature sensitivity, the speed of sound varies with temperature as

$$c = 331.3 + (0.606T) \text{ m/s}$$

where T is degrees Celsius. As the temperature decreases, the speed of sound also decreases. Setting 20 C as a design temperature and a maximum expected temperature range to -40 C to +60 C (-40 F to 140 F). The design speed of sound at 20 C is 343 m/s and the slowest speed of sound will be 307 m/s at -40 C with the fastest speed of sound 362 m/s at 60 C. Set the array length ( $2d_0$ ) to be 21 mm. For speech sources on the axis of the array, the difference in travel time for the largest change in the speed of sound is

$$\nabla t_{MAX} = \frac{d}{c_1} - \frac{d}{c_2} = 0.021m \left( \frac{1}{343 \text{ m/s}} - \frac{1}{307 \text{ m/s}} \right) = -7.2 \times 10^{-6} \text{ sec}$$

or approximately 7 microseconds. The response for  $N(s)$  given  $B = 1$  and  $D = 7.2 \mu\text{sec}$  is shown in **Figure 19**. **Figure 19** is a plot of amplitude (top) and phase (bottom) response of  $N(s)$  with  $B = 1$  and  $D = -7.2 \mu\text{sec}$ , under an embodiment. The resulting phase difference clearly affects high frequencies more than low. The amplitude response is less than approximately -10 dB for all frequencies less than 7 kHz and is only about -9 dB at 8 kHz. Therefore, assuming  $B = 1$ , this system would likely perform well at frequencies up to approximately 8 kHz. This means that a properly compensated system would work well even up to 8 kHz in an exceptionally wide (e.g., -40 C to 80 C) temperature range. Note that the phase 10 mismatch due to the delay estimation error causes  $N(s)$  to be much larger at high frequencies compared to low.

**[0096]** If  $B$  is not unity, the robustness of the system is reduced since the effect from non-unity  $B$  is cumulative with that of non-zero  $D$ . **Figure 20** shows the amplitude and phase response for  $B = 1.2$  and  $D = 7.2 \mu\text{sec}$ . **Figure 20** is a plot of amplitude (top) and phase (bottom) response of  $N(s)$  with  $B = 1.2$  and  $D = -7.2 \mu\text{sec}$ , under an embodiment. Non-unity  $B$  affects the entire frequency range. Now  $N(s)$  is below approximately -10 dB only for frequencies less than approximately 5 kHz and the response at low frequencies is much larger. Such a system would still perform well below 5 kHz and would only suffer from slightly elevated devoicing for frequencies above 5 kHz. For ultimate performance, a temperature sensor may be integrated into the system to allow the algorithm to adjust  $\gamma_T$  as the temperature varies.

**[0097]** Another way in which  $D$  can be non-zero is when the speech source is not where it is believed to be - specifically, the angle from the axis of the array to the speech source is incorrect. The distance to the source may be incorrect as well, but that introduces an error in  $B$ , not  $D$ .

**[0098]** Referring to **Figure 2**, it can be seen that for two speech sources (each with their own  $d_s$  and  $\theta$ ) that the time difference between the arrival of the speech at  $O_1$  and the arrival at  $O_2$  is where

$$\begin{aligned} d_{11} &= \sqrt{d_{s1}^2 - 2d_{s1}d_0 \cos(\theta_1) + d_0^2} \\ d_{12} &= \sqrt{d_{s1}^2 + 2d_{s1}d_0 \cos(\theta_1) + d_0^2} \\ d_{21} &= \sqrt{d_{s2}^2 - 2d_{s2}d_0 \cos(\theta_2) + d_0^2} \\ d_{22} &= \sqrt{d_{s2}^2 + 2d_{s2}d_0 \cos(\theta_2) + d_0^2} \end{aligned}$$

[0099] The  $V_2$  speech cancellation response for  $\theta_1 = 0$  degrees and  $\theta_2 = 30$  degrees and assuming that  $B = 1$  is shown in **Figure 21**. **Figure 21** is a plot of amplitude (top) and phase (bottom) response of the effect on the speech cancellation in  $V_2$  due to a mistake in the location of the speech source with  $q_1 = 0$  degrees and  $q_2 = 30$  degrees, under an embodiment. Note that the cancellation is still below -10 dB for frequencies below 6 kHz. The cancellation is still below approximately -10 dB for frequencies below approximately 6 kHz, so an error of this type will not significantly affect the performance of the system. However, if  $\theta_2$  is increased to approximately 45 degrees, as shown in **Figure 22**, the cancellation is below approximately -10 dB only for frequencies below approximately 2.8 kHz. **Figure 22** is a plot of amplitude (top) and phase (bottom) response of the effect on the speech cancellation in  $V_2$  due to a mistake in the location of the speech source with  $q_1 = 0$  degrees and  $q_2 = 45$  degrees, under an embodiment. Now the cancellation is below -10 dB only for frequencies below about 2.8 kHz and a reduction in performance is expected. The poor  $V_2$  speech cancellation above approximately 4 kHz may result in significant devoicing for those frequencies.

[00100] The description above has assumed that the microphones  $O_1$  and  $O_2$  were calibrated so that their response to a source located the same distance away was identical for both amplitude and phase. This is not always feasible, so a more practical calibration procedure is presented below. It is not as accurate, but is much simpler to implement. Begin by defining a filter  $\alpha(z)$  such that:

$$O_{1C}(z) = \alpha(z)O_{2C}(z)$$

where the "C" subscript indicates the use of a known calibration source. The simplest one to use is the speech of the user. Then

$$O_{1S}(z) = \alpha(z)O_{2C}(z)$$

The microphone definitions are now:

$$\begin{aligned} V_1(z) &= O_1(z) \cdot z^{-\gamma} - \beta(z)\alpha(z)O_2(z) \\ V_2(z) &= \alpha(z)O_2(z) - z^{-\gamma}\beta(z)O_1(z) \end{aligned}$$

**[00101]** The  $\beta$  of the system should be fixed and as close to the real value as possible. In practice, the system is not sensitive to changes in  $\beta$  and errors of approximately  $\pm 5\%$  are easily tolerated. During times when the user is producing speech but there is little or no noise, the system can train  $\alpha(z)$  to remove as much speech as possible. This is accomplished by:

1. Construct an adaptive system as shown in **Figure 1** with  $\beta O_{1s}(z)z^{-Y}$  in the "MIC1" position,  $O_{2s}(z)$  in the "MIC2" position, and  $\alpha(z)$  in the  $H_1(z)$  position.
2. During speech, adapt  $\alpha(z)$  to minimize the residual of the system.
3. Construct  $V_1(z)$  and  $V_2(z)$  as above.

**[00102]** A simple adaptive filter can be used for  $\alpha(z)$  so that only the relationship between the microphones is well modeled. The system of an embodiment trains only when speech is being produced by the user. A sensor like the SSM is invaluable in determining when speech is being produced in the absence of noise. If the speech source is fixed in position and will not vary significantly during use (such as when the array is on an earpiece), the adaptation should be infrequent and slow to update in order to minimize any errors introduced by noise present during training.

**[00103]** The above formulation works very well because the noise (far-field) responses of  $V_1$  and  $V_2$  are very similar while the speech (near-field) responses are very different. However, the formulations for  $V_1$  and  $V_2$  can be varied and still result in good performance of the system as a whole. If the definitions for  $V_1$  and  $V_2$  are taken from above and new variables  $B_1$  and  $B_2$  are inserted, the result is:

$$\begin{aligned} V_1(z) &= O_1(z) \cdot z^{-Y_T} - B_1 \beta_T O_2(z) \\ V_2(z) &= O_2(z) - z^{-Y_T} B_2 \beta_T O_1(z) \end{aligned}$$

where  $B_1$  and  $B_2$  are both positive numbers or zero. If  $B_1$  and  $B_2$  are set equal to unity, the optimal system results as described above. If  $B_1$  is allowed to vary from unity, the response of  $V_1$  is affected. An examination of the case where  $B_2$  is left at 1 and  $B_1$  is decreased follows. As  $B_1$  drops to approximately zero,  $V_1$  becomes less and less directional, until it becomes a simple omnidirectional microphone when  $B_1 = 0$ . Since  $B_2 = 1$ , a speech null remains in  $V_2$ , so very different speech responses remain for  $V_1$  and  $V_2$ . However, the noise responses are much less

similar, so denoising will not be as effective. Practically, though, the system still performs well. B1 can also be increased from unity and once again the system will still denoise well, just not as well as with B1 = 1.

**[00104]** If B2 is allowed to vary, the speech null in  $V_2$  is affected. As long as the speech null is still sufficiently deep, the system will still perform well. Practically values down to approximately B2 = 0.6 have shown sufficient performance, but it is recommended to set B2 close to unity for optimal performance.

**[00105]** Similarly, variables  $\varepsilon$  and  $\Delta$  may be introduced so that:

$$\begin{aligned} V_1(z) &= (\varepsilon - \beta)O_{2N}(z) + (1 + \Delta)O_{1N}(z)z^{-\gamma} \\ V_2(z) &= (1 + \Delta)O_{2N}(z) + (\varepsilon - \beta)O_{1N}(z)z^{-\gamma} \end{aligned}$$

This formulation also allows the virtual microphone responses to be varied but retains the all-pass characteristic of  $H_1(z)$ .

**[00106]** In conclusion, the system is flexible enough to operate well at a variety of B1 values, but B2 values should be close to unity to limit devoicing for best performance.

**[00107]** Experimental results for a  $2d_0 = 19$  mm array using a linear  $\beta$  of 0.83 and B1 = B2 = 1 on a Bruel and Kjaer Head and Torso Simulator (HATS) in very loud (~85 dBA) music/speech noise environment are shown in **Figure 23**. The alternate 30 microphone calibration technique discussed above was used to calibrate the microphones. The noise has been reduced by about 25 dB and the speech hardly affected, with no noticeable distortion. Clearly the technique significantly increases the SNR of the original speech, far outperforming conventional noise suppression techniques.

**[00108]** The DOMA can be a component of a single system, multiple systems, and/or geographically separate systems. The DOMA can also be a subcomponent or subsystem of a single system, multiple systems, and/or geographically separate systems. The DOMA can be coupled to one or more other components (not shown) of a host system or a system coupled to the host system.

**[00109]** One or more components of the DOMA and/or a corresponding system or application to which the DOMA is coupled or connected includes and/or runs under and/or in association with a processing system. The processing system includes any collection of processor-based

devices or computing devices operating together, or components of processing systems or devices, as is known in the art. For example, the processing system can include one or more of a portable computer, portable communication device operating in a communication network, and/or a network server. The portable computer can be any of a number and/or combination of devices selected from among personal computers, cellular telephones, personal digital assistants, portable computing devices, and portable communication devices, but is not so limited. The processing system can include components within a larger computer system.

**[00110]** The processing system of an embodiment includes at least one processor and at least one memory device or subsystem. The processing system can also include or be coupled to at least one database. The term "processor" as generally used herein refers to any logic processing unit, such as one or more central processing units (CPUs), digital signal processors (DSPs), application-specific integrated circuits (ASIC), etc. The processor and memory can be monolithically integrated onto a single chip, distributed among a number of chips or components, and/or provided by some combination of algorithms. The methods described herein can be implemented in one or more of software algorithm(s), programs, firmware, hardware, components, circuitry, in any combination.

**[00111]** The components of any system that includes the DOMA can be located together or in separate locations. Communication paths couple the components and include any medium for communicating or transferring files among the components. The communication paths include wireless connections, wired connections, and hybrid wireless/wired connections. The communication paths also include couplings or connections to networks including local area networks (LANs), metropolitan area networks (MANs), wide area networks (WANs), proprietary networks, interoffice or backend networks, and the Internet. Furthermore, the communication paths include removable fixed mediums like floppy disks, hard disk drives, and CD-ROM disks, as well as flash RAM, Universal Serial Bus (USB) connections, RS-232 connections, telephone lines, buses, and electronic mail messages.

**[00112]** Embodiments of the DOMA described herein include a microphone array comprising: a first virtual microphone comprising a first combination of a first microphone signal and a second microphone signal, wherein the first microphone signal is generated by a first physical microphone and the second microphone signal is generated by a second physical microphone; and a second virtual microphone comprising a second combination of the first microphone signal

and the second microphone signal, wherein the second combination is different from the first combination, wherein the first virtual microphone and the second virtual microphone are distinct virtual directional microphones with substantially similar responses to noise and substantially dissimilar responses to speech.

[00113] The first and second physical microphones of an embodiment are omnidirectional.

[00114] The first virtual microphone of an embodiment has a first linear response to speech that is devoid of a null, wherein the speech is human speech. The second virtual microphone of an embodiment has a second linear response to speech that includes a single null oriented in a direction toward a source of the speech.

[00115] The single null of an embodiment is a region of the second linear response having a measured response level that is lower than the measured response level of any other region of the second linear response.

[00116] The second linear response of an embodiment includes a primary lobe oriented in a direction away from the source of the speech.

[00117] The primary lobe of an embodiment is a region of the second linear response having a measured response level that is greater than the measured response level of any other region of the second linear response.

[00118] The first physical microphone and the second physical microphone of an embodiment are positioned along an axis and separated by a first distance.

[00119] A midpoint of the axis of an embodiment is a second distance from a speech source that generates the speech, wherein the speech source is located in a direction defined by an angle relative to the midpoint.

[00120] The first virtual microphone of an embodiment comprises the second microphone signal subtracted from the first microphone signal.

[00121] The first microphone signal of an embodiment is delayed.

[00122] The delay of an embodiment is raised to a power that is proportional to a time difference between arrival of the speech at the first virtual microphone and arrival of the speech at the second virtual microphone.

[00123] The delay of an embodiment is raised to a power that is proportional to a sampling frequency multiplied by a quantity equal to a third distance subtracted from a fourth distance, the

third distance being between the first physical microphone and the speech source and the fourth distance being between the second physical microphone and the speech source.

[00124] The second microphone signal of an embodiment is multiplied by a ratio, wherein the ratio is a ratio of a third distance to a fourth distance, the third distance being between the first physical microphone and the speech source and the fourth distance being between the second physical microphone and the speech source.

[00125] The second virtual microphone of an embodiment comprises the first microphone signal subtracted from the second microphone signal.

[00126] The first microphone signal of an embodiment is delayed.

[00127] The delay of an embodiment is raised to a power that is proportional to a time difference between arrival of the speech at the first virtual microphone and arrival of the speech at the second virtual microphone.

[00128] The power of an embodiment is proportional to a sampling frequency multiplied by a quantity equal to a third distance subtracted from a fourth distance, the third distance being between the first physical microphone and the speech source and the fourth distance being between the second physical microphone and the speech source.

[00129] The first microphone signal of an embodiment is multiplied by a ratio, wherein the ratio is a ratio of the third distance to the fourth distance.

[00130] The single null of an embodiment is located at a distance from at least one of the first physical microphone and the second physical microphone where the source of the speech is expected to be.

[00131] The first virtual microphone of an embodiment comprises the second microphone signal subtracted from a delayed version of the first microphone signal.

[00132] The second virtual microphone of an embodiment comprises a delayed version of the first microphone signal subtracted from the second microphone signal.

[00133] Embodiments of the DOMA described herein include a microphone array comprising: a first virtual microphone formed from a first combination of a first microphone signal and a second microphone signal, wherein the first microphone signal is generated by a first omnidirectional microphone and the second microphone signal is generated by a second omnidirectional microphone; and a second virtual microphone formed from a second combination of the first microphone signal and the second microphone signal, wherein the

second combination is different from the first combination; wherein the first virtual microphone has a first linear response to speech that is devoid of a null, wherein the second virtual microphone has a second linear response to speech that has a single null oriented in a direction toward a source of the speech, wherein the speech is human speech.

**[00134]** The first virtual microphone and the second virtual microphone of an embodiment have a linear response to noise that is substantially similar.

**[00135]** The single null of an embodiment is a region of the second linear response having a measured response level that is lower than the measured response level of any other region of the second linear response.

**[00136]** The second linear response of an embodiment includes a primary lobe oriented in a direction away from the source of the speech.

**[00137]** The primary lobe of an embodiment is a region of the second linear response having a measured response level that is greater than the measured response level of any other region of the second linear response.

**[00138]** Embodiments of the DOMA described herein include a device comprising: a first microphone outputting a first microphone signal and a second microphone outputting a second microphone signal; and a processing component coupled to the first microphone signal and the second microphone signal, the processing component generating a virtual microphone array comprising a first virtual microphone and a second virtual microphone, wherein the first virtual microphone comprises a first combination of the first microphone signal and the second microphone signal, wherein the second virtual microphone comprises a second combination of the first microphone signal and the second microphone signal, wherein the second combination is different from the first combination, wherein the first virtual microphone and the second virtual microphone have substantially similar responses to noise and substantially dissimilar responses to speech.

**[00139]** Embodiments of the DOMA described herein include a device comprising: a first microphone outputting a first microphone signal and a second microphone outputting a second microphone signal, wherein the first microphone and the second microphone are omnidirectional microphones; and a virtual microphone array comprising a first virtual microphone and a second virtual microphone, wherein the first virtual microphone comprises a first combination of the first microphone signal and the second microphone signal, wherein the second virtual

microphone comprises a second combination of the first microphone signal and the second microphone signal, wherein the second combination is different from the first combination, wherein the first virtual microphone and the second virtual microphone are distinct virtual directional microphones.

[00140] Embodiments of the DOMA described herein include a device comprising: a first physical microphone generating a first microphone signal; a second physical microphone generating a second microphone signal; and a processing component coupled to the first microphone signal and the second microphone signal, the processing component generating a virtual microphone array comprising a first virtual microphone and a second virtual microphone; wherein the first virtual microphone comprises the second microphone signal subtracted from a delayed version of the first microphone signal; wherein the second virtual microphone comprises a delayed version of the first microphone signal subtracted from the second microphone signal.

[00141] The first virtual microphone of an embodiment has a first linear response to speech that is devoid of a null, wherein the speech is human speech.

[00142] The second virtual microphone of an embodiment has a second linear response to speech that includes a single null oriented in a direction toward a source of the speech.

[00143] The single null of an embodiment is a region of the second linear response having a measured response level that is lower than the measured response level of any other region of the second linear response.

[00144] The second linear response of an embodiment includes a primary lobe oriented in a direction away from the source of the speech.

[00145] The primary lobe of an embodiment is a region of the second linear response having a measured response level that is greater than the measured response level of any other region of the second linear response.

[00146] The first physical microphone and the second physical microphone of an embodiment are positioned along an axis and separated by a first distance.

[00147] A midpoint of the axis of an embodiment is a second distance from a speech source that generates the speech, wherein the speech source is located in a direction defined by an angle relative to the midpoint.

[00148] One or more of the first microphone signal and the second microphone signal of an embodiment is delayed.

**[00149]** The delay of an embodiment is raised to a power that is proportional to a time difference between arrival of the speech at the first virtual microphone and arrival of the speech at the second virtual microphone.

**[00150]** The power of an embodiment is proportional to a sampling frequency multiplied by a quantity equal to a third distance subtracted from a fourth distance, the third distance being between the first physical microphone and the speech source and the fourth distance being between the second physical microphone and the speech source.

**[00151]** One or more of the first microphone signal and the second microphone signal of an embodiment is multiplied by a gain factor.

**[00152]** Embodiments of the DOMA described herein include a sensor comprising: a physical microphone array including a first physical microphone and a second physical microphone, the first physical microphone outputting a first microphone signal and the second physical microphone outputting a second microphone signal; a virtual microphone array comprising a first virtual microphone and a second virtual microphone, the first virtual microphone comprising a first combination of the first microphone signal and the second microphone signal, the second virtual microphone comprising a second combination of the first microphone signal and the second microphone signal, wherein the second combination is different from the first combination; the virtual microphone array including a single null oriented in a direction toward a source of speech of a human speaker.

**[00153]** The first virtual microphone of an embodiment has a first linear response to speech that is devoid of a null, wherein the second virtual microphone has a second linear response to speech that includes the single null.

**[00154]** The first virtual microphone and the second virtual microphone of an embodiment have a linear response to noise that is substantially similar.

**[00155]** The single null of an embodiment is a region of the second linear response to speech having a measured response level that is lower than the measured response level of any other region of the second linear response.

**[00156]** The second linear response to speech of an embodiment includes a primary lobe oriented in a direction away from the source of the speech.

**[00157]** The primary lobe of an embodiment is a region of the second linear response having a measured response level that is greater than the measured response level of any other region of the second linear response.

**[00158]** The single null of an embodiment is located at a distance from the physical microphone array where the source of the speech is expected to be.

**[00159]** Embodiments of the DOMA described herein include a device comprising: a headset including at least one loudspeaker, wherein the headset attaches to a region of a human head; a microphone array connected to the headset, the microphone array including a first physical microphone outputting a first microphone signal and a second physical microphone outputting a second microphone signal; and a processing component coupled to the microphone array and generating a virtual microphone array comprising a first virtual microphone and a second virtual microphone, the first virtual microphone comprising a first combination of the first microphone signal and the second microphone signal, the second virtual microphone comprising a second combination of the first microphone signal and the second microphone signal, wherein the second combination is different from the first combination, wherein the first virtual microphone and the second virtual microphone have substantially similar responses to noise and substantially dissimilar responses to speech.

**[00160]** The first and second physical microphones of an embodiment are omnidirectional.

**[00161]** The first virtual microphone of an embodiment has a first linear response to speech that is devoid of a null, wherein the speech is human speech.

**[00162]** The second virtual microphone of an embodiment has a second linear response to speech that includes a single null oriented in a direction toward a source of the speech.

**[00163]** The single null of an embodiment is a region of the second linear response having a measured response level that is lower than the measured response level of any other region of the second linear response.

**[00164]** The second linear response of an embodiment includes a primary lobe oriented in a direction away from the source of the speech.

**[00165]** The primary lobe of an embodiment is a region of the second linear response having a measured response level that is greater than the measured response level of any other region of the second linear response.

[00166] The first physical microphone and the second physical microphone of an embodiment are positioned along an axis and separated by a first distance.

[00167] A midpoint of the axis of an embodiment is a second distance from a speech source that generates the speech, wherein the speech source is located in a direction defined by an angle relative to the midpoint.

[00168] The first virtual microphone of an embodiment comprises the second microphone signal subtracted from the first microphone signal.

[00169] The first microphone signal of an embodiment is delayed.

[00170] The delay of an embodiment is raised to a power that is proportional to a time difference between arrival of the speech at the first virtual microphone and arrival of the speech at the second virtual microphone.

[00171] The delay of an embodiment is raised to a power that is proportional to a sampling frequency multiplied by a quantity equal to a third distance subtracted from a fourth distance, the third distance being between the first physical microphone and the speech source and the fourth distance being between the second physical microphone and the speech source.

[00172] The second microphone signal of an embodiment is multiplied by a ratio, wherein the ratio is a ratio of a third distance to a fourth distance, the third distance being between the first physical microphone and the speech source and the fourth distance being between the second physical microphone and the speech source.

[00173] The second virtual microphone of an embodiment comprises the first microphone signal subtracted from the second microphone signal.

[00174] The first microphone signal of an embodiment is delayed.

[00175] The delay of an embodiment is raised to a power that is proportional to a time difference between arrival of the speech at the first virtual microphone and arrival of the speech at the second virtual microphone.

[00176] The power of an embodiment is proportional to a sampling frequency multiplied by a quantity equal to a third distance subtracted from a fourth distance, the third distance being between the first physical microphone and the speech source and the fourth distance being between the second physical microphone and the speech source.

[00177] The first microphone signal of an embodiment is multiplied by a ratio, wherein the ratio is a ratio of the third distance to the fourth distance.

[00178] The first virtual microphone of an embodiment comprises the second microphone signal subtracted from a delayed version of the first microphone signal.

[00179] The second virtual microphone of an embodiment comprises a delayed version of the first microphone signal subtracted from the second microphone signal.

[00180] A speech source that generates the speech of an embodiment is a mouth of a human wearing the headset.

[00181] The device of an embodiment comprises a voice activity detector (VAD) coupled to the processing component, the VAD generating voice activity signals.

[00182] The device of an embodiment comprises an adaptive noise removal application coupled to the processing component, the adaptive noise removal application receiving signals from the first and second virtual microphones and generating an output signal, wherein the output signal is a denoised acoustic signal.

[00183] The microphone array of an embodiment receives acoustic signals including acoustic speech and acoustic noise.

[00184] The device of an embodiment comprises a communication channel coupled to the processing component, the communication channel comprising at least one of a wireless channel, a wired channel, and a hybrid wireless/wired channel.

[00185] The device of an embodiment comprises a communication device coupled to the headset via the communication channel, the communication device comprising one or more of cellular telephones, satellite telephones, portable telephones, wireline telephones, Internet telephones, wireless transceivers, wireless communication radios, personal digital assistants (PDAs), and personal computers (PCs).

[00186] Embodiments of the DOMA described herein include a device comprising: a housing; a loudspeaker connected to the housing; a first physical microphone and a second physical microphone connected to the housing, the first physical microphone outputting a first microphone signal and the second physical microphone outputting a second microphone signal, wherein the first and second physical microphones are omnidirectional; a first virtual microphone comprising a first combination of the first microphone signal and the second microphone signal; and a second virtual microphone comprising a second combination of the first microphone signal and the second microphone signal, wherein the second combination is different from the first combination, wherein the first virtual microphone and the second virtual

microphone are distinct virtual directional microphones with substantially similar responses to noise and substantially dissimilar responses to speech.

**[00187]** Embodiments of the DOMA described herein include a device comprising: a housing including a loudspeaker, wherein the housing is portable and configured for attaching to a mobile object; and a physical microphone array connected to the headset, the physical microphone array including a first physical microphone and a second physical microphone that form a virtual microphone array comprising a first virtual microphone and a second virtual microphone; the first virtual microphone comprising a first combination of a first microphone signal and a second microphone signal, wherein the first microphone signal is generated by the first physical microphone and the second microphone signal is generated by the second physical microphone; and the second virtual microphone comprising a second combination of the first microphone signal and the second microphone signal, wherein the second combination is different from the first combination; wherein the first virtual microphone has a first linear response to speech that is devoid of a null, wherein the second virtual microphone has a second linear response to speech that has a single null oriented in a direction toward a source of the speech, wherein the speech is human speech.

**[00188]** The first virtual microphone and the second virtual microphone of an embodiment have a linear response to noise that is substantially similar.

**[00189]** The single null of an embodiment is a region of the second linear response having a measured response level that is lower than the measured response level of any other region of the second linear response.

**[00190]** The second linear response of an embodiment includes a primary lobe oriented in a direction away from the source of the speech.

**[00191]** The primary lobe of an embodiment is a region of the second linear response having a measured response level that is greater than the measured response level of any other region of the second linear response.

**[00192]** Embodiments of the DOMA described herein include a device comprising: a housing that is attached to a region of a human speaker; a loudspeaker connected to the housing; and a physical microphone array including a first physical microphone and a second physical microphone connected to the housing, the first physical microphone outputting a first microphone signal and the second physical microphone outputting a second microphone signal

that in combination form a virtual microphone array; the virtual microphone array comprising a first virtual microphone and a second virtual microphone, the first virtual microphone comprising a first combination of the first microphone signal and the second microphone signal, the second virtual microphone comprising a second combination of the first microphone signal and the second microphone signal, wherein the second combination is different from the first combination; the virtual microphone array including a single null oriented in a direction toward a source of speech of the human speaker.

**[00193]** The first virtual microphone of an embodiment has a first linear response to speech that is devoid of a null, wherein the second virtual microphone has a second linear response to speech that includes the single null.

**[00194]** The first virtual microphone and the second virtual microphone of an embodiment have a linear response to noise that is substantially similar.

**[00195]** The single null of an embodiment is a region of the second linear response to speech having a measured response level that is lower than the measured response level of any other region of the second linear response.

**[00196]** The second linear response to speech of an embodiment includes a primary lobe oriented in a direction away from the source of the speech.

**[00197]** The primary lobe of an embodiment is a region of the second linear response having a measured response level that is greater than the measured response level of any other region of the second linear response.

**[00198]** The single null of an embodiment is located at a distance from the physical microphone array where the source of the speech is expected to be.

**[00199]** Embodiments of the DOMA described herein include a system comprising: a microphone array including a first physical microphone outputting a first microphone signal and a second physical microphone outputting a second microphone signal; a processing component coupled to the microphone array and generating a virtual microphone array comprising a first virtual microphone and a second virtual microphone, the first virtual microphone comprising a first combination of the first microphone signal and the second microphone signal, the second virtual microphone comprising a second combination of the first microphone signal and the second microphone signal, wherein the second combination is different from the first combination, wherein the first virtual microphone and the second virtual microphone have

substantially similar responses to noise and substantially dissimilar responses to speech; and an adaptive noise removal application coupled to the processing component and generating denoised output signals by forming a plurality of combinations of signals output from the first virtual microphone and the second virtual microphone, wherein the denoised output signals include less acoustic noise than acoustic signals received at the microphone array.

[00200] The first and second physical microphones of an embodiment are omnidirectional.

[00201] The first virtual microphone of an embodiment has a first linear response to speech that is devoid of a null, wherein the speech is human speech.

[00202] The second virtual microphone of an embodiment has a second linear response to speech that includes a single null oriented in a direction toward a source of the speech.

[00203] The single null of an embodiment is a region of the second linear response having a measured response level that is lower than the measured response level of any other region of the second linear response.

[00204] The second linear response of an embodiment includes a primary lobe oriented in a direction away from the source of the speech.

[00205] The primary lobe of an embodiment is a region of the second linear response having a measured response level that is greater than the measured response level of any other region of the second linear response.

[00206] The first physical microphone and the second physical microphone of an embodiment are positioned along an axis and separated by a first distance.

[00207] A midpoint of the axis of an embodiment is a second distance from a speech source that generates the speech, wherein the speech source is located in a direction defined by an angle relative to the midpoint.

[00208] The first virtual microphone of an embodiment comprises the second microphone signal subtracted from the first microphone signal.

[00209] The first microphone signal of an embodiment is delayed,

[00210] The delay of an embodiment is raised to a power that is proportional to a time difference between arrival of the speech at the first virtual microphone and arrival of the speech at the second virtual microphone.

[00211] The delay of an embodiment is raised to a power that is proportional to a sampling frequency multiplied by a quantity equal to a third distance subtracted from a fourth distance, the

third distance being between the first physical microphone and the speech source and the fourth distance being between the second physical microphone and the speech source.

[00212] The second microphone signal of an embodiment is multiplied by a ratio, wherein the ratio is a ratio of a third distance to a fourth distance, the third distance being between the first physical microphone and the speech source and the fourth distance being between the second physical microphone and the speech source.

[00213] The second virtual microphone of an embodiment comprises the first microphone signal subtracted from the second microphone signal.

[00214] The first microphone signal of an embodiment is delayed.

[00215] The delay of an embodiment is raised to a power that is proportional to a time difference between arrival of the speech at the first virtual microphone and arrival of the speech at the second virtual microphone.

[00216] The power of an embodiment is proportional to a sampling frequency multiplied by a quantity equal to a third distance subtracted from a fourth distance, the third distance being between the first physical microphone and the speech source and the fourth distance being between the second physical microphone and the speech source.

[00217] The first microphone signal of an embodiment is multiplied by a ratio, wherein the ratio is a ratio of the third distance to the fourth distance.

[00218] The first virtual microphone of an embodiment comprises the second microphone signal subtracted from a delayed version of the first microphone signal.

[00219] The second virtual microphone of an embodiment comprises a delayed version of the first microphone signal subtracted from the second microphone signal.

[00220] The system of an embodiment comprises a voice activity detector (VAD) coupled to the processing component, the VAD generating voice activity signals.

[00221] The system of an embodiment comprises a communication channel coupled to the processing component, the communication channel comprising at least one of a wireless channel, a wired channel, and a hybrid wireless/wired channel.

[00222] The system of an embodiment comprises a communication device coupled to the processing component via the communication channel, the communication device comprising one or more of cellular telephones, satellite telephones, portable telephones, wireline telephones,

Internet telephones, wireless transceivers, wireless communication radios, personal digital assistants (PDAs), and personal computers (PCs).

**[00223]** Embodiments of the DOMA described herein include a system comprising: a first virtual microphone formed from a first combination of a first microphone signal and a second microphone signal, wherein the first microphone signal is generated by a first physical microphone and the second microphone signal is generated by a second physical microphone; a second virtual microphone formed from a second combination of the first microphone signal and the second microphone signal, wherein the second combination is different from the first combination; wherein the first virtual microphone has a first linear response to speech that is devoid of a null, wherein the second virtual microphone has a second linear response to speech that has a single null oriented in a direction toward a source of the speech, wherein the speech is human speech; an adaptive noise removal application coupled to the first and second virtual microphones and generating denoised output signals by forming a plurality of combinations of signals output from the first virtual microphone and the second virtual microphone, wherein the denoised output signals include less acoustic noise than acoustic signals received at the first and second physical microphones.

**[00224]** The first virtual microphone and the second virtual microphone of an embodiment have a linear response to noise that is substantially similar.

**[00225]** The single null of an embodiment is a region of the second linear response having a measured response level that is lower than the measured response level of any other region of the second linear response.

**[00226]** The second linear response of an embodiment includes a primary lobe oriented in a direction away from the source of the speech.

**[00227]** The primary lobe of an embodiment is a region of the second linear response having a measured response level that is greater than the measured response level of any other region of the second linear response.

**[00228]** Embodiments of the DOMA described herein include a system comprising: a first microphone outputting a first microphone signal and a second microphone outputting a second microphone signal, wherein the first microphone and the second microphone are omnidirectional microphones; a virtual microphone array comprising a first virtual microphone and a second virtual microphone, wherein the first virtual microphone comprises a first combination of the

first microphone signal and the second microphone signal, wherein the second virtual microphone comprises a second combination of the first microphone signal and the second microphone signal, wherein the second combination is different from the first combination, wherein the first virtual microphone and the second virtual microphone are distinct virtual directional microphones; and an adaptive noise removal application coupled to the virtual microphone array and generating denoised output signals by forming a plurality of combinations of signals output from the first virtual microphone and the second virtual microphone, wherein the denoised output signals include less acoustic noise than acoustic signals received at the first microphone and the second microphone.

**[00229]** Embodiments of the DOMA described herein include a system comprising: a first physical microphone generating a first microphone signal; a second physical microphone generating a second microphone signal; a processing component coupled to the first microphone signal and the second microphone signal, the processing component generating a virtual microphone array comprising a first virtual microphone and a second virtual microphone; and wherein the first virtual microphone comprises the second microphone signal subtracted from a delayed version of the first microphone signal; wherein the second virtual microphone comprises a delayed version of the first microphone signal subtracted from the second microphone signal; an adaptive noise removal application coupled to the processing component and generating denoised output signals, wherein the denoised output signals include less acoustic noise than acoustic signals received at the first physical microphone and the second physical microphone.

**[00230]** The first virtual microphone of an embodiment has a first linear response to speech that is devoid of a null, wherein the speech is human speech.

**[00231]** The second virtual microphone of an embodiment has a second linear response to speech that includes a single null oriented in a direction toward a source of the speech.

**[00232]** The single null of an embodiment is a region of the second linear response having a measured response level that is lower than the measured response level of any other region of the second linear response.

**[00233]** The second linear response of an embodiment includes a primary lobe oriented in a direction away from the source of the speech.

**[00234]** The primary lobe of an embodiment is a region of the second linear response having a measured response level that is greater than the measured response level of any other region of the second linear response.

**[00235]** The first physical microphone and the second physical microphone of an embodiment are positioned along an axis and separated by a first distance.

**[00236]** A midpoint of the axis of an embodiment is a second distance from a speech source that generates the speech, wherein the speech source is located in a direction defined by an angle relative to the midpoint.

**[00237]** One or more of the first microphone signal and the second microphone signal of an embodiment is delayed.

**[00238]** The delay of an embodiment is raised to a power that is proportional to a time difference between arrival of the speech at the first virtual microphone and arrival of the speech at the second virtual microphone.

**[00239]** The power of an embodiment is proportional to a sampling frequency multiplied by a quantity equal to a third distance subtracted from a fourth distance, the third distance being between the first physical microphone and the speech source and the fourth distance being between the second physical microphone and the speech source.

**[00240]** One or more of the first microphone signal and the second microphone signal of an embodiment is multiplied by a gain factor.

**[00241]** The system of an embodiment comprises a voice activity detector (VAD) coupled to the processing component, the VAD generating voice activity signals.

**[00242]** The system of an embodiment comprises a communication channel coupled to the processing component, the communication channel comprising at least one of a wireless channel, a wired channel, and a hybrid wireless/wired channel.

**[00243]** The system of an embodiment comprises a communication device coupled to the processing component via the communication channel, the communication device comprising one or more of cellular telephones, satellite telephones, portable telephones, wireline telephones, Internet telephones, wireless transceivers, wireless 10 communication radios, personal digital assistants (PDAs), and personal computers (PCs).

**[00244]** Embodiments of the DOMA described herein include a system comprising: a physical microphone array including a first physical microphone and a second physical microphone, the

first physical microphone outputting a first microphone signal and the second physical microphone outputting a second microphone signal; a virtual microphone array comprising a first virtual microphone and a second virtual microphone, the first virtual microphone comprising a first combination of the first microphone signal and the second microphone signal, the second virtual microphone comprising a second combination of the first microphone signal and the second microphone signal, wherein the second combination is different from the first combination; the virtual microphone array including a single null oriented in a direction toward a source of speech of a human speaker; and an adaptive noise removal application coupled to the virtual microphone array and generating denoised output signals by forming a plurality of combinations of signals output from the virtual microphone array, wherein the denoised output signals include less acoustic noise than acoustic signals received at the physical microphone array.

**[00245]** The first virtual microphone of an embodiment has a first linear response to speech that is devoid of a null, wherein the second virtual microphone of an embodiment has a second linear response to speech that includes the single null.

**[00246]** The first virtual microphone and the second virtual microphone of an embodiment have a linear response to noise that is substantially similar.

**[00247]** The single null of an embodiment is a region of the second linear response to speech having a measured response level that is lower than the measured response level of any other region of the second linear response. The second linear response to speech of an embodiment includes a primary lobe oriented in a direction away from the source of the speech.

**[00248]** The primary lobe of an embodiment is a region of the second linear response having a measured response level that is greater than the measured response level of any other region of the second linear response.

**[00249]** The single null of an embodiment is located at a distance from the physical microphone array where the source of the speech is expected to be.

**[00250]** Embodiments of the DOMA described herein include a system comprising: a first virtual microphone comprising a first combination of a first microphone signal and a second microphone signal, wherein the first microphone signal is output from a first physical microphone and the second microphone signal is output from a second physical microphone; a second virtual microphone comprising a second combination of the first microphone signal and

the second microphone signal, wherein the second combination is different from the first combination, wherein the first virtual microphone and the second virtual microphone are distinct virtual directional microphones with substantially similar responses to noise and substantially dissimilar responses to speech; and a processing component coupled to the first and second virtual microphones, the processing component including an adaptive noise removal application receiving acoustic signals from the first virtual microphone and the second virtual microphone and generating an output signal, wherein the output Signal is a denoised acoustic signal.

**[00251]** Embodiments of the DOMA described herein include a method comprising: forming a first virtual microphone by generating a first combination of a first microphone signal and a second microphone signal, wherein the first microphone signal is generated by a first physical microphone and the second microphone signal is generated by a second physical microphone; and forming a second virtual microphone by generating a second combination of the first microphone signal and the second microphone Signal, wherein the second combination is different from the first combination, wherein the first virtual microphone and the second virtual microphone are distinct virtual directional microphones with substantially similar responses to noise and substantially dissimilar responses to speech.

**[00252]** Forming the first virtual microphone of an embodiment includes forming the first virtual microphone to have a first linear response to speech that is devoid of a null, wherein the speech is human speech.

**[00253]** Forming the second virtual microphone of an embodiment includes forming the second virtual microphone to have a second linear response to speech that includes a single null oriented in a direction toward a source of the speech.

**[00254]** The single null of an embodiment is a region of the second linear response having a measured response level that is lower than the measured response level of any other region of the second linear response.

**[00255]** The second linear response of an embodiment includes a primary lobe oriented in a direction away from the source of the speech.

**[00256]** The primary lobe of an embodiment is a region of the second linear response having a measured response level that is greater than the measured response level of any other region of the second linear response.

[00257] The method of an embodiment comprises positioning the first physical microphone and the second physical microphone along an axis and separating the first and second physical microphones by a first distance.

[00258] A midpoint of the axis of an embodiment is a second distance from a speech source that generates the speech, wherein the speech source is located in a direction defined by an angle relative to the midpoint.

[00259] Forming the first virtual microphone of an embodiment comprises subtracting the second microphone signal subtracted from the first microphone signal.

[00260] The method of an embodiment comprises delaying the first microphone signal.

[00261] The method of an embodiment comprises raising the delay to a power that is proportional to a time difference between arrival of the speech at the first virtual microphone and arrival of the speech at the second virtual microphone.

[00262] The method of an embodiment comprises raising the delay to a power that is proportional to a sampling frequency multiplied by a quantity equal to a third distance subtracted from a fourth distance, the third distance being between the first physical microphone and the speech source and the fourth distance being between the second physical microphone and the speech source.

[00263] The method of an embodiment comprises multiplying the second microphone signal by a ratio, wherein the ratio is a ratio of a third distance to a fourth distance, the third distance being between the first physical microphone and the speech source and the fourth distance being between the second physical microphone and the speech source.

[00264] Forming the second virtual microphone of an embodiment comprises subtracting the first microphone signal from the second microphone signal.

[00265] The method of an embodiment comprises delaying the first microphone signal.

[00266] The method of an embodiment comprises raising the delay to a power that is proportional to a time difference between arrival of the speech at the first virtual microphone and arrival of the speech at the second virtual microphone.

[00267] The method of an embodiment comprises raising the delay to a power that is proportional to a sampling frequency multiplied by a quantity equal to a third distance subtracted from a fourth distance, the third distance being between the first physical microphone and the

speech source and the fourth distance being between the second physical microphone and the speech source.

**[00268]** The method of an embodiment comprises multiplying the first microphone signal by a ratio, wherein the ratio is a ratio of the third distance to the fourth distance.

**[00269]** Forming the first virtual microphone of an embodiment comprises subtracting the second microphone signal from a delayed version of the first microphone signal.

**[00270]** Forming the second virtual microphone of an embodiment comprises: forming a quantity by delaying the first microphone signal; and subtracting the quantity from the second microphone signal.

**[00271]** The first and second physical microphones of an embodiment are omnidirectional.

**[00272]** Embodiments of the DOMA described herein include a method comprising: receiving a first microphone signal from a first omnidirectional microphone and receiving a second microphone signal from a second omnidirectional microphone; generating a first virtual directional microphone by generating a first combination of the first microphone signal and the second microphone signal; generating a second virtual directional microphone by generating a second combination of the first microphone signal and the second microphone signal, wherein the second combination is different from the first combination, wherein the first virtual microphone and the second virtual microphone are distinct virtual directional microphones with substantially similar responses to noise and substantially dissimilar responses to speech.

**[00273]** Embodiments of the DOMA described herein include a method of forming a microphone array comprising: forming a first virtual microphone by generating a first combination of a first microphone signal and a second microphone signal, wherein the first microphone signal is generated by a first omnidirectional microphone and the second microphone signal is generated by a second omnidirectional microphone; and forming a second virtual microphone by generating a second combination of the first microphone signal and the second microphone signal, wherein the second combination is different from the first combination; wherein the first virtual microphone has a first linear response to speech that is devoid of a null, wherein the second virtual microphone has a second linear response to speech that has a single null oriented in a direction toward a source of the speech, wherein the speech is human speech.

**[00274]** Forming the first and second virtual microphones of an embodiment comprises forming the first virtual microphone and the second virtual microphone to have a linear response to noise that is substantially similar.

**[00275]** The single null of an embodiment is a region of the second linear response having a measured response level that is lower than the measured response level of any other region of the second linear response.

**[00276]** The second linear response of an embodiment includes a primary lobe oriented in a direction away from the source of the speech. The primary lobe of an embodiment is a region of the second linear response having a measured response level that is greater than the measured response level of any other region of the second linear response.

**[00277]** Embodiments of the DOMA described herein include a method comprising: receiving acoustic signals at a first physical microphone and a second physical microphone; outputting in response to the acoustic signals a first microphone signal from the first physical microphone and outputting a second microphone signal from the second physical microphone; forming a first virtual microphone by generating a first combination of the first microphone signal and the second microphone signal; forming a second virtual microphone by generating a second combination of the first microphone signal and the second microphone signal, wherein the second combination is different from the first combination, wherein the first virtual microphone and the second virtual microphone are distinct virtual directional microphones with substantially similar responses to noise and substantially dissimilar responses to speech; generating output signals by combining signals from the first virtual microphone and the second virtual microphone, wherein the output signals include less acoustic noise than the acoustic signals.

**[00278]** The first and second physical microphones of an embodiment are omnidirectional microphones.

**[00279]** Forming the first virtual microphone of an embodiment includes forming the first virtual microphone to have a first linear response to speech that is devoid of a null, wherein the speech is human speech.

**[00280]** Forming the second virtual microphone of an embodiment includes forming the second virtual microphone to have a second linear response to speech that includes a single null oriented in a direction toward a source of the speech. The single null of an embodiment is a

region of the second linear response having a measured response level that is lower than the measured response level of any other region of the second linear response.

**[00281]** The second linear response of an embodiment includes a primary lobe oriented in a direction away from the source of the speech.

**[00282]** The primary lobe of an embodiment is a region of the second linear response having a measured response level that is greater than the measured response level of any other region of the second linear response.

**[00283]** Forming the first virtual microphone of an embodiment comprises subtracting the second microphone signal from a delayed version of the first microphone signal.

**[00284]** Forming the second virtual microphone of an embodiment comprises: forming a quantity by delaying the first microphone signal; and subtracting the quantity from the second microphone signal. Embodiments of the DOMA described herein include a method comprising: forming a physical microphone array including a first physical microphone and a second physical microphone, the first physical microphone outputting a first microphone signal and the second physical microphone outputting a second microphone signal; and forming a virtual microphone array comprising a first virtual microphone and a second virtual microphone, the first virtual microphone comprising a first combination of the first microphone signal and the second microphone signal, the second virtual microphone comprising a second combination of the first microphone signal and the second microphone signal, wherein the second combination is different from the first combination; the virtual microphone array including a single null oriented in a direction toward a source of speech of a human speaker.

**[00285]** Forming the first and second virtual microphones of an embodiment comprises forming the first virtual microphone and the second virtual microphone to have a linear response to noise that is substantially similar.

**[00286]** The single null of an embodiment is a region of the second linear response having a measured response level that is lower than the measured response level of any other region of the second linear response.

**[00287]** The second linear response of an embodiment includes a primary lobe oriented in a direction away from the source of the speech.

**[00288]** The primary lobe of an embodiment is a region of the second linear response having a measured response level that is greater than the measured response level of any other region of the second linear response.

**[00289]** The single null of an embodiment is located at a distance from the physical microphone array where the source of the speech is expected to be.

**[00290]** Aspects of the DOMA and corresponding systems and methods described herein may be implemented as functionality programmed into any of a variety of circuitry, including programmable logic devices (PLDs), such as field programmable gate arrays (FPGAs), programmable array logic (PAL) devices, electrically programmable logic and memory devices and standard cell-based devices, as well as application specific integrated circuits (ASICs). Some other possibilities for implementing aspects of the DOMA and corresponding systems and methods include: microcontrollers with memory (such as electronically erasable programmable read only memory (EEPROM)), embedded microprocessors, firmware, software, etc. Furthermore, aspects of the DOMA and corresponding systems and methods may be embodied in microprocessors having software-based circuit emulation, discrete logic (sequential and combinatorial), custom devices, fuzzy (neural) logic, quantum devices, and hybrids of any of the above device types. Of course the underlying device technologies may be provided in a variety of component types, e.g., metal-oxide semiconductor field-effect transistor (MOSFET) technologies like complementary metal-oxide semiconductor (CMOS), bipolar technologies like emitter-coupled logic (ECL), polymer technologies (e.g., silicon-conjugated polymer and metal-conjugated polymer-metal structures), mixed 15 analog and digital, etc.

**[00291]** It should be noted that any system, method, and/or other components disclosed herein may be described using computer aided design tools and expressed (or represented), as data and/or instructions embodied in various computer-readable media, in terms of their behavioral, register transfer, logic component, transistor, layout geometries, and/or other characteristics. Computer-readable media in which such formatted data and/or instructions may be embodied include, but are not limited to, non-volatile storage media in various forms (e.g., optical, magnetic or semiconductor storage media) and carrier waves that may be used to transfer such formatted data and/or instructions through wireless, optical, or wired signaling media or any combination thereof. Examples of transfers of such formatted data and/or instructions by carrier waves include, but are not limited to, transfers (uploads, downloads, e-mail, etc.) over the

Internet and/or other computer networks via one or more data transfer protocols (e.g., HTTP, FTP, SMTP, etc.). When received within a computer system via one or more computer-readable media, such data and/or instruction-based expressions of the above described components may be processed by a processing entity (e.g., one or more processors) within the computer system in conjunction with execution of one or more other computer programs.

**[00292]** Unless the context clearly requires otherwise, throughout the description and the claims, the words "comprise," "comprising," and the like are to be construed in an inclusive sense as opposed to an exclusive or exhaustive sense; that is to say, in a sense of "including, but not limited to." Words using the singular or plural number also include the plural or singular number respectively. Additionally, the words "herein," "hereunder," "above," "below," and words of similar import, when used in this application, refer to this application as a whole and not to any particular portions of this application. When the word "or" is used in reference to a list of two or more items, that word covers all of the following interpretations of the word: any of the items in the list, all of the items in the list and any combination of the items in the list.

**[00293]** The above description of embodiments of the DOMA and corresponding systems and methods is not intended to be exhaustive or to limit the systems and methods to the precise forms disclosed. While specific embodiments of, and examples for, the DOMA and corresponding systems and methods are described herein for illustrative purposes, various equivalent modifications are possible within the scope of the systems and methods, as those skilled in the relevant art will recognize. The teachings of the DOMA and corresponding systems and methods provided herein can be applied to other systems and methods, not only for the systems and methods described above.

**[00294]** The elements and acts of the various embodiments described above can be combined to provide further embodiments. These and other changes can be made to the DOMA and corresponding systems and methods in light of the above detailed description.

**[00295]** In general, in the following claims, the terms used should not be construed to limit the DOMA and corresponding systems and methods to the specific embodiments disclosed in the specification and the claims, but should be construed to include all systems that operate under the claims. Accordingly, the DOMA and corresponding systems and methods is not limited by the disclosure, but instead the scope is to be determined entirely by the claims.

[00296] While certain aspects of the DOMA and corresponding systems and methods are presented below in certain claim forms, the inventors contemplate the various aspects of the DOMA and corresponding systems and methods in any number of claim forms. Accordingly, the inventors reserve the right to add additional claims after filing the application to pursue such additional claim forms for other aspects of the DOMA and corresponding systems and methods.

**CLAIMS**

What is claimed is:

1. A microphone array comprising:
  - a first virtual microphone comprising a first combination of a first microphone signal and a second microphone signal, wherein the first microphone signal is generated by a first physical microphone and the second microphone signal is generated by a second physical microphone;
  - and
  - a second virtual microphone comprising a second combination of the first microphone signal and the second microphone signal, wherein the second combination is different from the first combination, wherein the first virtual microphone and the second virtual microphone are distinct virtual directional microphones with substantially similar responses to noise and substantially dissimilar responses to speech.

**FORMING VIRTUAL MICROPHONE ARRAYS USING DUAL  
OMNIDIRECTIONAL MICROPHONE ARRAY (DOMA)**

**ABSTRACT**

A dual omnidirectional microphone array noise suppression is described. Compared to conventional arrays and algorithms, which seek to reduce noise by nulling out noise sources, the array of an embodiment is used to form two distinct virtual directional microphones which are configured to have very similar noise responses and very dissimilar speech responses. The only null formed is one used to remove the speech of the user from  $V_2$ . The two virtual microphones may be paired with an adaptive filter algorithm and VAD algorithm to significantly reduce the noise without distorting the speech, significantly improving the SNR of the desired speech over conventional noise suppression systems.

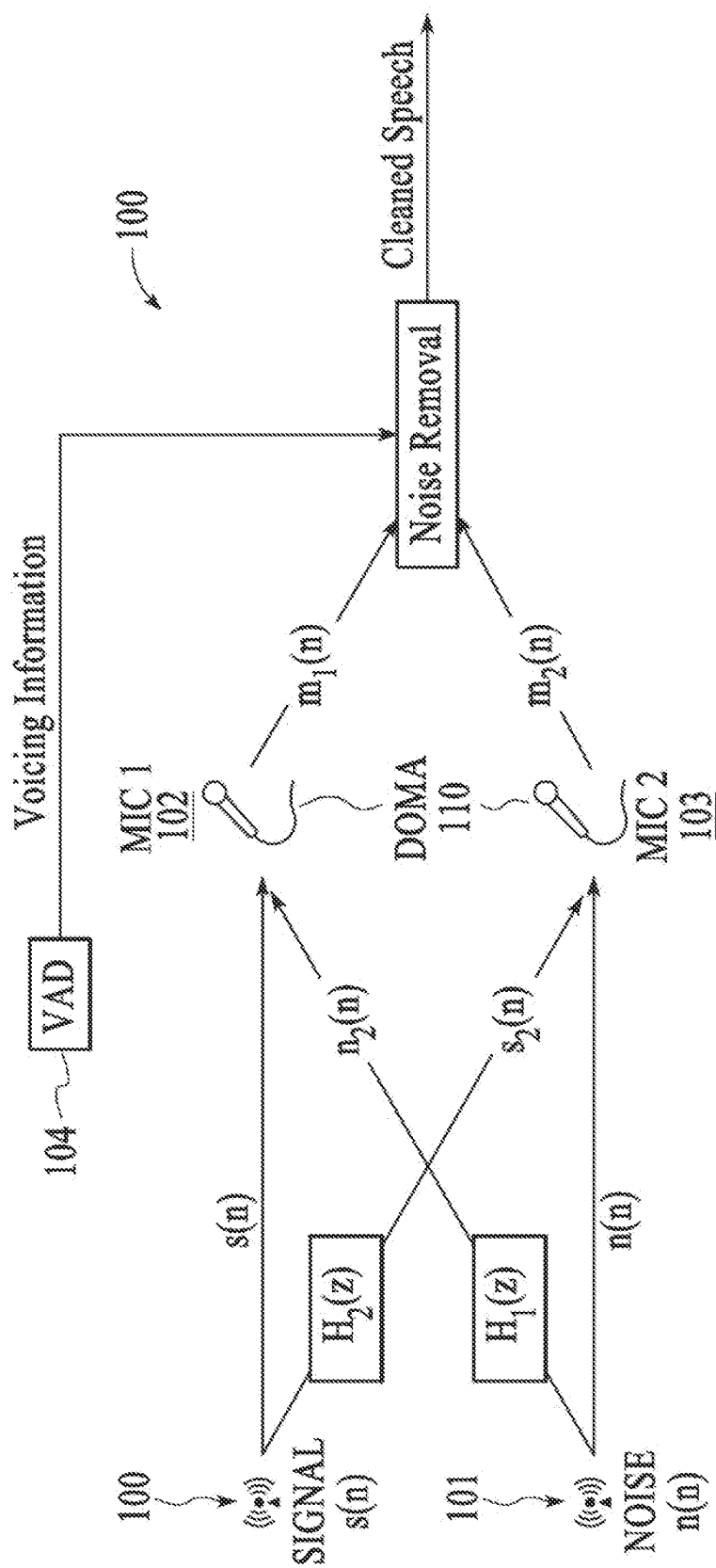


FIG.1

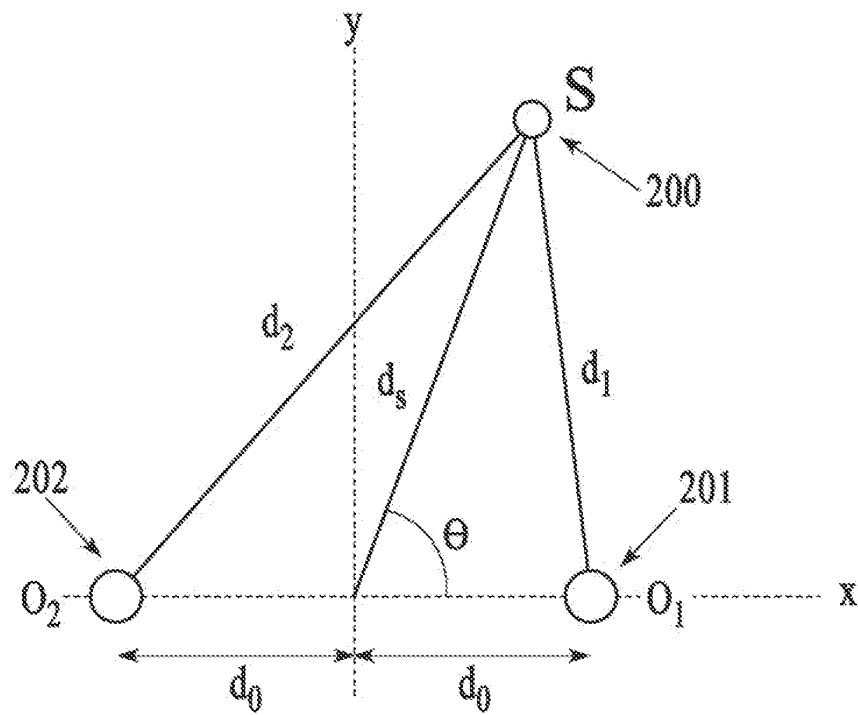


FIG.2

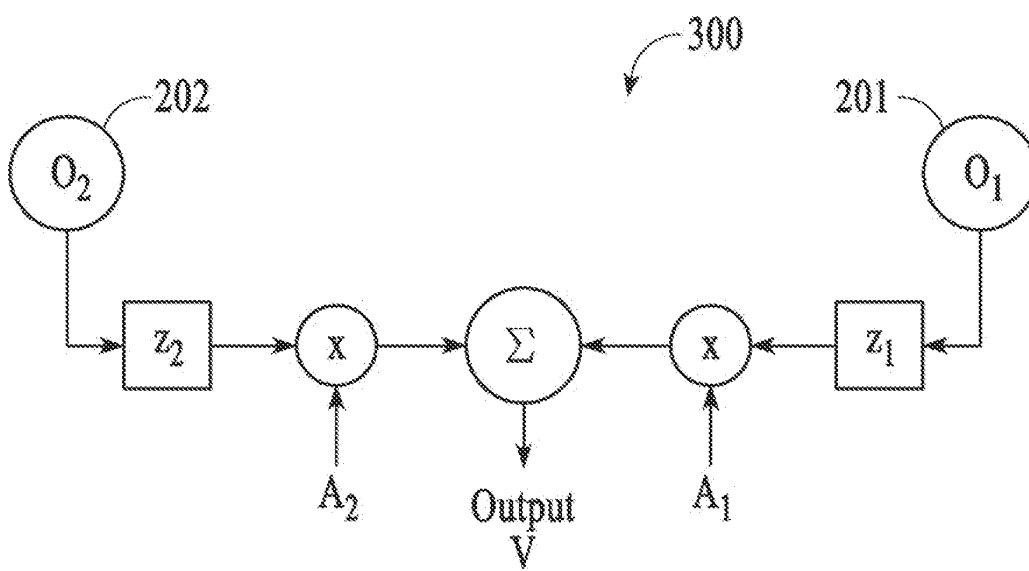


FIG.3

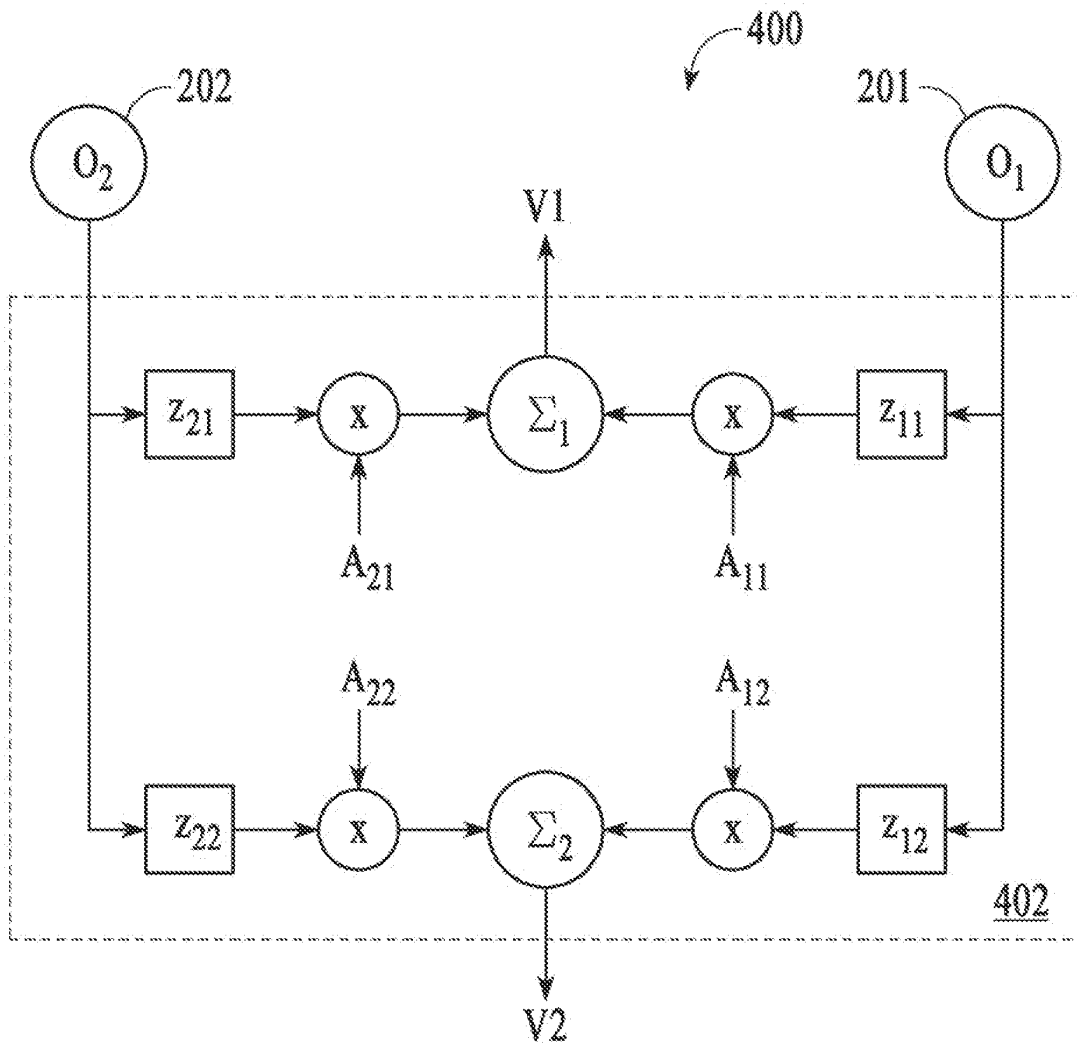


FIG.4

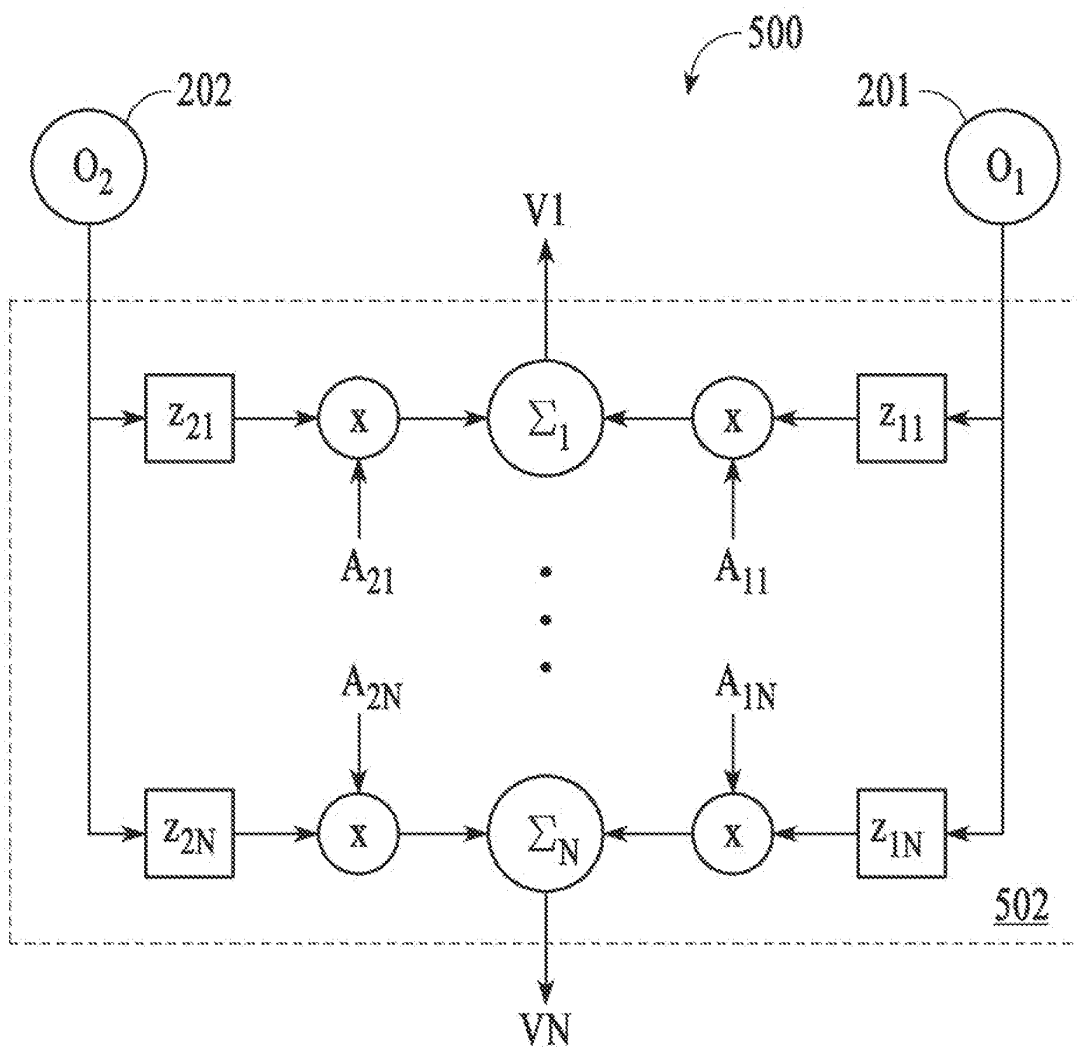


FIG.5

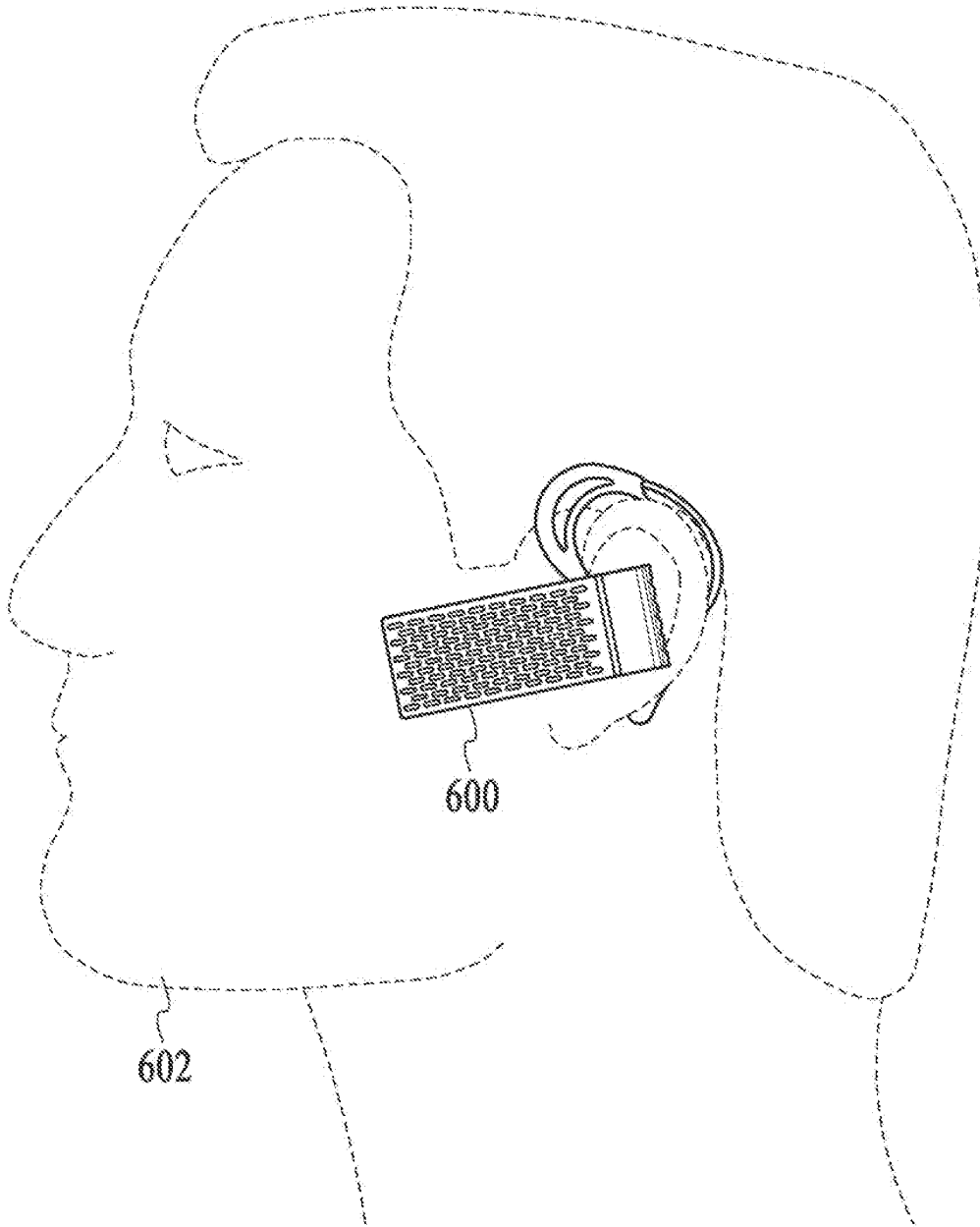


FIG.6

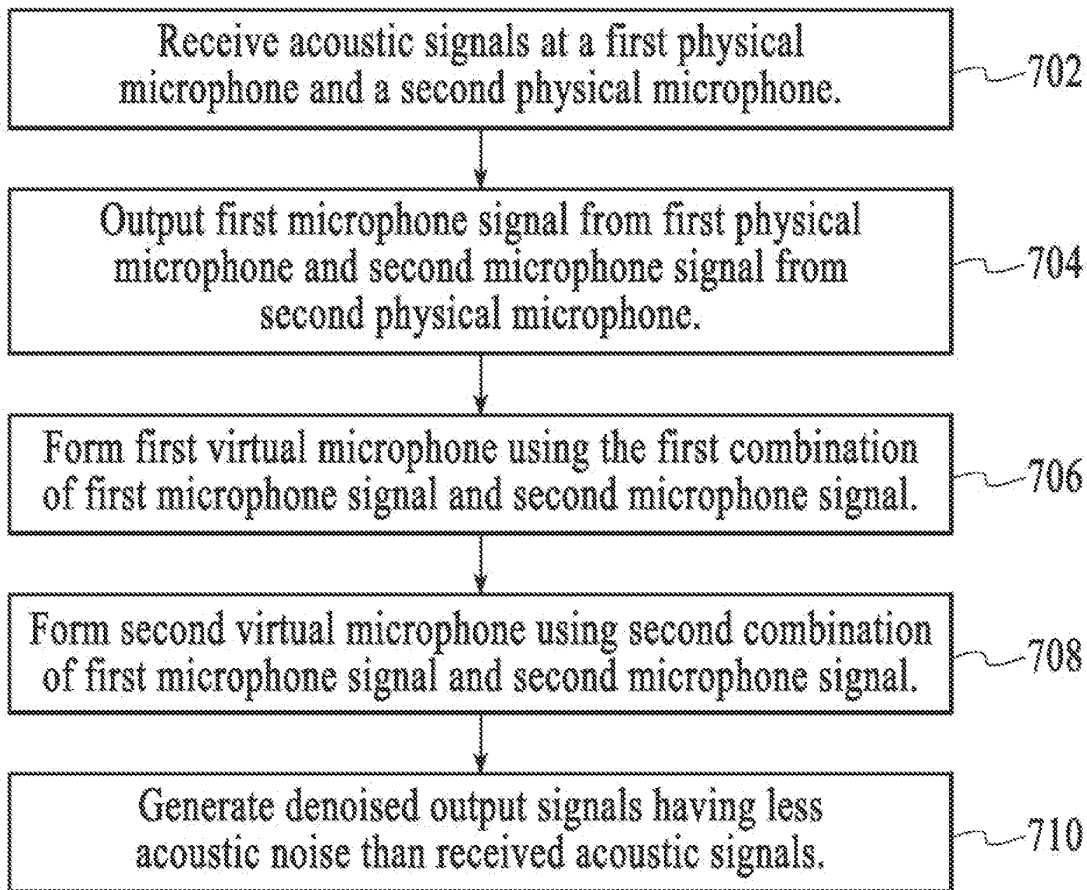


FIG. 7

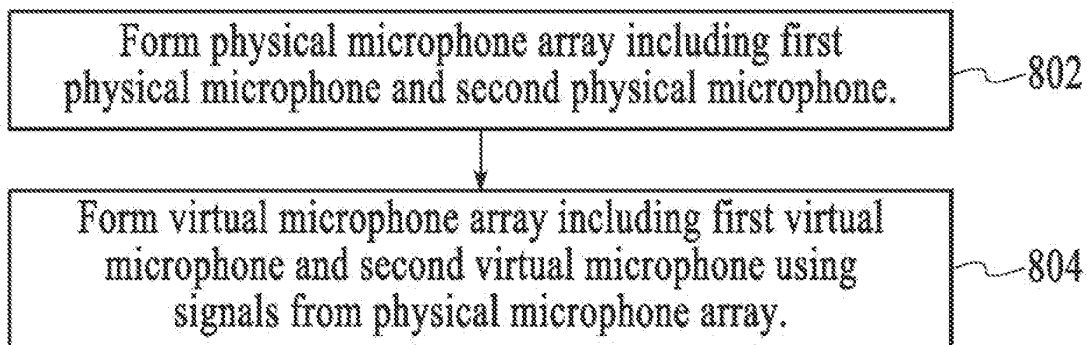


FIG. 8

Linear response of V2 to a speech source at 0.10 meters

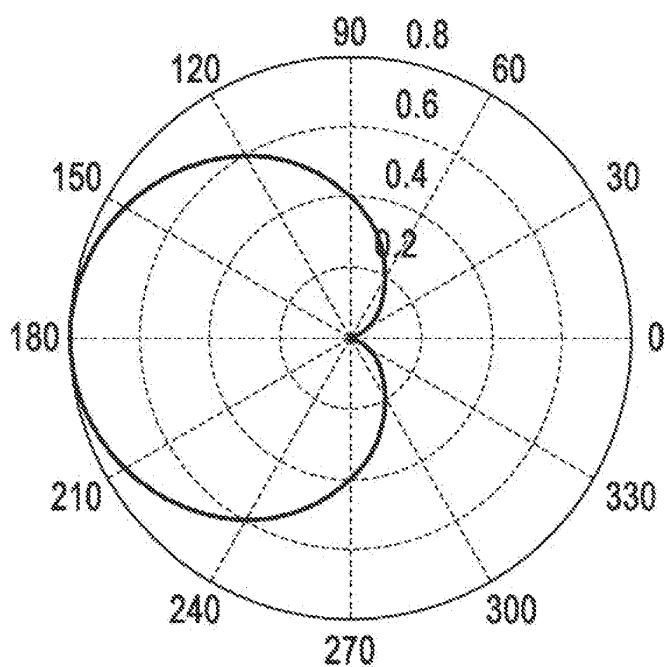


FIG.9

Linear response of V2 to a noise source at 1 meters

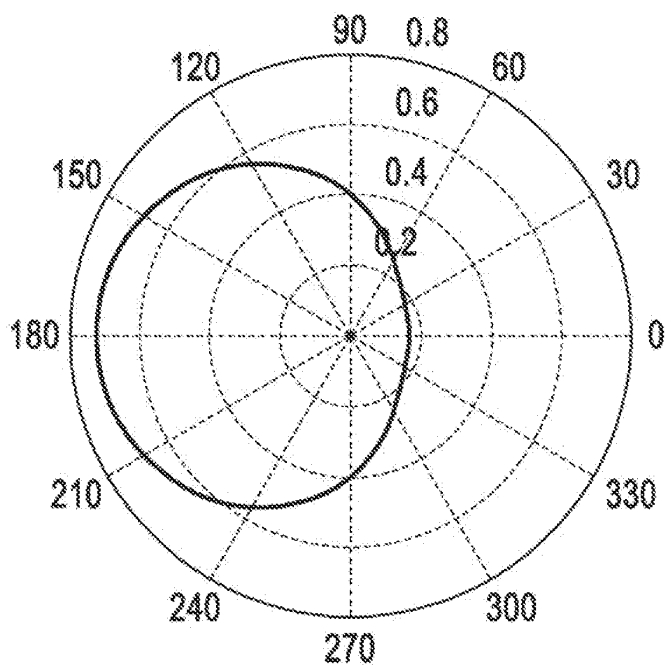


FIG.10

Linear response of V1 to a speech source at 0.10 meters

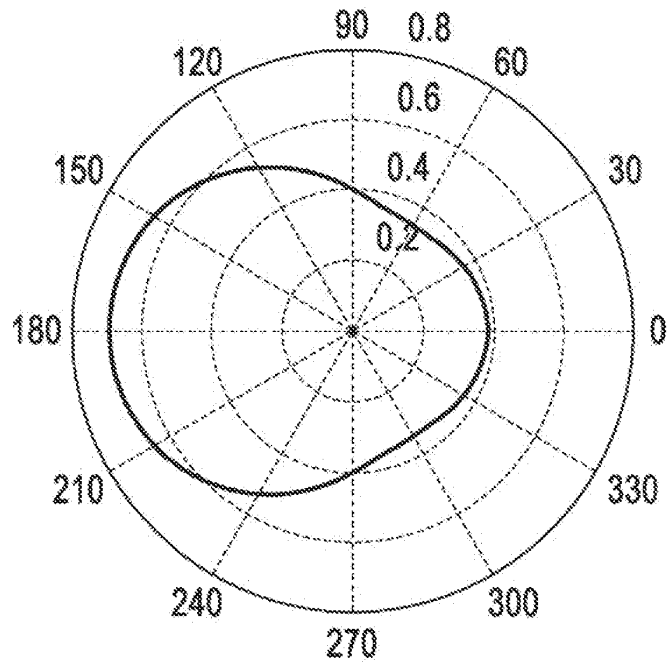


FIG.11

Linear response of V1 to a noise source at 1 meters

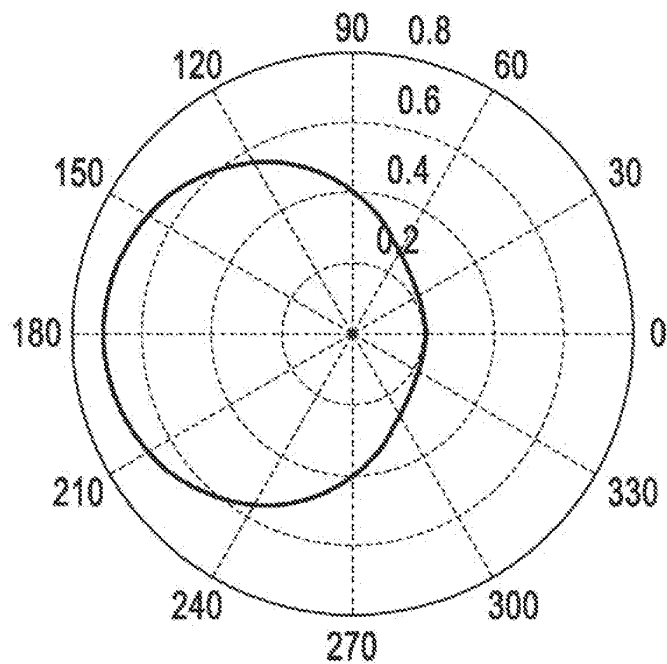


FIG.12

Linear response of V1 to a speech source at 0.1 meters

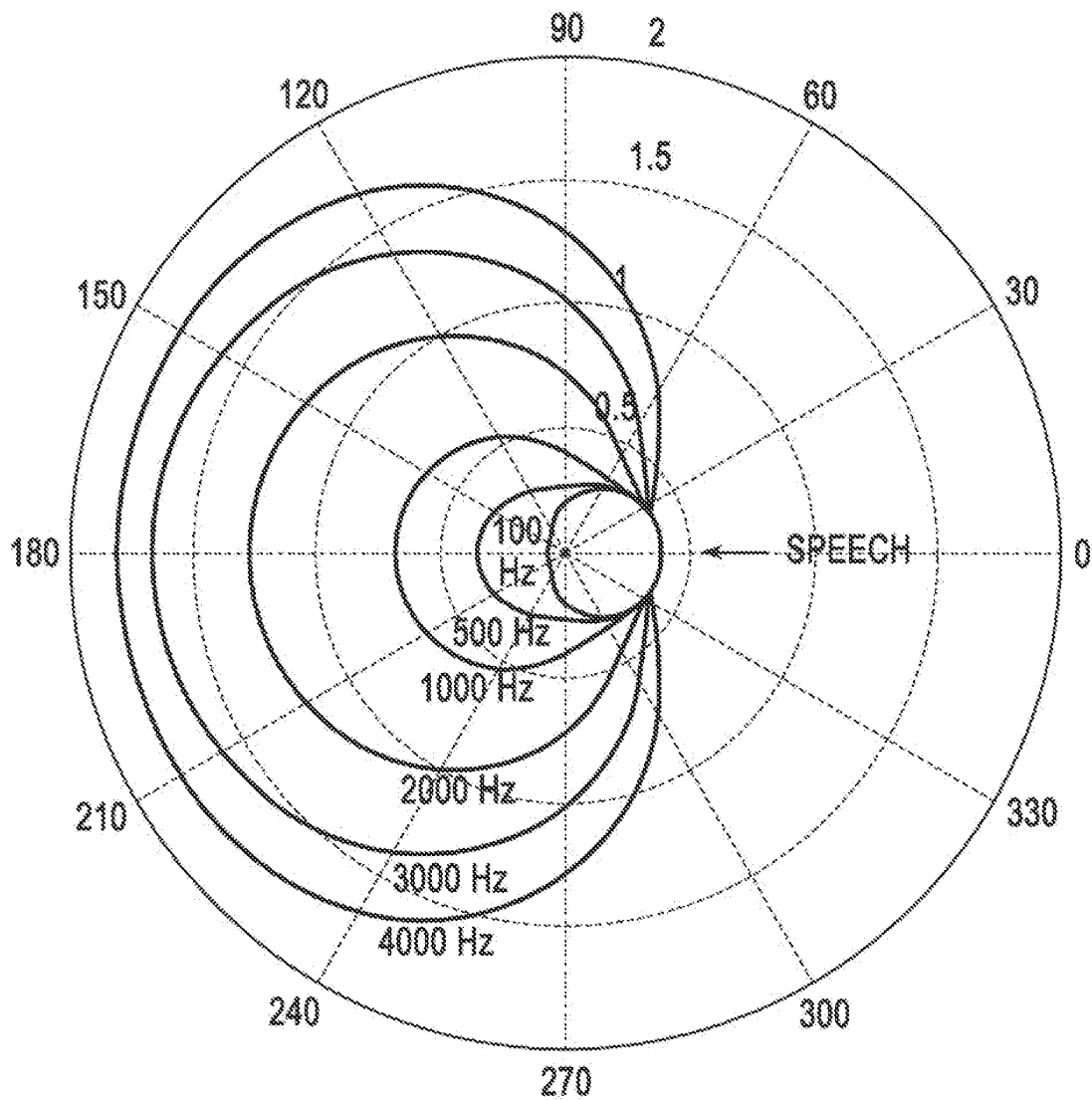


FIG.13

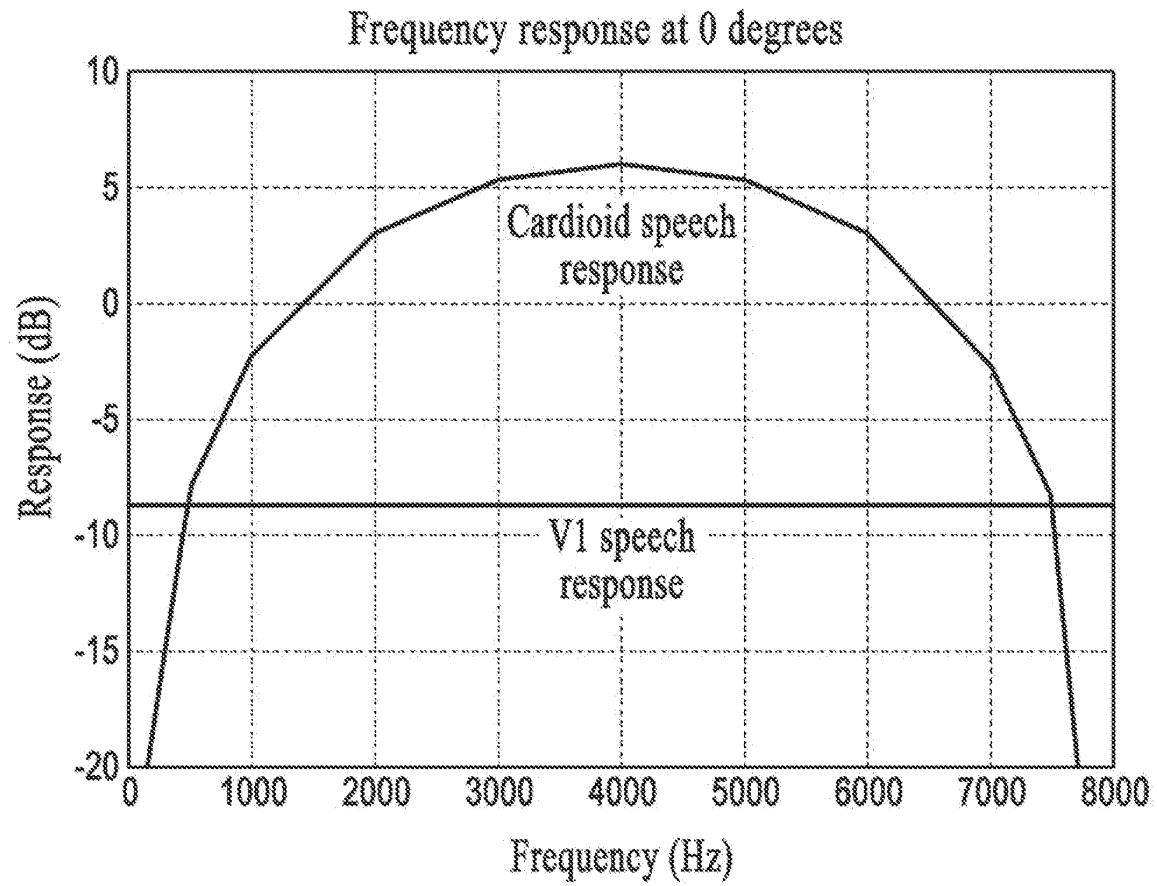


FIG.14

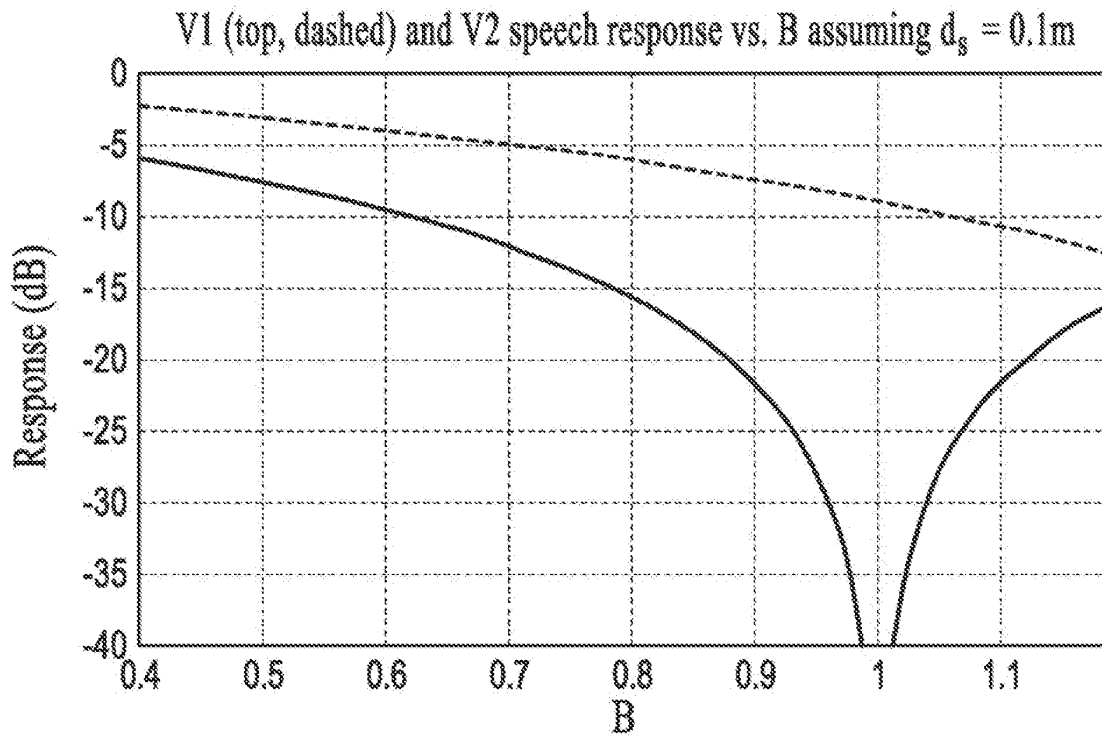


FIG.15

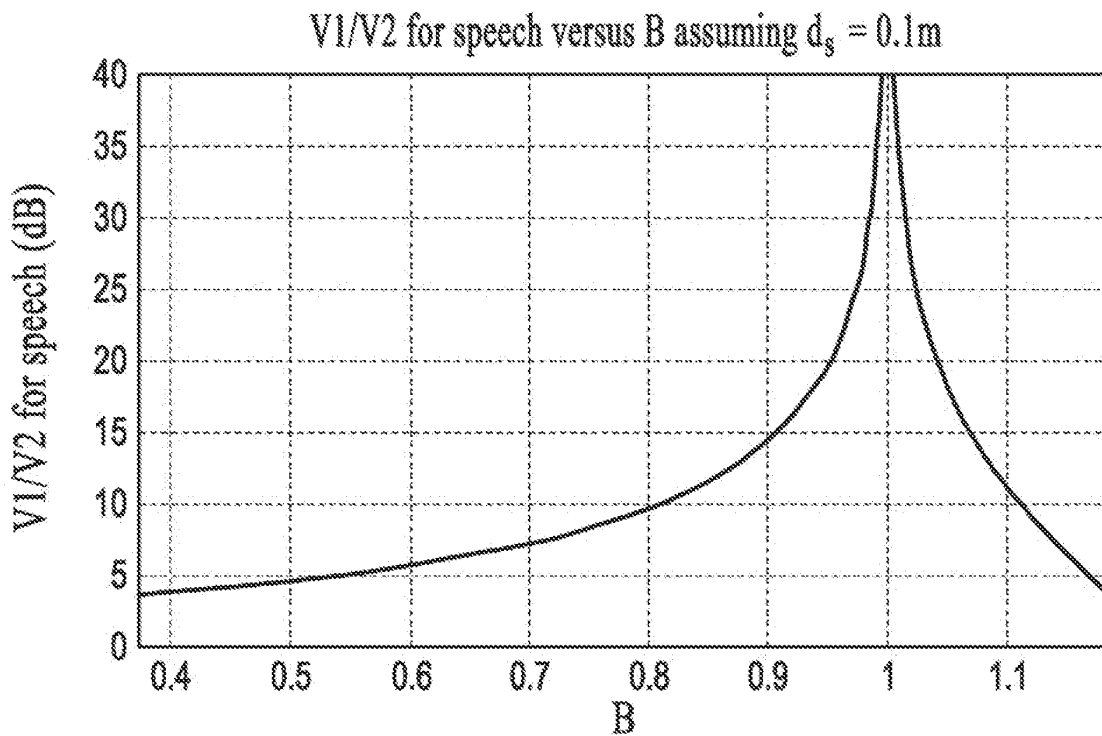


FIG.16

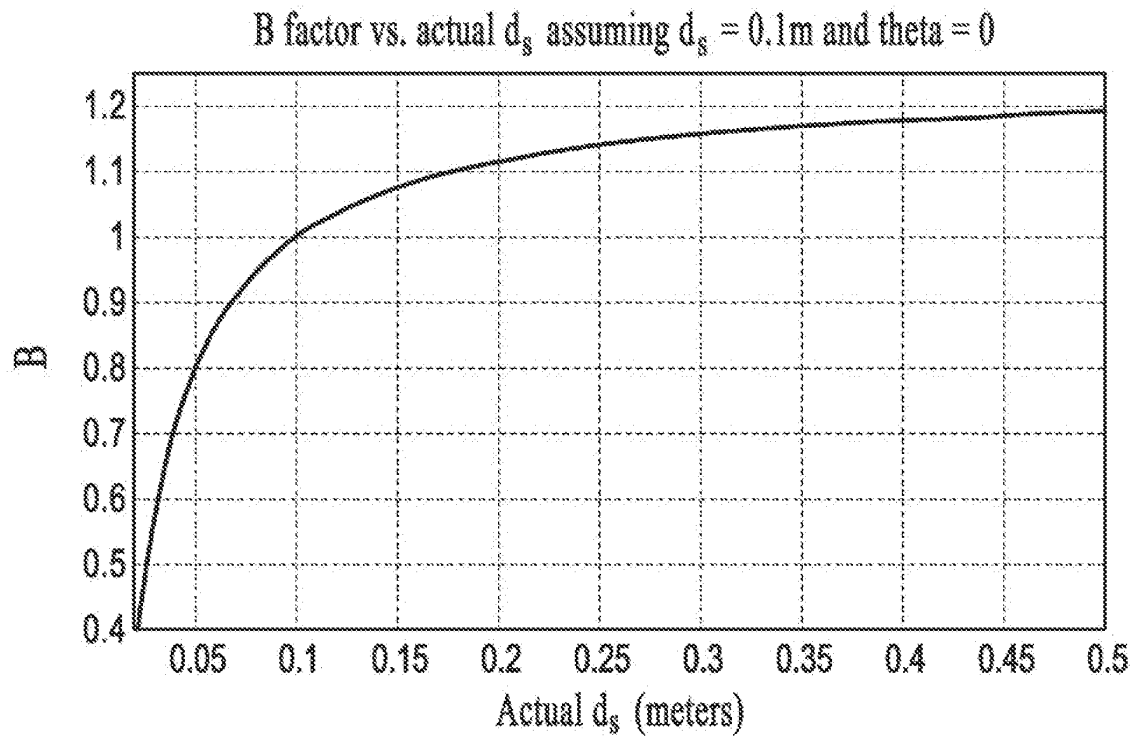


FIG.17

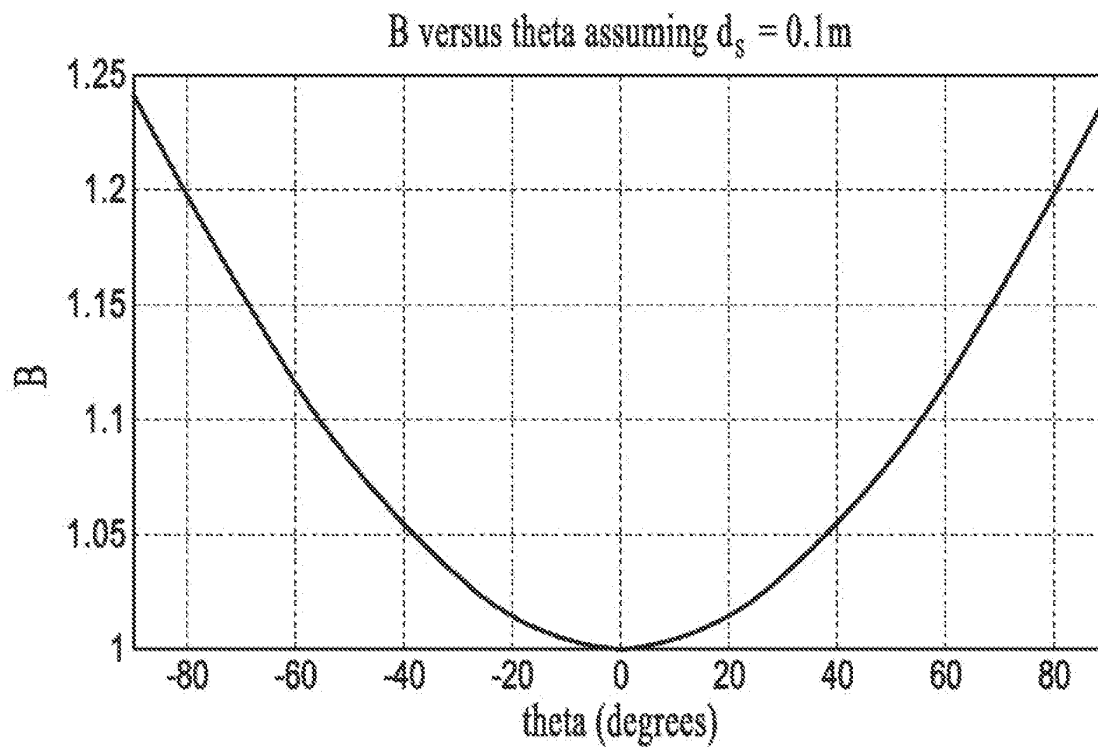


FIG.18

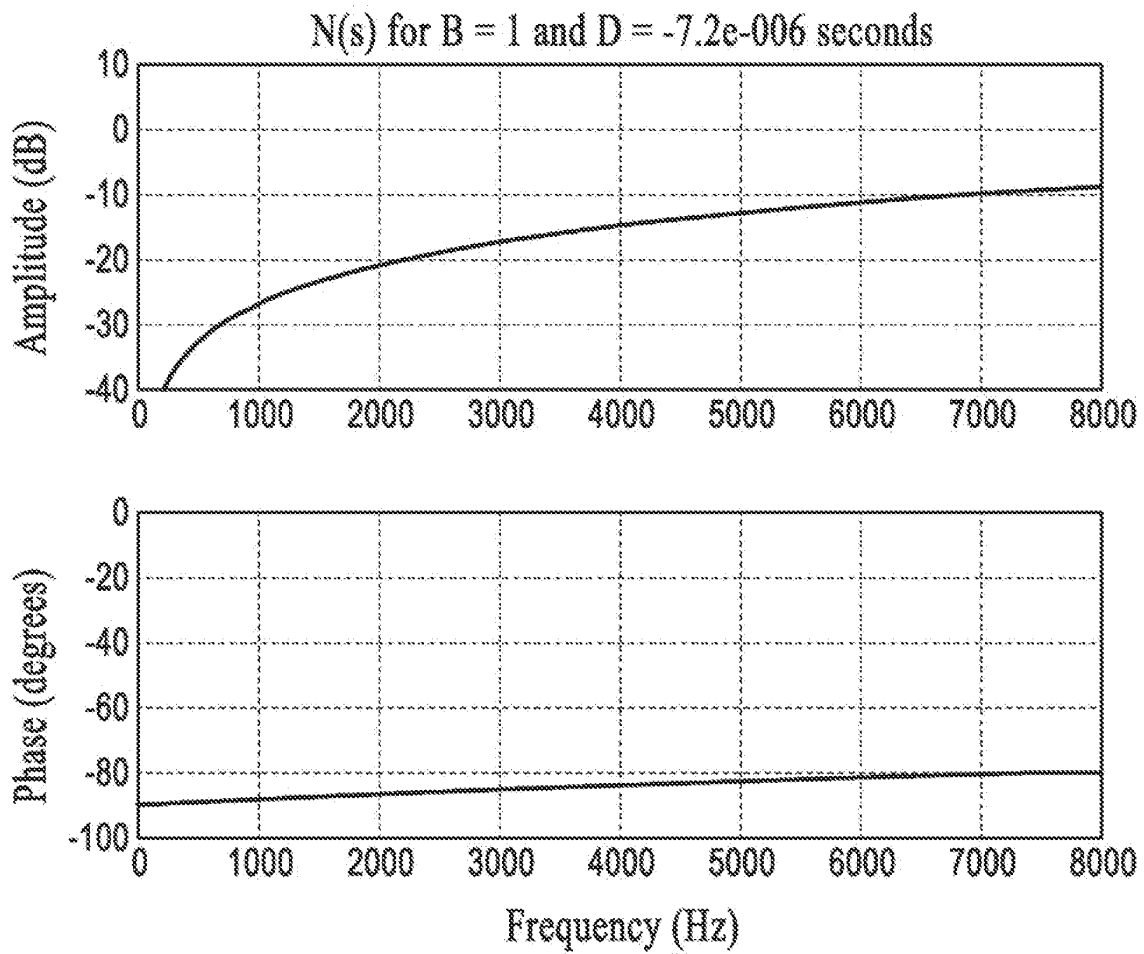


FIG.19

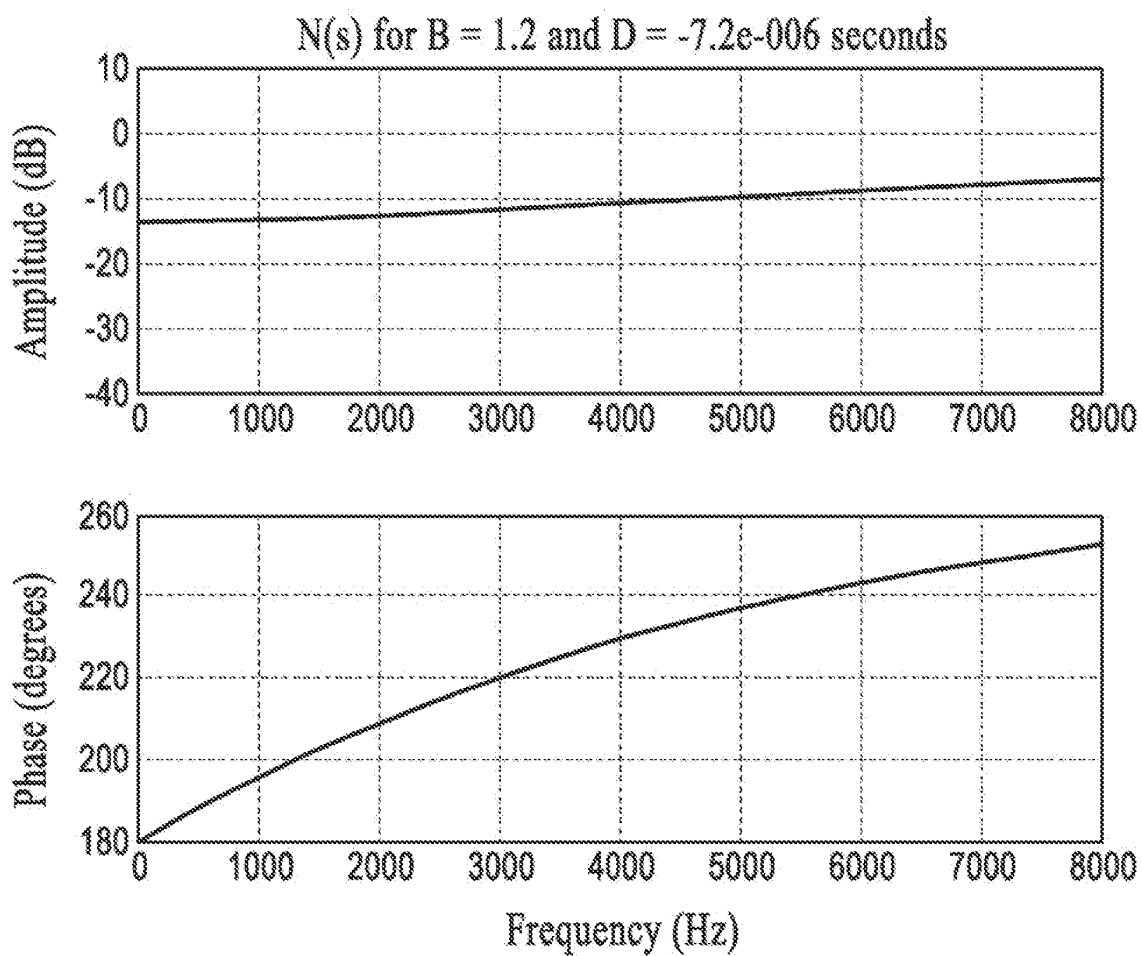


FIG.20

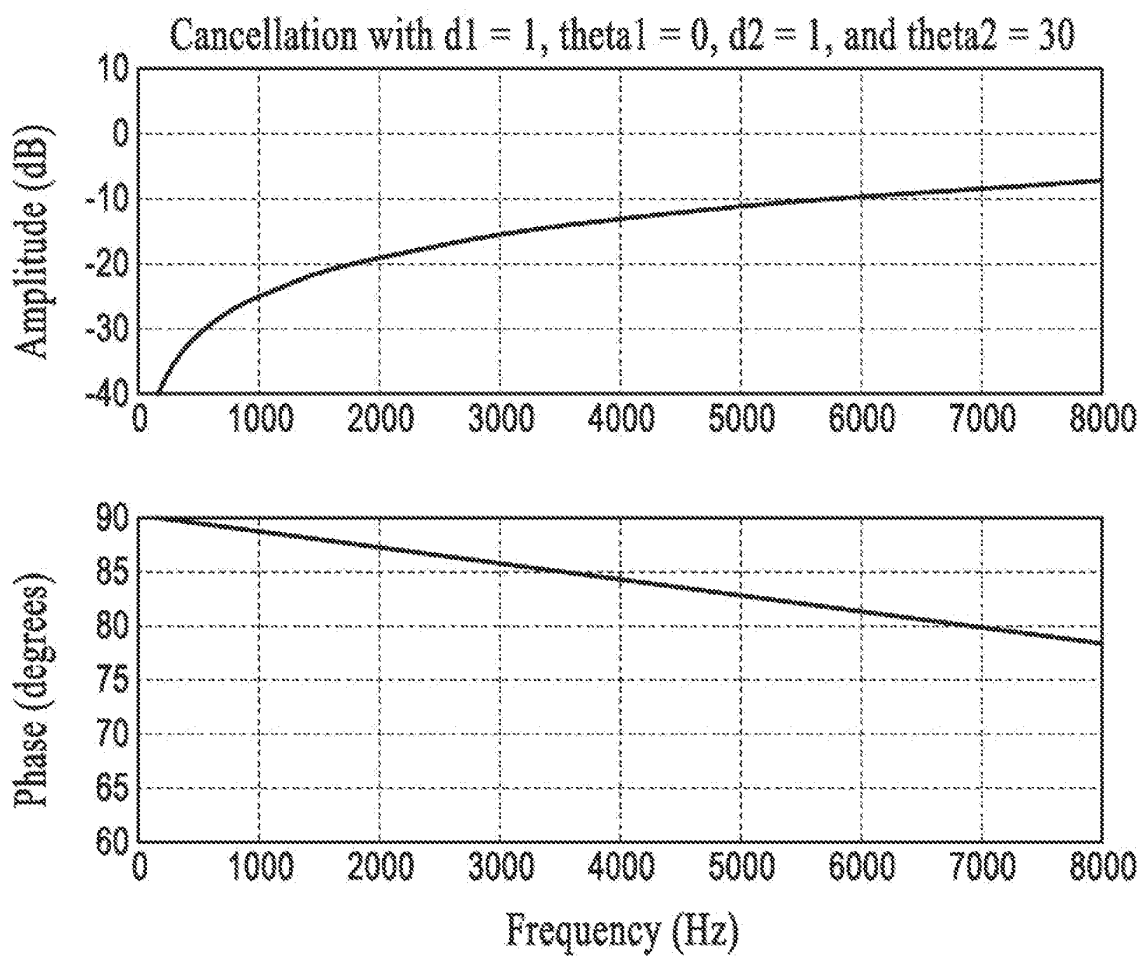


FIG.21

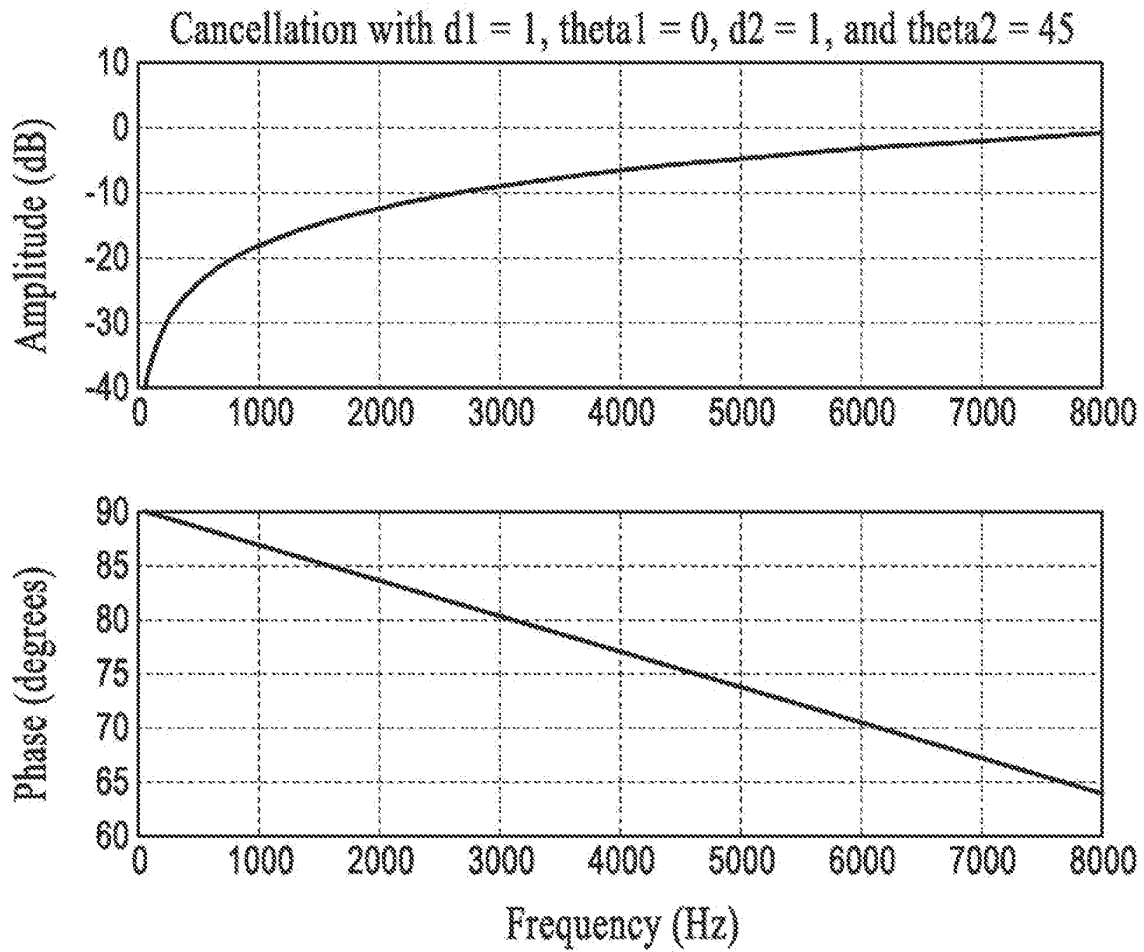


FIG.22

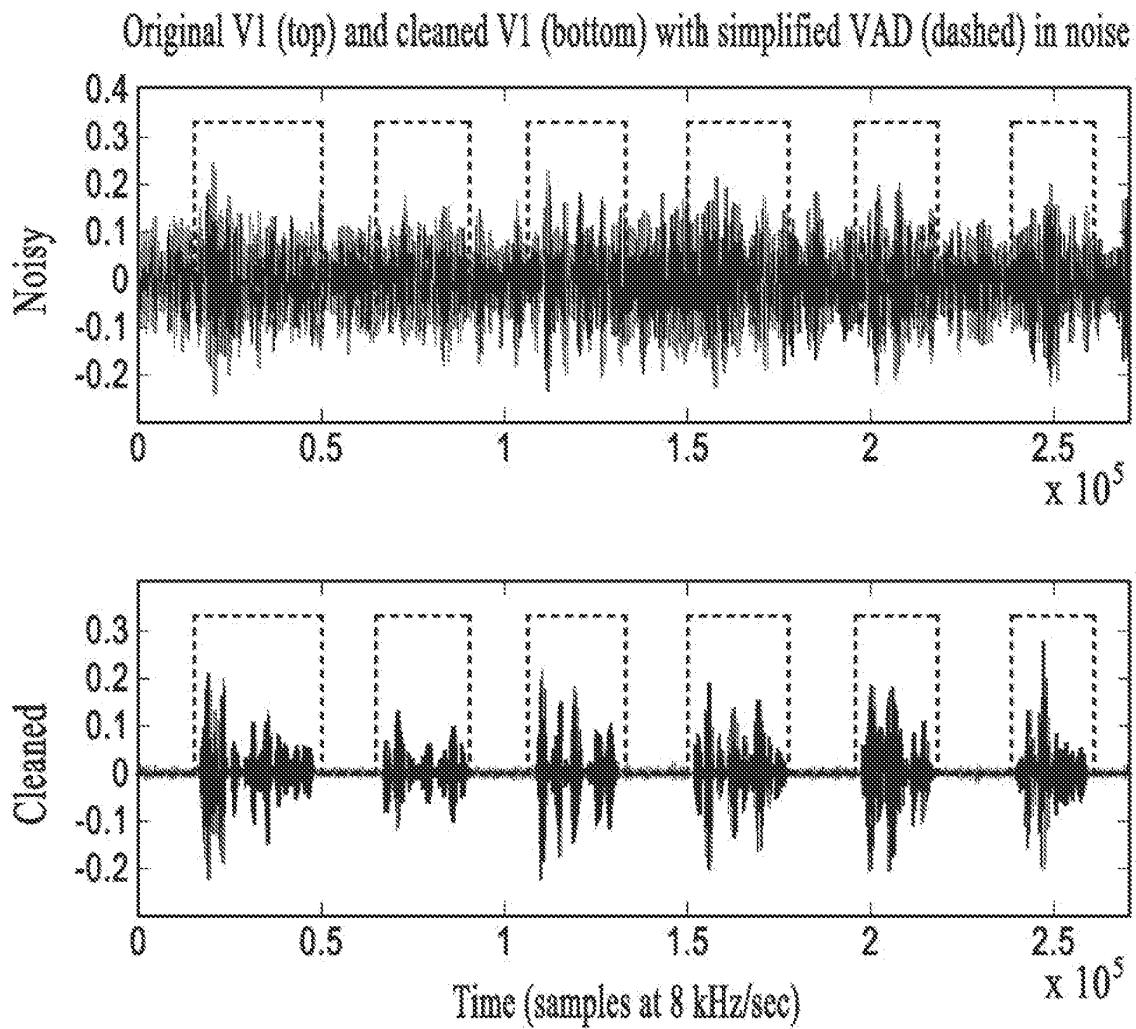


FIG.23

| Electronic Acknowledgement Receipt          |                                                                                      |
|---------------------------------------------|--------------------------------------------------------------------------------------|
| <b>EFS ID:</b>                              | 16506945                                                                             |
| <b>Application Number:</b>                  | 13959708                                                                             |
| <b>International Application Number:</b>    |                                                                                      |
| <b>Confirmation Number:</b>                 | 5622                                                                                 |
| <b>Title of Invention:</b>                  | FORMING VIRTUAL MICROPHONE ARRAYS USING DUAL OMNIDIRECTIONAL MICROPHONE ARRAY (DOMA) |
| <b>First Named Inventor/Applicant Name:</b> | Gregory C. Burnett                                                                   |
| <b>Customer Number:</b>                     | 15516                                                                                |
| <b>Filer:</b>                               | Scott Susumu Kokka                                                                   |
| <b>Filer Authorized By:</b>                 |                                                                                      |
| <b>Attorney Docket Number:</b>              | ALI-050ACON1                                                                         |
| <b>Receipt Date:</b>                        | 05-AUG-2013                                                                          |
| <b>Filing Date:</b>                         |                                                                                      |
| <b>Time Stamp:</b>                          | 22:40:44                                                                             |
| <b>Application Type:</b>                    | Utility under 35 USC 111(a)                                                          |

### Payment information:

| Submitted with Payment |                      | no                                       |                                                         |                  |                  |
|------------------------|----------------------|------------------------------------------|---------------------------------------------------------|------------------|------------------|
| <b>File Listing:</b>   |                      |                                          |                                                         |                  |                  |
| Document Number        | Document Description | File Name                                | File Size(Bytes)/<br>Message Digest                     | Multi Part /.zip | Pages (if appl.) |
| 1                      |                      | ALI-050ACON1_Application_as<br>filed.pdf | 1951207<br><br>3d16a33d1a394d3a3ddc6f154d95f24d82e78f5f | yes              | 75               |

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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Document Description                                | Start   | End |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Transmittal of New Application                      | 1       | 1   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Application Data Sheet                              | 2       | 4   |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Specification                                       | 5       | 56  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Claims                                              | 57      | 57  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Abstract                                            | 58      | 58  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Drawings-only black and white line drawings         | 59      | 75  |
| Warnings:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                     |         |     |
| Information:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                     |         |     |
| Total Files Size (in bytes):                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                     | 1951207 |     |
| <p>This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.</p> <p><b><u>New Applications Under 35 U.S.C. 111</u></b><br/>If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.</p> <p><b><u>National Stage of an International Application under 35 U.S.C. 371</u></b><br/>If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.</p> <p><b><u>New International Application Filed with the USPTO as a Receiving Office</u></b><br/>If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.</p> |                                                     |         |     |