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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
13/770,236	02/19/2013	Masaya KONISHI	KYO.P0221

CONFIRMATION NO. 4369

POA ACCEPTANCE LETTER



OC000000083673605

182086
DAIGNAULT IYER LLP
8229 Boone Boulevard
SUITE 450
VIENNA, VA 22182

Date Mailed: 01/29/2025

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 01/17/2025.

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.

/ylueng/



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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
13/770,236	02/19/2013	Masaya KONISHI	KYO.P0221

CONFIRMATION NO. 4369

26360

Renner Kenner Greive Bobak Taylor & Weber Co., LPA
Huntington Tower, Suite 400
106 South Main Street
Akron, OH 44308-1412

POWER OF ATTORNEY NOTICE



OC000000083673532

Date Mailed: 01/29/2025

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 01/17/2025.

- The Power of Attorney to you in this application has been revoked by the assignee who has intervened as provided by 37 CFR 3.71. Future correspondence will be mailed to the new address of record(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.

/ylueng/

STATEMENT UNDER 37 CFR 3.73(c)

Applicant/Patent Owner: JVC Kenwood Corporation

Application No./Patent No.: 9,070,374 Filed/Issue Date: 02/19/2013

Titled: Communication Apparatus and Condition Notification Method for Notifying a Used Condition of Communication Apparatus by Using a Light-Emitting Device Attached to Communication Apparatus

SoundClear Technologies, LLC, a corporation

(Name of Assignee)

(Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose **one** of options 1, 2, 3 or 4 below):

1. ☒ The assignee of the entire right, title, and interest.
2. ☐ An assignee of less than the entire right, title, and interest (check applicable box):
- ☐ The extent (by percentage) of its ownership interest is ____%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.
- ☐ There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3. ☐ The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. ☐ The recipient, via a court proceeding or the like (e.g., bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

- A. ☐ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel _____, Frame _____, or for which a copy thereof is attached.
- B. ☒ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: Masaya, Konishi; Tatsuya, Onoda To: JVC Kenwood Corporation

The document was recorded in the United States Patent and Trademark Office at
Reel 029830, Frame 0551, or for which a copy thereof is attached.

2. From: JVC Kenwood Corporation To: SoundClear Technologies, LLC

The document was recorded in the United States Patent and Trademark Office at
Reel 064988, Frame 0289, or for which a copy thereof is attached.

[Page 1 of 2]

This collection of information is required by 37 CFR 3.73(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.

STATEMENT UNDER 37 CFR 3.73(c)

3. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

4. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

5. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

6. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☒ As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Kevin H Sprenger/

Signature

Kevin H. Sprenger

Printed or Typed Name

01/17/2025

Date

79,466

Title or Registration 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.



UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #
13/770,236

RECEIPT DATE / TIME
01/17/2025 09:11:01 AM Z ET

ATTORNEY DOCKET #
KYO.P0221

Title of Invention

COMMUNICATION APPARATUS AND CONDITION NOTIFICATION METHOD FOR NOTIFYING A USED CONDITION OF COMMUNICATION APPARATUS BY USING A LIGHT-EMITTING DEVICE ATTACHED TO COMMUNICATION APPARATUS

Application Information

APPLICATION TYPE Utility - Nonprovisional Application
under 35 USC 111(a)

PATENT # 9070374

CONFIRMATION # 4369

FILED BY Kevin Sprenger

PATENT CENTER # 68791499

FILING DATE 02/19/2013

CUSTOMER # 26360

FIRST NAMED INVENTOR Masaya KONISHI

CORRESPONDENCE ADDRESS -

AUTHORIZED BY -

Documents

TOTAL DOCUMENTS: 2

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
1.15.2025_POA_9070374_Signed.pdf	1	Power of Attorney	654 KB
1.17.2025_3.73Statement_PTO-96_9070374.pdf	3	Assignee showing of ownership per 37 CFR 3.73	117 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
1.15.2025_POA_9070374_Signed.pdf	1D1DB5CDAEA8002C7E8860B43CEB30B986FB2505137664856 192BE551AF5696ED20A6A4D75985E62F9851231029B155A948 4D1F67B275F3A2286688B71D7D352

1.17.2025_3.73Statement_PTO
-96_9070374.pdf

22E3C20D4EF373F986A0F837148DE6F2E5C88E62CE6A551E8
D76BCA10194AD09CA3CFA7A5A88F936E421016B9A63A6844
B8EAE8256B69ADF4C1A8E60A9677626

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.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for 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

National Stage of an International Application under 35 U.S.C. 371

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.

New International Application Filed with the USPTO as a Receiving Office

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.

POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in either the attached transmittal letter or the boxes below.

Application Number

Filing Date

13/770,236

02/19/2013

(Note: The boxes above may be left blank if information is provided on form PTO/AIA/82A.)



I hereby appoint the Patent Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above:

182086

OR



I hereby appoint Practitioner(s) named in the attached list (form PTO/AIA/82C) as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the patent application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above. (Note: Complete form PTO/AIA/82C.)

Please recognize or change the correspondence address for the application identified in the attached transmittal letter or the boxes above to:



The address associated with the above-mentioned Customer Number

OR



The address associated with Customer Number:

OR



Firm or
Individual Name

Address

City

State

Zip

Country

Telephone

Email

I am the Applicant (if the Applicant is a juristic entity, list the Applicant name in the box):

SOUNDCLEAR TECHNOLOGIES LLC



Inventor or Joint Inventor (title not required below)



Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)



Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)



Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity).

Signature

Date (Optional)

Name

Yi Lu

Title

Authorized Signatory, SOUNDCLEAR TECHNOLOGIES LLC

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. If more than one applicant, use multiple forms.



Total of 1 forms are submitted.

A Federal agency may not conduct or sponsor, and a person is not required to respond to, nor shall a person be subject to a penalty for failure to comply with an information collection subject to the requirements of the Paperwork Reduction Act of 1995, unless the information collection has a currently valid OMB Control Number. The OMB Control Number for this information collection is 0651-0035. Public burden for this form is estimated to average 3 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the information collection. Send comments regarding this burden estimate or any other aspect of this information collection, including suggestions for reducing this burden to the Chief Administrative Officer, United States Patent and Trademark Office, P.O. Box 1450, Alexandria, VA 22313-1450 or email InformationCollection@uspto.gov. **DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS.** If filing this completed form by mail, 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.



UNITED STATES PATENT AND TRADEMARK OFFICE

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

APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/770,236	06/30/2015	9070374	KYO.P0221	4369

26360 7590 06/10/2015
Renner Kenner Greive Bobak Taylor & Weber Co., LPA
106 South Main Street, Suite 400
Akron, OH 44308-1412

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 209 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):

Masaya KONISHI, Yokohama-Shi, JAPAN;
Tatsuya ONODA, Yokohama-Shi, JAPAN;
JVC KENWOOD CORPORATION, Yokohama-Shi, JAPAN

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.

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)

26360 7590 02/26/2015
Renner Kenner Greive Bobak Taylor & Weber Co., LPA
106 South Main Street, Suite 400
Akron, OH 44308-1412

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.

Patricia Oakes	(Depositor's name)
<i>Patricia Oakes</i>	(Signature)
May 21, 2015	(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/770,236	02/19/2013	Masaya KONISHI	KYO.P0221	4369

TITLE OF INVENTION: COMMUNICATION APPARATUS AND CONDITION NOTIFICATION METHOD FOR NOTIFYING A USED CONDITION OF COMMUNICATION APPARATUS BY USING A LIGHT-EMITTING DEVICE ATTACHED TO COMMUNICATION APPARATUS

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	05/26/2015

EXAMINER	ART UNIT	CLASS-SUBCLASS
YANG, QIAN	2674	704-275000

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,
- (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 Renner, Kenner,
- 2 Greive, Bobak,
- 3 Taylor & Weber

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

JVC KENWOOD Corporation

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

Yokohama-shi, Kanagawa-ken, JAPAN

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 18-0987 (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

Edward G. Greive

Date May 21, 2015

Typed or printed name

Edward G. Greive

Registration No. 24,726

Electronic Patent Application Fee Transmittal				
Application Number:		13770236		
Filing Date:		19-Feb-2013		
Title of Invention:		COMMUNICATION APPARATUS AND CONDITION NOTIFICATION METHOD FOR NOTIFYING A USED CONDITION OF COMMUNICATION APPARATUS BY USING A LIGHT-EMITTING DEVICE ATTACHED TO COMMUNICATION APPARATUS		
First Named Inventor/Applicant Name:		Masaya KONISHI		
Filer:		Edward G. Greive/Patricia Oakes		
Attorney Docket Number:		KYO.P0221		
Filed as Large Entity				
Filing Fees for Utility under 35 USC 111(a)				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Utility Appl Issue Fee	1501	1	960	960

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				960

Electronic Acknowledgement Receipt	
EFS ID:	22412960
Application Number:	13770236
International Application Number:	
Confirmation Number:	4369
Title of Invention:	COMMUNICATION APPARATUS AND CONDITION NOTIFICATION METHOD FOR NOTIFYING A USED CONDITION OF COMMUNICATION APPARATUS BY USING A LIGHT-EMITTING DEVICE ATTACHED TO COMMUNICATION APPARATUS
First Named Inventor/Applicant Name:	Masaya KONISHI
Customer Number:	26360
Filer:	Edward G. Greive/Patricia Oakes
Filer Authorized By:	Edward G. Greive
Attorney Docket Number:	KYO.P0221
Receipt Date:	21-MAY-2015
Filing Date:	19-FEB-2013
Time Stamp:	13:11:27
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	\$ 960
RAM confirmation Number	15237
Deposit Account	180987
Authorized User	GREIVE, EDWARD G.
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees) Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)	

Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Issue Fee Payment (PTO-85B)	PTOL85FeeTransmittal05212015KYOp0221.pdf	65582 9d4ea5253fabbd4753b781dbd9a05358ed0eb22d	no	1

Warnings:

Information:

2	Fee Worksheet (SB06)	fee-info.pdf	30792 263ddb88a1d13f15387abfacfb690fbc13ab0058	no	2
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Warnings:

Information:

Total Files Size (in bytes):	96374
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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.

New Applications Under 35 U.S.C. 111

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.

National Stage of an International Application under 35 U.S.C. 371

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.

New International Application Filed with the USPTO as a Receiving Office

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.



UNITED STATES PATENT AND TRADEMARK OFFICE

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NOTICE OF ALLOWANCE AND FEE(S) DUE

26360 7590 02/26/2015
Renner Kenner Greive Bobak Taylor & Weber Co., LPA
106 South Main Street, Suite 400
Akron, OH 44308-1412

EXAMINER

YANG, QIAN

ART UNIT

PAPER NUMBER

2674

DATE MAILED: 02/26/2015

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/770,236	02/19/2013	Masaya KONISHI	KYO.P0221	4369

TITLE OF INVENTION: COMMUNICATION APPARATUS AND CONDITION NOTIFICATION METHOD FOR NOTIFYING A USED CONDITION OF COMMUNICATION APPARATUS BY USING A LIGHT-EMITTING DEVICE ATTACHED TO COMMUNICATION APPARATUS

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	05/26/2015

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)

26360 7590 02/26/2015
Renner Kenner Greive Bobak Taylor & Weber Co., LPA
106 South Main Street, Suite 400
Akron, OH 44308-1412

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.
13/770,236	02/19/2013	Masaya KONISHI	KYO.P0221	4369

TITLE OF INVENTION: COMMUNICATION APPARATUS AND CONDITION NOTIFICATION METHOD FOR NOTIFYING A USED CONDITION OF COMMUNICATION APPARATUS BY USING A LIGHT-EMITTING DEVICE ATTACHED TO COMMUNICATION APPARATUS

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	05/26/2015

EXAMINER	ART UNIT	CLASS-SUBCLASS
YANG, QIAN	2674	704-275000

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. _____



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/770,236	02/19/2013	Masaya KONISHI	KYO.P0221	4369

26360 7590 02/26/2015
Renner Kenner Greive Bobak Taylor & Weber Co., LPA
106 South Main Street, Suite 400
Akron, OH 44308-1412

EXAMINER

YANG, QIAN

ART UNIT	PAPER NUMBER
----------	--------------

2674

DATE MAILED: 02/26/2015

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 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.

Notice of Allowability	Application No. 13/770,236	Applicant(s) KONISHI ET AL.	
	Examiner QIAN YANG	Art Unit 2674	AIA (First Inventor to File) Status 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 amendment filed on 2/19/15 and Examiner's amendment.
☐ 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 1,2,4,6-12 and 15-19 (renumbered as 1-15 respectively). 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 or send an inquiry to 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. ☐ Notice of References Cited (PTO-892)	5. ☒ Examiner's Amendment/Comment
2. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____	6. ☒ Examiner's Statement of Reasons for Allowance
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material	7. ☐ Other _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____.	

/QIAN YANG/ Primary Examiner, Art Unit 2674	
--	--

DETAILED ACTION

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

EXAMINER'S AMENDMENT

An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Title:

COMMUNICATION APPARATUS AND CONDITION NOTIFICATION METHOD FOR
NOTIFYING A USED CONDITION OF COMMUNICATION APPARATUS BY USING A
LIGHT-EMITTING DEVICE ATTACHED TO COMMUNICATION APPARATUS

The following is an examiner's statement of reasons for allowance:

the present invention is directed to a communication apparatus and condition notification method for notifying a used condition of communication apparatus by using a light-emitting device attached to communication apparatus wherein determining whether or not the speech signal to be transmitted is a speech segment if the communication mode is the transmission mode, wherein, in the sound pick-up state determination step, the sound pick-up state of the sound carried by the speech signal to

be transmitted if the communication mode is the transmission mode is determined based on a determination result of the speech-segment determination step and an evaluation result of the speech-quality evaluation step; and/or to determine whether or not the first speech signal to be transmitted by the transmitter unit is a speech segment, wherein, the sound pick-up state determination unit determines the sound pick-up state of the sound to be transmitted as the first speech signal based on a determination result at the speech-segment determination unit and an evaluation result at the speech-quality evaluation unit.

The closest reference Abraham discloses a communication apparatus and condition notification method. However, it failed to teach the apparatus and method wherein determining whether or not the speech signal to be transmitted is a speech segment if the communication mode is the transmission mode, wherein, in the sound pick-up state determination step, the sound pick-up state of the sound carried by the speech signal to be transmitted if the communication mode is the transmission mode is determined based on a determination result of the speech-segment determination step and an evaluation result of the speech-quality evaluation step; and/or to determine whether or not the first speech signal to be transmitted by the transmitter unit is a speech segment, wherein, the sound pick-up state determination unit determines the sound pick-up state of the sound to be transmitted as the first speech signal based on a determination result at the speech-segment determination unit and an evaluation result at the speech-quality evaluation unit.

The prior arts of record fail to teach, or obvious to teach, the apparatus and method wherein determining whether or not the speech signal to be transmitted is a speech segment if the communication mode is the transmission mode, wherein, in the sound pick-up state determination step, the sound pick-up state of the sound carried by the speech signal to be transmitted if the communication mode is the transmission mode is determined based on a determination result of the speech-segment determination step and an evaluation result of the speech-quality evaluation step; and/or to determine whether or not the first speech signal to be transmitted by the transmitter unit is a speech segment, wherein, the sound pick-up state determination unit determines the sound pick-up state of the sound to be transmitted as the first speech signal based on a determination result at the speech-segment determination unit and an evaluation result at the speech-quality evaluation unit, in combination with all other limitations of the claims.

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

Any inquiry concerning this communication or earlier communications from the examiner should be directed to QIAN YANG whose telephone number is (571)270-7239. The examiner can normally be reached on Monday-Friday 8:00-16:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benny Tieu can be reached on 5712727490. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/QIAN YANG/
Primary Examiner, Art Unit 2674

Issue Classification 	Application/Control No. 13770236	Applicant(s)/Patent Under Reexamination KONISHI ET AL.	
	Examiner QIAN YANG	Art Unit 2674	

CPC					
Symbol				Type	Version
G10L	21	06		F	2013-01-01
G10L	25	60		I	2013-01-01
H04B	1	401		I	2013-01-01
G10L	25	84		I	2013-01-01
H04B	1	46		I	2013-01-01

CPC Combination Sets				
Symbol	Type	Set	Ranking	Version

NONE (Assistant Examiner) _____ (Date) _____		Total Claims Allowed: 15	
/QIAN YANG/ Primary Examiner.Art Unit 2674 (Primary Examiner) _____ (Date) _____		2/20/15 O.G. Print Claim(s) 1	O.G. Print Figure 2

Issue Classification 	Application/Control No. 13770236	Applicant(s)/Patent Under Reexamination KONISHI ET AL.
	Examiner QIAN YANG	Art Unit 2674

☐ Claims renumbered in the same order as presented by applicant				☐ CPA		☐ T.D.		☐ R.1.47							
Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	1	13	17												
2	2	14	18												
	3	15	19												
3	4		20												
	5														
4	6														
5	7														
6	8														
7	9														
8	10														
9	11														
10	12														
	13														
	14														
11	15														
12	16														

NONE (Assistant Examiner) _____ (Date) _____		Total Claims Allowed: 15	
/QIAN YANG/ Primary Examiner.Art Unit 2674 (Primary Examiner) _____ (Date) _____		O.G. Print Claim(s) 1	O.G. Print Figure 2

Search Notes 	Application/Control No. 13770236	Applicant(s)/Patent Under Reexamination KONISHI ET AL.
	Examiner QIAN YANG	Art Unit 2674

CPC- SEARCHED		
Symbol	Date	Examiner

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner
704	275	11/7/14	QY

SEARCH NOTES		
Search Notes	Date	Examiner
Inventor name search	11/7/14	QY
Text related search	11/7/14	QY
Updated	2/20/15	QY
Interference search history printout	2/20/15	QY

INTERFERENCE SEARCH			
US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner
704	275	2/20/15	QY
	PGPUB text search. See interference search history printout	2/20/15	QY

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UNITED STATES DEPARTMENT OF COMMERCE
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 Alexandria, Virginia 22313-1450
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BIB DATA SHEET

CONFIRMATION NO. 4369

SERIAL NUMBER	FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.		
13/770,236	02/19/2013	704	2674	KYO.P0221		
RULE						
APPLICANTS JVC KENWOOD CORPORATION, Yokohama-Shi, JAPAN INVENTORS Masaya KONISHI, Yokohama-Shi, JAPAN; Tatsuya ONODA, Yokohama-Shi, JAPAN; ** CONTINUING DATA ***** ** FOREIGN APPLICATIONS ***** JAPAN JP 2012-034192 02/20/2012 JAPAN JP 2012-034189 02/20/2012 ** IF REQUIRED, FOREIGN FILING LICENSE GRANTED ** 03/11/2013						
Foreign Priority claimed ☒ Yes ☐ No 35 USC 119(a-d) conditions met ☒ Yes ☐ No Verified and Acknowledged <u>/QIAN YANG/</u> Examiner's Signature		☐ Met after Allowance Initials	STATE OR COUNTRY JAPAN	SHEETS DRAWINGS 28	TOTAL CLAIMS 20	INDEPENDENT CLAIMS 3
ADDRESS Renner Kenner Greive Bobak Taylor & Weber Co., LPA 106 South Main Street, Suite 400 Akron, OH 44308-1412 UNITED STATES						
TITLE COMMUNICATION APPARATUS AND CONDITION NOTIFICATION METHOD FOR NOTIFYING A USED CONDITION OF COMMUNICATION APPARATUS BY USING A LIGHT-EMITTING DEVICE ATTACHED TO COMMUNICATION APPARATUS						
FILING FEE RECEIVED 1260	FEES: Authority has been given in Paper No. _____ to charge/credit DEPOSIT ACCOUNT No. _____ for following:			☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit		

EAST Search History**EAST Search History (Interference)**

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	3899	704/275.ccls.	US-PGPUB; USPAT; UPAD	OR	OFF	2015/02/20 10:16
L2	1	1 and (light\$1emit\$4 adj device same determin\$5 same mode).clm.	US-PGPUB; USPAT; UPAD	OR	ON	2015/02/20 10:19

2/ 20/ 2015 10:19:45 AM**C:\ Users\ qyang\ Documents\ EAST\ Workspaces\ Default EAST Workspace 13770236.wsp**

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S1	15	((Masaya) near2 (KONISHI)).INV.	US-PGPUB; USPAT	OR	OFF	2014/11/05 10:57
S2	4	((Tatsuya) near2 (ONODA)).INV.	US-PGPUB; USPAT	OR	OFF	2014/11/05 10:57
S3	73575	(sound speech) same (LED LCD light adj emit\$4 adj device)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/05 14:55
S4	12157	S3 same transmi\$5	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/05 14:56
S5	272	S4 and "704".clas.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/05 14:58
S6	46023	(sound speech) same (LED light adj emit\$4 adj device)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/05 15:17
S7	460	S6 same (determin\$5 detect\$3) near3 (transmi\$5 transfer\$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/05 15:18
S8	8	S7 and "704".clas.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/05 15:20
S9	2	(determin\$5 detect\$3) near3 (transmi\$5 transfer\$4) with (voice sound speech) with simplex\$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/06 09:30
S10	8	(determin\$5 detect\$3) near3 (transmi\$5 transfer\$4) with (voice sound speech) same simplex\$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/06 09:31
S11	6467	(determin\$5) near3 (transmi\$5 transfer\$4) with (voice sound speech)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/06 09:32
S12	66	S11 and simplex\$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/06 09:33
S13	745	S11 and "704".clas.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/06 09:39

S14	237	S13 and direction\$2	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/06 09:40
S15	6858	(determin\$5 detect\$3) with (transmi\$5 transfer\$4) with (standby)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/06 09:44
S16	10	S15 same (simplex\$3 uni\$1direct\$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/06 09:45
S17	12200	(determin\$5 detect\$3) with (stand\$3by) near2 mode	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/06 10:09
S18	84	S17 and (simplex\$3 uni\$1direct\$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/06 10:10
S19	1	sub\$1microphon\$3 same (feed\$1back adapter) same nois\$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/06 15:44
S20	4214	(sub\$1microphon\$3 microphon\$3) same (feed\$1back adapter) same nois\$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/06 15:44
S21	387	S20 same quality	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/06 15:45
S22	32	S21 and "704".clas.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/06 15:45
S23	195	(sub\$1microphon\$3 second\$3 near2 microphon\$3) same (feed\$1back adapter) same nois\$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/06 16:32
S24	54742	(nois\$3 quality) near2 evaluat\$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/06 16:52
S25	271	S24 same cancel\$6	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/06 16:52
S26	20	S25 and "704".clas.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/06 16:52
S27	130	S24 same (noise echo) near3 cancel\$6	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/06 16:56

2/ 20/ 2015 10:19:57 AM

C:\Users\qyang\Documents\EAST\Workspaces\Default EAST Workspace 13770236.wsp

<i>Index of Claims</i> 	Application/Control No. 13770236	Applicant(s)/Patent Under Reexamination KONISHI ET AL.
	Examiner QIAN YANG	Art Unit 2674

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant				☐ CPA				☐ T.D.				☐ R.1.47			
CLAIM		DATE													
Final	Original	11/07/2014	02/20/2015												
1	1	✓	=												
2	2	✓	=												
	3	✓	-												
3	4	✓	=												
	5	O	-												
4	6	✓	=												
5	7	✓	=												
6	8	O	=												
7	9	O	=												
8	10	O	=												
9	11	✓	=												
10	12	✓	=												
	13	✓	-												
	14	O	-												
11	15	✓	=												
12	16	O	=												
13	17	O	=												
14	18	✓	=												
15	19	O	=												
	20	✓	-												

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In the application of	)	Group Art Unit 2674
	)	Confirmation No. 4369
MASAYA KONISHI <i>et al.</i>	)	Qian Yang, Examiner
	)	Docket No. KYO.P0221
Serial No. 13/770,236	)	
	)	Certificate of Electronic Filing
Filed: February 19, 2013	)	I hereby certify that the following correspondence was
	)	transmitted to the U.S. Patent & Trademark Office via EFS
	)	Web on February 9, 2015.
For: AUDIO INPUT APPARATUS,	)	<u>/Edward G. Greive/</u>
COMMUNICATION APPARATUS	)	Edward G. Greive, Reg. No. 24,726
AND CONDITION NOTIFICATION	)	
METHOD	)	

RESPONSE AND AMENDMENT

COMMISSIONER FOR PATENTS
Alexandria, VA 22313-1450

Sir:

In response to the Office Action mailed November 14, 2015 the
Applicants, through their attorney, respond as follows:

Amendments to the Claims are reflected in the listing of claims, which begins on
page 2 of this paper.

Remarks/Arguments begin on page 8 of this paper.

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Currently Amended) A condition notification method for notifying a used condition of a simplex communication apparatus by using a light-emitting device attached to the simplex communication apparatus, the method comprising:
 - a communication-mode determination step of determining whether a communication mode of the simplex communication apparatus is a transmission mode or a standby mode;
 - a sound pick-up state determination step of determining a sound pick-up state of a sound carried by a speech signal to be transmitted if the communication mode is the transmission mode; [[and]]
 - a control step of controlling the light-emitting device so that the light-emitting device is turned off, turned on or repeatedly turned on and off based on determination results of the communication-mode determination step and the sound pick-up state determination step;
 - a speech-quality evaluation step of evaluating speech quality of the speech signal to be transmitted, wherein, in the sound pick-up state determination step, the sound pick-up state of the sound carried by the speech signal to be transmitted is determined if the communication mode is the transmission mode based on the speech quality of the speech signal evaluated by the speech-quality evaluation step;
 - and
 - a speech-segment determination step of determining whether or not the speech signal to be transmitted is a speech segment if the communication mode is the transmission mode, wherein, in the sound pick-up state determination step, the sound pick-up state of the sound carried by the speech signal to be transmitted, if the communication mode is the transmission mode, is determined based on a

determination result of the speech-segment determination step and an evaluation result of the speech-quality evaluation step.

2. (Original) The condition notification method according to claim 1, wherein, in the control step, the light-emitting device is turned on if the communication mode is the transmission mode whereas the light-emitting device is repeatedly turned on and off based on the sound pick-up state determined in the sound pick-up state determination step if the communication mode is the transmission mode.

3. (Canceled)

4. (Currently Amended) The condition notification method according to claim ~~[[3]]~~ 1, wherein, in the speech-quality evaluation step, the speech quality of the speech signal to be transmitted is evaluated based on a volume level of a sound to be picked up.

5. (Canceled)

6. (Currently Amended) The condition notification method according to claim ~~[[3]]~~ 1 further comprising a noise cancellation step of performing noise cancellation to a first speech signal input from a first sound pick-up unit by using a second speech signal input from a second sound pick-up unit, the first and second sound pick-up units being provided for the simplex communication apparatus, wherein, speech quality of a speech signal after the noise cancellation is evaluated in the speech-quality evaluation step.

7. (Currently Amended) The condition notification method according to claim ~~3~~ further comprising a 1, wherein in the speech-segment determination step of ~~determining~~ it is determined whether or not the speech signal to be transmitted is a speech segment if the communication mode is the transmission mode, wherein, in

the speech-quality evaluation step, the speech quality of the speech signal to be transmitted is evaluated while the speech signal to be transmitted is being determined as the speech segment.

8. (Currently Amended) The condition notification method according to claim [[3]] 1 further comprising a microphone-direction determination step of determining a direction of a main microphone based on a phase difference of sounds picked up by a first sound pick-up unit and a second sound pick-up unit both provided for the simplex communication apparatus, the first sound pick-up unit including the main microphone, wherein, in the speech-quality evaluation step, the speech quality of the speech signal to be transmitted is evaluated based on the direction of the main microphone thus determined in the microphone-direction determination step.

9. (Original) The condition notification method according to claim 6, wherein, in the control step, the light-emitting device is turned off if the communication mode is the standby mode, the light-emitting device is turned on if the communication mode is the transmission mode and if the speech signal to be transmitted is not the speech segment, the light-emitting device is turned on if the communication mode is the transmission mode and if the speech signal to be transmitted is the speech segment, and if the speech quality of the speech signal to be transmitted is evaluated as bad, and the light-emitting device is repeatedly turned on and off if the communication mode is the transmission mode and if the speech signal to be transmitted is the speech segment, and if the speech quality of the speech signal to be transmitted is evaluated as good.

10. (Currently Amended) The condition notification method according to claim [[5]] 1, wherein the speech-segment determination step includes:
a frequency conversion step of converting a signal input from a sound pick-up unit provided for the simplex communication apparatus into a signal component in unit of a specific length in a frequency domain; and

a sound determination step of determining whether the signal input from the sound pick-up unit carries a voice component or a noise component based on a spectrum component of the signal component thus converted into the frequency domain.

11. (Currently Amended) A communication apparatus comprising:

a first pick-up unit configured to pick up a voice sound;

a transmitter unit configured to transmit the voice sound picked up by the first pick-up unit to outside as a first speech signal;

a communication-mode switching unit configured to switch a communication mode between a standby mode in which the transmitter unit does not transmit the speech signal and a transmission mode in which the transmitter unit transmits the speech signal;

a sound pick-up state determination unit configured to determine a pick-up state of the voice sound picked up by the first pick-up unit;

a light emission device configured to emit light; and

a control unit configured to control the light-emitting device so that the light-emitting device is turned off, turned on or repeatedly turned on and off based on the communication mode switched by the communication-mode switching unit, and the pick-up state of the voice sound picked up by the first pick-up unit and determined by the sound pick-up state determination unit;

a speech-quality evaluation unit configured to evaluate speech quality of the first speech signal to be transmitted by the transmitter unit, wherein the sound pick-up state determination unit determines the sound pick-up state of the voice sound picked up by the first sound pick-up unit based on the speech quality of the speech signal evaluated by the speech-quality evaluation unit; and

a speech-segment determination unit configured to determine whether or not the first speech signal to be transmitted by the transmitter unit is a speech segment, wherein, the sound pick-up state determination unit determines the sound pick-up state of the sound to be transmitted as the first speech signal based on a

determination result at the speech-segment determination unit and an evaluation result at the speech-quality evaluation unit.

12. (Original) The communication apparatus according to claim 11, wherein the light-emitting device is turned on if the communication mode is switched into the transmission mode whereas the light-emitting device is repeatedly turned on and off based on the pick-up state determined by the sound pick-up state determination unit if the communication mode is switched into the transmission mode.

13. (Canceled)

14. (Canceled)

15. (Currently Amended) The communication apparatus according to claim [[13]] 11 further comprising:

a second sound pick-up unit configured to pick up a voice sound;

a noise cancellation unit configured to perform noise cancellation to the first speech signal input from the first sound pick-up unit by using a second speech signal input from the second sound pick-up unit,

wherein the transmitter unit transmits a speech signal after the noise cancellation by the noise cancellation unit and the speech-quality evaluation unit evaluates speech quality of the speech signal after the noise cancellation.

16. (Original) The communication apparatus according to claim 15 further comprising a microphone-direction determination unit configured to determine a direction of a main microphone based on a phase difference of the voice sounds picked up the first and second sound pick-up units, respectively, the first sound pick-up unit including the main microphone, wherein, the speech-quality evaluation unit evaluates the speech quality of the speech signal to be transmitted by the

transmitter unit based on the direction of the main microphone thus determined by the microphone-direction determination unit.

17. (Currently Amended) The communication apparatus according to claim [[14]] 11, wherein the control unit controls the light-emitting device so that the light-emitting device is turned off if the communication mode is the standby mode, the light-emitting device is turned on if the communication mode is the transmission mode and if the speech signal to be transmitted is not the speech segment, the light-emitting device is turned on if the communication mode is the transmission mode, if the speech signal to be transmitted is the speech segment, and if the speech quality of the speech signal to be transmitted is evaluated as bad, and the light-emitting device is repeatedly turned on and off if the communication mode is the transmission mode, if the speech signal to be transmitted is the speech segment, and if the speech quality of the speech signal to be transmitted is evaluated as good.

18. (Original) The communication apparatus according to claim 15, wherein the first and second sound pick-up units are a main microphone and a sub-microphone, respectively, and the main microphone and the sub-microphone are arranged at a front face and a rear face of the communication apparatus, respectively.

19. (Currently Amended) The communication apparatus according to claim [[14]] 11, wherein the speech-segment determination unit converts the first signal input from the first sound pick-up unit into a signal component in unit of a specific length in a frequency domain and determines whether the first signal carries a voice component or a noise component based on a spectrum component of the signal component thus converted into the frequency domain.

20. (Canceled)

REMARKS

The Examiner has indicated that claims 5, 8-10, 14, 16, 17 and 19 would be allowable if rewritten into independent form. Accordingly, claim 1 has been amended to incorporate the limitations of allowable claim 5 and intervening claim 3, and claim 11 has been amended to incorporate the limitations of allowable claim 14 and intervening claim 13. Thus, claims 1 and 11, and all claims depending therefrom, are now in proper form for allowance.

In view of the foregoing, it is the Applicants' position that claims 1, 2, 4, 6-12 and 15-19 are in condition for allowance. Reconsideration by the Examiner and the issuance of a formal Notice of Allowance is most earnestly solicited.

If any further issues remain after this amendment, a telephone call to the undersigned would be appreciated.

Respectfully submitted,

/Edward G. Greive/

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February 9, 2015

Attorney for the Applicants

Electronic Acknowledgement Receipt

EFS ID:	21434200
Application Number:	13770236
International Application Number:	
Confirmation Number:	4369
Title of Invention:	AUDIO INPUT APPARATUS, COMMUNICATION APPARATUS AND CONDITION NOTIFICATION METHOD
First Named Inventor/Applicant Name:	Masaya KONISHI
Customer Number:	26360
Filer:	Edward G. Greive/Martha Hastings
Filer Authorized By:	Edward G. Greive
Attorney Docket Number:	KYO.P0221
Receipt Date:	09-FEB-2015
Filing Date:	19-FEB-2013
Time Stamp:	10:40:08
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment		no			
File Listing:					
Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		KYOP221RESPONSE.pdf	100163	yes	8
			f6f5cba206675e6c8cb248903795dfb5837ffefd		

	Multipart Description/PDF files in .zip description		
	Document Description	Start	End
	Amendment/Req. Reconsideration-After Non-Final Reject	1	1
	Claims	2	7
	Applicant Arguments/Remarks Made in an Amendment	8	8
Warnings:			
Information:			
Total Files Size (in bytes):		100163	
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. <u>New Applications Under 35 U.S.C. 111</u> 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. <u>National Stage of an International Application under 35 U.S.C. 371</u> 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. <u>New International Application Filed with the USPTO as a Receiving Office</u> 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.			

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.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875				Application or Docket Number 13/770,236		Filing Date 02/19/2013		☐ To be Mailed	
ENTITY: ☒ LARGE ☐ SMALL ☐ MICRO									
APPLICATION AS FILED – PART I									
(Column 1)		(Column 2)							
FOR	NUMBER FILED	NUMBER EXTRA			RATE (\$)	FEE (\$)			
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A			N/A				
☐ SEARCH FEE (37 CFR 1.16(k), (l), or (m))	N/A	N/A			N/A				
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A			N/A				
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*			X \$	=			
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*			X \$	=			
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$310 (\$155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).								
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))									
* If the difference in column 1 is less than zero, enter "0" in column 2.					TOTAL				
APPLICATION AS AMENDED – PART II									
(Column 1)		(Column 2)		(Column 3)					
AMENDMENT	02/09/2015	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE (\$)		ADDITIONAL FEE (\$)	
	Total (37 CFR 1.16(i))	* 15	Minus	** 20	= 0	X \$80 =		0	
	Independent (37 CFR 1.16(h))	* 2	Minus	*** 3	= 0	X \$420 =		0	
	☐ Application Size Fee (37 CFR 1.16(s))								
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))								
						TOTAL ADD'L FEE		0	
(Column 1)		(Column 2)		(Column 3)					
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE (\$)		ADDITIONAL FEE (\$)	
	Total (37 CFR 1.16(i))	*	Minus	**	=	X \$		=	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X \$		=	
	☐ Application Size Fee (37 CFR 1.16(s))								
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))								
						TOTAL ADD'L FEE			
* If the entry in column 1 is less than the entry in column 2, write "0" in column 3. ** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20". *** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3". The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.									

This collection of information is required by 37 CFR 1.16. 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, 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.**

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/770,236	02/19/2013	Masaya KONISHI	KYO.P0221	4369
26360 7590 11/14/2014 Renner Kenner Greive Bobak Taylor & Weber Co., LPA 106 South Main Street, Suite 400 Akron, OH 44308-1412			EXAMINER YANG, QIAN	
			ART UNIT 2674	PAPER NUMBER
			MAIL DATE 11/14/2014	DELIVERY MODE 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.

Office Action Summary	Application No. 13/770,236	Applicant(s) KONISHI ET AL.	
	Examiner QIAN YANG	Art Unit 2674	AIA (First Inventor to File) Status 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 2/19/13.
☐ 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) 1-20 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) 1-4, 6, 7, 11-13, 18 and 20 is/are rejected.
- 8) ☒ Claim(s) 5, 8-10, 14, 16, 17 and 19 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 or send an inquiry to PPHfeedback@uspto.gov.

Application Papers

- 10) ☐ The specification is objected to by the Examiner.
- 11) ☒ The drawing(s) filed on 2/19/13 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 2/19/13
- 3) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. ____.
- 4) ☐ Other: ____.

DETAILED ACTION

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

Priority

1. Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

Claim Rejections - 35 USC § 103

2. The following is a quotation of pre-AIA 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1, 2, 11 and 12 are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Abraham (US Patent Application Publication 2008/0032624) in view of Ouchi (Japan Patent Application Publication 2000-106588).

Regarding claim 1, Abraham discloses a condition notification method for notifying a used condition of a simplex communication apparatus (**Fig. 3**), the method comprising:

a communication-mode determination step of determining whether a communication mode of the simplex communication apparatus is a transmission mode

or a standby mode (**Table 1, [0098 – 0100], it is apparent there is a determination for the mode between standby mode and active mode (transmission mode));**

a sound pick-up state determination step of determining a sound pick-up state of a sound carried by a speech signal to be transmitted if the communication mode is the transmission mode (**Table 1, it is apparent there is a pick-up state to pick-up a voice sound in a frequency exhibited in Table 1 for different mode).**

However, Abraham fails to explicitly disclose the method further comprising a control step of controlling the light-emitting device so that the light-emitting device is turned off, turned on or repeatedly turned on and off based on determination results of the communication-mode determination step and the sound pick-up state determination step.

However, in a similar field of endeavor Ouchi discloses a communication apparatus (**Fig. 1**). In addition, Ouchi discloses the apparatus comprising a light emission device configured to emit light (**[0023], LED**); and a control unit configured to control the light-emitting device so that the light-emitting device is turned off, turned on or repeatedly turned on and off based on the communication (**[0019, 0032 and 0033]**).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the invention of Abraham, and further comprising a control step of controlling the light-emitting device so that the light-emitting device is turned off, turned on or repeatedly turned on and off based on determination results of the communication-mode determination step and the sound pick-up state determination

step, as taught by Ouchi. The motivation for doing this is that the sound effect can be exhibited.

Regarding claim 11, Abraham discloses a communication apparatus (**Fig. 3**) comprising:

a first pick-up unit configured to pick up a voice sound (**Fig. 3, #42**);

a transmitter unit configured to transmit the voice sound picked up by the first pick-up unit to outside as a first speech signal (**Fig. 3, #32**);

a communication-mode switching unit configured to switch a communication mode between a standby mode in which the transmitter unit does not transmit the speech signal and a transmission mode in which the transmitter unit transmits the speech signal (**Table 1, [0098 – 0100], it is apparent there is a switch unit to switch the mode between standby mode and active mode (transmission mode)**);

a sound pick-up state determination unit configured to determine a pick-up state of the voice sound picked up by the first pick-up unit (**Table 1, it is apparent there is a pick-up state to pick-up a voice sound in a frequency exhibited in Table 1 for different mode**).

However, Abraham fails to explicitly disclose the apparatus further comprising a light emission device configured to emit light; and a control unit configured to control the light-emitting device so that the light-emitting device is turned off, turned on or repeatedly turned on and off based on the communication mode switched by the

communication-mode switching unit, and the pick-up state of the voice sound picked up by the first pick-up unit and determined by the sound pick-up state determination unit.

However, in a similar field of endeavor Ouchi discloses a communication apparatus (**Fig. 1**). In addition, Ouchi discloses the apparatus comprising a light emission device configured to emit light (**[0023], LED**); and a control unit configured to control the light-emitting device so that the light-emitting device is turned off, turned on or repeatedly turned on and off based on the communication (**[0019, 0032 and 0033]**).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the invention of Abraham, and further comprising a light emission device configured to emit light, and to control the light-emitting device so that the light-emitting device is turned off, turned on or repeatedly turned on and off based on the communication mode switched by the communication-mode switching unit, and the pick-up state of the voice sound picked up by the first pick-up unit and determined by the sound pick-up state determination unit, as taught by Ouchi. The motivation for doing this is that the sound effect can be exhibited.

Regarding claim 12 (depend on claim 11), Abraham discloses the apparatus wherein the voice signal is transmitted if the communication mode is switched into the transmission based on the pick-up state determined by the sound pick-up state determination unit if the communication mode is switched into the transmission mode (**Table 1, [0100]**).

However, Abraham fails to explicitly disclose under this situation, the light-emitting device is turned on, whereas the light-emitting device is repeatedly turned on and off based on the pick-up state.

However, in a similar field of endeavor Ouchi discloses a communication apparatus (**Fig. 1**). In addition, Ouchi discloses the apparatus comprising a light emission device configured to emit light (**[0023], LED**); and a control unit configured to control the light-emitting device so that the light-emitting device is turned off, turned on or repeatedly turned on and off based on voice signal and communication (**[0019, 0032 and 0033]**).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the invention of Abraham, and further comprising a light emission device configured to emit light, and the light-emitting device is turned on, whereas the light-emitting device is repeatedly turned on and off based on the pick-up state, as taught by Ouchi. The motivation for doing this is that the sound effect can be exhibited.

Regarding claim 2, it is obvious variations of claim 12, thus it is interpreted and rejected for the reasons set forth above in the rejection of claim 12.

4. Claims 3, 4, 7 and 13 are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Abraham in view of Ouchi, and in further view of Beaucoup et al. (US Patent Application Publication 2013/0039503), hereinafter referred as Beaucoup.

Regarding claim 13 (depend on claim 11), Abraham in view of Ouchi fails to explicitly disclose the apparatus further comprising a speech-quality evaluation unit configured to evaluate speech quality of the first speech signal to be transmitted by the transmitter unit, wherein the sound pick-up state determination unit determines the sound pick-up state of the voice sound picked up by the first sound pick-up unit based on the speech quality of the speech signal evaluated by the speech-quality evaluation unit.

However, in a similar field of endeavor Beaucoup discloses a speech quality enhancement apparatus (**Fig. 1**). In addition, Beaucoup discloses the apparatus comprising a speech-quality evaluation unit configured to evaluate speech quality of the original speech signal to be transmitted (**Fig. 1, after echo (noise) cancellation module 111, noise evaluation 107 (speech-quality evaluation) is processed**).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the invention of Abraham in view of Ouchi, and further comprising a speech-quality evaluation unit configured to evaluate speech quality of the first speech signal to be transmitted by the transmitter unit, wherein the sound pick-up state determination unit determines the sound pick-up state of the voice sound picked up by the first sound pick-up unit based on the speech quality of the speech signal evaluated by the speech-quality evaluation unit, as taught by Beaucoup. The motivation for doing this is that the speech quality can be further enhanced.

Regarding claim 3, it is obvious variations of claim 13, thus it is interpreted and rejected for the reasons set forth above in the rejection of claim 13.

Regarding claim 4 (depend on claim 3), Beaucoup discloses the method wherein, in the speech-quality evaluation step, the speech quality of the speech signal to be transmitted is evaluated based on a volume level of a sound to be picked up ([0022], the **evaluation is based on the level of annoyance**).

Regarding claim 7 (depend on claim 3), Abraham in view of Ouchi fails to explicitly disclose the method further comprising a speech-segment determination step of determining whether or not the speech signal to be transmitted is a speech segment if the communication mode is the transmission mode, wherein, in the speech-quality evaluation step, the speech quality of the speech signal to be transmitted is evaluated while the speech signal to be transmitted is being determined as the speech segment.

However, in a similar field of endeavor Beaucoup discloses a speech quality enhancement apparatus (**Fig. 1**). In addition, Beaucoup discloses the apparatus comprising a speech-segment determination step of determining whether or not the speech signal to be transmitted is a speech segment, wherein, in the speech-quality evaluation step, the speech quality of the speech signal to be transmitted is evaluated while the speech signal to be transmitted is being determined as the speech segment ([0022], the **evaluation determines the level of annoyance to attenuate the noise, thus speech segment is determined**).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the invention of Abraham in view of Ouchi, and further comprising a speech-segment determination step of determining whether or not the speech signal to be transmitted is a speech segment if the communication mode is the transmission mode, wherein, in the speech-quality evaluation step, the speech quality of the speech signal to be transmitted is evaluated while the speech signal to be transmitted is being determined as the speech segment, as taught by Beaucoup. The motivation for doing this is that the speech quality can be further enhanced.

5. Claims 6, 15, 18 are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Abraham in view of Ouchi, in further view of Beaucoup and Holzrichter (US Patent Application Publication 2012/0053931).

Regarding claim 15 (depend on claim 13), Beaucoup discloses the apparatus further comprising :

a second sound pick-up unit configured to pick up a voice sound (**Fig. 1, second microphone of 117**);

a noise cancellation unit configured to perform noise cancellation to the first speech signal input from the first sound pick-up unit (**Fig. 1, 107, [0019]**),

wherein the transmitter unit transmits a speech signal after the noise cancellation by the noise cancellation unit and the speech-quality evaluation unit evaluates speech quality of the speech signal after the noise cancellation (**Fig. 1, 108**).

However, Abraham in view of Ouchi and in further view of Beaucoup fails to explicitly disclose the noise cancellation to the first speech signal input from the first sound pick-up unit by using a second speech signal input from the second sound pick-up unit.

However, in a similar field of endeavor Holzrichter discloses a noise cancellation apparatus (**Fig. 1**). In addition, Holzrichter discloses the apparatus that the noise cancellation to the first speech signal input from the first sound pick-up unit by using a second speech signal input from the second sound pick-up unit (**[0039]**).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the invention of Holzrichter, and using a second speech signal input from the second sound pick-up unit to cancel the noise of first speech signal, as taught by Holzrichter. The motivation for doing this is that the noise cancellation can be easily implemented.

Regarding claim 6, it is obvious variations of claim 15, thus it is interpreted and rejected for the reasons set forth above in the rejection of claim 15.

Regarding claim 18 (depend on claim 15), Beaucoup discloses the apparatus wherein the first and second sound pick-up units are a main microphone and a sub-microphone, respectively, and the main microphone and the sub-microphone are arranged at a front face and a rear face of the communication apparatus, respectively (**Fig. 1, microphone 117 can be arranged to different locations including a front face and a rear face of**

the communication apparatus).

6. Claim 20 is rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Holzrichter in view of Beaucoup.

Regarding claim 20, Holzrichter discloses an audio input apparatus (**Fig. 1**) comprising:

a first sound pick-up unit (**Fig. 1, #5**);

a second sound pick-up unit (**Fig. 1, #14**);

a noise-cancellation processing unit configured to perform noise cancellation to a first speech signal input from the first sound pick-up unit by using a second speech signal input from the second sound pick-up unit (**[0039]**).

However, Holzrichter fails to explicitly disclose the apparatus further comprising a speech-quality evaluation unit configured to evaluate speech quality of a speech signal after the noise cancellation at the noise-cancellation processing unit; and an evaluation-result notification unit configured to notify an evaluation result at the speech-quality evaluation unit.

However, in a similar field of endeavor Beaucoup discloses a speech quality enhancement apparatus (**Fig. 1**). In addition, Beaucoup discloses the apparatus comprising a speech-quality evaluation unit configured to evaluate speech quality of a speech signal after the noise cancellation at the noise-cancellation processing unit (**Fig. 1, after echo (noise) cancellation module 111, noise evaluation 107 (speech-quality evaluation) is processed**); and

an evaluation-result notification unit configured to notify an evaluation result at the speech-quality evaluation unit (**Fig. 1, the evaluation result is notified to Beamformer Application module 108, [0020]**).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the invention of Holzrichter, and further comprising a speech-quality evaluation unit configured to evaluate speech quality of a speech signal after the noise cancellation at the noise-cancellation processing unit; and an evaluation-result notification unit configured to notify an evaluation result at the speech-quality evaluation unit, as taught by Beaucoup. The motivation for doing this is that the speech quality can be further enhanced.

Allowable Subject Matter

7. Claims 5, 8 – 10, 14, 16, 17 and 19 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to QIAN YANG whose telephone number is (571)270-7239. The examiner can normally be reached on Monday-Friday 8:00-16:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benny Tieu can be reached on 5712727490. The fax phone number for the

organization where this application or proceeding is assigned is 571-273-8300.

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). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/QIAN YANG/
Primary Examiner, Art Unit 2674

Notice of References Cited	Application/Control No. 13/770,236	Applicant(s)/Patent Under Reexamination KONISHI ET AL.	
	Examiner QIAN YANG	Art Unit 2674	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-2008/0032624	02-2008	Abraham, Neil	455/11.1
*	B	US-2013/0039503	02-2013	BEAUCOUP et al.	381/66
*	C	US-2012/0053931	03-2012	Holzrichter, John F.	704/200.1
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

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	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	Machine translation for JP 2000-106588, IDS, 04/2000
	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.

<i>Index of Claims</i> 	Application/Control No. 13770236	Applicant(s)/Patent Under Reexamination KONISHI ET AL.
	Examiner QIAN YANG	Art Unit 2674

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant			☐ CPA			☐ T.D.			☐ R.1.47		
CLAIM		DATE									
Final	Original	11/07/2014									
	1	✓									
	2	✓									
	3	✓									
	4	✓									
	5	O									
	6	✓									
	7	✓									
	8	O									
	9	O									
	10	O									
	11	✓									
	12	✓									
	13	✓									
	14	O									
	15	✓									
	16	O									
	17	O									
	18	✓									
	19	O									
	20	✓									

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	15	((Masaya) near2 (KONISHI)).INV.	US-PGPUB; USPAT	OR	OFF	2014/11/07 10:30
L2	4	((Tatsuya) near2 (ONODA)).INV.	US-PGPUB; USPAT	OR	OFF	2014/11/07 10:30
L3	1	(L1 L2) and (light\$1emit\$4 same standby).clm.	US-PGPUB; USPAT	OR	OFF	2014/11/07 10:30
S1	15	((Masaya) near2 (KONISHI)).INV.	US-PGPUB; USPAT	OR	OFF	2014/11/05 10:57
S2	4	((Tatsuya) near2 (ONODA)).INV.	US-PGPUB; USPAT	OR	OFF	2014/11/05 10:57
S3	73575	(sound speech) same (LED LCD light adj emit\$4 adj device)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/05 14:55
S4	12157	S3 same transmi\$5	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/05 14:56
S5	272	S4 and "704".clas.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/05 14:58
S6	46023	(sound speech) same (LED light adj emit\$4 adj device)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/05 15:17
S7	460	S6 same (determin\$5 detect\$3) near3 (transmi\$5 transfer\$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/05 15:18
S8	8	S7 and "704".clas.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/05 15:20
S9	2	(determin\$5 detect\$3) near3 (transmi\$5 transfer\$4) with (voice sound speech) with simplex\$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/06 09:30
S10	8	(determin\$5 detect\$3) near3 (transmi\$5 transfer\$4) with (voice sound speech) same simplex\$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/06 09:31
S11	6467	(determin\$5) near3 (transmi\$5 transfer\$4) with (voice sound speech)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/06 09:32
S12	66	S11 and simplex\$3	US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	ON	2014/11/06 09:33

			JPO; DERWENT; IBM_TDB			
S13	745	S11 and "704".clas.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/06 09:39
S14	237	S13 and direction\$2	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/06 09:40
S15	6858	(determin\$5 detect\$3) with (transmi\$5 transfer\$4) with (standby)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/06 09:44
S16	10	S15 same (simplex\$3 uni\$1direct\$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/06 09:45
S17	12200	(determin\$5 detect\$3) with (stand\$3by) near2 mode	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/06 10:09
S18	84	S17 and (simplex\$3 uni\$1direct\$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/06 10:10
S19	1	sub\$1microphon\$3 same (feed\$1back adapter) same nois\$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/06 15:44
S20	4214	(sub\$1microphon\$3 microphon\$3) same (feed\$1back adapter) same nois\$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/06 15:44
S21	387	S20 same quality	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/06 15:45
S22	32	S21 and "704".clas.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/06 15:45
S23	195	(sub\$1microphon\$3 second\$3 near2 microphon\$3) same (feed\$1back adapter) same nois\$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/06 16:32
S24	54742	(nois\$3 quality) near2 evaluat\$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/06 16:52
S25	271	S24 same cancel\$6	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/06 16:52
S26	20	S25 and "704".clas.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/11/06 16:52

EAST Search History

S27	130	S24 same (noise echo) near3 cancel\$6	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM TDB	OR	ON	2014/11/06 16:56
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11 / 7 / 2014 10:30:50 AM

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Search Notes 	Application/Control No. 13770236	Applicant(s)/Patent Under Reexamination KONISHI ET AL.
	Examiner QIAN YANG	Art Unit 2674

CPC- SEARCHED		
Symbol	Date	Examiner

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner
704	275	11/7/14	QY

SEARCH NOTES		
Search Notes	Date	Examiner
Inventor name search	11/7/14	QY
Text related search	11/7/14	QY

INTERFERENCE SEARCH			
US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner

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Receipt date: 02/19/2013

Doc code: IDS

Doc description: Information Disclosure Statement (IDS) Filed

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Approved for use through 07/31/2012. OMB 0851-0031

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	First Named Inventor	Masaya KONISHI	
	Art Unit		
	Examiner Name		
	Attorney Docket Number	KYO.P0221	

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	1	2000-106588	JP		2000-04-11	BROTHER IND LTD		☒
	2	2004-120717	JP		2004-04-15	MARANTZ JAPAN INC		☒
	3	2010-28531	JP		2010-02-04	HITACHI LTD		☒

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			Filing Date			
			First Named Inventor	Masaya KONISHI		
			Art Unit			
			Examiner Name			
			Attorney Docket Number		KYO.P0221	

	4	2010-279043	JP		2010-12-09	TOSHIBA CORP		☒
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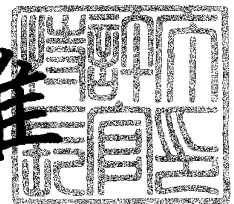
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【書類名】明細書

【発明の名称】音声入力装置、通信装置、状態通知方法

【技術分野】

【0001】

本発明は音声入力装置に関し、特にノイズキャンセル機能を有する音声入力装置に関する。

【背景技術】

【0002】

業務用無線機に代表される音声入力装置は、工場や建設現場、また、消防・警察等といった高い騒音下で使用される機会が多い。そのため、マイクで收音された音声信号に含まれる雑音成分を抑圧することで、高い騒音下でも良好な通話を確保できることが求められる。

【0003】

特許文献1には、筐体に音声收音用マイク（以下メインマイクと称する）および雑音收音用マイク（以下サブマイクと称する）の2個のマイクを備え、サブマイクで收音した信号から生成したノイズの逆相成分をメインマイクの信号に加算することにより、メインマイクの雑音成分を抑圧する音声入力システムが開示されている。当該技術はアクティブノイズキャンセル方式と呼ばれ、高騒音下でも明瞭な音声を收音することが可能となる。

【0004】

また、特許文献2には、複数のマイクロホンから出力された信号から雑音を除去した残留信号の方向別の音量を算出し、方向別残留信号の音量を表示することで、マイクロホンで収集された音声がいかに抑圧されているかを音源ごとに確認できる音収集システムが開示されている。

【0005】

また、特許文献3には、外部デバイスへコンテンツデータの送信を行う電子機器が開示されている。当該電子機器は、外部デバイスとの間で伝送される一つ以上のコンテンツに関するコンテンツ情報を取得し、一つ以上のコンテンツを伝送する際、前記取得したコンテンツ情報に基づき、コンテンツが伝送されている期間中インジケータの発光部を点滅又は点灯する。当該構成により、コンテンツデータの伝送状況の切り替わりを適切にユーザに報知することが可能となる。

【0006】

また、特許文献4には、所謂ハンズフリー通話が可能な電話装置であって、マイクから入力された音声所定の音声であるかを判断する音声認識部を備え、当該音声の認識結果を表示する表示手段を更に備える音声応答機能付電話装置が開示されている。当該装置によれば、使用者に音声認識部の認識結果を報知することで、音声応答機能の信頼性を向上させている。

【先行技術文献】

【特許文献】

【0007】

【特許文献1】特開2004-120717号公報

【特許文献2】特開2010-028531号公報

【特許文献3】特開2010-279043号公報

【特許文献4】特開2000-106588号公報

【発明の概要】

【発明が解決しようとする課題】

【0008】

アクティブノイズキャンセル機能を有する音声入力装置において、ノイズキャンセル性能を効果的に発揮するためには、メインマイクが適度な距離で話者の口の方に向けられていることが望ましい。ヘッドセットのような接話型のマイクは、比較的マイクと口との位置関係がほぼ固定されるが、ハンドセットのような手に持って使用するタイプのマイクに

おいては、口との距離や方向が使用状態に応じて変動する。

【0009】

すなわち、ハンドセット型マイクは、作業の都合上肩に装着して使用される場合や、マイクと口の距離が遠い状況で使用される場合など、ノイズキャンセルを行うための音声の入力条件が良くない場合での使用が想定される。

【0010】

このような場合、サブマイク側への音声の回り込みが大きくなるため、ノイズキャンセル効果によりメインマイクの信号の音声成分が打ち消されてしまい、明瞭な音声を伝送することができなくなってしまうという課題を有していた。

【0011】

本発明は、上記課題を鑑み、ノイズキャンセル機能を適切に働かせて明瞭な音声を伝送できるようにする事を可能とする音声入力装置、通信装置、及び状態通知方法を提供することを目的とする。

【課題を解決するための手段】

【0012】

本発明の一態様である音声入力装置は、第1收音部(101)と、第2收音部(102)と、前記第2收音部から入力される第2音声信号を用いて、前記第1收音部から入力される第1音声信号に対するノイズキャンセルを行うノイズキャンセル処理部(103)と、前記ノイズキャンセル処理部におけるノイズキャンセル後の音声信号の音声品質を判定する音声品質判定部(104)と、前記音声品質判定部における判定結果を通知する判定結果通知部(105)と、を具備する。当該構成とすることで、使用者に使用状態の改善の注意喚起を促して明瞭な音声を伝送することが可能となる。

また、前記音声品質判定部は、前記ノイズキャンセル処理部が行う前記ノイズキャンセルが効果的に働いているかに基づいて前記ノイズキャンセル後の音声信号の音声品質を判定することができる。

また、前記音声品質判定部は、前記ノイズキャンセル前の前記第1音声信号と前記ノイズキャンセル後の音声信号とを比較することで、前記ノイズキャンセルが効果的に働いているかを判定し、前記ノイズキャンセルが効果的に働いていると判定した場合に前記ノイズキャンセル後の音声信号の音声品質が良いと判定することができる。

また、前記音声品質判定部は、前記ノイズキャンセル前の前記第1音声信号と前記ノイズキャンセル後の音声信号との比較の結果、前記ノイズキャンセルが効果的に働いていると判定し、かつ、前記ノイズキャンセル後の音声信号の平均強度が所定の閾値以上である場合に、前記ノイズキャンセル後の音声信号の音声品質が良いと判定することができる。

また、前記音声品質判定部は、前記ノイズキャンセル前の前記第1音声信号の平均強度と、前記ノイズキャンセル後の音声信号の平均強度との差が所定の閾値以上である場合に、前記ノイズキャンセル後の音声信号の音声品質が良いと判定することができる。

また、前記音声品質判定部は、前記ノイズキャンセル前の前記第1音声信号の平均強度に対する前記ノイズキャンセル後の音声信号の平均強度との比率が所定の閾値以下である場合に、前記ノイズキャンセル後の音声信号の音声品質が良いと判定することができる。

また、前記ノイズキャンセル処理部は、前記第1收音部で收音された音声に含まれる雑音成分を前記第2收音部で收音された音声に基づいて抑制することで前記ノイズキャンセルを行うことができる。

また、前記ノイズキャンセル処理部は、前記第1收音部で收音された音声に混入する雑音成分の逆相成分を前記第2收音部で收音された音声に基づいて生成し、前記第1收音部で收音された音声に前記生成した雑音成分の逆送成分を加算することで前記ノイズキャンセルを行うことができる。

また、前記判定結果通知部は、光を発光する発光素子と、前記発光素子を制御する発光制御部と、を備え、前記発光制御部は、前記音声品質判定部における判定結果に基づいて、前記発光素子を点灯又は点滅させる制御を行うことで前記判定結果を通知する構成を採用するとなお良好である。

また、第1 收音部で收音された音声に基づいて音声区間であるかの判定を行う音声区間判定部を更に備え、前記音声品質判定部は、前記音声区間判定部において音声区間であると判定されている場合に、前記ノイズキャンセル処理部におけるノイズキャンセル後の音声信号の音声品質を判定することができる。

また、前記音声区間判定部は、第1 收音部から入力される第1 音声信号を一定長の単位で周波数領域に変換する周波数変換部と、前記周波数変換部における変換後のスペクトル成分に基づいて、音声であるか音声ではない雑音成分であるかを判定する音声判定部と、を備える構成であっても良い。

また、前記第1 收音部は、装置本体正面に配置されるメインマイクであり、前記第2 收音部は、装置本体背面に配置されるサブマイクであるとノイズキャンセル効果を高めることができる。

ここで、前記第1 收音部で收音される音声と前記第2 收音部で收音される音声との位相差に基づいてメインマイク方向を判定するマイク方向判定部を更に具備し、前記音声品質判定部は、前記マイク方向判定部における前記メインマイク方向の判定結果に基づいて前記ノイズキャンセル処理部におけるノイズキャンセル後の音声信号の音声品質を判定すると、より適切な音声品質判定が可能となる。

また、当該音声品質判定に関しては、前記第1 收音部で收音される音声と前記第2 收音部で收音される音声との位相差を検出する位相差検出部と、前記位相差検出部で検出された位相差が適切な使用状態時における位相差として設定されている範囲内であるかを判定する位相差判定部と、を備え、前記音声品質判定部は、前記位相差判定部における判定結果に基づいて、前記ノイズキャンセル処理部におけるノイズキャンセル後の音声信号の音声品質を判定する構成を採用することができる。

本発明の一態様に係る通知装置は、第1 收音部と、第2 收音部と、前記第2 收音部から入力される第2 音声信号を用いて、前記第1 收音部から入力される第1 音声信号に対するノイズキャンセルを行うノイズキャンセル処理部と、前記ノイズキャンセル処理部におけるノイズキャンセル後の音声信号の音声品質を判定する音声品質判定部と、前記ノイズキャンセル後の音声信号を送信する送信部と、前記音声品質判定部における判定結果を通知する判定結果通知部と、音声信号を受信する受信部と、前記受信部で受信した前記音声信号に基づいて音声を放音する放音部と、を具備する。

ここで、前記受信部で音声信号を受信するか前記送信部で音声信号を送信するかを切り替える切り替え部を更に具備し、前記判定結果通知部は、前記切り替え部が前記送信部で音声信号を送信するように切り替えている場合において、前記ノイズキャンセル後の音声信号の音声品質が良好でないことを視覚的に通知する構成とするとなお良好である。

本発明の一態様に係る状態通知方法は、第1 マイクロホンと第2 マイクロホンの少なくとも2つのマイクロホンを具備する装置で使用される状態通知方法であって、前記第1 マイクロホンと前記第2 マイクロホンでそれぞれ音声を收音する收音ステップと、前記第2 マイクロホンで收音された音声を用いて、前記第1 マイクロホンで收音された音声に対するノイズキャンセルを行うノイズキャンセル処理ステップと、前記ノイズキャンセル後の音声信号の音声品質を判定する音声品質判定ステップと、前記判定結果に基づいて状態を通知する状態通知ステップと、を有する。

【発明の効果】

【0013】

本発明によれば、ノイズキャンセル機能を適切に働かせて明瞭な音声を伝送できるようにする事を可能とする音声入力装置、通信装置、及び状態通知方法を提供することができる。

【図面の簡単な説明】

【0014】

【図1】 実施の形態1に係る音声入力装置の構成を示すブロック図である。

【図2】 実施の形態1に係る音声入力装置の動作の流れを示すフローチャート図である。

【図3】実施の形態2に係る音声入力装置の構成を示すブロック図である。

【図4】実施の形態2に係るノイズキャンセル効果の判定処理の流れを示すフローチャート図である。

【図5】実施の形態3に係る音声入力装置の構成を示すブロック図である。

【図6】音声入力装置の使用に対する方向と位相との関係を説明する図である。

【図7】実施の形態3に係るメインマイク方向の判定処理（第1判定処理）の流れを示すフローチャート図である。

【図8】実施の形態3に係るノイズキャンセル効果の判定処理の流れを示すフローチャート図である。

【図9】実施の形態3に係る音声品質に関する総合判定処理の動作の流れを示すフローチャート図である。

【図10】実施の形態4に係るノイズキャンセルマイク（音声入力装置）の外観（（a）正面図、（b）背面図）を示す図である。

【図11】実施の形態4に係るノイズキャンセルマイク（音声入力装置）の構成を示すブロック図である。

【図12】実施の形態4に係るLEDの状態を示すグラフである。

【図13】本発明の別の音声品質判定処理の流れを示すフローチャート図である。

【発明を実施するための形態】

【0015】

本発明の実施の形態について以下に図面を参照して説明する。以下の説明は、本発明の好適な実施の形態を示すものであって、本発明の範囲が以下の実施の形態に限定されるものではない。以下の説明において、同一の符号が付されたものは実質的に同様の内容を示している。

【0016】

（実施の形態1）

以下、図面を参照して本発明の実施の形態について説明する。図1は、本実施の形態1に係る音声入力装置100の構成を示すブロック図である。音声入力装置100は、第1收音部101と、第2收音部102と、ノイズキャンセル処理部103と、音声品質判定部104と、判定結果通知部105と、を具備する。

【0017】

第1收音部101は、音声入力装置100に取り付けられたマイクであり、音声を收音する。第1收音部101で收音された音声信号（第1音声信号）は、ノイズキャンセル処理部103に出力される。

【0018】

第2收音部102も第1收音部101と同様、音声入力装置100に取り付けられたマイクであり、音声を收音する。第2收音部102で收音された音声信号（第2音声信号）は、ノイズキャンセル処理部103に出力される。

【0019】

ここで、第1收音部101と第2收音部102の2つのマイクのうち、第1收音部101は話者（使用者）からの発声を主に收音するメインマイクに相当し、装置表面に配置される。一方、第2收音部102は、主にノイズキャンセル処理に利用するために設けられた周辺の雑音を收音するサブマイクに相当し、装置の背面に配置される。

【0020】

なお、第2收音部102であるサブマイクの配置位置は、装置背面に限定されるものではなく、装置側面や装置底面その他装置の内部に配置されていても良い。但し、後述するノイズキャンセル効果を高めるために、メインマイクである第1收音部101が使用者側である装置正面に配置され、サブマイクである第2收音部102が使用者の反対側である装置背面にそれぞれ配置されることが好ましい。

【0021】

以下の説明では、第1收音部101をメインマイク101と、第2收音部102をサブ

マイク１０２と適宜記載して説明を行うことにする。

【００２２】

ノイズキャンセル処理部１０３は、メインマイク１０１より入力した第１音声信号とサブマイク１０２より入力した第２音声信号とに基づいてノイズキャンセル処理（雑音成分抑圧処理）を実行する。ここで、ノイズキャンセル処理部１０３は、メインマイク１０１から入力した第１音声信号に対して一定期間（例えば２５６サンプル）のフレーム毎にノイズキャンセル処理を実行する。

【００２３】

具体的には、ノイズキャンセル処理部１０３は、適応フィルタによってサブマイク１０２で収音された音声に基づいてメインマイク１０１に混入する雑音成分の逆相成分を生成する。そして、ノイズキャンセル処理部１０３は、メインマイク１０１から入力した第１音声信号と、当該生成した雑音成分の逆相成分によるノイズキャンセル用信号とを加算することによってメインマイク１０１に混入する雑音成分を抑圧する。ノイズキャンセル処理部１０３は、当該ノイズキャンセル後の音声信号を音声品質判定部１０４に出力する。

【００２４】

音声品質判定部１０４は、ノイズキャンセル処理部１０３から入力したノイズキャンセル後の音声信号の音声品質を判定し、判定結果を判定結果通知部１０５に出力する。音声品質判定部１０４は、ノイズキャンセル処理部１０３が行ったノイズキャンセルが効果的に働いているかどうかに基づいて音声品質の良し悪しを判定する。

【００２５】

ここで、音声品質判定部１０４は、ノイズキャンセル処理部１０３が行うノイズキャンセル処理によって第１音声信号に対して生じる減衰量に基づいてノイズキャンセルが効果的に働いているかを判定することができる。

【００２６】

具体的に、音声品質判定部１０４は、メインマイク１０１からの第１音声信号が、上記ノイズキャンセル処理によってどれくらい減衰しているかを算出し、減衰量が一定の閾値以上であればノイズキャンセルが効果的に働いていると判定することができる。

【００２７】

すなわち、音声品質判定部１０４は、ノイズキャンセル処理前の第１音声信号の平均パワー（平均強度）と、当該ノイズキャンセル処理後の信号の平均パワー（平均強度）とを比較し、当該比較結果に基づいてノイズキャンセルが効果的に働いているかを判定することができる。

【００２８】

判定結果通知部１０５は、音声品質判定部１０４より入力した上記判定結果を使用者に通知する。すなわち、判定結果通知部１０５は、音声品質が良いか悪いかを通知する。

【００２９】

ここで、音声品質判定部１０４は、ノイズキャンセルが効果的に働いているかに基づいて音声品質を判定するため、判定結果通知部１０５は、ノイズキャンセル処理部１０３においてノイズキャンセルが効果的に働いているかどうかを使用者に対して通知することになる。

【００３０】

なお、判定結果通知部１０５は、上記音声品質が良好であるかどうかについて、視覚的に通知しても良いし、警告音等の音声をスピーカから出力することで通知しても良い。その他、判定結果通知部１０５は、内部に備える振動素子を振動させることでノイズキャンセルが効果的に働いているかどうかを通知しても良い。

【００３１】

ここでは、周囲の雑音が大きく、又、肉体的な労働環境下で使用される場合を想定し、周囲の雑音に掻き消されてしまう可能性がある音声による通知や、使用者が激しく動いている場合に感知し辛い可能性が残る振動による通知では無く、視覚的に通知するものとして説明する。すなわち、判定結果通知部１０５は、ノイズキャンセルが効果的に働いてい

るかどうかを表示することで通知する手段を採用するものとする。

【0032】

次に、音声入力装置100の動作について説明する。図2は、音声入力装置100の動作の流れを示すフローチャート図である。

【0033】

ノイズキャンセル処理部103は、メインマイク101から入力した第1音声信号とサブマイク102から入力した第2音声信号とに基づいてノイズキャンセル処理を行う（ステップS101）。具体的には、ノイズキャンセル処理部103は、1フレーム分についてサブマイク102から入力した第2音声信号に基づいて生成したメインマイク101に混入する雑音成分の逆相成分をメインマイク101から入力した第1音声信号に加算する処理を行う。当該処理により、メインマイク101に混入する雑音成分が抑圧される。ノイズキャンセル処理後の音声信号は音声品質判定部104に送られる。

【0034】

次に、音声品質判定部104は、ステップS101で行われたノイズキャンセル後の音声信号の音声品質を判定する（ステップS102）。

【0035】

具体的には、音声品質判定部104は、メインマイク101から入力した第1音声信号の平均パワー（ P_{in} ）と、当該ノイズキャンセル処理後の信号の平均パワー（ P_{nc} ）とを比較し、当該比較結果に基づいてノイズキャンセルが効果的に行われたかを判定する。

【0036】

例えば、音声品質判定部104は、ノイズキャンセル処理によって生じる減衰量、すなわち P_{in} から P_{nc} を減じた $[P_{in}-P_{nc}]$ の値が所定の閾値 P_{th} を超えている場合に、ノイズキャンセルが効果的に行われて良好な音声品質が得られていると判定する。

【0037】

また、音声品質判定部104は、上記2つのパワー比 $[P_{in}/P_{nc}]$ を算出し、当該パワー比が所定の閾値 P_{th}' を超えている場合に、ノイズキャンセルが効果的に行われて良好な音声品質が得られていると判定しても良い。

【0038】

また、音声品質判定部104が行う判定方法としては、その他の判定手法を採用することも可能である。

【0039】

判定結果通知部105は、音声品質判定部104における判定結果、ノイズキャンセルが効果的に行われておらず、良好な音声品質が得られていないと判定された場合（すなわちステップS102でNo）、当該ノイズキャンセルが効果的に行われず、良好な音声品質が得られていないことを使用者に通知する（ステップS103）。

【0040】

なお、判定結果通知部105が使用者に対して判定結果を通知する第1の目的は、使用者に対する正しいマイクの持ち方を指導することにより、結果としてノイズキャンセル効果を高め、良好な音声を聞き手に伝送することにある。従って、判定結果通知部105が音声品質に関する判定結果を使用者に通知するということは、使用者に対して装置が適切に使用されているかどうかの使用状態を通知することを意味している。

【0041】

以上のように、本実施の形態1に係る音声入力装置は、装置が適切に使用されているかどうかの使用状態を通知（報知）可能な構成を有する。別の角度から見れば、当該音声入力装置によれば、使用者は、当該音声入力装置から発せられる当該通知に基づいてノイズキャンセルが効果的に働いているかを認識することができる。

【0042】

当該構成によれば、当該ノイズキャンセルが効果的に働いていないことを認識した使用

者は、音声入力装置（マイク）の持ち方を変更したり、装置と口との距離とを変更したりするなどの試みを行ってノイズキャンセルが適切に働くようにできるため、話し相手に対してクリアな音声を届けることができる。

【0043】

すなわち、使用者にマイクの正しい持ち方になるよう誘導することによって、高騒音下の環境においても、ノイズキャンセル性能を最大限に発揮して明瞭な音声を受信者に伝送することができ、使用者自身も自分の音声が見事に伝送されているかどうかを知ることができる。

【0044】

また、初めて本発明に代表されるノイズキャンセルマイクを使用する場合のトレーニング用としても本発明に係る音声入力装置を使用することができる。

【0045】

すなわち、背景技術に係る装置（ノイズキャンセルマイク）では、口からどのような距離、どのような角度であれば適正に使用可能な範囲であるかを知る術がなかった。そのため、使用者は、適切に音声を伝えたいがあまり、不必要に口に近付けて使用すると言ったケースやノイズキャンセルが効果的に働いておらず受信者が適切に聞き取れていないにもかかわらずそのまま話を進めてしまうと言ったミスコミュニケーションが発生していた。一方、上述した実施の形態1に係る音声入力装置によれば、このような問題点を解消することができ、実際の使用環境において利便性を大きく向上させることができる。

【0046】

ここで、ノイズキャンセル処理部103は、上述のように、第1收音部101で收音された音声に含まれる雑音成分を第2收音部102で收音された音声に基づいて抑制することでノイズキャンセルを行うことができる。具体的には、ノイズキャンセル処理部103は、前記第1收音部101で收音された音声に混入する雑音成分の逆相成分を第2收音部102で收音された音声に基づいて生成し、生成した雑音成分の逆送成分を第1收音部101で收音された音声に対して加算することでノイズキャンセルを行うことができる。

【0047】

そして、音声品質判定部104がノイズキャンセル処理部103におけるノイズキャンセルの効果を判定し、判定結果通知部105が、音声品質判定部104における判定結果を通知する。

【0048】

具体的には、音声品質判定部104は、ノイズキャンセル処理部103におけるノイズキャンセルが効果的に働いているかどうかを判定する。そして、判定結果通知部105は、音声品質判定部104においてノイズキャンセルが効果的に働いていると判定された場合は、ノイズキャンセルが効果的に働き、良好な音声品質であることを通知する。音声品質判定部104は、ノイズキャンセルが効果的に働いているかどうかを、ノイズキャンセル前後の平均パワー（平均強度）を比較することで判定可能である。すなわち、第1收音部101で收音されたノイズキャンセル前の音声の平均パワー（ P_{in} ）と、ノイズキャンセル処理が行われた後の音声の平均パワーと（ P_{nc} ）と、ノイズキャンセルが効果的に働いているかの基準となる第1閾値 P_{th} と、の関係が、

$$(1) \quad P_{in} - P_{nc} > P_{th}$$

を満たしている場合や、パワー比である P_{nc}/P_{in} と、ノイズキャンセルが効果的に働いているかの別の基準となる第2閾値 P_{th}' との関係が

$$(2) \quad P_{nc}/P_{in} < P_{th}'$$

である場合に、ノイズキャンセルが効果的に働いていると判定する。

【0049】

なお、上記説明では、具体的には、判定結果通知部105が、LED等の発光素子を点灯又は点滅させるといった表示部により通知する場合を想定して説明したがこれに限るものではない。音声入力装置100に別途液晶表示部等の表示部を配置し、当該表示部にノイズキャンセルが効果的に働いているかを表示することで使用者に対する通知を行っても

良い。

【0050】

また、上述したように、当該判定結果通知部については、視覚的な表示部に限るものではなく、高騒音下でも知覚できる手段、例えば、バイブレータのような振動子によって、マイク（音声入力装置）を持つ手に知覚させるような方法を採用しても良い。

【0051】

また、判定結果通知部105は、音声品質判定部104における判定結果、ノイズキャンセルが効果的に行われ、良好な音声品質が得られていると判定された場合、当該ノイズキャンセルが効果的に行われ、良好な音声品質が得られていることを使用者に通知する構成であっても良い。当該構成において、発話している話者は、良好な音声品質が得られていることの通知がなされないことを持って、装置の使用状態が適切ではないことを認識することができる。

【0052】

（実施の形態2）

本実施の形態2に係る音声入力装置200は、実施の形態1に係る音声入力装置100と比較して消費電力を抑える機能を更に備えることを特徴としている。実施の形態1に係る音声入力装置100では、ノイズキャンセルが効果的に働いているかを使用者に通知するために、音声品質判定部104が、平均パワー算出処理や比較判定処理等を行っていた。ここで、使用者が装置を使用していない期間にこのような比較的消費電力の大きい処理を行って使用者に通知することは、装置を使用していない使用者にとって不要な通知や処理となる。本実施の形態2では、特にこのような問題に対して新たな対処を行っている。

【0053】

以下、図面を参照して本発明の実施の形態2について説明する。但し、実施の形態1で既に説明した部分については発明の明確化のために一部説明を省略する。また、以下の説明では、ノイズキャンセル処理部においてノイズキャンセル処理が行われた後の音声信号をノイズキャンセル処理後信号と称して説明することがある。

【0054】

図3は、本実施の形態2に係る音声入力装置200の構成を示すブロック図である。音声入力装置200は、第1收音部101と、第2收音部102と、ノイズキャンセル処理部203と、音声品質判定部204と、判定結果通知部105と、音声区間判定部206と、ノイズサプレッサ207と、送信部208と、を具備する。ここで、判定結果通知部105は、発光制御部209及び発光素子210を含んで構成されることで視覚的な通知を行う。

【0055】

音声区間判定部206は、メインマイク101から入力する第1音声信号に基づいて音声区間判定を行うことで、音声区間を検出する。

【0056】

音声区間判定部206が行う音声区間であるかどうかの判定は、メインマイク101からの第1音声信号を一定長の単位で周波数領域に変換し、そのスペクトル成分を分析することにより、母音であるか、子音であるか、また音声ではない雑音成分であるかを判定する。

【0057】

音声区間判定部206は、音声区間であることを示す信号をノイズキャンセル処理部203及び音声品質判定部204に出力する。以下の説明では、当該音声区間であることを示す信号を音声区間指示信号と称して説明する。

【0058】

ノイズキャンセル処理部203は、音声区間判定部206より音声区間指示信号を入力すると、メインマイク101からの第1音声信号とサブマイク102からの第2音声信号とに基づいてノイズキャンセル処理を実行する。なお、具体的なノイズキャンセル処理は、上述したノイズキャンセル処理部103の処理内容と同一であるためここでは説明を省

略する。ノイズキャンセル処理部203は、ノイズキャンセル処理後信号をノイズサプレッサ207と音声品質判定部204にそれぞれ出力する。

【0059】

音声品質判定部204は、音声区間判定部206から入力される音声区間指示信号と、ノイズキャンセル処理部203より入力されるノイズキャンセル処理後信号とに基づいて、ノイズキャンセル処理後信号の音声品質を判定する。

【0060】

ここで、音声品質判定部204は、音声区間判定部206で音声区間であると判定されている間に関して上記音声品質の判定を行う。音声品質判定部204は、ノイズキャンセル処理後信号の音声品質を示す情報である判定結果を判定結果通知部105に含まれる発光制御部209に出力する。

【0061】

また、音声品質判定部204は、ノイズキャンセル処理部203におけるノイズキャンセルが効果的に働いているかを判定し、更にノイズキャンセル処理後信号の強度レベルが所定の閾値を保っているかを合せて判定する。音声品質判定部204は、これらの複数の判定を駆使することで、後述する送信部208より送信されるノイズキャンセル処理後信号の音声品質をよりの確に判断する。

【0062】

発光制御部209は、発光素子210を駆動するためのドライバであり、音声品質判定部204から入力するノイズキャンセル処理後信号の音声品質を示す情報に従って、発光素子210を駆動するための駆動電流を流す。このように、発光制御部209が、発光素子210を点灯又は点滅させることで使用者に対する音声品質の通知を行う。ここで、具体的に発光素子210はLED (Light Emitting Diode) であるとする。例えば、発光制御部209は、音声品質が良いことを示す信号を入力した場合、又は、音声品質が悪いことを示す信号を入力しない場合、LEDを点滅させることで当該通知を行う。

【0063】

ノイズサプレッサ207は、ノイズキャンセル処理部203より入力したノイズキャンセル処理後信号の周波数軸上に現れる音声以外の雑音成分を抑圧する処理を行う。ノイズサプレッサ207は、雑音成分の抑圧後の信号を時間領域の音声信号に戻した後、送信部208に出力する。

【0064】

送信部208は、ノイズサプレッサ207より受け取った信号に対して適宜音声符号化を行った後、外部の受信装置へ向けて送信する。

【0065】

次に、本実施の形態2における音声入力装置200の動作について説明する。図4は、音声入力装置200の動作の流れを示すフローチャート図である。

【0066】

音声区間判定部206は、メインマイク101からの第1音声信号に基づいて音声区間判定処理を行う(ステップS201)。当該判定の結果、音声区間でないと判定された場合(ステップS202のNo)、ステップS201に戻って判定処理を継続する。一方、当該判定の結果、音声区間であると判定された場合(ステップS202のYes)、ステップS203に進む。

【0067】

音声品質判定部204は、ノイズキャンセル処理部203がフレーム単位でノイズキャンセル処理を実行する場合に、当該1フレームの期間におけるメインマイク101からの第1音声信号の平均パワー(平均強度)を算出する(ステップS203)。

【0068】

次に、音声品質判定部204は、ノイズキャンセル処理部203におけるノイズキャンセル処理後の信号の平均パワー(平均強度)を算出する(ステップS204)。

【0069】

次に、音声品質判定部204は、上記算出したノイズキャンセル処理前の第1音声信号の平均パワーと、ノイズキャンセル処理後の信号の平均パワーとの比較を行う（ステップS205）。

【0070】

当該比較の結果、第1音声信号に対するノイズキャンセル処理後信号のパワー比が一定レベル（第1閾値）以上であれば（ステップS205がNoの場合）、ノイズキャンセルが効果的に働いておらず、音声品質は不良であると判定する（ステップS207）。

【0071】

一方、当該比較の結果、第1音声信号に対するノイズキャンセル処理後信号のパワー比が一定レベル（第1閾値）以下であれば（ステップS205がYesの場合）、音声品質判定部204は、ノイズキャンセル処理後信号の平均パワーが一定レベル（第2閾値）以上であるかを判定する（ステップS206）。

【0072】

ステップS206における判定の結果、ノイズキャンセル処理後信号の平均パワーが一定レベル（第2閾値）以下であれば（ステップS206のNo）、音声品質判定部204は、ステップS207に進み、音声品質は不良であると判定する。

【0073】

一方、ステップS206における判定の結果、ノイズキャンセル処理後信号の平均パワーが一定レベル（第2閾値）以上であれば（ステップS206のYes）、好ましい音声レベルが得られており、音声品質が良好と判定する（ステップS208）。

【0074】

ステップS207又はステップS208でそれぞれ得られた音声の品質が不良であるか良好であるかの判定結果は音声品質を示す情報として、判定結果通知部105の発光制御部209に送られ、発光素子210を用いた音声品質に関する通知が行われる。

【0075】

以上のように本実施の形態2に係る音声入力装置は、第1收音部101で收音された音声に基づいて音声区間であるかの判定を行う音声区間判定部206を更に備える。音声品質判定部204は、音声区間判定部206において音声区間であると判定されている場合に、音声品質を判定する。

【0076】

当該構成によれば、音声品質判定部204が、話者が発声していない期間において不要な判定処理を行って電力を無駄に消費することを防ぐことができる。また、音声区間と判定されていない場合には、判定結果通知部105よりマイクの使用状態に関する誤った警告（通知）が使用者に向けて通知されることが無いため、使用者が警告を誤認すると言ったことを防ぐことができる。

【0077】

ここで音声区間判定部206は、第1收音部101で收音された音声の信号である第1音声信号を一定長の単位で周波数領域に変換する周波数変換部と、変換後のスペクトル成分に基づいて、音声であるか音声ではない雑音成分であるかを判定する音声判定部と、を内部に有することで音声区間判定を行うことができる。この時、当該音声判定部は、前記スペクトル成分を分析して、母音であるか、子音であるか、音声ではない雑音成分であるかを判定することも可能である。

【0078】

また、上述したように音声品質判定部204は、ノイズキャンセル処理部203におけるノイズキャンセルが効果的に働いているかという基準と、ノイズキャンセル後の音声信号の信号強度が所定の閾値を超えているかという基準と、を用いて音声品質を判定している。従って、聞き手が実際に感じる音声品質をより適切に表しており、このような音声品質の良し悪しを話者に適切に通知することができる。

【0079】

すなわち、音声品質判定部204は、音声区間においてメインマイク101で收音され

た音声に対するノイズキャンセル処理後の音声レベルが一定以上であるかどうかを算出することで、メインマイク１０１に口が充分近い距離にあるかを判定する。音声品質判定部２０４は、その判定結果をＬＥＤ等の表示装置を点滅させる等の手法により、音声に連動させて話者に知らせることができる。

【００８０】

なお、上記説明では、音声品質判定部２０４は、ノイズキャンセル処理部２０３より出力されるノイズキャンセル処理後信号に基づいて、ノイズキャンセルが効果的に働いているかを判定し、最終的に音声品質を判定する場合について説明したがこれに限るものではない。例えば、音声品質判定部２０４は、ノイズサプレッサ２０７で周波数軸上での雑音抑制が行われた後の信号について音声品質の判定を行っても良い。

【００８１】

（実施の形態３）

本実施の形態３に係る音声入力装置３００は、実施の形態２に係る音声入力装置２００と比較して、より適切に音声品質を判定して通知することを特徴としている。

【００８２】

実施の形態２に係る音声入力装置２００では、ノイズキャンセルがうまくいっていないにもかかわらず、音声品質判定部２０４が行うノイズキャンセル効果判定で誤判定を出してしまう場合があった。

【００８３】

このような誤判定が起きる典型的な事例として、音声入力装置２００が話者に対して横～斜め方向を向いている場合がある。この場合、装置自体が横を向いているために、装置背面に設置されたサブマイク１０２側にも使用者（話者）からの音声の成分が強く入る。ノイズキャンセル処理部２０３が行うノイズキャンセル処理では、サブマイク１０２の信号を参照信号としてノイズキャンセルを行う。従って、サブマイク１０２側に入る音声成分をノイズであると判断してしまい、メインマイク１０１の信号から残すべき音声も削られてしまうことになる。

【００８４】

この場合、横を向いた装置の正面に強力なノイズ源が存在すると、メインマイク１０１で收音された当該ノイズ源のノイズ音が残存し、ノイズキャンセル処理後信号の強度レベルが閾値を超えて最終的に音声品質が良好と判定されて話者に通知されてしまう可能性がある。

【００８５】

本実施の形態３では、このような場合についても適切に音声品質を判定して適切な通知を行うことができる音声入力装置を提供することを実現している。以下、図面を参照して詳しく説明する。なお、実施の形態１、２で既に説明した部分については、発明の明確化のため説明を一部省略する。

【００８６】

図５は、本実施の形態３に係る音声入力装置３００の構成を示すブロック図である。音声入力装置３００は、第１收音部１０１と、第２收音部１０２と、ノイズキャンセル処理部２０３と、音声品質判定部３０４と、判定結果通知部１０５と、音声区間判定部２０６と、ノイズサプレッサ２０７と、送信部２０８と、マイク方向判定部３１１と、ノイズキャンセル効果判定部３１２と、を備える。

【００８７】

マイク方向判定部３１１は、メインマイク１０１とサブマイク１０２でそれぞれ收音される音声の位相差を検出し、当該位相差に基づいてメインマイク１０１の方向を判定する。マイク方向判定部３１１は、メインマイク方向に関する判定結果を音声品質判定部３０４に出力する。

【００８８】

図６は、当該マイクの方角によって生じる音声の位相差を説明する図である。図６から分かるように、音声入力装置３００本体が話者と対面しており、正常な使用状態である場

合は、メインマイク101に入る音声と本体を回り込んでサブマイク102に入る音声との位相差が大きくなる。一方、装置本体の方向が話者に対して傾いている場合は、口から2つのマイクまでの距離差が縮まり、メインマイク101に入る音声とサブマイク102に入る音声との位相差が小さくなる。特に装置正面に取り付けられたメインマイク101の方向が使用者に対して90度の方向を向いている場合は、メインマイク101及びサブマイク102の各々から口までの距離がほぼ等しいとみなされることから位相差は0に近づくことになる。

【0089】

そこで、マイク方向判定部311は、メインマイク101とサブマイク102でそれぞれ收音される音声の位相差が所定の閾値以下である場合は、メインマイクの方向が話者の口の方を向いていないと推定し、使用者は適切な使用を行っていないものと判定する。逆に、メインマイク101とサブマイク102でそれぞれ收音される音声の位相差が、上記所定の閾値を超えた所定の範囲内である場合には、マイク方向判定部311は、使用者が適切な使用を行っているかと判定することができる。

【0090】

ノイズキャンセル効果判定部312は、ノイズキャンセル処理部203から入力したノイズキャンセル処理後信号に基づいてノイズキャンセル処理部203が行ったノイズキャンセルが効果的に働いているかを判定する。

【0091】

ノイズキャンセル効果判定部312は、ノイズキャンセル処理前の信号である第1音声信号の平均パワー P_{in} と、ノイズキャンセル処理後の信号であるノイズキャンセル処理後信号の平均パワー P_{nc} とに基づいてノイズキャンセルが効果的に働いているかを判定する。例えば、ノイズキャンセル効果判定部312は、ノイズキャンセルが効果的に働くとみなす減衰量の閾値を P_{th} として、

$$P_{in} - P_{nc} > P_{th}$$

の関係を満たしている場合に、ノイズキャンセルが効果的に働いていると判定する。

【0092】

また、ノイズキャンセル効果判定部312は、ノイズキャンセル後の音声信号の信号強度が所定の閾値を超えているかを判定する。ノイズキャンセル効果判定部312は、上記2つの判定結果を音声品質判定部304に出力する。

【0093】

音声品質判定部304は、マイク方向判定部311から出力されたマイク方向に関する判定結果とノイズキャンセル効果判定部312から出力されたノイズキャンセル効果等に関する判定結果に基づいてノイズキャンセル処理後信号の音声品質を判定する。

【0094】

具体的には、音声品質判定部304は、マイク方向判定部311から入力したマイク方向に関する判定結果において、メインマイクが使用者方向を向いている事が示されており、かつ、ノイズキャンセル効果判定部312から入力した判定結果において、ノイズキャンセルが効果的に働いており、ノイズキャンセル後の音声信号の信号強度が所定の閾値を超えている場合に、音声品質が良好と判定する。音声品質判定部304は、判定結果を、音声品質を示す情報として判定結果通知部105に出力する。

【0095】

次に、音声入力装置300の動作について説明する。図7は、マイク方向判定部311における判定動作の流れを示すフローチャート図である。

【0096】

マイク方向判定部311は、メインマイク101から入力した第1音声信号の位相差とサブマイク102から入力した第2音声信号の位相差とを比較する（ステップS301）。次にマイク方向判定部311は、メインマイク101からの第1音声信号とサブマイク102からの第2音声信号との位相差が一定値以下であるかを判定する（ステップS302）。上述の通り、メインマイク101の方向のずれがそのまま当該位相差に現れるため

である。

【0097】

ステップS302における判定の結果、位相差が一定値以上である場合は、マイク方向判定部311は、メインマイク101と口との位置関係が良好であり、適正な使用がなされているものとして判定する（ステップS303）。一方、ステップS302における判定の結果、当該位相差が一定値以内である場合は、マイク方向判定部311は、メインマイク101と口との位置関係が不良であり、不適正な使用がなされているものとして判定する（ステップS304）。

【0098】

マイク方向判定部311は、ステップS303及びステップS304で得られた判定結果を、第1判定結果として音声品質判定部304に出力する（ステップS305）。ここで、当該第1判定結果は、上述の通りメインマイク方向が適切であるかどうかを示す情報であり、別の観点から見て、装置が適切な使用状態で使用されているかどうかを示す情報である。

【0099】

次に、ノイズキャンセル効果判定部312の動作について説明する。図8は、ノイズキャンセル効果判定部312の動作の流れを示すフローチャート図である。

【0100】

ノイズキャンセル効果判定部312は、音声区間判定部206において音声区間であると判定され、音声区間指示信号が入力されるのを待つ（ステップS311）。ノイズキャンセル効果判定部312は、当該音声区間指示信号が入力された場合、ステップS312に進む。なお、ステップS312～ステップS315は、図4のステップS203～ステップS206と略同一であるため説明を省略する。

【0101】

ノイズキャンセル効果判定部312は、ステップS314においてノイズキャンセル処理前後の信号のパワー比が一定レベル以上である場合（ステップS314のNo）、また、ステップS315におけるノイズキャンセル処理後の信号のパワーが一定レベル以下の場合（ステップS315のNo）、ノイズキャンセルは効果的に働いていないと判定する（ステップS316）。

【0102】

一方、ノイズキャンセル効果判定部312は、ノイズキャンセル処理後の信号のパワーが一定レベル以上と判定した場合（ステップS315のYes）、ノイズキャンセルは効果的に働いていると判定する（ステップS317）。ノイズキャンセル効果判定部312は、ステップS316又はステップS317で得られた判定結果を第2判定結果として音声品質判定部304に出力する。ここで、当該第2判定結果は、ノイズキャンセルが効果的に働いているかどうかを示す情報である。

【0103】

次に、音声品質判定部304の動作について説明する。図9は、音声品質判定部304の動作の流れを示すフローチャート図である。

【0104】

音声品質判定部304は、マイク方向判定部311より図7の処理フローに従って出力される第1判定結果を入力する（ステップS321）。音声品質判定部304は、マイク方向判定部311より入力する当該第1判定結果において、メインマイク101と口との位置関係が良好と示されているかを判定する（ステップS322）。

【0105】

当該判定の結果、メインマイク101と口との関係が不良であると第1判定結果に示されている場合（ステップS322のNo）、音声品質判定部304は、判定結果通知部105に警告を表示させる（ステップS323）。すなわち、音声品質判定部304は、発光制御部209に警告を示すよう、発光素子210を点灯させる。

【0106】

一方、当該判定の結果、メインマイク101と口との関係が良好であると第1判定結果に示されている場合（ステップS322のYes）、音声品質判定部304は、ノイズキャンセル効果判定部312より図8の処理フローに従って出力される第2判定結果を入力する（ステップS324）。

【0107】

音声品質判定部304は、ノイズキャンセル効果判定部312より入力する当該第2判定結果において、ノイズキャンセルが効果的に働いていると示されているかを判定する（ステップS325）。

【0108】

ステップS325における判定の結果、ノイズキャンセルが効果的に働いていないと第2判定結果に示されている場合（ステップS325のNo）、音声品質判定部304は、判定結果通知部105に警告を表示させる（ステップS326）。この場合の警告方法は、ステップS323と同様、発光制御部209に警告を示すよう、発光素子210を点灯させることで行うことができる。

【0109】

一方、ステップS325における判定の結果、ノイズキャンセルが効果的に働いていると示されている場合（ステップS325のYes）、音声品質は良好と判定し、判定結果通知部105に音声品質が良好であることを表示させる（ステップS327）。ここで、音声品質が良好であることがデフォルトとして設定されている場合、判定結果通知部105は、特に何かを通知しなくても良い。すなわち、何も音声送信状態において何も通知しないことが音声品質が良好であることを示している。

【0110】

なお、ステップS323及びステップS326において、発光制御部209の制御に従って報知される上記警告は、使用者（話者）に対して装置の使用状態が適切でないことを通知する注意喚起である。話者は、当該注意喚起を受けてクリアな音声伝送されていないことを気付き、メインマイクの位置や方向を変更する等を試みることで音声品質の改善を試みることができる。当該変更を受けて第1判定結果と第2判定結果が共に良好であることを示すようになった場合は、当該警告が消えてステップS327に移行するため使用状態の適正化が図られる。

【0111】

以上のように、本実施の形態3にかかる音声入力装置は、メインマイクが適切な方向を向いているか、又、ノイズキャンセルが効果的に働いているか、の両面から音声品質を判定している。従って、ノイズキャンセル効果に関する判定だけでは音声品質を誤判定してしまう場合についても、2つのマイクに入力される音声の位相差を利用して使用状態をチェックし、適切な音声品質判定を可能としている。

【0112】

ノイズキャンセル効果に関する判定部に加え、マイク方向に関する判定部を用いるのは、騒音環境において判定の精度を上げる目的もあるが、より大きい目的として使用者に対する正しいマイク（装置）の持ち方を指導する効果を高めることにある。

【0113】

すなわち、ノイズキャンセル効果に関する判定部は、周辺雑音が小さい静かな環境などにおいては正しい判定が出来ないことがある。ここで、使用者に対して正しいマイクの持ち方を指導する場合、必ずしも周辺に雑音がある環境で行われるとは限らない。また、正しくない持ち方をしても周囲の状況によってはノイズキャンセルが効果的に働く場合もある。このようなことを鑑み、正しい持ち方に誘導するという目的を達成するため、マイク方向に関する判定部での警告がノイズキャンセル効果に関する判定部の判定結果に優先される。

【0114】

そして、マイク方向に関する判定部若しくはノイズキャンセル効果に関する判定部において、否定的な判断がなされている場合には、LED等の表示部で使用者に正しい持ち方

をするよう警告を促す。ここで、繰り返し判断をする間隔が非常に短い（1／30秒程度）ため、当該表示部において、視認しやすい一定時間同じ状態を保持する機能を備えて使用者への報知効果を高めても良い。

【0115】

（実施の形態4）

本実施の形態4に係る音声入力装置は、単方向無線送信機能を有するノイズキャンセルマイクであり、装置筐体に配置されるスイッチを用いて通信方向を切り替える機能を有する。

【0116】

上述してきたように、本実施の形態4に係る音声入力装置は、正面と背面とにそれぞれ1つずつのマイクを備えた2マイク方式のアクティブノイズキャンセル機能を搭載している。

【0117】

具体的に本実施の形態4に係る音声入力装置は、2つのマイクから入力される音声信号を用いて、話者の音声に混入する周辺雑音信号をキャンセルすることにより音声を明瞭に伝送することを目的としたノイズキャンセルマイクである。通常的使用方法においては、使用者側にメインマイク、使用者と反対側にサブマイクが配置され、メインマイクには主に話者の音声が入音され、またサブマイクには主に周辺の雑音が入音される。

【0118】

図10は、本実施の形態4に係るノイズキャンセルマイク400の（a）正面図と、（b）背面図とをそれぞれ示している。

【0119】

図10から分かるように、ノイズキャンセルマイク400は、筐体420と無線通信装置440が伸縮自在なコード430を介して接続されている。

【0120】

筐体420は、音声収音用のマイクであるメインマイク401とスピーカ421が正面に配置され、上面にLED410が、側面にPTT（Push To Talk）部422が配置されている。

【0121】

また、筐体420の背面には、ノイズ音収音用のマイクであるサブマイク402と、ベルト等で保持するためのベルトクリップ423とが配置されている。

【0122】

図11は、ノイズキャンセルマイク400の構成を示すブロック図である。なお、図5で既に説明した部分は説明を省略する。

【0123】

無線送信部408は、外部からの音声信号を受信する無線受信部413と共に無線通信装置440に格納されている。無線送信部408は、ノイズサプレッサ部207より入力したノイズ抑制後の音声信号に必要なに応じて音声符号化を行った後に無線送信する。

【0124】

無線受信部413は、外部の無線送信装置より無線送信される音声信号を無線受信し、受信した音声信号を放音部であるスピーカ421に出力する。スピーカ421は、無線受信部413より出力された音声信号に基づいて音声を放音する。

【0125】

PTT部422は、筐体420に配置されたスイッチであり、装置の通信モード（通信状態）を送信モード（送信状態）と非送信モード（スタンバイ状態）とを切り替える。使用者は音声を発してメッセージを伝える際には、当該PTT部422を押下することで装置を非送信モードから送信モードに切り替えて使用する。当該PTT部422が押下されている間は、装置全体が送信モードとなり、図11に示す送信機能をつかさどる各部がそれぞれ動作する。一方、PTT部422が押下されている間、無線受信部413は受信機能を停止する。

【0126】

P T T 4 2 2 が押下されている場合、P T T 部 4 2 2 より総合判定処理部 4 1 2 に送信モードである事を示す信号である送信モード信号が入力される。

【0127】

総合判定処理部 4 1 2 は、音声品質判定部 3 0 4 から入力する音声品質判定の結果を示す音声品質判定信号と、P T T 部 4 2 2 から入力する送信モード信号とに基づいて発光制御部である L E D ドライバ 4 0 9 に対応する信号を出力する。すなわち、L E D ドライバ 4 0 9 が取るべき状態を総合的に判定する。L E D ドライバ 4 0 9 は、総合判定処理部 4 1 2 からの信号に基づいて L E D 4 1 0 を駆動する。

【0128】

図 1 2 は、総合判定処理部 4 1 2 が行う処理と L E D 4 1 0 の状態との対応関係を示している。P T T 部 4 2 2 が押下されて送信モードであり、かつ、音声品質が良好である場合は、L E D ドライバ 4 0 9 は、L E D を点滅させる。一方、P T T 部 4 2 2 が押下されて送信モードであり、かつ、音声品質が不良である場合は、L E D ドライバ 4 0 9 は、L E D を点灯させることで使用者に使用状態改善のための注意喚起を行う。また、P T T 部 4 2 2 が押下されて送信モードであり、かつ、音声信号が入力されていない場合は、L E D ドライバ 4 0 9 は、L E D を点灯させる。また、P T T 部 4 2 2 が押下されておらず、非送信モードである場合は、L E D ドライバ 4 0 9 は、L E D に駆動電流を流さず、L E D 4 1 0 を消灯させる。

【0129】

以上のように、本実施の形態 4 に係るノイズキャンセルマイク（音声入力装置）は、単方向無線通信装置であって、音声を送信するモードである送信モードに移行するための P T T 部 4 2 2 を有する。ここで、使用者は現在の装置の状態が送信モードであるか非送信モード（スタンバイ状態）であるかを判別できることが好ましい。従って、P T T 部 4 2 2 が押下されて送信モードになっている場合に、L E D が点灯し、非送信モードとなっている場合に L E D を消灯するように制御する発光制御部が備えられている。

【0130】

ここで、送信モードにおいて、高品質の音声が適切に送信されているかを話者（使用者）に報知できることが好ましい。すなわち、音声品質が良好であるかについての判定結果を使用者に報知できることが好ましい。ここで、使用環境上の制約や部品点数を削減したいというコスト面からの制約等により、表示に用いる L E D の数はできるだけ削減したいという要求がある。そこで、送信モードであるかどうかを示す L E D と音声品質が良好であるかどうかを示す L E D を共用できることが好ましい。このような点を鑑み、上記発光制御部は、音声品質の判定結果に基づいて、1 つの L E D を点灯状態か点滅状態かに切り替える制御機能を有する。

【0131】

ここで、P T T 部 4 2 2 を押下して送信モードに切り替えた場合の L E D の状態を点灯状態とする場合、L E D ドライバ 4 0 9 は、音声品質が良好であると判断されている区間で L E D を点滅させると、話者は自分の通話に連動して装置が反応していると感じることができるため、判定結果通知方法として好ましい。

【0132】

以上各実施の形態で説明したように、本発明によればノイズキャンセルマイクを正しく使用者に使わせるよう誘導することにより、ノイズキャンセルの性能を高めて高品質の音声を聞き手に伝送することができる。すなわち、音声品質等の判定結果を L E D 等の判定結果通知部を用いて通知する目的は、ノイズキャンセル性能を表示することではなく、使用者にノイズキャンセルマイクを正しく使わせるための誘導にある。

【0133】

これは、2 マイク方式のアクティブノイズキャンセル機能を搭載した無線機、あるいは無線機用外部マイクにおいて、使用者のマイクの持ち方や口からの距離によって、ノイズキャンセル効果は大きく左右されるという解決すべき課題があったためである。

【0134】

すなわち、無線機本体あるいは本体に接続するハンドマイクは、持ち方によってはマイクが話者の口に対して90度方向であったり、口から離れすぎていたりする場合がある。このような場合に、メインマイクに十分な音声が届かず相対的に雑音成分も増えるため、ノイズキャンセル処理を行なっても十分な効果が得られない。また作業の都合上、両手を空けるために肩や胸にマイクを装着したまま通話を行う場合もあり、その場合のノイズキャンセル性能は正しい持ち方をしている場合に比べ低下してしまう。

【0135】

そこで、マイクの入力信号から、音声／非音声区間情報、ノイズキャンセル処理によるノイズの減衰量、2つのマイクの位相差を用いたマイク位置推定情報等を使って、使用者が正しいマイクの持ち方をしているかどうかを判定し、LED等の表示部によって正しいマイクの持ち方をするよう誘導するという方法で解決したものである。

【0136】

すなわち、ノイズキャンセル機能を備えた無線機用外部マイクにおいて、ノイズキャンセル機能が効果的に動くような持ち方をしているかどうかを推定する信号処理技術を組み込んでいる。

【0137】

また、本発明によれば、話者の後方に雑音源がある場合や、雑音の周波数特性が音声の特性に近い場合等、状況によってはノイズキャンセルがうまくいかない場合であっても適切な対処が可能となる。

【0138】

すなわち、第一の判定部として、マイクの入力信号からノイズキャンセル効果が効果的に得られているかどうかを推定し、ノイズキャンセル効果があまり得られていない場合には、マイクに備えられた表示装置により使用者に警告を与えて正しい持ち方をするよう促す。入力信号からノイズキャンセル効果を推定するには、ある一定区間（フレーム）が音声であるか雑音であるかを判定する音声区間判定情報、入力信号にノイズキャンセル処理を行った結果、ノイズ成分がどの程度減衰したかを示すノイズ低減量等を用いて判定する。さらに第二の判定部として、2つのマイクの入力信号の位相差から、マイクと話者の口との位置関係を推定し、メインマイクが正しく口の方向に向いていない場合には使用者に警告を与える。

【0139】

ここで、第二の判定部で行われる判定には、第1音声信号（目的音）と第2音声信号（参照音）とを用いて2つ以上のマイクロホン配置した音声入力装置に対する、目的音の到来方向を検知する目的音方向検知部とを備えることで実現可能である。

【0140】

また、本発明の音声品質判定部が行う判定処理は上記説明した方法に限定されるものではない。図13は、本発明の音声品質判定部が行う音声品質判定処理の別の流れを示している。

【0141】

図13において、ステップS411～ステップS413、ステップS416～ステップS419は、図8に示すステップS311～ステップS313、ステップS314～ステップS317と略同一であるため説明を省略する。図13において、音声品質判定部は、サブマイクから入力する第2音声信号のパワーを算出する（ステップS414）。ここで算出される第2音声信号のパワーは、雑音強度を示しているとみなすことができる。

【0142】

次に、音声品質判定部は、ステップS414で求めた第2音声信号のパワーが所定の閾値を超えているかを判定する（ステップS415）。ステップS415における判定の結果、第2音声信号が一定レベルを超えていない場合は、周囲が静寂な環境であるとして、音声品質が良好と判定する（ステップS418）。一方、ステップS415における判定の結果、第2音声信号のパワーが一定レベル以上であれば、周囲の雑音が大きく、ノイズ

キャンセル処理により、第1音声信号に対してキャンセル処理後信号のパワーが減っている必要があるため、ステップS416に進み、第1音声信号とキャンセル処理後信号のパワーを比較することでノイズキャンセル処理が適切に行われているかを判定する処理に進む。

【0143】

このような構成とすることで、周囲の雑音環境も考慮に入れた適切な音声品質に関する判定が可能となる。

【0144】

なお、ノイズキャンセル処理部でノイズキャンセル処理を行うか否かを決定するノイズキャンセル処理要否決定部を新たに備える構成であっても良い。静寂な環境下では、ノイズキャンセル処理を行わないほうが、良質な音声を送信できる場合がある。そこで、当該ノイズキャンセル処理要否決定部は、第2收音部で收音される音声のパワーを算出し、当該パワーが所定の基準値以上であれば、周囲雑音が大きくノイズキャンセル処理を行う必要があると決定する。一方、第2收音部で收音される音声のパワーが所定の基準値未満である場合は、ノイズキャンセル処理を行う必要はないと決定する。ノイズキャンセル処理部は、当該ノイズキャンセル処理要否決定部における決定に従ってノイズキャンセル処理を実行する。ノイズキャンセル処理要否決定部が行うノイズキャンセル処理を行うか否かの決定結果はフラグとして管理され、ノイズキャンセル処理部は当該フラグを参照してノイズキャンセル処理を行う。このような構成としても良い。

【0145】

また、この場合、音声品質判定部は、上記ノイズキャンセル処理が行われていることを示すフラグがあるかないかを検出して音声品質が良いか悪いかの判定を行う。すなわち、当該フラグがノイズキャンセル処理が行われていない事を示している場合、第2收音部から入力した第2音声信号のパワーが一定レベル以下であり、周囲が静寂な環境下であることを意味しているため、音声品質判定部は、音声品質は良好であると判定する。一方、当該フラグがノイズキャンセル処理が行われていることを示している場合に、音声品質判定部は、図8に示す音声品質が良好か否かの判定処理を行う。このような構成とすることで、消費電力を抑えつつ、適切な音声品質の判定を行うことができる。

なお、上記ノイズキャンセル処理要否決定部は、ノイズキャンセル処理を行うか否かの判定については、第2音声信号のパワーが一定レベル以上であるか以外の基準に基づいて当該要否判定を行っても良い。例えば、ノイズキャンセル処理要否決定部は、第1收音部からの第1音声信号と第2收音部からの第2音声信号との位相差により音声の到来方向を判定し、当該到来方向に応じてノイズキャンセル処理を行うか否かを決定してもよい。

【0146】

なお、本発明は上記実施の形態に限られたものではなく、趣旨を逸脱しない範囲で適宜変更することが可能である。また、上記の処理は、メインプロセッサのROM等に格納されたコンピュータプログラムによって実行可能である。上述の例において、各処理をコンピュータ（プロセッサ）に行わせるための命令群を含むプログラムは、様々なタイプの非一時的なコンピュータ可読媒体（non-transitory computer readable medium）を用いて格納され、コンピュータに供給することができる。非一時的なコンピュータ可読媒体は、様々なタイプの実体のある記録媒体（tangible storage medium）を含む。非一時的なコンピュータ可読媒体の例は、磁気記録媒体（例えばフレキシブルディスク、磁気テープ、ハードディスクドライブ）、光磁気記録媒体（例えば光磁気ディスク）、CD-ROM（Read Only Memory）、CD-R、CD-R/W、半導体メモリ（例えば、マスクROM、PROM（Programmable ROM）、EPROM（Erasable PROM）、フラッシュROM、RAM（Random Access Memory））を含む。また、プログラムは、様々なタイプの一時的なコンピュータ可読媒体（transitory computer readable medium）によってコンピュータに供給されてもよい。一時的なコンピュータ可読媒体の例は、電気信号、光信号、及び電磁波を含む。一時的なコンピュータ可読媒体は、電線及び光ファイバ等の有線通信路、又は無線通信路を介して、プログラムをコンピュータに供給できる。

【符号の説明】

【0147】

100	音声入力装置		
101	第1収音部（メインマイク）	102	第2収音部（サブマイク）
103	ノイズキャンセル処理部	104	音声品質判定部
105	判定結果通知部		
200	音声入力装置		
203	ノイズキャンセル処理部	204	音声品質判定部
206	音声区間判定部	207	ノイズサプレッサ部
208	送信部	209	発光制御部
210	発光素子（LED）		
300	音声入力装置		
304	音声品質判定部	311	マイク方向判定部
312	ノイズキャンセル効果判定部		
400	ノイズキャンセルマイク（音声入力装置）		
401	第1収音部（メインマイク）	402	第2収音部（サブマイク）
405	判定結果通知部	408	無線送信部
409	LEDドライバ（発光制御部）	410	LED
412	総合判定処理部	413	無線受信部
420	筐体	421	スピーカ（放音部）
422	P/T/T部	423	ベルトクリップ
430	コード	440	無線通信装置

【書類名】特許請求の範囲

【請求項 1】

第 1 収音部と、

第 2 収音部と、

前記第 2 収音部から入力される第 2 音声信号を用いて、前記第 1 収音部から入力される第 1 音声信号に対するノイズキャンセルを行うノイズキャンセル処理部と、

前記ノイズキャンセル処理部におけるノイズキャンセル後の音声信号の音声品質を判定する音声品質判定部と、

前記音声品質判定部における判定結果を通知する判定結果通知部と、
を具備する音声入力装置。

【請求項 2】

前記音声品質判定部は、前記ノイズキャンセル処理部が行う前記ノイズキャンセルが効果的に働いているかに基づいて前記ノイズキャンセル後の音声信号の音声品質を判定する、
請求項 1 に記載の音声入力装置。

【請求項 3】

前記音声品質判定部は、前記ノイズキャンセル前の前記第 1 音声信号と前記ノイズキャンセル後の音声信号とを比較することで、前記ノイズキャンセルが効果的に働いているかを判定し、前記ノイズキャンセルが効果的に働いていると判定した場合に前記ノイズキャンセル後の音声信号の音声品質が良いと判定する、
請求項 1 に記載の音声入力装置。

【請求項 4】

前記音声品質判定部は、前記ノイズキャンセル前の前記第 1 音声信号と前記ノイズキャンセル後の音声信号との比較の結果、前記ノイズキャンセルが効果的に働いていると判定し、かつ、前記ノイズキャンセル後の音声信号の平均強度が所定の閾値以上である場合に、前記ノイズキャンセル後の音声信号の音声品質が良いと判定する、
請求項 2 に記載の音声入力装置。

【請求項 5】

前記音声品質判定部は、前記ノイズキャンセル前の前記第 1 音声信号の平均強度と、前記ノイズキャンセル後の音声信号の平均強度との差が所定の閾値以上である場合に、前記ノイズキャンセル後の音声信号の音声品質が良いと判定する、
請求項 1 に記載の音声入力装置。

【請求項 6】

前記音声品質判定部は、前記ノイズキャンセル前の前記第 1 音声信号の平均強度に対する前記ノイズキャンセル後の音声信号の平均強度との比率が所定の閾値以下である場合に、前記ノイズキャンセル後の音声信号の音声品質が良いと判定する、
請求項 1 に記載の音声入力装置。

【請求項 7】

前記ノイズキャンセル処理部は、前記第 1 収音部で収音された音声に含まれる雑音成分を前記第 2 収音部で収音された音声に基づいて抑制することで前記ノイズキャンセルを行う、
請求項 1 乃至 6 のいずれか 1 項に記載の音声入力装置。

【請求項 8】

前記ノイズキャンセル処理部は、前記第 1 収音部で収音された音声に混入する雑音成分の逆相成分を前記第 2 収音部で収音された音声に基づいて生成し、前記第 1 収音部で収音された音声に前記生成した雑音成分の逆送成分を加算することで前記ノイズキャンセルを行う請求項 7 記載の音声入力装置。

【請求項 9】

前記判定結果通知部は、

光を発光する発光素子と、

前記発光素子を制御する発光制御部と、

を備え、

前記発光制御部は、前記音声品質判定部における判定結果に基づいて、前記発光素子を点灯又は点滅させる制御を行うことで前記判定結果を通知する、
請求項 1 乃至 8 のいずれか 1 項に記載の音声入力装置。

【請求項 1 0】

第 1 收音部で收音された音声に基づいて音声区間であるかの判定を行う音声区間判定部を更に備え、

前記音声品質判定部は、前記音声区間判定部において音声区間であると判定されている場合に、前記ノイズキャンセル処理部におけるノイズキャンセル後の音声信号の音声品質を判定する、

請求項 1 乃至 9 のいずれか 1 項に記載の音声入力装置。

【請求項 1 1】

前記音声区間判定部は、

第 1 收音部から入力される第 1 音声信号を一定長の単位で周波数領域に変換する周波数変換部と、

前記周波数変換部における変換後のスペクトル成分に基づいて、音声であるか音声ではない雑音成分であるかを判定する音声判定部と、

を備える請求項 1 0 に記載の音声入力装置。

【請求項 1 2】

前記第 1 收音部は、装置本体正面に配置されるメインマイクであり、

前記第 2 收音部は、装置本体背面に配置されるサブマイクである、

請求項 1 乃至 1 1 のいずれか 1 項に記載の音声入力装置。

【請求項 1 3】

前記第 1 收音部で收音される音声と前記第 2 收音部で收音される音声との位相差に基づいてメインマイク方向を判定するマイク方向判定部を更に具備し、

前記音声品質判定部は、前記マイク方向判定部における前記メインマイク方向の判定結果に基づいて前記ノイズキャンセル処理部におけるノイズキャンセル後の音声信号の音声品質を判定する、

請求項 1 2 に記載の音声入力装置。

【請求項 1 4】

前記第 1 收音部で收音される音声と前記第 2 收音部で收音される音声との位相差を検出する位相差検出部と、

前記位相差検出部で検出された位相差が適切な使用状態時における位相差として設定されている範囲内であるかを判定する位相差判定部と、

を備え、

前記音声品質判定部は、前記位相差判定部における判定結果に基づいて、前記ノイズキャンセル処理部におけるノイズキャンセル後の音声信号の音声品質を判定する、

請求項 1 2 に記載の音声入力装置。

【請求項 1 5】

第 1 收音部と、

第 2 收音部と、

前記第 2 收音部から入力される第 2 音声信号を用いて、前記第 1 收音部から入力される第 1 音声信号に対するノイズキャンセルを行うノイズキャンセル処理部と、

前記ノイズキャンセル処理部におけるノイズキャンセル後の音声信号の音声品質を判定する音声品質判定部と、

前記ノイズキャンセル後の音声信号を送信する送信部と、

前記音声品質判定部における判定結果を通知する判定結果通知部と、

音声信号を受信する受信部と、

前記受信部で受信した前記音声信号に基づいて音声を放音する放音部と、

を具備する通信装置。

【請求項 1 6】

自装置の状態を前記送信部で音声信号を送信する送信状態へ切り替える切り替え部を更に具備し、

前記判定結果通知部は、前記切り替え部が前記送信部で音声信号を送信するように切り替えている場合において、前記ノイズキャンセル後の音声信号の音声品質が良好であることを視覚的に通知する、

請求項 1 5 記載の通信装置。

【請求項 1 7】

第 1 マイクロホンと第 2 マイクロホンの少なくとも 2 つのマイクロホンを具備する装置で使用される状態通知方法であって、

前記第 1 マイクロホンと前記第 2 マイクロホンでそれぞれ音声を受音する受音ステップと

、
前記第 2 マイクロホンで受音された音声を用いて、前記第 1 マイクロホンで受音された音声に対するノイズキャンセルを行うノイズキャンセル処理ステップと、

前記ノイズキャンセル後の音声信号の音声品質を判定する音声品質判定ステップと、

前記判定結果に基づいて状態を通知する状態通知ステップと、

を有する状態通知方法。

【書類名】 要約書

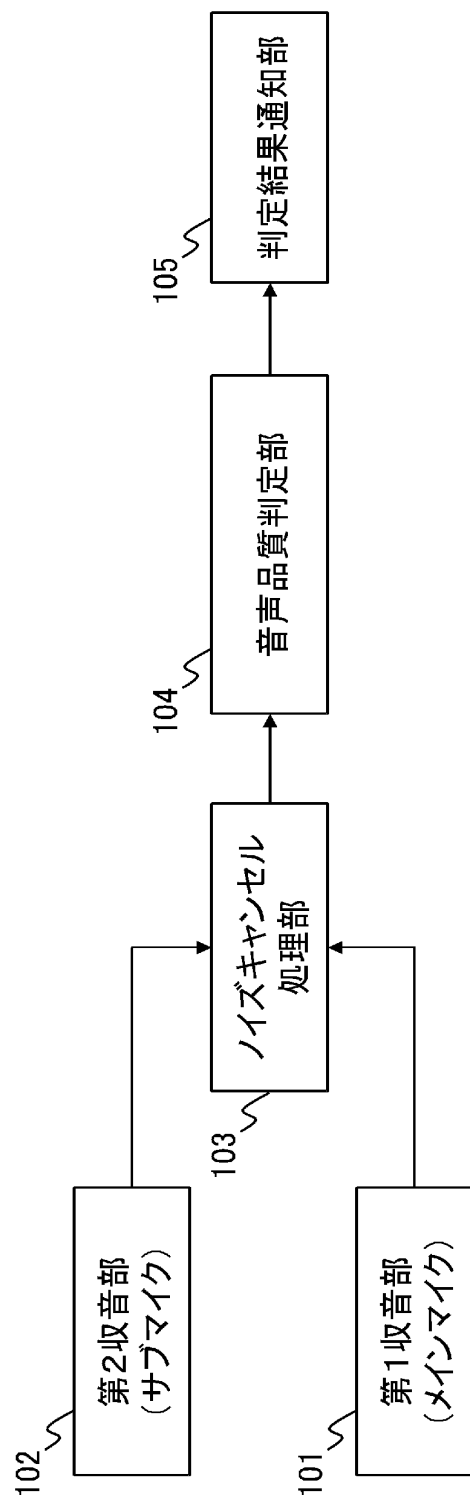
【要約】

【課題】 ノイズキャンセル機能を適切に働かせて明瞭な音声を伝送できるようにする事を可能とする音声入力装置が求められていた。

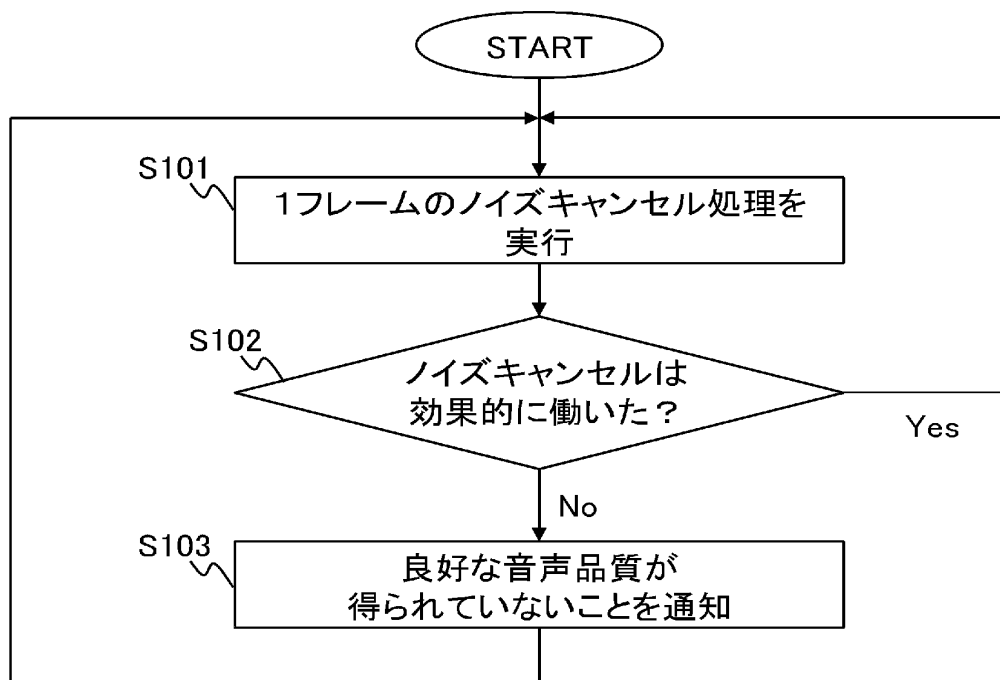
【解決手段】 本発明の音声入力装置は、 音声を収音する第1収音部（101）と、 音声を収音する第2収音部と（102）、 の2つの収音部を具備する。そして、 前記第2収音部から入力される第2音声信号を用いて、 前記第1収音部から入力される第1音声信号に対するノイズキャンセルを行うノイズキャンセル処理部（103）により、 アクティブノイズキャンセル機能を実現する。そして、 前記ノイズキャンセル処理部におけるノイズキャンセル後の音声信号の音声品質を判定する音声品質判定部（104）と、 前記音声品質判定部における判定結果を通知する判定結果通知部（105）と、 を具備する。

【選択図】 図1

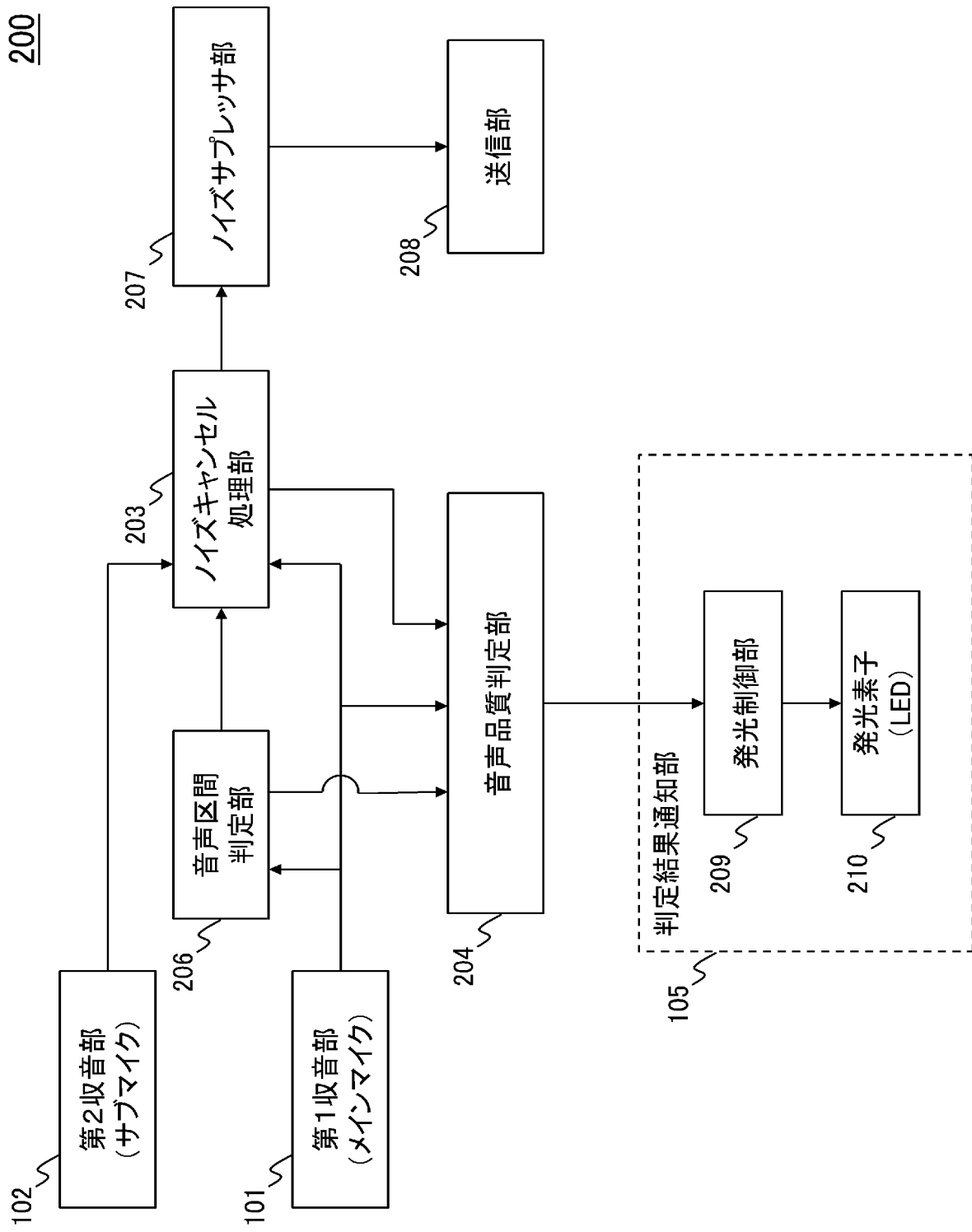
100



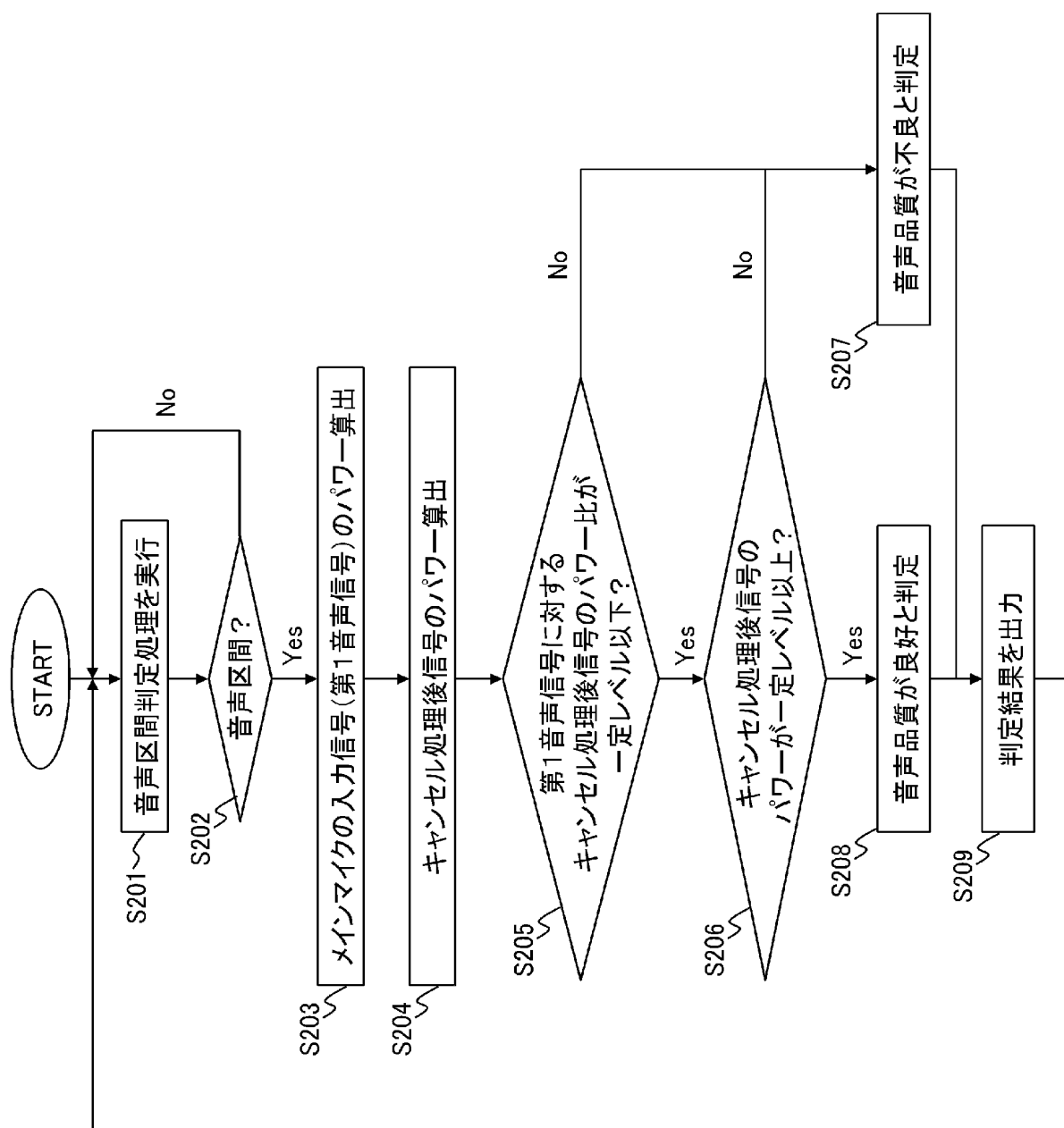
【図2】



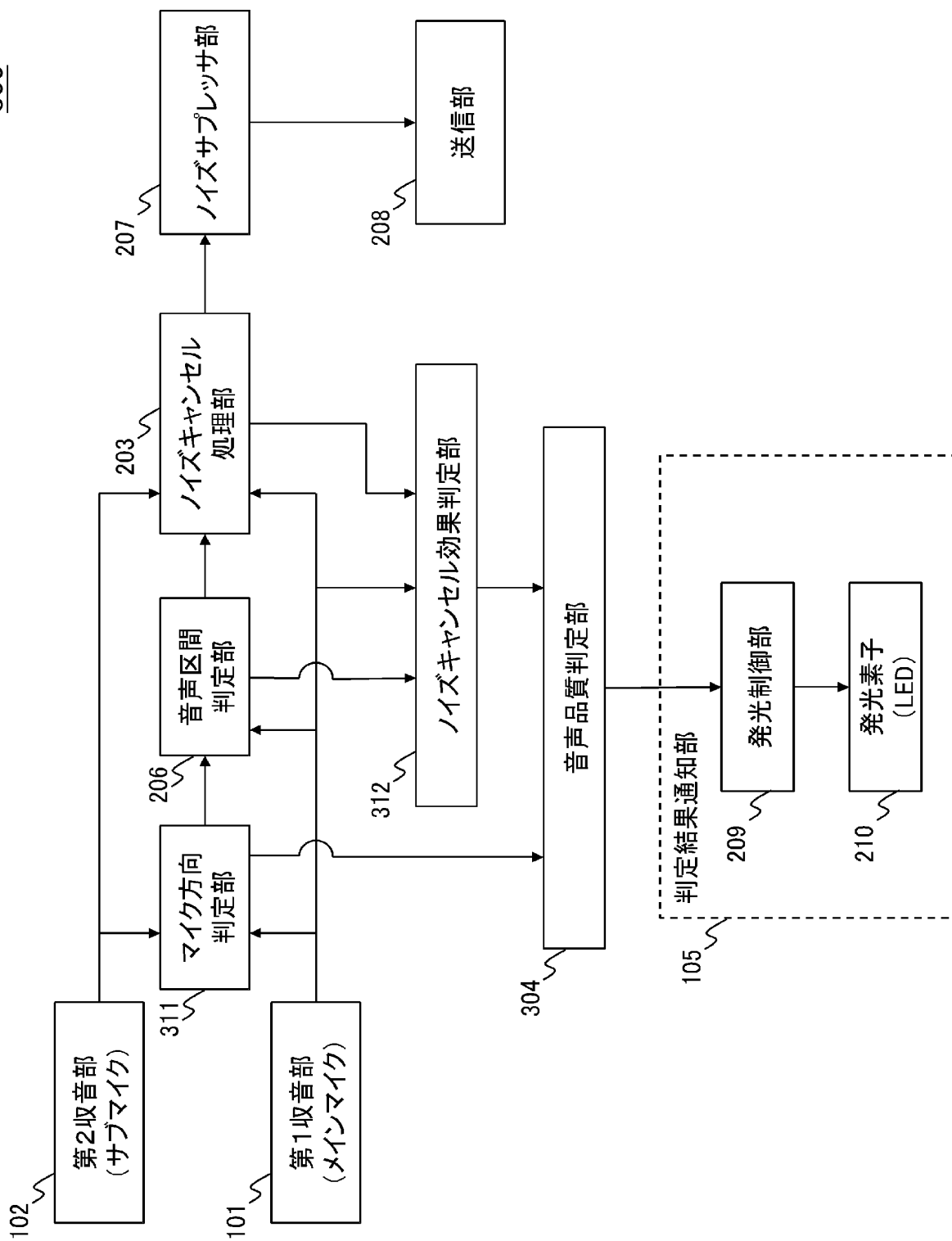
【図3】



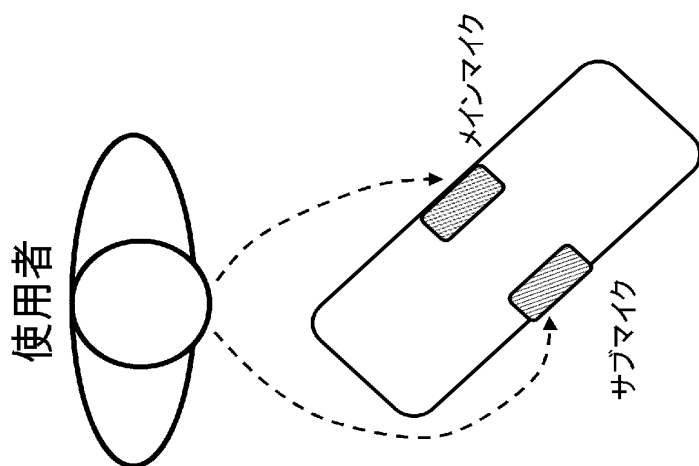
【図4】



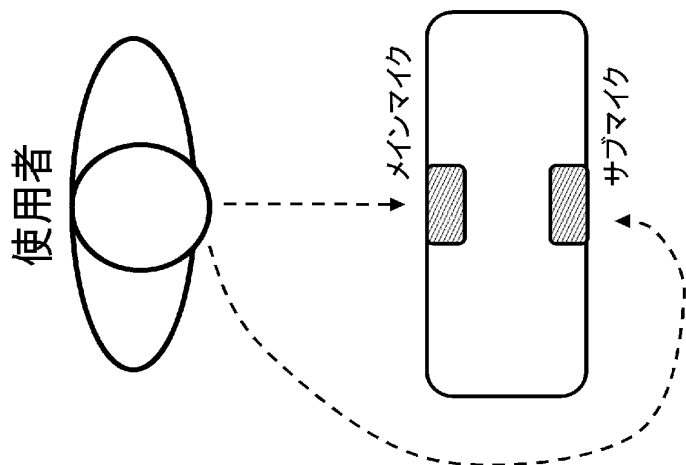
300



【図 6】

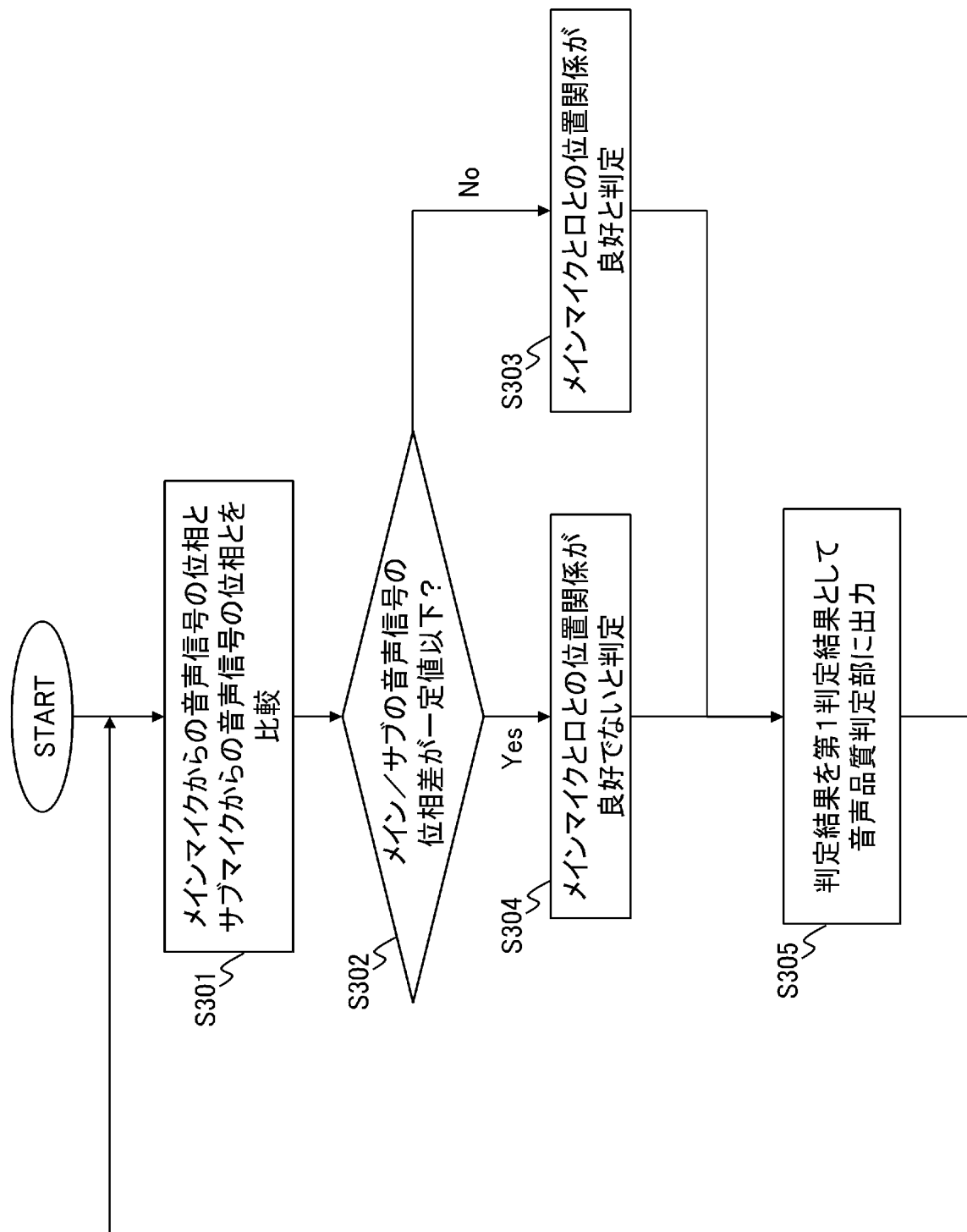


位相差が小さい

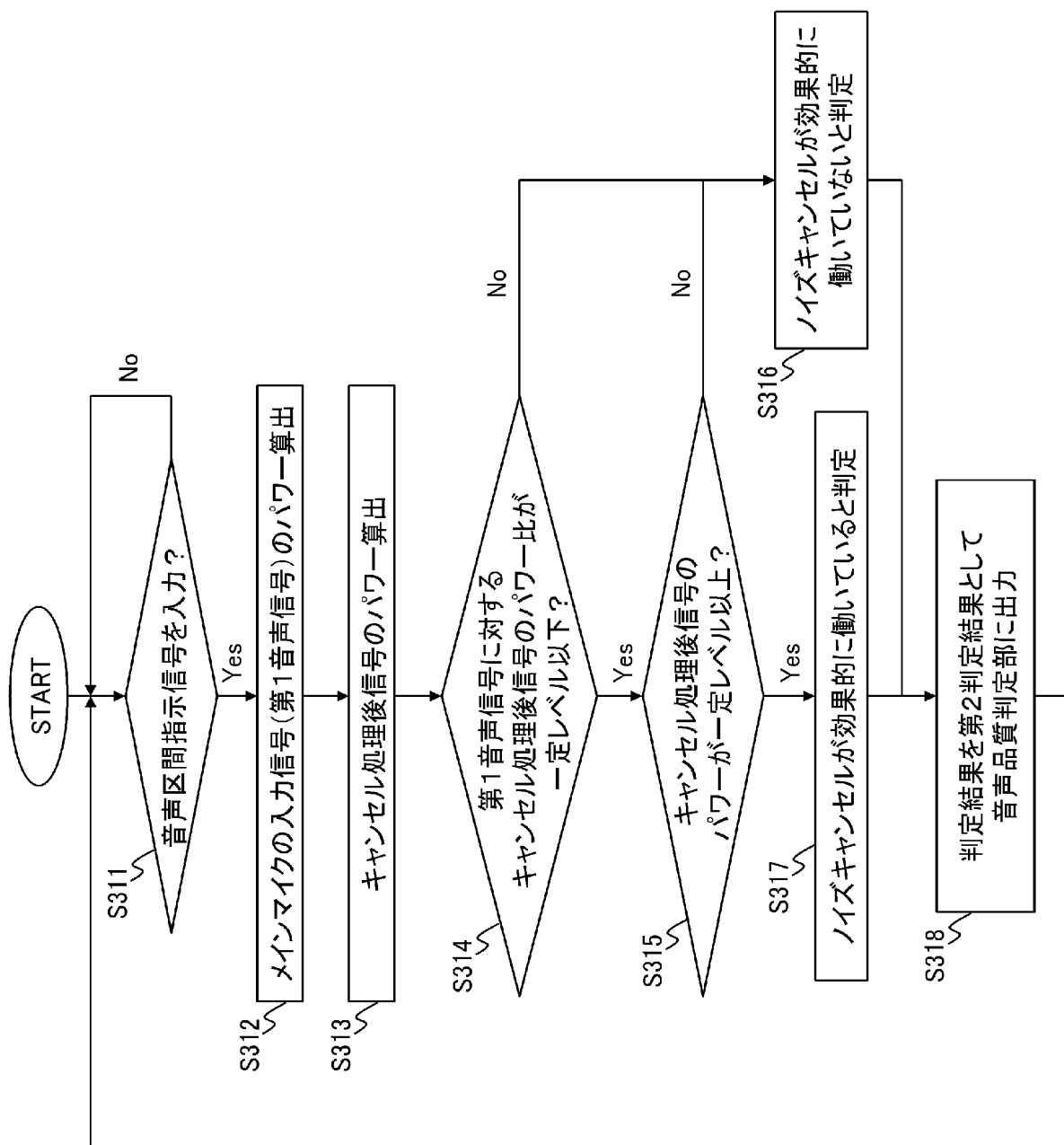


位相差が大きい

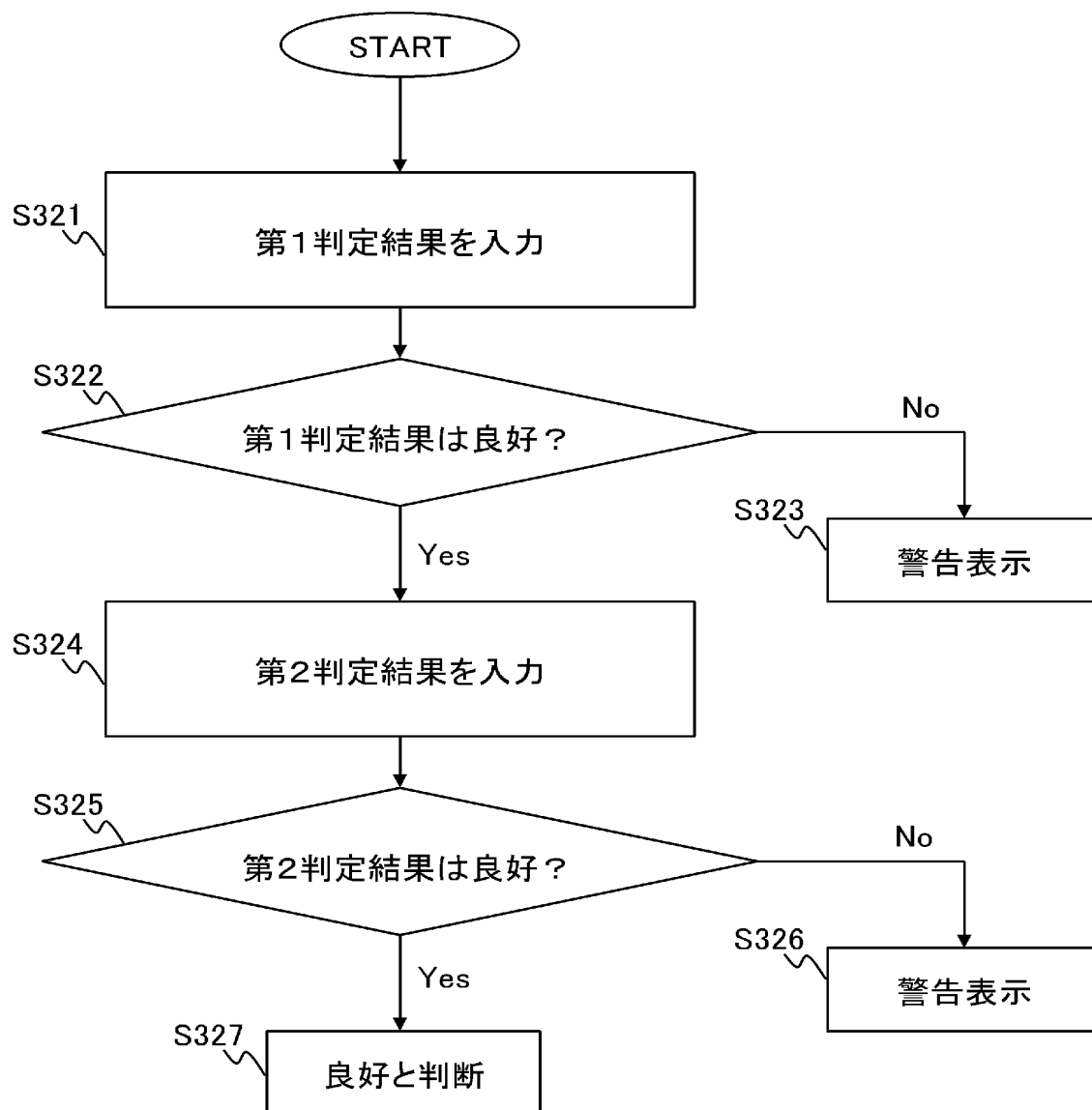
【図 7】

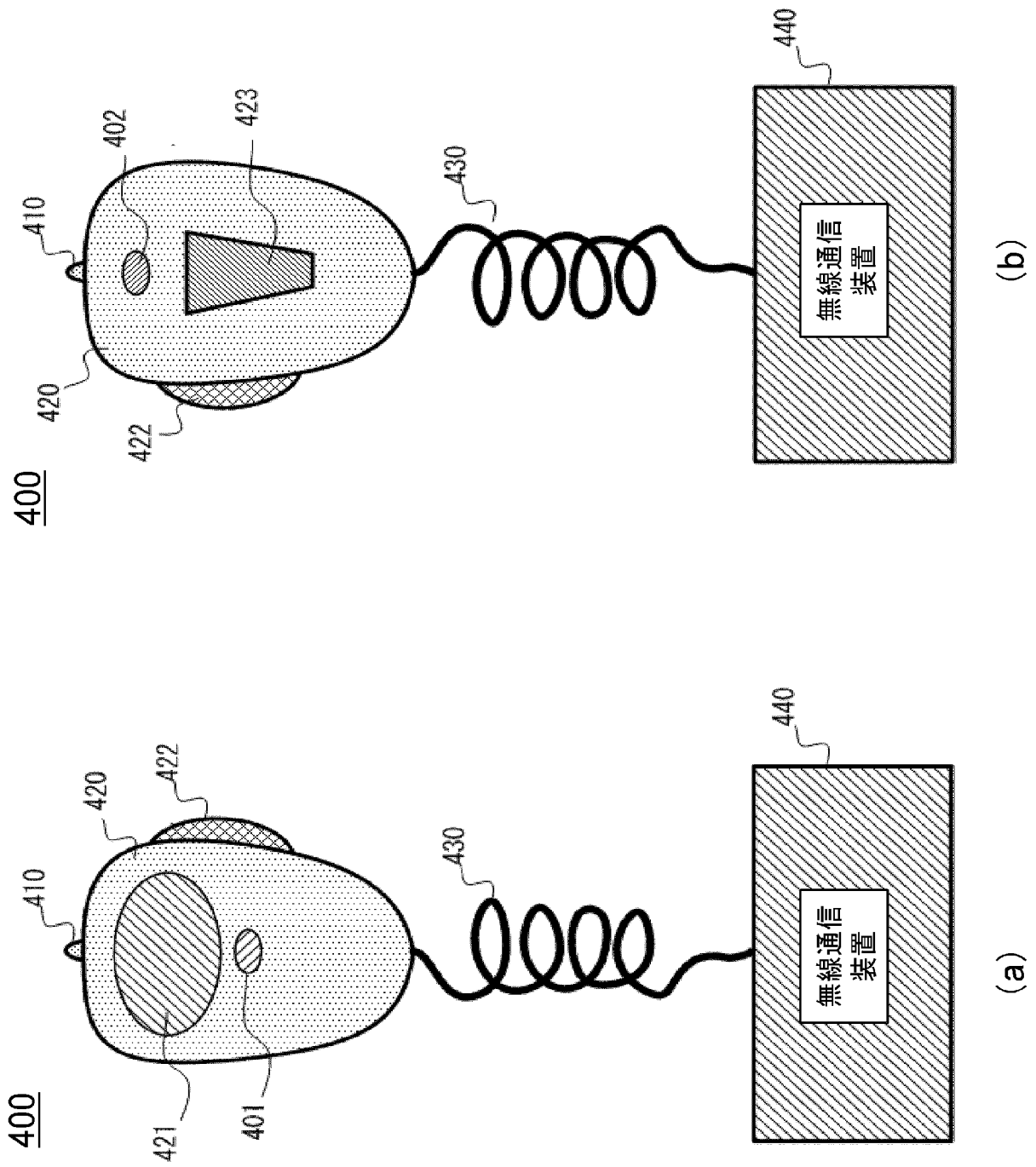


【図 8】

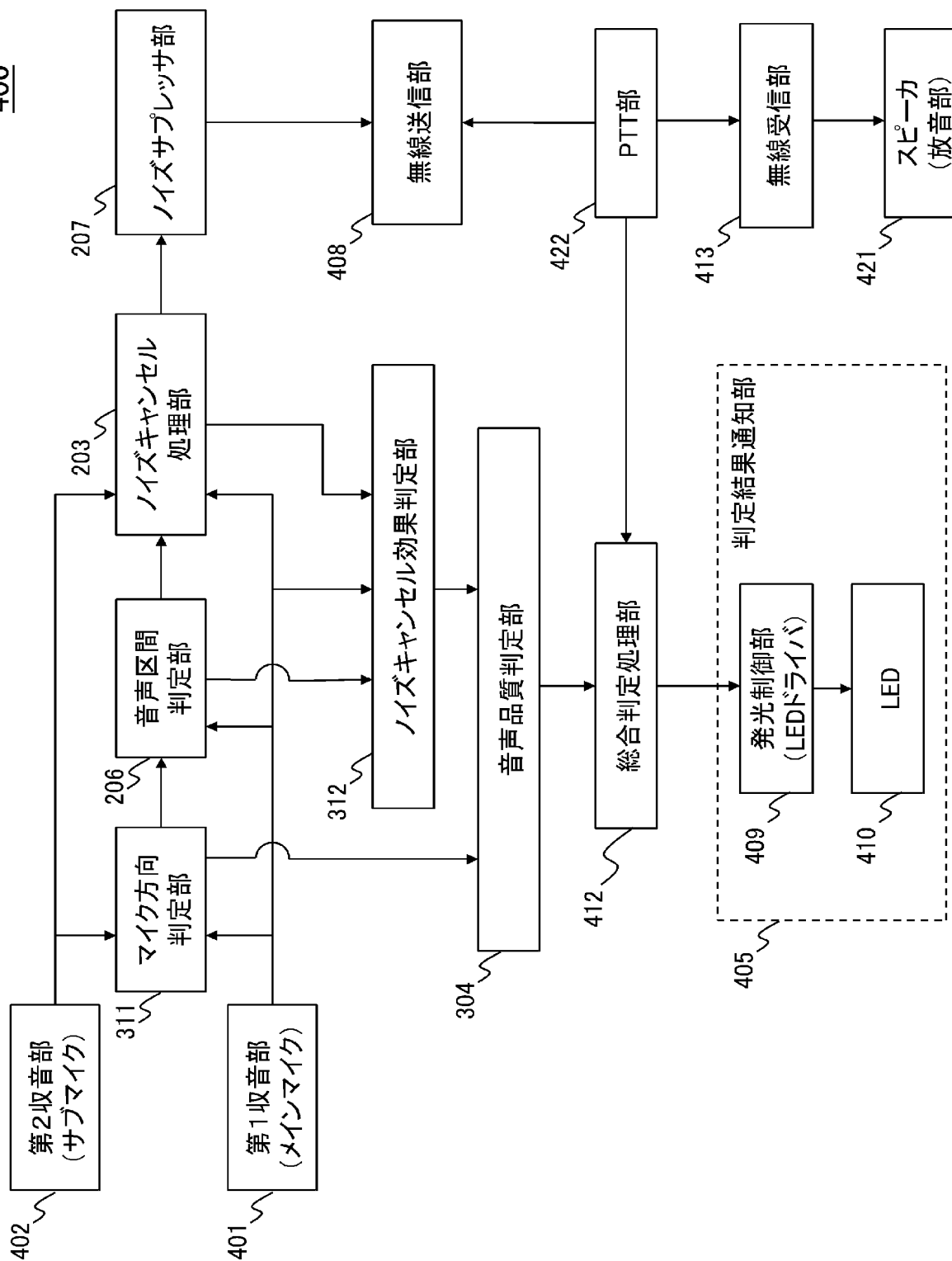


【図9】





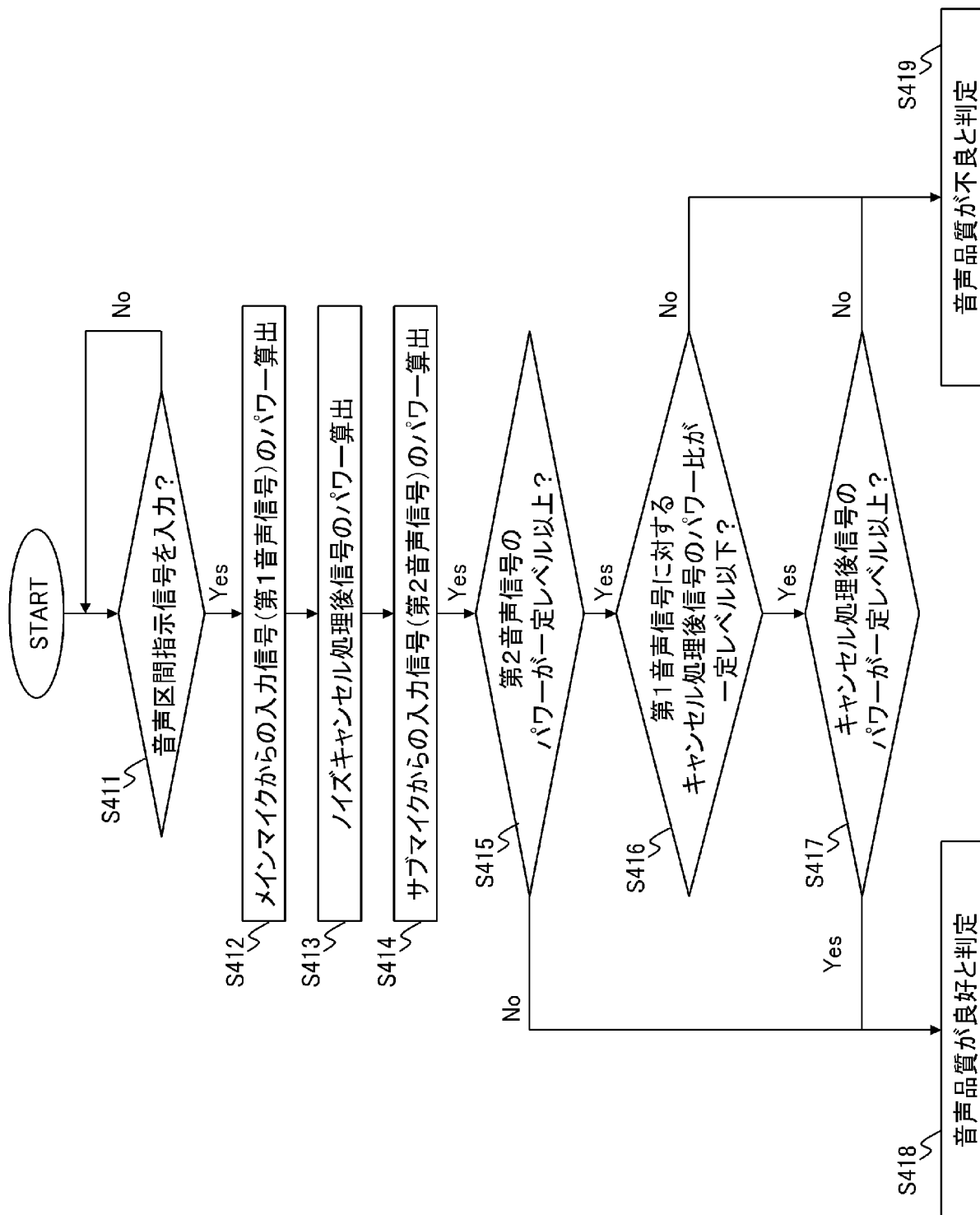
400



【図 1 2】

	送信モード情報 (PTT部から)	音声品質判定情報 (音声品質判定部から)	LED状態
No1	送信モード (PTT部が押下されている)	音声品質良好	点滅
No2		音声品質不良	点灯
No3		信号無し	点灯
No4	非送信モード (PTT部が押下されていない)	信号無し	消灯

【図 13】



【書類名】	手続補正書
【整理番号】	P120124-01
【提出日】	平成24年 3月 6日
【あて先】	特許庁長官殿
【事件の表示】	
【出願番号】	特願2012- 34189
【補正をする者】	
【識別番号】	308036402
【氏名又は名称】	株式会社 J V C ケンウッド
【代表者】	不破 久温
【代理人】	
【識別番号】	100103894
【弁理士】	
【氏名又は名称】	家入 健
【手続補正1】	
【補正対象書類名】	特許願
【補正対象項目名】	発明者
【補正方法】	変更
【補正の内容】	
【発明者】	
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【氏名】	小野田 達也
【その他】	誤記の理由は、2 人の発明者を記載すべきところ、記載ミスにより 1 名のみ記載したことによるものです。

出願人履歴

3 0 8 0 3 6 4 0 2

20110810

名称変更

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日 本 国 特 許 庁
JAPAN PATENT OFFICE

別紙添付の書類に記載されている事項は下記の出願書類に記載されている事項と同一であることを証明する。

This is to certify that the annexed is a true copy of the following application as filed with this Office.

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Date of Application:

出 願 番 号 特 願 2 0 1 2 - 0 3 4 1 9 2
Application Number:

パリ条約による外国への出願
に用いる優先権の主張の基礎
となる出願の国コードと出願
番号
The country code and number
of your priority application,
to be used for filing abroad
under the Paris Convention, is

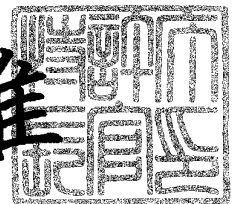
J P 2 0 1 2 - 0 3 4 1 9 2

出 願 人 株式会社 J V C ケンウッド
Applicant(s):

2 0 1 3 年 9 月 2 4 日

特許庁長官
Commissioner,
Japan Patent Office

羽 藤 秀 雄



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	H04M 5/00
	H04M 5/04
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【代表者】	不破 久温
【代理人】	
【識別番号】	100103894
【弁理士】	
【氏名又は名称】	家入 健
【手数料の表示】	
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【物件名】	特許請求の範囲 1
【物件名】	要約書 1
【物件名】	図面 1
【包括委任状番号】	1007589

【書類名】明細書

【発明の名称】通信装置、状態通知方法

【技術分野】

【0001】

本発明は通信装置に関し、特にノイズキャンセル機能を有する単方向通信装置に関する。

【背景技術】

【0002】

業務用無線機に代表される音声入力装置は、工場や建設現場、また、消防・警察等といった高い騒音下で使用される機会が多い。そのため、マイクで収音された音声信号に含まれる雑音成分を抑圧することで、高い騒音下でも良好な通話を確保できることが求められる。

【0003】

特許文献1には、筐体に音声収音用マイク（以下メインマイクと称する）および雑音収音用マイク（以下サブマイクと称する）の2個のマイクを備え、サブマイクで収音した信号から生成したノイズの逆相成分をメインマイクの信号に加算することにより、メインマイクの雑音成分を抑圧する音声入力システムが開示されている。当該技術はアクティブノイズキャンセル方式と呼ばれ、高騒音下でも明瞭な音声を収音することが可能となる。

【0004】

また、特許文献2には、複数のマイクロホンから出力された信号から雑音を除去した残留信号の方向別の音量を算出し、方向別残留信号の音量を表示することで、マイクロホンで収集された音声がいずれだけ抑圧されているかを音源ごとに確認できる音収集システムが開示されている。

【0005】

また、特許文献3には、外部デバイスへコンテンツデータの送信を行う電子機器が開示されている。当該電子機器は、外部デバイスとの間で伝送される一つ以上のコンテンツに関するコンテンツ情報を取得し、一つ以上のコンテンツを伝送する際、前記取得したコンテンツ情報に基づき、コンテンツが伝送されている期間中インジケータの発光部を点灯又は点滅する。当該構成により、コンテンツデータの伝送状況の切り替わりを適切にユーザーに報知することが可能となる。

【0006】

また、特許文献4には、所謂ハンズフリー通話が可能な電話装置であって、マイクから入力された音声所定の音声であるかを判断する音声認識部を備え、当該音声の認識結果を表示する表示手段を更に備える音声応答機能付電話装置が開示されている。当該装置によれば、使用者に音声認識部の認識結果を報知することで、音声応答機能の信頼性を向上させている。

【先行技術文献】

【特許文献】

【0007】

【特許文献1】特開2004-120717号公報

【特許文献2】特開2010-028531号公報

【特許文献3】特開2010-279043号公報

【特許文献4】特開2000-106588号公報

【発明の概要】

【発明が解決しようとする課題】

【0008】

高騒音下の環境で使用される単方向通信機能を有する通信装置には、送信モード（送信状態）と非送信状態（スタンバイ状態）とを切り替えるスイッチが配置されており、使用者が当該切り替えスイッチを押下することで送信モードへと切り替える。

【0009】

このような装置においては、使用者に対して現在の通信状態を誤認しないよう、現在の通信状態が送信状態か非送信状態かのどちらであるかを適切に通知する必要がある。そこで、装置筐体にLED等の発光部が設けられ、上記切り替えスイッチに連動して当該LEDの発光状態を制御する構成がとられる。

【0010】

ここで、高騒音下の環境で使用される通信装置では、その使用環境や部品点数、部品コストなどの制約上、装置筐体に配置されるLEDの数や色を増やすことが難しい場合がある。そこで、1つのLEDが装置筐体に配置され、上記送信モードの切り替えに対応してLEDを点灯又は消灯させる制御が行われる。

【0011】

ここで、工事現場等の高騒音下の環境で使用される通信装置において音声を收音して送信する場合、話者からの音声が周囲雑音で潰されてしまい、受信先にいる聞き手が会話内容を適切に理解できない場合があるという課題が発生していた。このような状況においては、話者に対して装置の使用状態を改善するように指導（注意喚起）できることが求められていた。

【0012】

上記課題を鑑み、本発明は、限られた制約下で良質な音声を送信できる送信装置と状態通知方法を提供することを目的とする。

【課題を解決するための手段】

【0013】

本発明の一態様である通信装置は、音声を收音する第1收音部と、第1收音部で收音される音声を音声信号として外部に送信する送信部と、前記送信部が前記音声信号を送信しない非送信状態から前記送信部が前記音声信号を送信する送信状態に自装置の通信状態を切り替える切り替え部と、前記送信部で送信される前記音声信号の音声品質を判定する音声品質判定部と、光を発光する発光部と、前記発光部を制御する発光制御部と、を具備し、前記発光制御部は、前記切り替え部が切り替える前記通信状態と、前記音声品質判定部における前記音声品質の判定結果とに基づいて、前記発光部が、消灯状態、点滅状態、点灯状態、のいずれかの状態をとるように制御する。

また、前記発光制御部は、前記通信状態が非送信状態である場合は前記発光部を消灯状態とし、前記通信状態が送信状態で、かつ、前記音声品質が良好と判定されている場合は前記発光部を点滅状態とし、前記通信状態が送信状態で、かつ、前記音声品質が不良と判定されている場合は前記発光部を点灯状態としても良い。

また、前記発光制御部は、前記通信状態が非送信状態である場合は前記発光部を消灯状態とし、前記通信状態が送信状態で、かつ、前記音声品質が良好と判定されている場合は前記発光部を点灯状態とし、前記通信状態が送信状態で、かつ、前記音声品質が不良と判定されている場合は前記発光部を点滅状態としても良い。

また、前記音声品質判定部は、前記第1收音部で收音される音声の音量レベルに基づいて前記音声品質を判定しても良い。

また、音声を收音する第2收音部と、前記第2收音部から入力される第2音声信号を用いて、前記第1收音部から入力される第1音声信号に対するノイズキャンセルを行うノイズキャンセル処理部と、を更に具備し、前記送信部は、前記ノイズキャンセル処理部における前記ノイズキャンセル後の音声信号を外部に送信し、前記音声品質判定部は、前記ノイズキャンセル後の音声信号の音声品質を判定しても良い。

また、第1收音部で收音された音声に基づいて音声区間であるかの判定を行う音声区間判定部を更に備え、前記音声品質判定部は、前記音声区間判定部において音声区間であると判定されている場合に、前記ノイズキャンセル処理部におけるノイズキャンセル後の音声信号の音声品質を判定しても良い。

また、前記音声区間判定部は、第1收音部から入力される第1音声信号を一定長の単位で周波数領域に変換する周波数変換部と、前記周波数変換部における変換後のスペクトル成分に基づいて、発話による音声成分であるか音声ではない雑音成分であるかを判定する

音声判定部と、を備えても良い。

また、前記発光制御部は、前記通信状態が非送信状態である場合は前記発光部を消灯状態とし、前記通信状態が送信状態で、かつ、音声区間でない場合は、前記発光部を点灯状態とし、前記通信状態が送信状態で、かつ、音声区間であり、前記音声品質が不良と判定されている場合は、前記発光部を点灯状態とし、前記通信状態が送信状態で、かつ、音声区間であり、前記音声品質が良好と判定されている場合は前記発光部を点滅状態とする制御を行っても良い。

また、前記第1 收音部は、装置本体正面に配置されるメインマイクであり、前記第2 收音部は、装置本体背面に配置されるサブマイクとすることができる。

また、前記第1 收音部で收音される音声と前記第2 收音部で收音される音声との位相差に基づいてメインマイク方向を判定するマイク方向判定部を更に具備し、前記音声品質判定部は、前記マイク方向判定部における前記メインマイク方向の判定結果に基づいて前記ノイズキャンセル処理部におけるノイズキャンセル後の音声信号の音声品質を判定することができる。

また、前記発光部は、装置本体に設置されたLED (Light Emitting Diode) である。

また、本発明の一態様である状態通知方法は、単方向通信装置に設けられた発光素子を用いて前記単方向通信装置の使用状態を通知する状態通知方法であって、前記単方向通信装置の通信状態が送信状態であるか非送信状態であるかを判定する通信状態判定ステップと、前記通信状態が前記送信状態である場合に送信される音声信号の音声品質を判定する音声品質判定ステップと、通信状態判定ステップにおける判定結果と前記音声品質判定ステップにおける判定結果とに基づいて前記発光素子を消灯状態、点灯状態、点滅状態のいずれかの状態となるように制御する制御ステップと、を有する。

また、本発明の一態様である通信装置は、音声を受音する第1 收音部と、前記第1 收音部で收音される音声を音声信号として外部に送信する送信部と、前記送信部が前記音声信号を送信しない非送信状態から前記送信部が前記音声信号を送信する送信状態に自装置の通信状態を切り替える切り替え部と、前記第1 收音部での音声の收音状態を判定する收音状態判定部と、光を発光する発光部と、前記発光部を制御する発光制御部と、を具備し、前記発光制御部は、前記切り替え部が切り替える前記通信状態と、前記收音状態判定部における前記第1 收音部での音声の收音状態とに基づいて、前記発光部が、消灯状態、点滅状態、点灯状態、のいずれかの状態をとるように制御する。

ここで、前記発光制御部は、前記切り替え部が前記通信状態を送信状態に切り替えた場合に、前記発光部を点灯状態とし、前記收音状態判定部で判定された收音状態に基づいて、前記発光部を点滅状態とすることを特徴としても良い。

【発明の効果】

【0014】

本発明によれば、限られた制約下で良質な音声を送信できる送信装置と状態通知方法を提供することができる。

【図面の簡単な説明】

【0015】

【図1】実施の形態1に係る通信装置の構成を示すブロック図である。

【図2】実施の形態1に係る通信装置の動作の流れを示すフローチャート図である。

【図3】実施の形態2に係る通信装置（ノイズキャンセルマイク）の外観（（a）正面図、（b）背面図）を示す図である。

【図4】実施の形態2に係る通信装置の構成を示すブロック図である。

【図5】実施の形態2に係る音声品質の判定処理の流れを示すフローチャート図である。

【図6】LEDの発光状態と通信状態と音声品質の判定結果との関係を纏めたグラフである。

【図7】実施の形態3に係る通信装置の構成を示すブロック図である。

【図8】通信装置（音声入力装置）の使用者に対する方向と位相との関係を説明する

図である。

【図 9】実施の形態 3 に係るメインマイク方向の判定処理（第 1 判定処理）の流れを示すフローチャート図である。

【図 10】実施の形態 3 に係るノイズキャンセル効果の判定処理の流れを示すフローチャート図である。

【図 11】実施の形態 3 に係る音声品質に関する総合判定処理の動作の流れを示すフローチャート図である。

【図 12】実施の形態 4 に係る音声入力装置（通信装置）の構成を示すブロック図である。

【図 13】実施の形態 4 に係る発光制御部の制御内容を示したグラフである。

【図 14】実施の形態 4 に係る発光制御部制御動作の流れを示すフローチャート図である。

【図 15】実施の形態 4 に係る別の音声入力装置（通信装置）の構成を示すブロック図である。

【発明を実施するための形態】

【0016】

本発明の実施の形態について以下に図面を参照して説明する。以下の説明は、本発明の好適な実施の形態を示すものであって、本発明の範囲が以下の実施の形態に限定されるものではない。以下の説明において、同一の符号が付されたものは実質的に同様の内容を示している。

【0017】

（実施の形態 1）

以下、図面を参照して本発明の実施の形態について説明する。図 1 は、本実施の形態 1 に係る通信装置 100 の構成を示すブロック図である。通信装置 100 は、第 1 收音部 101 と、送信部 102 と、音声品質判定部 103 と、PTT（Push To Talk）部 104 と、発光制御部 105 と、発光素子 106 と、を具備する。

【0018】

第 1 收音部 101 は、通信装置 100 に取り付けられたマイクであり、音声を收音する。第 1 收音部 101 で收音された音声は第 1 音声信号として、送信部 102 及び音声品質判定部 103 に出力される。

【0019】

送信部 102 は、第 1 收音部 101 より入力した第 1 音声信号を、必要に応じて音声符号化処理を行った上で外部に設置された他の通信装置へ送信する。送信部 102 は後述する PTT 部 104 が押下され、当該 PTT 部 104 から送信モード信号を入力している場合に、音声信号を外部の通信装置へ送信する。

【0020】

音声品質判定部 103 は、第 1 收音部 101 より入力した第 1 音声信号に基づいて、送信部 102 より送信される音声信号の音声品質を判定する。音声品質判定部 103 は、当該判定結果を、音声品質を示す音声品質信号として発光制御部 105 に出力する。

【0021】

ここで、具体的に音声品質判定部 103 は、第 1 收音部 101 で收音される音声の音量レベルを判定することで送信部 102 から送信される音声信号の音声品質を判定する。すなわち、第 1 收音部 101 で收音される音声の音量レベルが所定の基準値より低い場合は、受信者側で十分に聞き取ることができないと判断し、音声品質が不良であると判定する。

【0022】

PTT 部 104 は、送信部 102 で音声信号を送信するかしないかを切り替える。

【0023】

すなわち、PTT 部 104 は、自装置 100 の通信状態（通信モード）を、送信部 102 が音声信号を送信する送信状態（送信モード）又は送信部 102 が音声信号を送信しな

い非送信状態（スタンバイモード）のいずれかの状態に切り替える切り替え部である。P T T部104が押下されることにより、通信装置100の状態が非送信状態から送信状態へ切り替えられることで、音声信号の送信が行われる。

【0024】

なお、非送信状態（スタンバイモード）には、外部より送信される信号の受信はしていないが受信信号を検知する状態である、いわゆる受信待ち受け状態及び電波を実際に受信している受信状態を含む。また、通信装置100が受信機能を有さない、送信専用の送信装置の場合には、非送信状態は、何もしない状態である。非送信状態は、このような受信状態や何もしない状態などを含み、送信部102が音声信号を送信しない状態を指している。なお、車載用無線機のマイクロホンの場合には、スピーカは車載用無線機に配置される。

【0025】

P T T部104は、より具体的には、通信装置100の筐体に取り付けられた通信状態を切り替える切り替えスイッチであり、使用者が発話を行う時に当該P T T部104が押下されることで、通信状態が、非送信状態から送信状態に切り替えられる。すなわち、装置100の通信状態はデフォルトで非送信状態をとり、発話を行いたい使用者がP T T部104を押下することで使用者によって手動で送信状態に切り替えられる。P T T部104が押下されると、送信状態に切り替えられたことを示す送信モード信号が送信部102と、発光制御部105とに出力される。

【0026】

発光制御部105は、発光素子106の発光を制御することで装置100の使用状態を使用者に通知する。発光素子106は、装置100の筐体に取り付けられており、具体的にはL E D（Light Emitting Diode）であるものとして説明する。

【0027】

発光制御部105は、音声品質判定部103から入力される音声品質を示す音声品質信号と、P T T部104より入力する現在の通信状態が送信状態に切り替えられていることを示す送信モード信号とに基づいて発光素子106の発光状態を制御する。

【0028】

図2は、通信装置100の動作の流れを示すフローチャート図である。

【0029】

発光制御部105は、現在の通信状態が送信状態であるかを判定する（ステップS101）。P T T部104が押下されておらず、送信モード信号が入力されていない場合は、現在の通信状態は非送信状態であるため（ステップS101のN o）、発光制御部105は、発光素子106に駆動電流を流さず、発光素子106を消灯状態とする（ステップS102）。一方、P T T部104が押下されて現在の通信状態が送信状態である場合は、音声品質判定部103において音声品質判定処理が行われる（ステップS103）。

【0030】

発光制御部105は、音声品質判定部103における判定処理に基づいて、送信部102より送信される音声信号の音声品質が良好であるかを判定する（ステップS104）。すなわち、音声品質判定部103より入力する音声品質信号において当該音声品質が良好と示されているか不良と示されているかを確認する。

【0031】

ステップS104における判定の結果、音声品質が良好であると示されている場合は、発光制御部105は、発光素子106を点滅させる（ステップS105）。一方、音声品質が不良であると示されている場合は、発光制御部105は発光素子106を点灯させる（ステップS106）。

【0032】

このように、発光制御部105は、P T T部104が切り替える通信状態と、音声品質判定部103における音声品質の判定結果とに基づいて、発光素子106が、消灯状態、点滅状態、点灯状態、のいずれかの状態となるように制御する。発光素子106の3つの

状態を通じて、装置１００の使用状態を使用者に通知することができ、点灯状態の発光素子１０６を視覚的に認識した使用者は現在の音声品質が悪いことを認識し、マイク１０１に口を近づける等の改善行動を行うことができる。

【００３３】

以上のように、本実施の形態１では、通信機能を切り替えて通信を行う単方向通信装置において、装置筐体に取り付けられたＬＥＤ等の発光素子を用いて通信方向を適切に使用者に通知しつつ、送信される音声信号の音声品質の良し悪しを併せて通知することができる。

【００３４】

すなわち、本実施の形態１の通信装置は、通信状態を非送信状態から送信部が音声信号を送信する送信状態に切り替える切り替え部を有する。当該切り替え部であるＰＴＴ部が押下されることで、発光制御部は、非送信状態を示す消灯状態から送信状態を示す点灯状態に変更するよう発光素子を制御する。更に、発光制御部は、音声品質の判定結果に基づき、良好な音声品質が得られている場合は点灯状態から点滅状態に変更することで使用者に対して装置の使用状態を通知する。従って使用者が、当該通知を受けて装置の使用状態を変更する行動をとることで、聞き手側に送られる音声の品質を改善することができる。

【００３５】

なお、上記通信装置は、ＰＴＴ部１０４が押下されておらず、装置１００の通信状態が非送信状態である場合に、外部の通信装置より送信される音声信号を受信する受信部を備えていても良い。受信部で受信された音声信号は、適宜復号された後、スピーカより音声が発音される。

【００３６】

（実施の形態２）

高騒音下での使用が想定される本発明の送信装置において、マイクで收音される音声の音量レベルが高い場合でも、話者の発話が周囲の雑音に埋もれてしまい、音声品質が劣悪である場合がある。

【００３７】

このような環境下では、音量レベルが音声品質を適切に表しているとは言えない。従って、音量レベルが閾値を超えており、発光素子が注意喚起を促していない場合であっても、聞き手側に伝送される音声は品質が悪く、聞き手が会話内容を適切に理解することができないと言った問題が生じていた。

【００３８】

特に、音声をデジタル無線送信で送信する場合、音声符号化を行って帯域圧縮された上で送信されることになるが、周囲の雑音により、適切な音声符号化が行われず、音声が悪くなるという課題が顕著になる。

【００３９】

そこで、本実施の形態２に係る通信装置では、聞き手側に伝送される音声の音声品質を的確に話者に通知することで、装置の使用状態の指導及び改善を促して音声品質の改善に繋げることを可能とすることを特徴とする。以下、図面を用いて詳細に説明する。

【００４０】

図３は、本実施の形態２に係る通信装置２００の外観を示す図である。図３（ａ）は、通信装置２００の正面図を、図３（ｂ）は、通信装置２００の背面図を、それぞれ示している。

【００４１】

通信装置２００は、ノイズキャンセルマイク部２２０と無線通信機２４０とがコード２３０で相互に接続されている装置である。ここで、ノイズキャンセルマイク部２２０とは、主にマイク等が配置される音声入力装置に該当する。ノイズキャンセルマイク部２２０の筐体正面には、第１收音部であるメインマイク２０１とスピーカ２１２とがそれぞれ配置されている。

【００４２】

また、ノイズキャンセルマイク部２２０の背面には、第２收音部であるサブマイク２０２と、ベルト等に保持するためのベルトクリップ２２１とがそれぞれ配置されている。

【００４３】

ノイズキャンセルマイク部２２０の上部には、ＬＥＤ２１０が、また、側面にはＰＴＴ部２０７がそれぞれ配置されている。

【００４４】

次に、通信装置２００の構成を図４のブロック図を参照して説明する。通信装置２００は、メインマイク２０１と、サブマイク２０２と、音声区間判定部２０３と、ノイズキャンセル処理部２０４と、ノイズサプレッサ部２０５と、無線送信部２０６と、ＰＴＴ部２０７と、音声品質判定部２０８と、ＬＥＤ制御部２０９と、ＬＥＤ２１０と、無線受信部２１１と、スピーカ２１２と、を具備する。

【００４５】

メインマイク２０１は、通信装置２００のノイズキャンセルマイク部２２０に取り付けられたマイクであり、音声を收音する。メインマイク２０１で收音された音声信号（第１音声信号）は、音声区間判定部２０３、ノイズキャンセル処理部２０４、及び音声品質判定部２０８に出力される。

【００４６】

サブマイク２０２もメインマイク２０１と同様、通信装置２００のノイズキャンセルマイク部２２０に取り付けられたマイクであり、音声を收音する。サブマイク２０２で收音された音声信号（第２音声信号）は、ノイズキャンセル処理部２０４及び音声品質判定部２０８に出力される。

【００４７】

ここで、メインマイク２０１とサブマイク２０２の２つのマイクのうち、メインマイク２０１は、主に話者（使用者）からの発話を收音する第１收音部に相当し、装置表面に配置される。一方、サブマイク２０２は、主にノイズキャンセル処理に利用するために設けられた周辺の雑音を收音する第２收音部に相当し、装置背面に配置される。

【００４８】

なお、サブマイク２０２の配置位置は、装置背面に限定されるものではなく、装置側面や装置底面その他装置の内部に配置されていても良い。但し、後述するノイズキャンセル効果を高めるために、メインマイク２０１が使用者側である装置正面に配置され、サブマイク２０２が使用者の反対側である装置背面にそれぞれ配置されることが好ましい。

【００４９】

音声区間判定部２０３は、メインマイク２０１から入力する第１音声信号に基づいて音声区間判定を行うことで、発話が行われている区間である音声区間を検出する。

【００５０】

音声区間判定部２０３が行う音声区間であるかどうかの判定は、メインマイク２０１からの第１音声信号を一定長の単位で周波数領域に変換し、そのスペクトル成分を分析することにより、母音であるか、子音であるか、また音声ではない雑音成分であるかを判定する。

【００５１】

音声区間判定部２０３は、音声区間であることを示す信号をノイズキャンセル処理部２０４及び音声品質判定部２０８に出力する。以下の説明では、当該音声区間であることを示す信号を音声区間指示信号と称して説明する。

【００５２】

ノイズキャンセル処理部２０４は、メインマイク２０１より入力した第１音声信号とサブマイク２０２より入力した第２音声信号とに基づいてノイズキャンセル処理（雑音成分抑圧処理）を実行する。

【００５３】

具体的には、ノイズキャンセル処理部２０４は、適応フィルタを用いてサブマイク２０２で收音された音声に基づいてメインマイク２０１に混入する雑音成分の逆相成分を生成

する。そして、ノイズキャンセル処理部204は、メインマイク201から入力した第1音声信号と、当該生成した雑音成分の逆相成分によるノイズキャンセル用信号とを加算することによってメインマイク201に混入する雑音成分を抑圧する。ノイズキャンセル処理部204は、当該ノイズキャンセル後の音声信号をノイズサプレッサ205と音声品質判定部208とへ出力する。

【0054】

ここで、ノイズキャンセル処理部204は、メインマイク201から入力した第1音声信号に対して一定期間（例えば256サンプル）のフレーム毎にノイズキャンセル処理を実行する。

【0055】

以下の説明では、ノイズキャンセル処理部204でノイズキャンセル処理が行われて雑音成分が抑圧されたノイズキャンセル後の音声信号のことをノイズキャンセル処理後信号と称して説明することがある。

【0056】

ノイズサプレッサ部205は、ノイズキャンセル処理部204より入力したノイズキャンセル処理後信号の周波数軸上に現れる音声以外の雑音成分を抑圧する処理を行う。ノイズサプレッサ205は、雑音成分の抑圧後の信号を時間領域の音声信号に戻した後、無線送信部206に出力する。

【0057】

無線送信部206は、ノイズサプレッサ部205より受け取った信号に対して適宜音声符号化を行った後、当該音声符号化後の音声信号を搬送波に変調して外部の無線通信装置へ向けて無線送信する。

【0058】

なお、以下の説明では、上記説明したノイズサプレッサ部205と無線送信部206とを纏めて通信部として扱うことがある。

【0059】

P T T部207は、ノイズキャンセル後の音声信号を無線送信部206より送信するかしないかを切り替える。

【0060】

すなわち、P T T部207は、自装置200の通信状態（通信モード）を、無線送信部206が音声信号を送信する送信状態（送信モード）又は待機状態である非送信状態のいずれかの通信状態に切り替える。ここで、無線受信部211が外部より送信される音声信号を受信する受信状態（受信モード）は、上記非送信状態に含まれるため、使用者は、信号を受信したい場合は非送信状態に切り替える。P T T部207により、通信状態として通信装置200が取り得る送信状態又は非送信状態のいずれかが選択される。

【0061】

使用者が発話を行う時に当該P T T部207が押下されることで、通信状態が、非送信状態から送信状態に切り替えられる。P T T部207が押下されると、送信状態に切り替えられたことを示す送信モード信号が無線送信部206と、L E D制御部209と、無線受信部211とに出力される。

【0062】

音声品質判定部208は、送信部より送信される音声信号であるノイズキャンセル処理部204において行われたノイズキャンセル処理後の音声信号の音声品質を判定する。音声品質判定部208は、判定結果を音声品質信号としてL E D制御部209に出力する。

【0063】

ここで、音声品質判定部208は、外部の雑音環境や、ノイズキャンセル処理部204が行ったノイズキャンセルが効果的に働いているか等の複数の観点から送信部より送信される音声信号の音声品質の良し悪しを判定する。

【0064】

例えば、音声品質判定部208は、ノイズキャンセル処理部204が行うノイズキャン

セル処理によってメインマイク 201 からの第 1 音声信号に対して生じる減衰量に基づいてノイズキャンセルが効果的に働いているかを判定することができる。

【0065】

具体的に、音声品質判定部 208 は、メインマイク 201 からの第 1 音声信号が、上記ノイズキャンセル処理によってどれくらい減衰しているかを算出し、減衰量が一定の閾値以上であればノイズキャンセルが効果的に働いていると判定することができる。

【0066】

すなわち、音声品質判定部 208 は、ノイズキャンセル処理前の第 1 音声信号の平均パワー（平均強度）と、当該ノイズキャンセル処理後の信号の平均パワー（平均強度）とを比較し、当該比較結果に基づいてノイズキャンセルが効果的に働いているかを判定することができる。メインマイク 201 で收音される音声には話者の発話音声と周辺雑音が混在しており、一定以上の減衰量が認められれば周辺雑音が効果的に抑圧されていると判断することができるためである。

【0067】

LED 制御部 209 は、図 1 の発光制御部 105 に対応し、発光素子である LED 210 に駆動電流を流して発光状態を制御する。LED 制御部 209 は、PTT 部 207 から入力する通信状態を示す送信モード信号と、音声品質判定部 208 から入力する送信部より送信される音声信号の音声品質を示す音声品質信号とに基づいて LED を制御する。

【0068】

無線受信部 211 は、外部の無線通信装置より無線送信される音声信号を受信する。無線受信部 211 は、PTT 部 207 より送信モード信号を入力している場合は、現在の装置の通信状態が送信状態に切り替えられているとして、無線受信を行わない。無線受信部 211 は、受信した音声信号を復号した後にスピーカ 212 に出力する。

【0069】

スピーカ 212 は、無線受信部 211 より入力した音声信号を音声として放音する。

【0070】

次に、通信装置 200 における音声品質判定処理の流れを図 5 のフローチャートを参照して説明する。

【0071】

音声区間判定部 203 は、メインマイク 201 からの第 1 音声信号に基づいて話者が発話中であるかどうかの音声区間判定処理を行う（ステップ S201）。当該判定の結果、音声区間でないと判定された場合は、ステップ S201 に戻って判定処理を継続する。

【0072】

ステップ S201 における判定の結果、音声区間である場合、音声品質判定部 208 は、信号強度算出処理を行う（ステップ S202～ステップ S204）。

【0073】

まず、音声品質判定部 208 は、サブマイク 202 から入力される第 2 音声信号の 1 フレーム区間における平均パワーを算出する（ステップ S202）。次に、音声品質判定部 208 は、メインマイク 201 から入力される第 1 音声信号の 1 フレーム区間における平均パワーを算出する（ステップ S203）。次に、音声品質判定部 208 は、ノイズキャンセル処理部 204 から入力されるノイズキャンセル処理後信号の 1 フレーム区間における平均パワーを算出する（ステップ S204）。

【0074】

次に、音声品質判定部 208 は、ステップ S202 で求めた第 2 音声信号の平均パワーが所定の閾値 P_{th1} を超えているかを判定する（ステップ S205）。

【0075】

第 2 音声信号の平均パワーが所定の閾値 P_{th1} を超えていない場合、音声品質判定部 208 は、音声品質が良好であると判定する（ステップ S208）。これは、サブマイク 202 で收音される音声は主に周囲の環境雑音であるため、第 2 音声信号の平均パワーが P_{th1} 以下であることは静寂な環境下にあるとみなすことができる。従って、話者の発

話による音声周囲の雑音で潰れると言ったことが起きず、音声品質が良好であると判定することができる。

【0076】

一方、第2音声信号の平均パワーが閾値 P_{th1} を超えている場合、音声品質判定部208は、ステップS203で算出したノイズキャンセル処理前の第1音声信号の平均パワーと、ステップS204で算出したノイズキャンセル処理後の信号の平均パワーとの比較を行う（ステップS206）。

【0077】

ステップS206の比較の結果、第1音声信号に対するノイズキャンセル処理後信号のパワー比が所定の閾値 P_{th2} を超えていれば、ノイズキャンセルが効果的に働いておらず、音声品質は不良であると判定する（ステップS209）。

【0078】

これは、ステップS205の判定で環境雑音が所定の強度以上存在していると判定されている中で、ノイズキャンセル処理前後のパワーに変動が見られない事を意味しており、ノイズキャンセルが効果的に働いていないとみなすことができるためである。

【0079】

一方、当該ステップS206の比較の結果、第1音声信号に対するノイズキャンセル処理後信号のパワー比が第2閾値 P_{th2} を超えていなければ、ノイズキャンセル処理後信号の平均パワーが所定の閾値 P_{th3} を超えているかを判定する（ステップS207）。

【0080】

ステップS207における判定の結果、ノイズキャンセル処理後信号の平均パワーが閾値 P_{th3} を超えていなければ、音声品質は不良であると判定する（ステップS209）。

【0081】

これは、ノイズキャンセル処理によって本来残るべき話者の発話音声についても削られているとみなすことができ、聞き手側において話者の発話内容を聞き取ることが困難であることを意味しているため、音声品質が不良であると判定することができる。

【0082】

一方、ステップS207における判定の結果、ノイズキャンセル処理後信号の平均パワーが閾値 P_{th3} を超えていれば、好ましい音声レベルが得られており、音声品質が良好と判定する（ステップS208）。

【0083】

ステップS208又はステップS209でそれぞれ得られた音声の品質が良好であるか不良であるかの判定結果は音声品質を示す音声品質信号として、LED制御部209に送られる。

【0084】

LED制御部209は、実施の形態1の図2の処理動作と同様、PTT部207から入力される送信モード信号に基づいて現在の通話状態が送信状態であるかどうかの判定を行い、更に音声品質判定部208から入力される音声品質信号に基づいて音声品質が良好か不良かの判定を行う。

【0085】

LED制御部209は、図6に示すグラフの対応関係に基づき、PTT部207が押下されて通信状態が送信状態であり、かつ、音声品質が良好と判定されている場合は、正常な送信状態であることを意味する点滅状態となるようにLED210に駆動電流を流す。

【0086】

一方、LED制御部209は、PTT部207が押下されて通信状態が送信状態であり、かつ、音声品質が不良と判定されている場合は、送信状態において音声品質の改善が必要であることを意味する点灯状態となるようにLED210に駆動電流を流す。

【0087】

また、LED制御部209は、PTT部207が押下されて通信状態が送信状態である

場合であって、音声品質信号が入力されていない場合は、送信状態を示す点灯状態となるようにLED210に駆動電流を流す。このように、音声品質信号が入力されない場合としては、音声区間判定部203で音声区間と判定されていない場合がある。この場合、音声品質判定部208において図5に示した音声品質判定処理が進まないため、音声品質信号がLED制御部209に出力されることは無い。LED制御部209は、PTT部207より送信モード信号を入力していながら、音声品質判定部208より音声品質信号が入力されない場合は、通信状態は送信状態であり、一方、発話が検出されない非音声区間であると判定し、LED210を点灯状態とする。

【0088】

このように、送信状態において、非音声区間におけるLEDの発光状態と、送信状態かつ音声区間であって音声品質が悪い場合のLEDの発光状態を同一とすると、使用者にとって音声適切に装置に入っていないことが感じやすくなるため好ましい。

【0089】

発話を行っていても当該LED210の点灯が点滅状態に移行しないことを視認した使用者は、使用状態が適切ではないことを認識して、装置（マイク）の持ち方や方向、口までの距離を変更し、LED210が点灯状態から点滅状態に戻ることを試みる。すなわち、使用者に装置の使用状態を指導すると言った手法を通じて、聞き手側に伝送される音声信号の音声品質を改善することができる。

【0090】

一方、LED制御部209は、PTT部207が押下されておらず、通信状態が送信状態ではない、すなわち、非送信状態である場合には、LED210に駆動電流を流さず、LED210を消灯状態に維持する。

【0091】

以上のように本実施の形態2に係る通信装置は、話者の発話音声周囲のノイズに埋もれてしまわないように、複数の收音部を備え、ノイズキャンセル処理を行った上で、ノイズキャンセル処理後の音声信号を送信する構成をとる。従って、周囲の雑音が大きい場合においても、聞き手側によりクリアな音声を伝送することができる。

【0092】

但し、ノイズキャンセル機能を搭載した場合でも、ノイズキャンセルが効果的に働かず、未だ聞き手側に伝えられる会話の音声品質が悪い場合が起こり得る。この時、単方向通信装置では、聞き手側から音声品質が劣悪であることを伝えることができないため、話者は会話が成り立っていないにもかかわらず、そのことに気づかず会話を進めてしまうと言ったことが起こる。

【0093】

そこで、本実施の形態2に係る通信装置では、このような問題に対処するため、ノイズキャンセルが効果的に働いているかの判定を行い、その他の判定も必要に応じて組み合わせることで聞き手側における音声品質を推定する。そして、音声品質の改善が必要とされる場合においては、通信装置に設けられたLEDを上手く活用して話者である使用者に注意喚起を促すことができる。

【0094】

（実施の形態3）

実施の形態2に係る通信装置は、ノイズキャンセルが効果的に働いているかどうかを基準として音声品質の判定を行っている。当該構成により、メインマイク音量レベルを基準として音声品質の判定を行う場合と比較してより適切な音声品質の判定が可能となる。

【0095】

ここで、実施の形態2に係る通信装置200では、ノイズキャンセルがうまくいっていないにもかかわらず、音声品質判定部208が行うノイズキャンセル効果判定で誤判定を出してしまう場合があった。

【0096】

このような誤判定が起きる典型的な事例として、通信装置200が話者に対して横～斜

め方向を向いている場合がある。この場合、装置自体が横を向いているために、装置背面に設置されたサブマイク２０２側にも使用者（話者）からの発話音声の成分が強く入る。ノイズキャンセル処理部２０４が行うノイズキャンセル処理では、サブマイク２０２の信号を参照信号としてノイズキャンセルを行う。従って、サブマイク２０２側に入る音声成分をノイズであると判断してしまい、メインマイク２０１から入力される音声信号の中から残すべき音声成分も削られてしまうことになる。

【００９７】

この場合、横を向いた装置の正面に強力なノイズ源が存在すると、メインマイク２０１で収音された当該ノイズ源のノイズ音が残存し、ノイズキャンセル処理後信号の強度レベルが閾値を超える。従って、図５に示したステップＳ２０５～ステップＳ２０７の判定の結果、最終的に音声品質が良好と誤った判定がなされてしまう可能性がある。

【００９８】

本実施の形態３では、このような場合についても適切に音声品質を判定して適切な通知を行うことができる通信装置を提供することを実現している。以下、図面を参照して詳しく説明する。なお、実施の形態１、２で既に説明した部分については、発明の明確化のため説明を一部省略する。

【００９９】

図７は、本実施の形態３に係る通信装置３００の構成を示すブロック図である。通信装置３００は、メインマイク２０１と、サブマイク２０２と、音声区間判定部３０３と、ノイズキャンセル処理部２０４と、ノイズサプレッサ部２０５と、無線送信部２０６と、ＰＴＴ部２０７と、音声品質判定部３０８と、ＬＥＤ制御部２０９と、ＬＥＤ２１０と、無線受信部２１１と、スピーカ２１２と、マイク方向判定部３１３と、を具備する。また、音声品質判定部３０８は、ノイズキャンセル効果判定部３１４と、総合判定部３１５の２つの判定部を内部に有する。また、通信装置３００の外観は図３で示した通信装置２００と同様であるものとする。

【０１００】

音声区間判定部３０３は、使用者が発話している音声区間であるか、使用者が発話していない非音声区間であるかを、メインマイク２０１から入力する第１音声信号を一定長の単位で周波数領域に変換した上でスペクトル成分を分析する手法を用いて判定する。音声区間判定部３０３は、音声区間であるかどうかの判定結果を、ノイズキャンセル処理部２０４、マイク方向判定部３１３、及びノイズキャンセル効果判定部３１４に出力する。

【０１０１】

マイク方向判定部３１３は、メインマイク２０１とサブマイク２０２でそれぞれ収音される音声の位相差を検出し、当該位相差に基づいてメインマイク２０１の方向を判定する。マイク方向判定部３１３は、メインマイク方向に関する判定結果を第１判定結果として総合判定部３１５に出力する。

【０１０２】

図８は、当該マイクの方向によって生じる音声の位相差を説明する図である。図８から分かるように、メインマイク２０１が取り付けられた通信装置３００本体が話者と対面しており、正常な使用状態である場合は、メインマイク２０１に入る音声と本体を回り込んでサブマイク２０２に入る音声との位相差が大きくなる。一方、通信装置３００本体の方向が話者に対して傾いている場合は、口から２つのマイクまでの距離差が縮まり、メインマイク２０１に入る音声とサブマイク２０２に入る音声との位相差が小さくなる。特に装置正面に取り付けられたメインマイク２０１の方向が使用者に対して９０度の方向を向いている場合は、メインマイク２０１及びサブマイク２０２の各々から口までの距離がほぼ等しいとみなされることから位相差は０に近づくことになる。

【０１０３】

そこで、マイク方向判定部３１３は、メインマイク２０１とサブマイク２０２でそれぞれ収音される音声の位相差が所定の閾値以下である場合は、メインマイクの方向が話者の口の方を向いていないと推定し、使用者は適切な使用を行っていないものと判定する。逆

に、メインマイク 201 とサブマイク 202 でそれぞれ收音される音声の位相差が、上記所定の閾値を超えた所定の範囲内である場合には、マイク方向判定部 313 は、使用者が適切な使用を行っているかと判定することができる。

【0104】

ノイズキャンセル効果判定部 314 は、ノイズキャンセル処理部 204 が行うノイズキャンセルが効果的に働いているかを判定する。ノイズキャンセル効果判定部 314 は、ノイズキャンセル効果に関する判定結果を第 2 判定結果として総合判定部 315 に出力する。

【0105】

総合判定部 315 は、サブマイク 202 より入力する第 2 音声信号の平均パワーや、マイク方向判定部 313 から入力する第 1 判定結果、ノイズキャンセル効果判定部 314 から入力する第 2 判定結果等を総合的に判定することで、送信部より送信される音声信号の音声品質が良好であるかどうかを判定する。総合判定部 315 で総合的に判定された音声品質は LED 制御部 209 に出力されて LED 210 の発光制御に用いられる。

【0106】

次に、通信装置 300 の動作について説明する。図 9 は、マイク方向判定部 313 における判定処理の流れを示すフローチャート図である。

【0107】

マイク方向判定部 313 は、メインマイク 201 から入力した第 1 音声信号の位相とサブマイク 202 から入力した第 2 音声信号の位相とを比較する（ステップ S301）。次にマイク方向判定部 313 は、メインマイク 201 からの第 1 音声信号とサブマイク 202 からの第 2 音声信号との位相差が一定値以下であるかを判定する（ステップ S302）。上述の通り、メインマイク 201 の方向のずれがそのまま当該位相差に現れるためである。

【0108】

ステップ S302 における判定の結果、位相差が一定値以上である場合は、マイク方向判定部 313 は、メインマイク 201 と口との位置関係が良好であり、適正な使用がなされているものとして判定する（ステップ S303）。一方、ステップ S302 における判定の結果、当該位相差が一定値以内である場合は、マイク方向判定部 313 は、メインマイク 201 と口との位置関係が不良であり、不適正な使用がなされているものとして判定する（ステップ S304）。

【0109】

マイク方向判定部 313 は、ステップ S303 又はステップ S304 で得られた判定結果を、第 1 判定結果として音声品質判定部 308 の総合判定部 315 に出力する（ステップ S305）。ここで、当該第 1 判定結果は、上述の通りメインマイク方向が適切であるかどうかを示す情報であり、別の観点から見て、装置が適切な使用状態で使用されているかどうかを示す情報である。

【0110】

次にノイズキャンセル効果判定部 314 の動作を図 10 に示すフローチャートを参照して説明する。ノイズキャンセル効果判定部 314 は、音声区間判定部 303 において音声区間であると判定され、音声区間指示信号が入力されるのを待つ（ステップ S311）。ノイズキャンセル効果判定部 314 は、当該音声区間指示信号が入力された場合、ステップ S312 に進む。

【0111】

ノイズキャンセル効果判定部 314 は、ノイズキャンセル処理部 204 がフレーム単位でノイズキャンセル処理を実行する場合に、当該 1 フレームの期間におけるメインマイク 201 からの第 1 音声信号の平均パワー（平均強度）を算出する（ステップ S312）。

【0112】

次に、ノイズキャンセル効果判定部 314 は、ノイズキャンセル処理部 204 におけるノイズキャンセル処理後の信号の平均パワー（平均強度）を算出する（ステップ S313）。

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【0113】

次に、ノイズキャンセル効果判定部314は、上記算出したノイズキャンセル処理前の第1音声信号の平均パワーと、ノイズキャンセル処理後の信号の平均パワーとの比較を行う（ステップS314）。

【0114】

当該比較の結果、第1音声信号に対するノイズキャンセル処理後信号のパワー比が一定レベル（閾値 P_{th2} ）以上であればノイズキャンセルが効果的に働いていないと判定する（ステップS317）。

【0115】

一方、当該比較の結果、第1音声信号に対するノイズキャンセル処理後信号のパワー比が一定レベル（閾値 P_{th2} ）以下であれば、ノイズキャンセル処理後信号の平均パワーが一定レベル（閾値 P_{th3} ）以上であるかを判定する（ステップS315）。

【0116】

ステップS315における判定の結果、ノイズキャンセル処理後信号の平均パワーが一定レベル以下であれば、ステップS317に進み、音声品質は不良であると判定する。

【0117】

一方、ステップS315における判定の結果、ノイズキャンセル処理後信号の平均パワーが一定レベル（閾値 P_{th3} ）以上であれば、好ましい音声レベルが得られており、ノイズキャンセルは効果的に働いていると判定する（ステップS316）。

【0118】

ステップS316又はステップS317でそれぞれ得られたノイズキャンセルが効果的に働いているかどうかの判定結果は、第2判定結果として総合判定部315に送られる。

【0119】

このように、ノイズキャンセル効果判定部314は、ノイズキャンセルが効果的に働いているかどうかをノイズキャンセル処理部204におけるノイズキャンセル処理前後の信号強度を利用して判定する。ここで、ノイズキャンセルが効果的に働いているとは、話者の発話音声と周囲雑音とが混ざった信号の中から周囲雑音が取り除かれて発話音声部分を適切に残っていることを意味する。

【0120】

従って、ノイズキャンセル処理によって周囲雑音が適切に取り除かれたならば、ノイズキャンセル処理後の音声信号の信号強度 P_{nc} はノイズキャンセル処理前の音声信号の信号強度 P_{in} と比較して周囲雑音成分の信号強度分差し引かれて低くなる。そこで、ノイズキャンセル処理前後の音声信号の信号強度 P_{in} と P_{nc} とを比較することでノイズキャンセルが効果的に働いているかを判断することができる。

【0121】

ここでは、ノイズキャンセル効果判定部314が

$$(1-a) \quad (P_{nc}/P_{in}) < P_{th2}$$

であるかを判定するか、又は

$$(1-b) \quad (P_{in} - P_{nc}) > P_{th2}'$$

であるかを判定することでノイズキャンセルが効果的に働いているかを調べることができる。

【0122】

また、上記判定を行った上で

$$(2) \quad P_{nc} > P_{th3}$$

を判定することで、ノイズキャンセル処理によって残すべき音声部分まで削られていないかを判定することができる。ノイズキャンセル効果判定部314は、これらの判定に基づいてノイズキャンセルが効果的に働いているかどうかの判定を行うことができる。

【0123】

次に、総合判定部315の動作について図11のフローチャートを参照して説明する。

【0124】

総合判定部315は、サブマイク202から入力される第2音声信号の1フレーム区間における平均パワーを算出する（ステップS321）。

【0125】

総合判定部315は、ステップS321で求めた第2音声信号の平均パワーが所定の閾値 P_{th1} を超えているかを判定する（ステップS322）。

【0126】

第2音声信号の平均パワーが所定の閾値 P_{th1} を超えていない場合、総合判定部315は、音声品質が良好であると判定する（ステップS327）。これは、通信装置300が静寂な環境下で使用されているとみなすことができ、話者の発話が周囲の雑音で潰れると言ったことが起きないことから、音声品質が良好であると判定することができるためである。

【0127】

総合判定部315は、ステップS322における判定の結果、第2音声信号の平均パワーが一定レベルを超えていると判定した場合、マイク方向判定部313より第1判定結果を入力する（ステップS323）。

【0128】

総合判定部315は、第1判定結果において良好な結果が示されているかを判定する（ステップS324）。第1判定結果が良好ではない場合、すなわち、第1判定結果においてメインマイクと話者の口との位置関係が不良であると示されている場合、総合判定部315は、音声品質が不良と判定する（ステップS328）。

【0129】

一方、第1判定結果が良好である場合、総合判定部315は、ノイズキャンセル効果判定部314より第2判定結果を入力する（ステップS325）。

【0130】

総合判定部315は、第2判定結果において良好な結果が示されているかを判定する（ステップS326）。第2判定結果が良好ではない場合、すなわち、第2判定結果においてノイズキャンセルが効果的に働いていないと示されている場合、音声品質が不良と判定する（ステップS328）。

【0131】

一方、総合判定部315は、第2判定結果が良好である場合、すなわち、第2判定結果においてノイズキャンセルが効果的に働いていると示されている場合、音声品質が良好と判定する（ステップS327）。

【0132】

総合判定部315は、上記処理の流れに従い、ステップS327又はステップS328で得られた音声品質が良好であるかどうかについての情報を音声品質信号としてLED制御部209に出力する（ステップS329）。

【0133】

なお、ノイズキャンセル効果判定部314は、ノイズキャンセル処理が行われている場合、又は、ノイズキャンセルが行われる必要がある場合にのみ動作させるようにしてもよい。例えば、第2音声信号のパワーが一定レベル以上の場合、または、ノイズキャンセル処理が行われていることを示すフラグがある場合、などにノイズキャンセル効果判定部314を動作するようにする。ノイズキャンセル処理を行うか否かについては、例えば、第2音声信号のパワーが一定レベル以上であるか以外に、第1音声信号と第2音声信号との位相差により音声の到来方向を判定して、到来方向に応じて決めてもよい。

【0134】

次に、LED制御部209の動作について図2に示すフローチャートを流用して説明する。

【0135】

LED制御部209は、所定の間隔（例えば1／30秒毎）で現在の通信状態をチェッ

クする（ステップS101）。すなわち、PTT部207が押下されて送信モードに切り替えられているかを確認する。

【0136】

確認の結果、PTT部207は押下されておらず、装置の通信状態が非送信状態にセットされている場合は、LED制御部209は、LED210に駆動電流を流さずLED210の発光状態を消灯状態とする制御を行う（ステップS102）。

【0137】

一方、PTT部207が押下されて装置の通信状態が送信状態にセットされている場合は、LED制御部209は、音声品質判定部308の総合判定部315より音声品質信号を入力する（ステップS103）。LED制御部209は、当該音声品質信号で示される音声品質をチェックする（ステップS104）

【0138】

LED制御部209は、音声品質信号において音声品質が良好であると示されている場合は、駆動電流を流してLED210の発光状態を点滅状態とする制御を行う（ステップS105）。一方、LED制御部209は、音声品質信号において音声品質が不良であると示されている場合は、駆動電流を流してLED210の発光状態を点灯状態とする制御を行う（ステップS106）。

【0139】

以上のように、本実施の形態3に係る通信装置300は、ノイズキャンセル効果に関する判定結果と、マイク方向に関する判定結果を利用して総合的に音声信号の音声品質を判定した上でLEDの発光状態を制御する。当該構成によれば、より適切な音声品質を使用者に通知することができる。

【0140】

（実施の形態4）

図12は、本実施の形態4に係る音声入力装置1000の構成を示すブロック図である。音声入力装置1000は、收音部1001と、送信部1002と、收音状態判定部1003と、送信指示部1004と、発光制御部1005と、発光部1006とを具備する。なお、音声入力装置1000の各部は、図1の通信装置100における第1收音部101、送信部102、音声品質判定部103、PTT部104、発光制御部105、発光部107にそれぞれ対応している。

【0141】

收音部1001は、音声を收音し、收音した音声を音声信号として、送信部1002及び收音状態判定部1003に出力する。

【0142】

送信部1002は、收音部1001より入力した音声信号を、送信指示部1004からの指示に従って他の通信装置へ送信する。送信部1002は送信指示部1004より送信指示信号を入力している場合に、音声信号を外部の通信装置へ送信する。

【0143】

收音状態判定部1003は、收音部1001より入力した音声信号に基づいて、送信部1002より送信される音声信号の收音状態を判定する。ここで、当該收音状態とは、音声信号の音声品質や、音声区間であるか否かの判定結果など、送信部1002より送信される音声信号の特徴を示している。收音状態判定部1003は、收音状態の判定結果を收音状態情報として、発光制御部1005に出力する。

【0144】

送信指示部1004は、送信部1002に音声信号を送信させる指示を行う。

【0145】

すなわち、送信指示部1004は、PTTスイッチと連動しており、当該PTTスイッチの押下に連動して送信指示信号を送信部1002と発光制御部1005とに出力する。送信指示部1004は、当該送信指示信号を送信部1002に出力することで、自装置1000の通信状態（通信モード）を、送信部1002が音声信号を送信しない非送信状態

(スタンバイモード) から送信部1002が音声信号を送信する送信状態(送信モード)に切り替える。

【0146】

発光制御部1005は、発光部1006の発光を制御することで装置1000の使用状態を使用者に通知する。発光部1006は、装置1000の筐体に取り付けられており、ここではLEDであるものとして説明する。

【0147】

発光制御部1005は、送信指示部1004より入力する送信指示信号と、收音状態判定部1003から入力される收音状態情報と、に基づいて発光部1006の発光状態を制御する。

【0148】

以上のように、音声入力装置1000は、音声を受音する收音部と、前記收音部で收音される音声を音声信号として外部に送信する送信部と、前記送信部に前記音声信号の送信を指示する送信指示部と、前記送信部で送信される前記音声信号の收音状態を判定する收音状態判定部と、光を発光する発光部と、前記発光部を制御する発光制御部と、を具備する。前記発光制御部は、前記送信指示部における指示状態と、前記收音状態判定部で判定された收音状態とに基づいて、前記発光部が、消灯状態、点滅状態、点灯状態、のいずれかの状態をとるように制御する。

【0149】

例えば、收音状態判定部1003は、音量レベルを測定する音量レベル測定部を内部に有し、送信部1002で送信される音声信号の音量レベルを收音状態として判定することができる。この場合、発光制御部1005は、送信指示部1004が音声信号の送信を指示していない場合は、発光部1006を消灯状態とし、送信指示部1004が音声信号の送信を指示しており、かつ、音量レベルが所定の基準値未満である場合は、前記発光部1006を点灯状態とし、送信指示部1004が音声信号の送信を指示しており、かつ、音量レベルが所定の基準値以上である場合は、発光部1006を点滅状態とするように制御することができる。

【0150】

次に、発光制御部1005が行う制御について詳しく説明する。ここで、收音状態判定部1003は、收音状態として、発話による音声区間であるか否かの判定を行うものとする。また、收音状態判定部1003は、收音状態として、送信部1002で送信される音声信号の音声品質を判定するものとする。これらの判定結果は、それぞれ発話による音声区間であるか否かを示す音声区間情報と音声品質を示す音声品質情報として発光制御部1005に出力される。

【0151】

図13は、発光制御部1005が行う発光制御の制御内容を纏めたグラフである。発光制御部1005は、当該グラフに示すようにLEDの状態を消灯状態、点灯状態、点滅状態とする制御を行う。図14に示す発光制御部1005が行う発光制御の処理の流れを示すフローチャート図と共に説明する。

【0152】

発光制御部1005は、所定の処理フレーム毎に、送信指示信号が入力されたかを判定する(ステップS1001)。判定の結果、送信指示信号が入力されていない場合は、発光制御部1005は、PTTスイッチは押下されておらず、送信指示部1004より送信指示信号が出力されていないため、装置の通信状態は非送信状態であると判断する。この場合、発光制御部1005は、図13のNo1のエントリに示すように、消灯状態となるようにLEDを制御する(ステップS1002)。

【0153】

一方、ステップS1001の判定の結果、送信指示信号が入力されていると判定した場合、発光制御部1005は、收音状態判定部1003より入力した音声区間情報において、音声区間として示されているかを判定する(ステップS1003)。判定の結果、音声

区間として判定されていない場合は、発光制御部1005は、PTTスイッチは押下されて送信状態であるものの、使用者は発話を行っていないものと判断する。この場合、発光制御部1005は、図13のN○2のエントリに示すように点灯状態となるようにLEDを制御する（ステップS1004）。

【0154】

ステップS1003の判定の結果、音声区間情報において音声区間であると示されている場合は、併せて收音状態判定部1003より收音状態情報の一部として入力した音声品質情報に基づいて音声品質が良好であると示されているかを判定する（ステップS1005）。

【0155】

当該判定の結果、音声品質は良好ではないと示されている場合、発光制御部1005は、使用者が発話しているものの、音声装置の使用状態が適切では無いため、音声品質が保たれていないと判断する。この場合、発光制御部1005は、図13のN○3のエントリに示すように、点灯状態となるようにLEDを制御する（ステップS1006）。

【0156】

一方、ステップS1005の判定の結果、音声品質は良好であると示されている場合、適切な使用状態で装置が使用されていると判断し、図13のN○4のエントリに示すように、LEDを点滅状態とする制御を行う（ステップS1007）。

【0157】

以上のように、本実施の形態4に係る音声入力装置（通信装置）1000において、收音状態判定部1003は、発話による音声区間であるかの判定結果と、送信部1002で送信される音声信号の音声品質と、を收音状態として判定する。この時、発光制御部1005は、送信指示部1004が音声信号の送信を指示していない場合は、発光部1006を消灯状態とする。送信指示部1004が音声信号の送信を指示しており、かつ、発話による音声区間ではない場合は、前記発光部1006を点灯状態とする。送信指示部1004が前記音声信号の送信を指示しており、かつ、発話による音声区間であり、かつ、音声品質が所定の基準値未満である場合は、発光部1006を点灯状態とする。送信指示部1004が音声信号の送信を指示しており、かつ、発話による音声区間であり、かつ、前記音声品質が所定の基準値以上である場合は、発光部1006を点滅状態とする。

【0158】

発光制御部1005が上記処理手順に従ってLEDの発光状態を制御することで、使用者に対して適切な通知を行うことが可能となる。

【0159】

なお、本実施の形態4に係る音声入力装置としては、図7と対応させて図15の構成とすることも可能である。当該音声入力装置2000は、更にノイズキャンセル処理部1007と、ノイズサプレッサ部1008と、を配置して時間領域および周波数領域でそれぞれノイズ抑圧処理を行うことで送信前に音声信号の音声品質の改善を行う。また、收音状態判定部1003は、具体的に、音声区間判定部1009と、ノイズキャンセル効果判定部1010と、マイク方向判定部1011と、音声品質判定部1012と、を具備する。なお、各ブロックの機能や動作については、他の実施の形態の対応するブロックについて既に説明済みであるため、説明を省略する。

【0160】

また、発光制御部1005は收音状態判定部1003から、音声区間と、音声品質との両方の情報を受け取り、発光部1006の制御を行ったが、例えば、收音状態判定部1003は音声品質については判定せず音声区間の情報についてのみ判定して、発光制御部1005に出力し、発光制御部1005は、音声区間の情報のみに基づいて発光部1006の制御を行ってもよい。また、收音状態判定部1003は第1收音部1001で收音された音声信号の音量情報を発光制御部1005に出力し、発光制御部1005は、音声信号の音量情報に基づいて発光部1006の制御を行ってもよい。

【0161】

以上説明したように、本発明によれば、送信状態と非送信状態とを切り替える単方向通信装置において、現在の通信状態（音声の伝送状態）を適切に使用者に報知することで通信状態の誤認を防ぎつつ、音声品質の改善を可能としている。

【0162】

すなわち、LEDを搭載しているハンディマイクにおいて、伝送される音声は周囲ノイズに埋もれるか埋もれないかは使用者のマイクの持ち方や口からの距離、声の大きさ等によって左右される。そこで、ハンディマイクを正しく使用者に使用して貰うために、本発明の通信装置は、ノイズキャンセル処理の情報や音声レベルの情報等に基づいて、話者の発話音声は明瞭に伝送可能かを判断する判定部を備えている。そして当該判定機能によって判定された音声を送信している状態であるかの情報に基づいてLEDを点滅、点灯、消灯させるための制御部を備えている。当該構成とすることで、装置筐体に設置される表示部品点数を抑えつつ、総合的な判定結果をLEDの表示を点滅、点灯、消灯させる等して効果を音声に連動させて通話者に知らせることができる。

【0163】

ここで、伝送される音声信号の音声品質が良好である場合に、LED制御部はLEDを高速で点滅させると使用者に対して音声品質が良好であることの通知機能が高いため好ましい。当該表示方法であれば、音声信号の送信中においても使用者へ違和感なく話者の発話音声と連動させて情報を通知することが可能となる。また、検出された音声区間において、音声品質が不良であれば、LEDが警告ランプとして点灯し続けることで適切な装置使用を使用者に促して改善を試みることにより結果として明瞭な音声を送送することができる。

【0164】

また、当該表示機能を備えることで、初めてノイズキャンセルマイクを使用する場合のトレーニング用としても本発明を利用することができる。

【0165】

また、上記説明では、主に2マイク方式のアクティブノイズキャンセル機能を搭載した無線通信装置について説明したがこれに限定されるものではなく、有線で通信を行う通信装置の他、ノイズキャンセルマイクといった音声收音装置としても良い。また、装置筐体に取り付けられるノイズキャンセルのための雑音收音用サブマイクの数複数設けられていても良い。

【0166】

本発明は、上述の各実施の形態で説明したように、ノイズキャンセルマイクを正しく使用者に使わせるよう誘導することにより、ノイズキャンセルの性能を高めて高品質の音声を聞き手に伝送することができる。すなわち、音声品質等の判定結果をLED等の判定結果通知部を用いて通知する目的は、ノイズキャンセル性能を表示することではなく、使用者にノイズキャンセルマイクを正しく使わせるための誘導にある。

【0167】

これは、2マイク方式のアクティブノイズキャンセル機能を搭載した無線機、あるいは無線機用外部マイクにおいて、使用者のマイクの持ち方や口からの距離によって、ノイズキャンセル効果は大きく左右されるという解決すべき課題があったためである。

【0168】

すなわち、ヘッドセットのような説話型のマイクと異なり、無線機本体あるいは本体に接続するハンドマイクは、持ち方によってはマイクが話者の口に対して90度方向であったり、口から離れすぎていたりする場合がある。このような場合に、メインマイクに十分な音声が届かず相対的に雑音成分も増えるため、ノイズキャンセル処理を行っても十分な効果が得られない。また作業の都合上、両手を空けるために肩や胸にマイクを装着したまま通話を行う場合もあり、その場合のノイズキャンセル性能は正しい持ち方をしている場合に比べ低下してしまう。

【0169】

そこで、マイクの入力信号から、音声／非音声区間情報、ノイズキャンセル処理による

ノイズの減衰量、2つのマイクの位相差を用いたマイク位置推定情報等を使って、使用者が正しいマイクの持ち方をしているかどうかを判定し、LED等の表示部によって正しいマイクの持ち方をしよう誘導するという方法で解決したものである。

【0170】

すなわち、ノイズキャンセル機能を備えた無線機用外部マイクにおいて、ノイズキャンセル機能が効果的に働くような持ち方をしているかどうかを推定する信号処理技術を組み込んでいる。

【0171】

また、本発明によれば、話者の後方に雑音源がある場合や、雑音の周波数特性が音声の特性に近い場合等、状況によってはノイズキャンセルがうまくいかない場合であっても適切な対処が可能となる。

【0172】

すなわち、第一の判定部として、マイクの入力信号からノイズキャンセル効果が効果的に得られているかどうかを推定し、ノイズキャンセル効果があまり得られていない場合には、マイクに備えられた表示装置により使用者に警告を与えて正しい持ち方をしよう促す。入力信号からノイズキャンセル効果を推定するには、ある一定区間（フレーム）が音声であるか雑音であるかを判定する音声区間判定情報、入力信号にノイズキャンセル処理を行った結果、ノイズ成分がどの程度減衰したかを示すノイズ低減量等を用いて判定する。さらに第二の判定部として、2つのマイクの入力信号の位相差から、マイクと話者の口との位置関係を推定し、メインマイクが正しく口の方向に向いていない場合には使用者に警告を与える。

【0173】

ここで、第二の判定部で行われる判定には、第1音声信号（目的音）と第2音声信号（参照音）とを用いて2つ以上のマイクロホンを設置した音声入力装置に対する、目的音の到来方向を検知する目的音方向検知部とを備えることで実現可能である。

【0174】

また、本発明において、音声区間判定部で話者から発話された音声を検出されない場合、すなわち音声区間でない場合であってPTT部が押下されている場合は、LED制御部は、LEDを点灯状態とすることができる。

【0175】

すなわち、LED制御部はPTT部が押下されているかいないかに基づいて、LEDを点灯又は消灯させる制御を行う。換言すれば、LED制御部は、装置の通信状態が、送信部が音声信号を送信する送信状態である場合はLEDを点灯状態とする制御を行い、送信部が音声信号を送信しない非送信状態である場合はLEDを消灯状態とする制御を行う。ここで、音声区間判定部において音声区間であると判定され、音声品質判定部において送信部より送信される音声信号の音声品質が良好であると判定されている場合に、LED制御部はLEDを点滅状態とする制御を行う。

【0176】

すなわち、当該通信装置は、音声を收音する第1收音部と、第1收音部で收音される音声を音声信号として外部に送信する送信部と、第1收音部で收音された音声に基づいて音声区間であるかの判定を行う音声区間判定部と、外部より送信される音声信号を受信する受信部と、通信状態を前記送信部が前記音声信号を送信する送信状態に切り替える切り替え部と、前記音声区間判定部において前記音声区間であると判定されている場合に、送信部で送信される前記音声信号の音声品質を判定する音声品質判定部と、光を発光する発光部と、前記発光部を制御する発光制御部と、を具備し、発光制御部は、前記通信状態が非送信状態である場合に前記発光部を消灯状態とする制御を行い、前記切り替え部によって前記通信状態が前記送信状態に切り替えられている場合に前記発光部を点灯状態とする制御を行い、前記通信状態が前記送信状態に切り替えられている場合であって、前記音声品質判定部において、前記送信部で送信される前記音声信号の音声品質が良好であると判定されている場合は、前記発光部を点滅状態とする制御を行う。

【0177】

このように構成することで、使用者がPTT部を押下した上で発話していてもLEDが点灯状態である場合は、使用者は通信装置が正しく音声に反応していないと感ずることが出来る。すなわち、通信装置は、発話している使用者に対して適切な音声伝送が行えていないことを使用者により明確に伝えることができる。

【0178】

このように、PTT部が押下されて送信状態である場合であって、音声区間でない場合のLED表示と、PTT部が押下されて送信状態である場合であって、音声区間であって音声品質が良好ではない時のLED表示を同一とすることが好ましい。当該構成とすることで、良好な音声品質の音声伝送が行えているかどうかを使用者に対して適切に通知することができる。

【0179】

なお、本発明は上記実施の形態に限られたものではなく、趣旨を逸脱しない範囲で適宜変更することが可能である。

【0180】

例えば、点滅と点灯を逆に設定しても良い。すなわち、上記実施の形態では、LED制御部は、音声の送信中であれば、音声に対する判定を使用して、ノイズキャンセル処理が良好に動作し、伝送される音声に問題が無ければLEDを点滅させ、一方伝送される音声に問題があればLEDを点灯させていた。そしてLED制御部は、音声の送信中でなければLEDを消灯させていた。しかしながらこれに限定されるものではない。

【0181】

ここで、LED制御部は、PTT部が押下されて通信状態が送信状態にセットされている場合において、音声品質判定部で判定される音声信号の音声品質が良好でない場合に、LEDを点滅させる制御を行っても良い。この場合、LED制御部は、PTT部が押下されて通信状態が送信状態にセットされている場合において、音声品質判定部で判定される音声信号の音声品質が良好である場合に、LEDを点灯させる制御を行っても良い。この場合も、LED制御部は、通信状態が送信状態でない場合には、LEDを消灯させる。このような構成であっても良い。

【0182】

また、上記の処理は、メインプロセッサのROM等に格納されたコンピュータプログラムによって実行可能である。上述の例において、各処理をコンピュータ（プロセッサ）に行わせるための命令群を含むプログラムは、様々なタイプの非一時的なコンピュータ可読媒体（non-transitory computer readable medium）を用いて格納され、コンピュータに供給することができる。非一時的なコンピュータ可読媒体は、様々なタイプの実体のある記録媒体（tangible storage medium）を含む。非一時的なコンピュータ可読媒体の例は、磁気記録媒体（例えばフレキシブルディスク、磁気テープ、ハードディスクドライブ）、光磁気記録媒体（例えば光磁気ディスク）、CD-ROM（Read Only Memory）、CD-R、CD-R/W、半導体メモリ（例えば、マスクROM、PROM（Programmable ROM）、EPROM（Erasable PROM）、フラッシュROM、RAM（Random Access Memory））を含む。また、プログラムは、様々なタイプの一時的なコンピュータ可読媒体（transitory computer readable medium）によってコンピュータに供給されてもよい。一時的なコンピュータ可読媒体の例は、電気信号、光信号、及び電磁波を含む。一時的なコンピュータ可読媒体は、電線及び光ファイバ等の有線通信路、又は無線通信路を介して、プログラムをコンピュータに供給できる。

【符号の説明】

【0183】

100	通信装置	101	第1 收音部
102	送信部	103	音声品質判定部
104	PTT部	105	発光制御部
106	発光素子	200	通信装置

201	メインマイク（第1収音部）	202	サブマイク（第2収音部）
203	音声区間判定部	204	ノイズキャンセル処理部
205	ノイズサプレッサ部	206	無線送信部
207	P T T部	208	音声品質判定部
209	L E D制御部	210	L E D
211	無線受信部	212	スピーカ
220	ノイズキャンセルマイク部	221	ベルトクリップ
230	コード	240	無線通信機
300	通信装置	303	音声区間判定部
308	音声品質判定部	313	マイク方向判定部
314	ノイズキャンセル効果判定部	315	総合判定部

【書類名】特許請求の範囲

【請求項 1】

音声を収音する第 1 収音部と、
第 1 収音部で収音される音声を音声信号として外部に送信する送信部と、
前記送信部が前記音声信号を送信しない非送信状態から前記送信部が前記音声信号を送信する送信状態に自装置の通信状態を切り替える切り替え部と、
前記送信部で送信される前記音声信号の音声品質を判定する音声品質判定部と、
光を発光する発光部と、
前記発光部を制御する発光制御部と、
を具備し、
前記発光制御部は、前記切り替え部が切り替える前記通信状態と、前記音声品質判定部における前記音声品質の判定結果とに基づいて、前記発光部が、消灯状態、点滅状態、点灯状態、のいずれかの状態をとるように制御する通信装置。

【請求項 2】

前記発光制御部は、
前記通信状態が非送信状態である場合は前記発光部を消灯状態とし、
前記通信状態が送信状態で、かつ、前記音声品質が良好と判定されている場合は前記発光部を点滅状態とし、
前記通信状態が送信状態で、かつ、前記音声品質が不良と判定されている場合は前記発光部を点灯状態とする、
請求項 1 に記載の通信装置。

【請求項 3】

前記発光制御部は、
前記通信状態が非送信状態である場合は前記発光部を消灯状態とし、
前記通信状態が送信状態で、かつ、前記音声品質が良好と判定されている場合は前記発光部を点灯状態とし、
前記通信状態が送信状態で、かつ、前記音声品質が不良と判定されている場合は前記発光部を点滅状態とする、
請求項 1 に記載の通信装置。

【請求項 4】

前記音声品質判定部は、前記第 1 収音部で収音される音声の音量レベルに基づいて前記音声品質を判定する、
請求項 1 に記載の通信装置。

【請求項 5】

音声を収音する第 2 収音部と、
前記第 2 収音部から入力される第 2 音声信号を用いて、前記第 1 収音部から入力される第 1 音声信号に対するノイズキャンセルを行うノイズキャンセル処理部と、
を更に具備し、
前記送信部は、前記ノイズキャンセル処理部における前記ノイズキャンセル後の音声信号を外部に送信し、
前記音声品質判定部は、前記ノイズキャンセル後の音声信号の音声品質を判定する、
請求項 1 に記載の通信装置。

【請求項 6】

第 1 収音部で収音された音声に基づいて音声区間であるかの判定を行う音声区間判定部を更に備え、
前記音声品質判定部は、前記音声区間判定部において音声区間であると判定されている場合に、前記ノイズキャンセル処理部におけるノイズキャンセル後の音声信号の音声品質を判定する、
請求項 5 に記載の通信装置。

【請求項 7】

前記音声区間判定部は、
第1収音部から入力される第1音声信号を一定長の単位で周波数領域に変換する周波数変換部と、

前記周波数変換部における変換後のスペクトル成分に基づいて、発話による音声成分であるか音声ではない雑音成分であるかを判定する音声判定部と、

を備える請求項6に記載の音声入力装置。

【請求項8】

前記発光制御部は、

前記通信状態が非送信状態である場合は前記発光部を消灯状態とし、

前記通信状態が送信状態で、かつ、音声区間でない場合は、前記発光部を点灯状態とし、

前記通信状態が送信状態で、かつ、音声区間であり、前記音声品質が不良と判定されている場合は、前記発光部を点灯状態とし、

前記通信状態が送信状態で、かつ、音声区間であり、前記音声品質が良好と判定されている場合は前記発光部を点滅状態とする制御を行う、

請求項6又は7に記載の通信装置。

【請求項9】

前記第1収音部は、装置本体正面に配置されるメインマイクであり、

前記第2収音部は、装置本体背面に配置されるサブマイクである、

請求項5乃至8のいずれか1項に記載の通信装置。

【請求項10】

前記第1収音部で収音される音声と前記第2収音部で収音される音声との位相差に基づいてメインマイク方向を判定するマイク方向判定部を更に具備し、

前記音声品質判定部は、前記マイク方向判定部における前記メインマイク方向の判定結果に基づいて前記ノイズキャンセル処理部におけるノイズキャンセル後の音声信号の音声品質を判定する、

請求項9に記載の音声入力装置。

【請求項11】

前記発光部は、装置本体に設置されたLED (Light Emitting Diode) である、

請求項1乃至10のいずれか1項に記載の通信装置。

【請求項12】

単方向通信装置に設けられた発光素子を用いて前記単方向通信装置の使用状態を通知する状態通知方法であって、

前記単方向通信装置の通信状態が送信状態であるか非送信状態であるかを判定する通信状態判定ステップと、

前記通信状態が前記送信状態である場合に送信される音声信号の音声品質を判定する音声品質判定ステップと、

通信状態判定ステップにおける判定結果と前記音声品質判定ステップにおける判定結果とに基づいて前記発光素子を消灯状態、点灯状態、点滅状態のいずれかの状態となるように

制御する制御ステップと、

を有する状態通知方法。

【請求項13】

音声を収音する第1収音部と、

前記第1収音部で収音される音声を音声信号として外部に送信する送信部と、

前記送信部が前記音声信号を送信しない非送信状態から前記送信部が前記音声信号を送信する送信状態に自装置の通信状態を切り替える切り替え部と、

前記第1収音部での音声の収音状態を判定する収音状態判定部と、

光を発光する発光部と、

前記発光部を制御する発光制御部と、

を具備し、

前記発光制御部は、前記切り替え部が切り替える前記通信状態と、前記収音状態判定部に

おける前記第 1 収音部での音声の収音状態とに基づいて、前記発光部が、消灯状態、点滅状態、点灯状態、のいずれかの状態をとるように制御する通信装置。

【請求項 1 4】

前記発光制御部は、前記切り替え部が前記通信状態を送信状態に切り替えた場合に、前記発光部を点灯状態とし、前記収音状態判定部で判定された収音状態に基づいて、前記発光部を点滅状態とする、請求項 1 3 記載の通信装置。

【書類名】 要約書

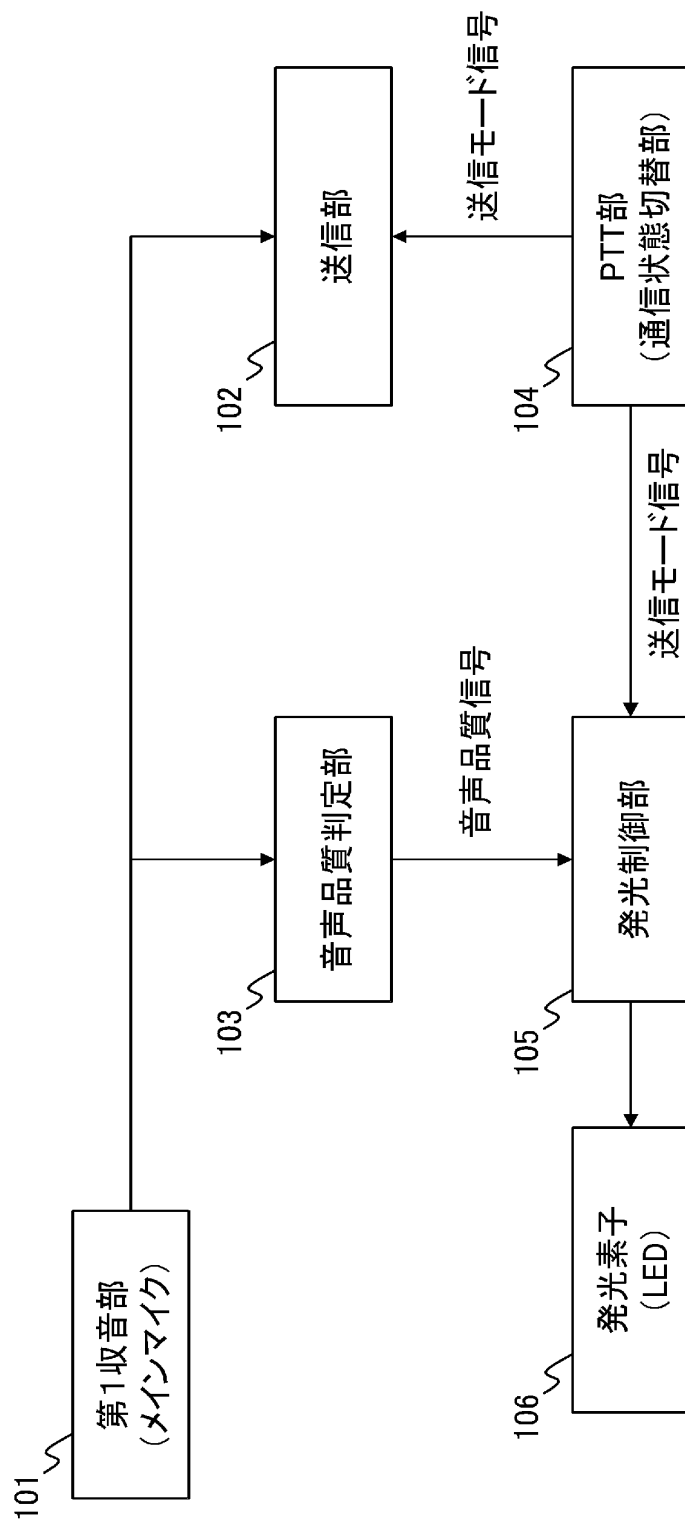
【要約】

【課題】 限られた制約下で良質な音声を送信できる送信装置が求められていた。

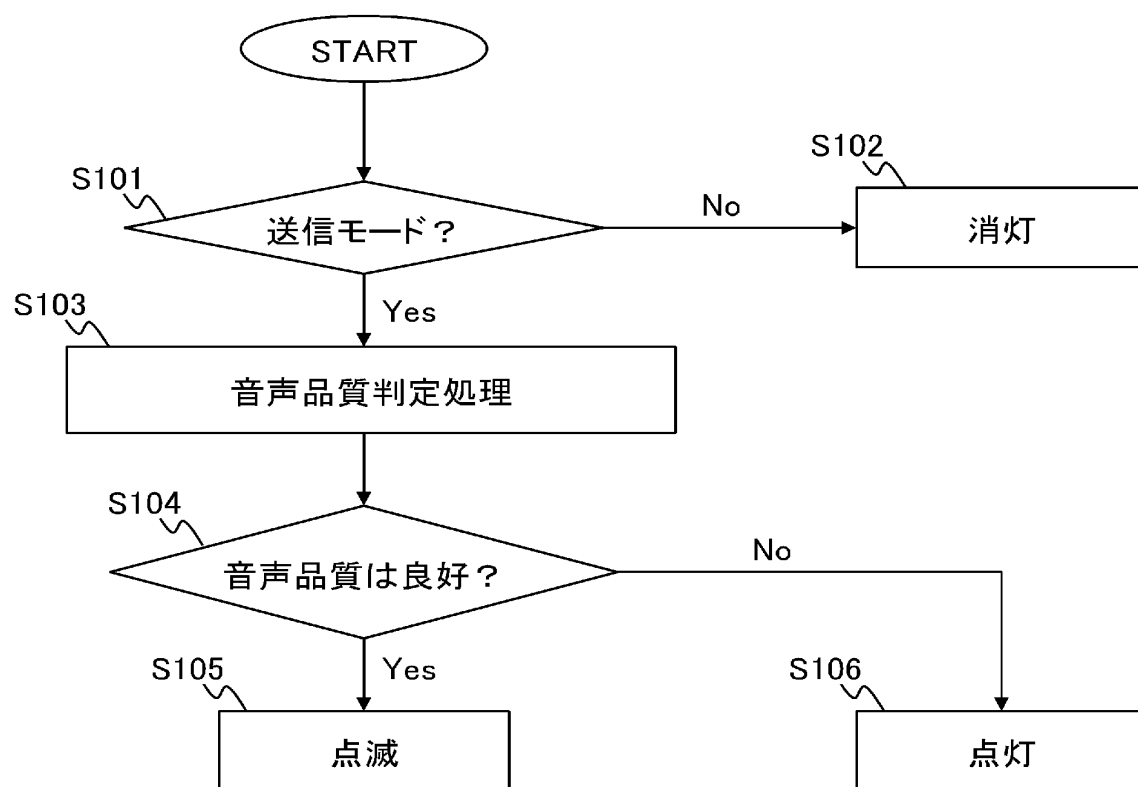
【解決手段】 本発明の通信装置は、音声を受音する第1収音部（101）と、第1収音部で収音される音声を音声信号として外部に送信する送信部（102）と、前記送信部が前記音声信号を送信しない非送信状態から前記送信部が前記音声信号を送信する送信状態に自装置の通信状態を切り替える切り替え部（104）と、前記送信部で送信される前記音声信号の音声品質を判定する音声品質判定部（103）と、光を発光する発光部（106）と、前記発光部を制御する発光制御部（105）と、を具備する。前記発光制御部は、前記切り替え部が切り替える前記通信状態と、前記音声品質判定部における前記音声品質の判定結果とに基づいて、前記発光部が、消灯状態、点滅状態、点灯状態、のいずれかの状態をとるように制御する。

【選択図】 図1

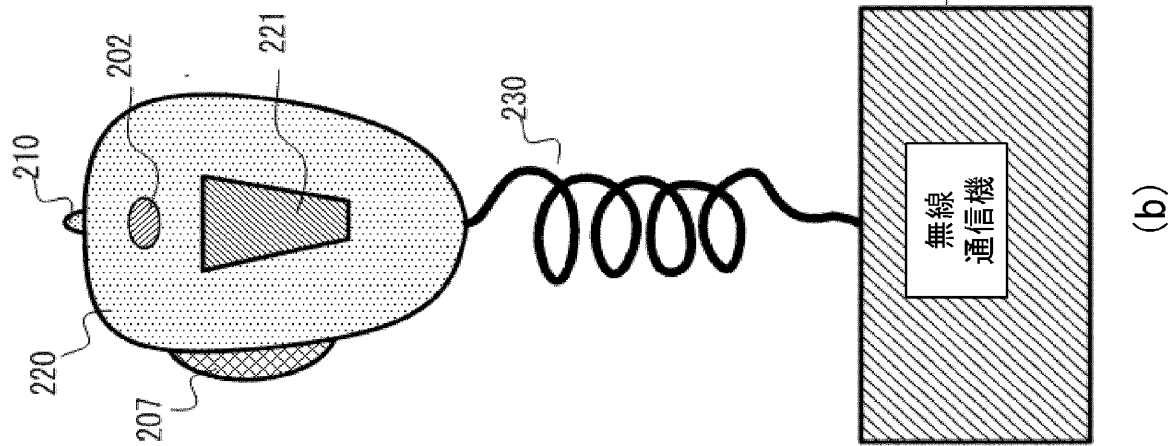
100



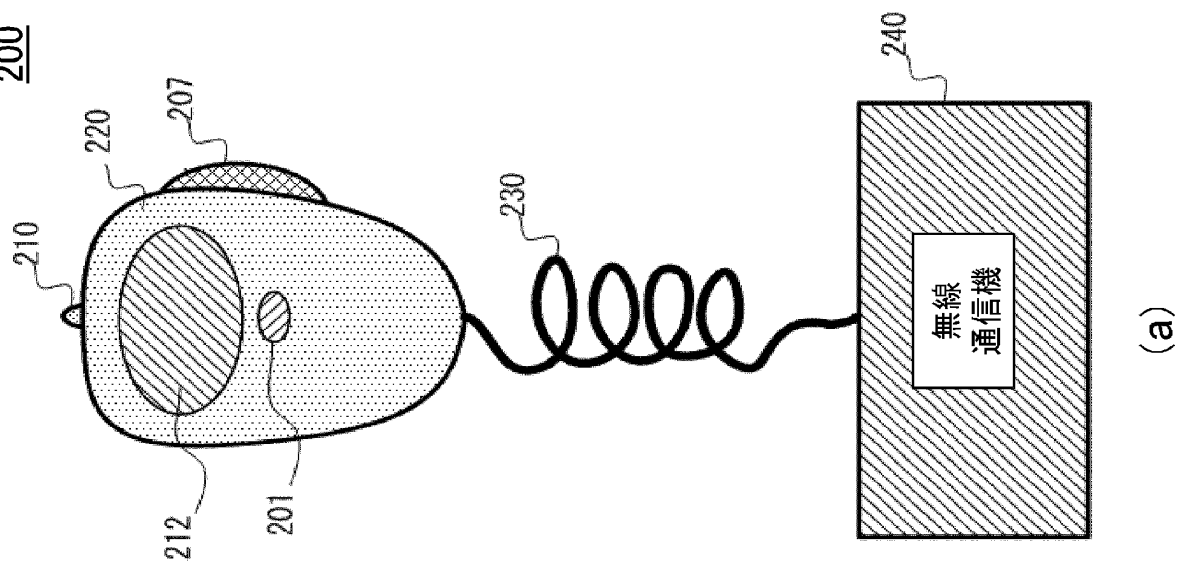
【図2】



200

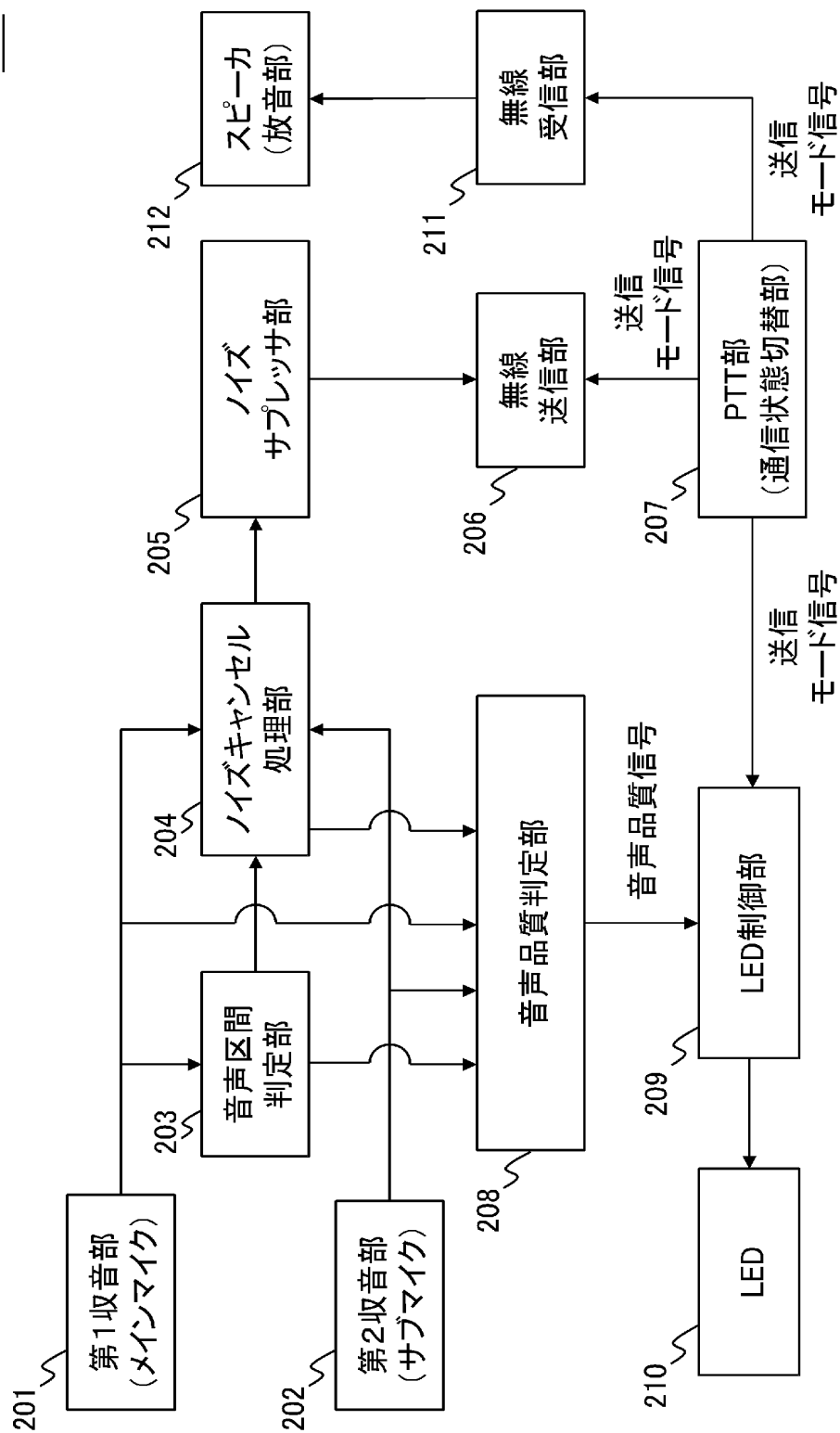


200



【図4】

200



【図5】

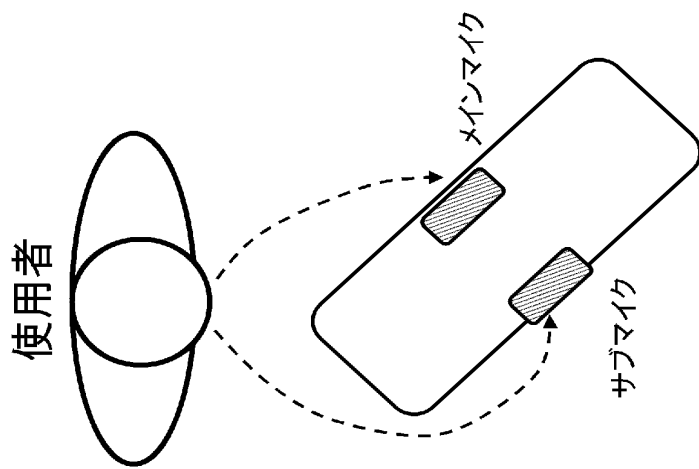


【図 6】

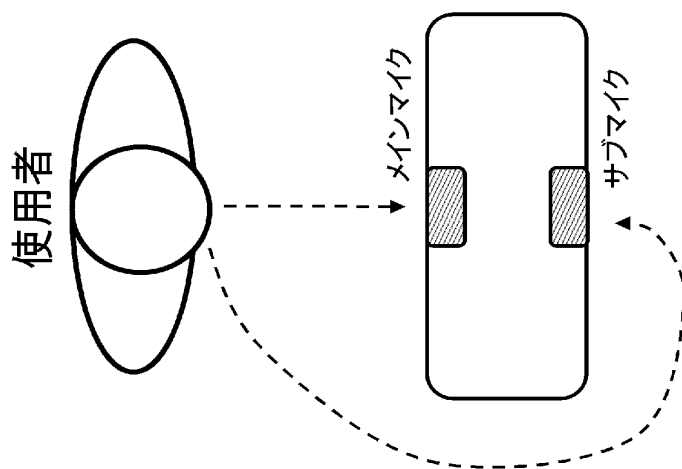
	送信モード信号 (PTT部から)	音声品質信号 (音声品質判定部から)	LED状態
No1	送信モード (PTT部が押下されている)	音声品質良好	点滅
No2		音声品質不良	点灯
No3		信号無し	点灯
No4	受信モード (PTT部が押下されていない)	信号無し	消灯



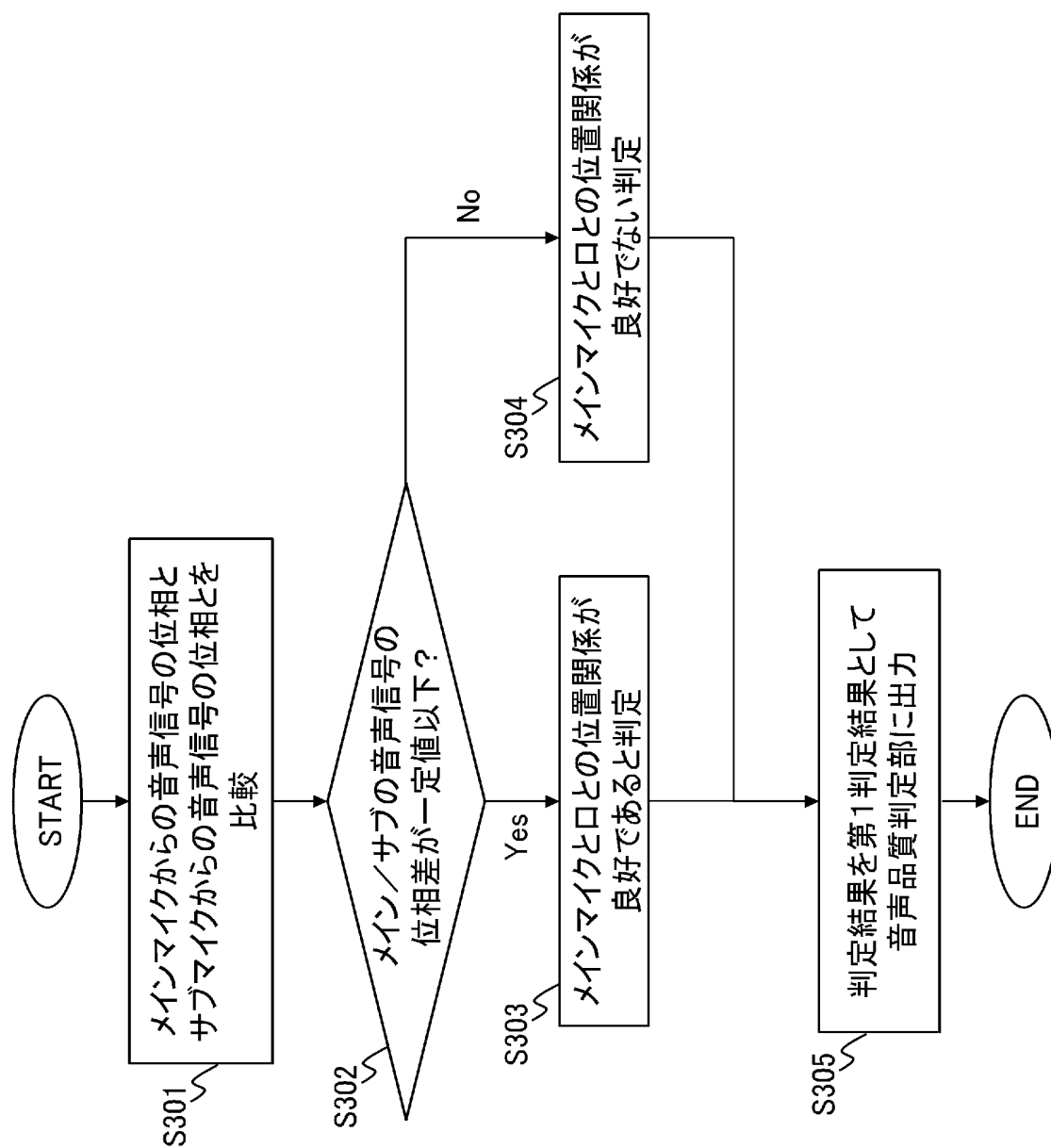
【図 8】



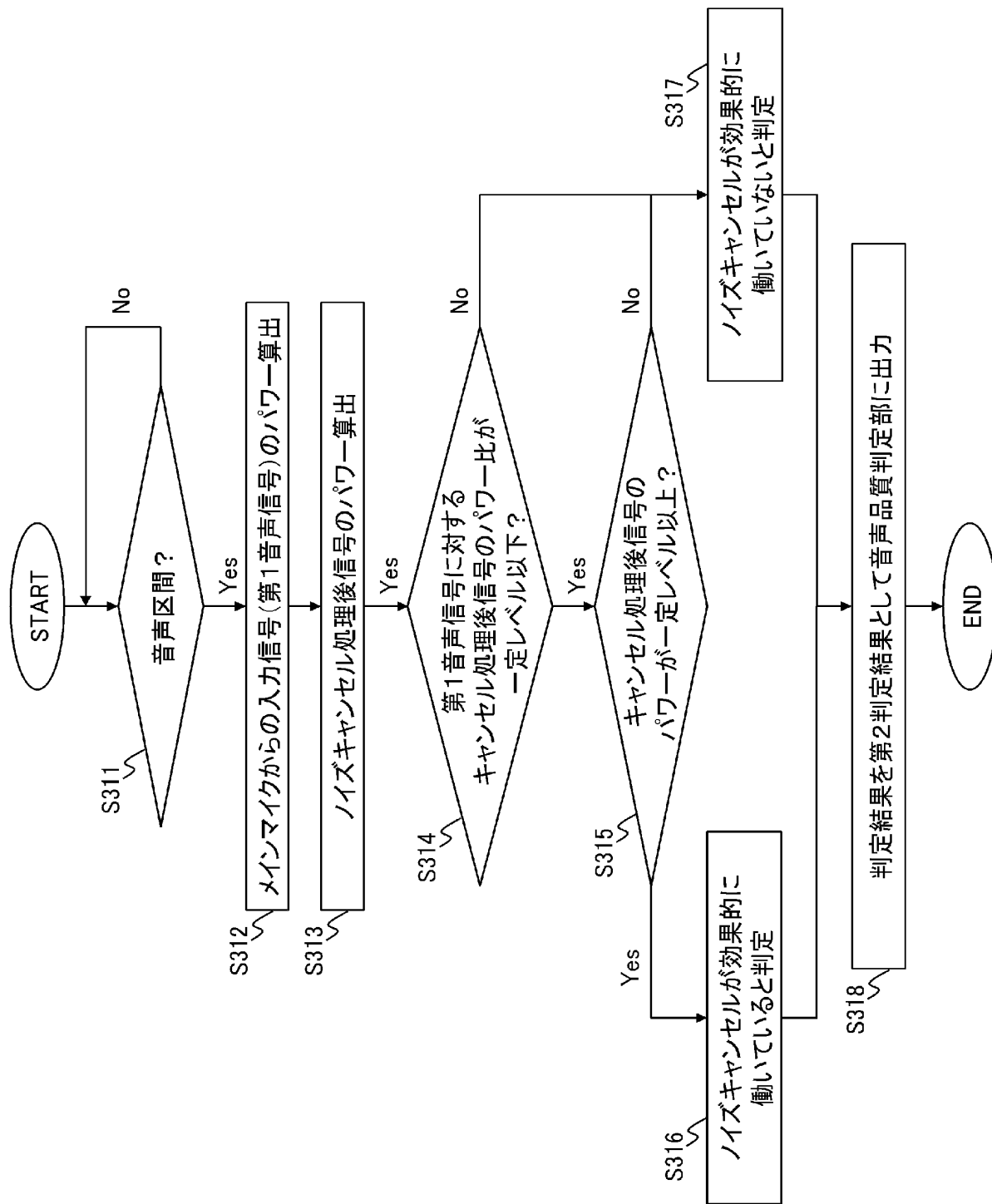
位相差が小さい

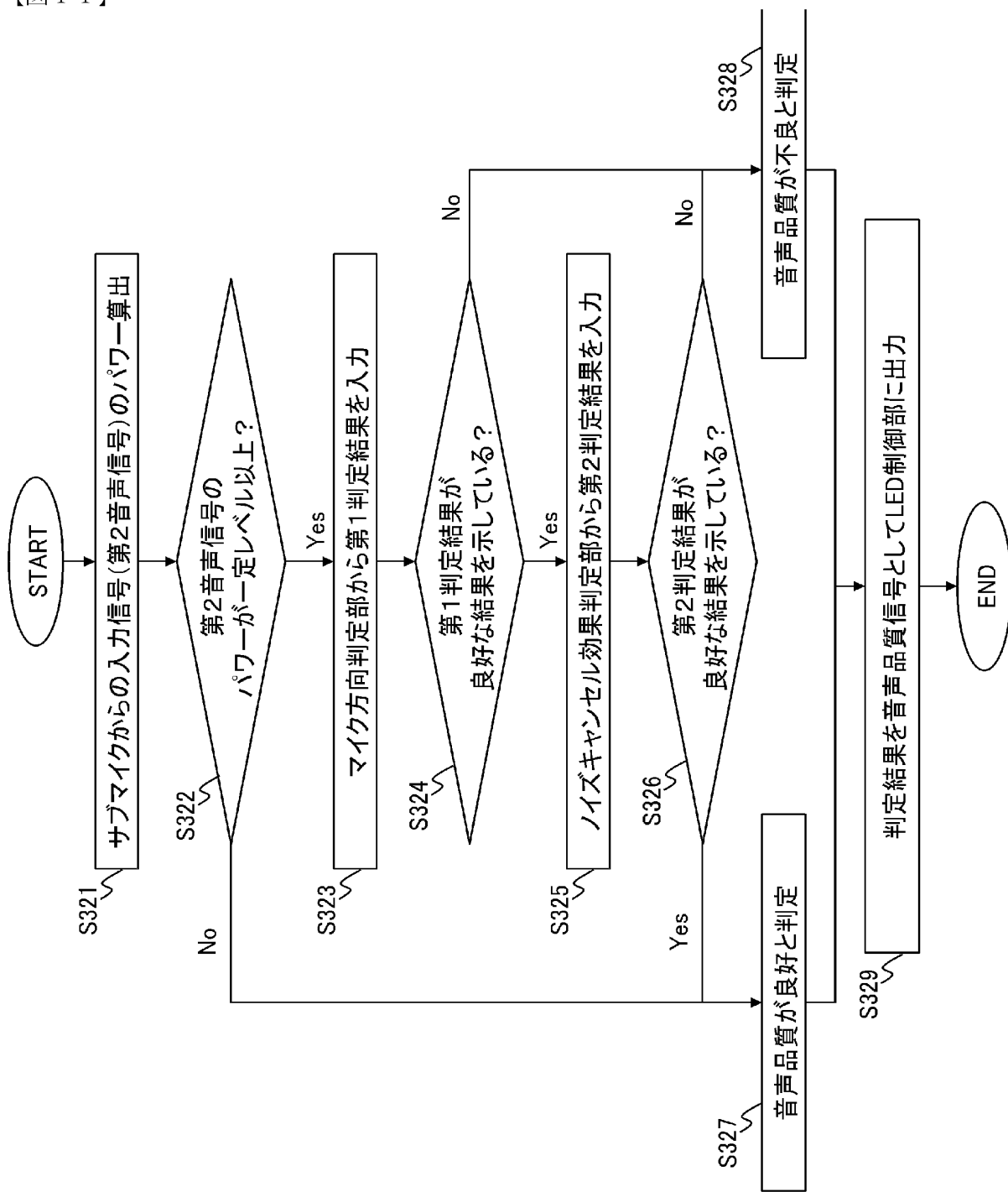


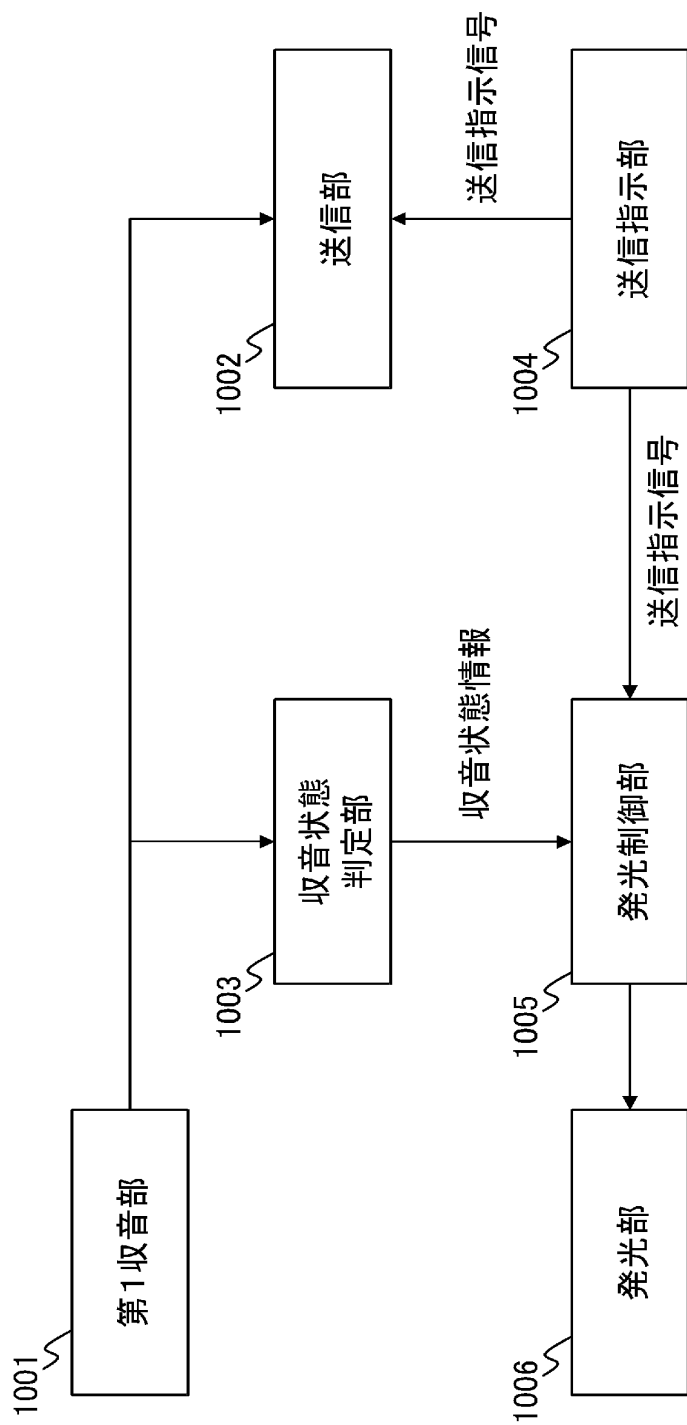
位相差が大きい



【図 10】

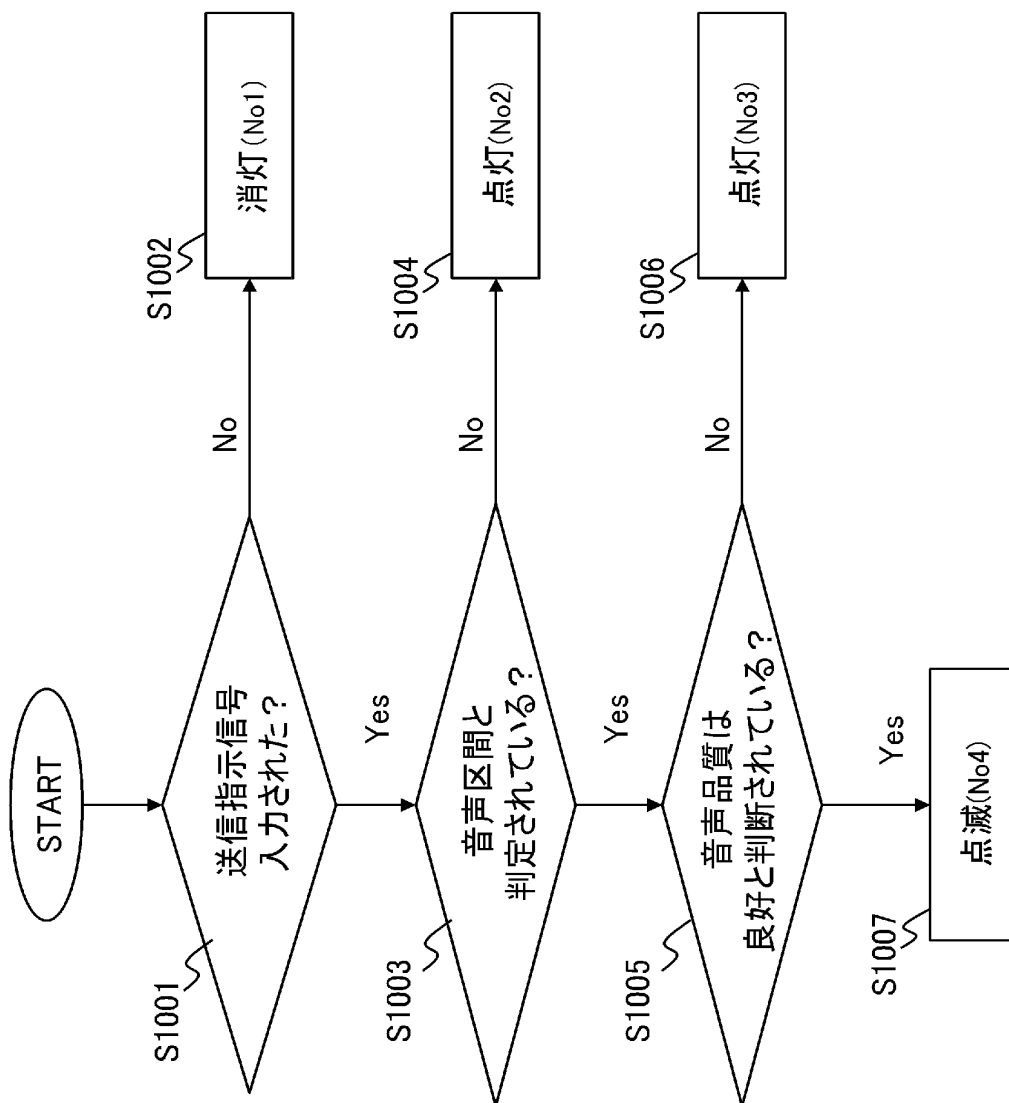




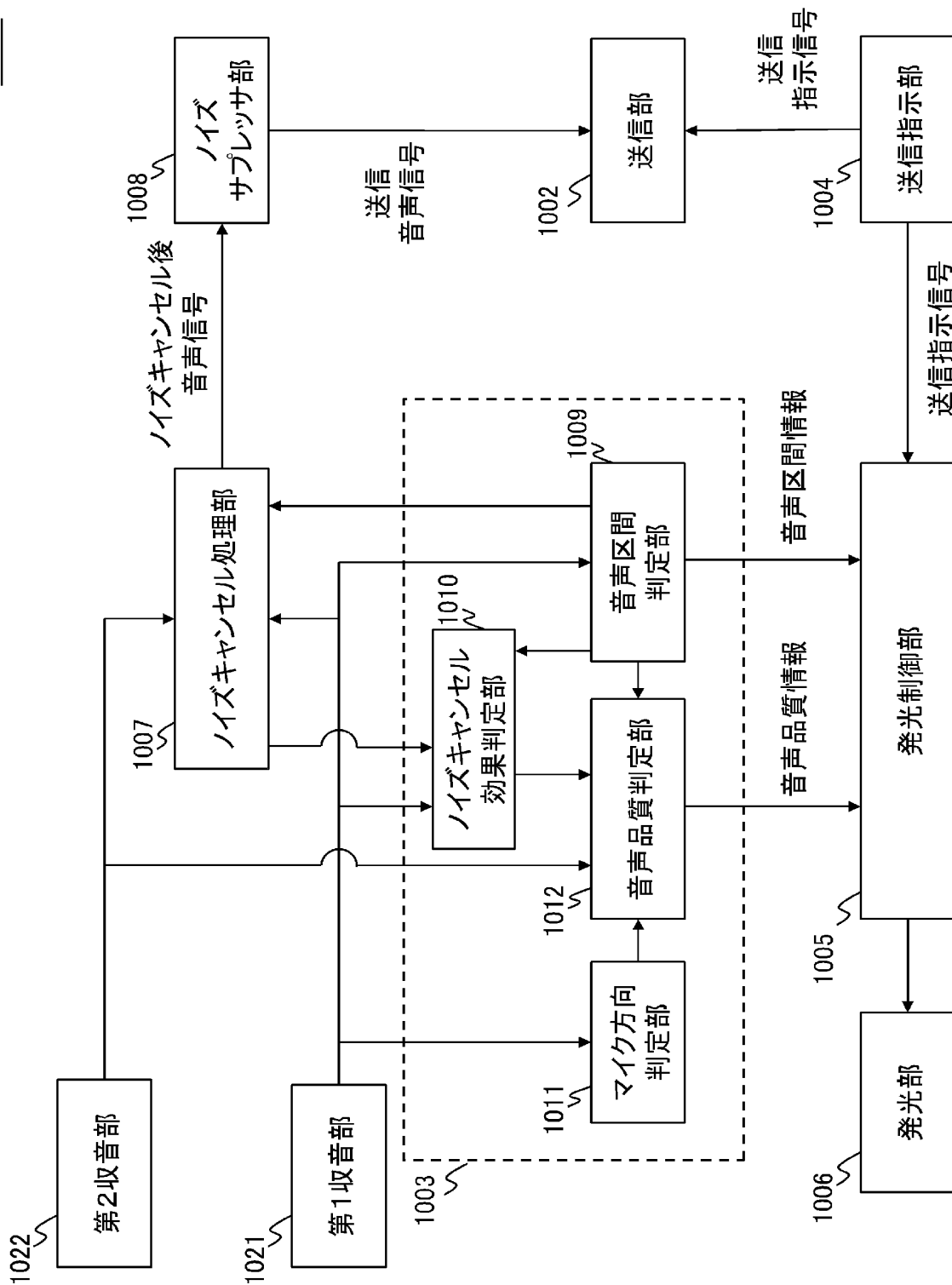


	通信状態	收音状態判定		LED状態
		音声区間判定	音声品質判定	
No1	非送信状態 (送信指示信号入力されず)	判定無し	判定無し	消灯
No2	送信状態 (送信指示信号を入力)	非音声区間	判定無し	点灯
No3		音声区間	音声品質不良	点灯
No4			音声品質良好	点滅

【図 14】



2000



出願人履歴

3 0 8 0 3 6 4 0 2

20110810

名称変更

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CONFIRMATION NO. 4369

26360

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PUBLICATION NOTICE



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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY. DOCKET NO	TOT CLAIMS	IND CLAIMS
13/770,236	02/19/2013	2656	1260	KYO.P0221	20	3

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FILING RECEIPT



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26360

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Date Mailed: 03/12/2013

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**

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Assignment For Published Patent Application

JVC KENWOOD CORPORATION, Yokohama-Shi, JAPAN

Power of Attorney: The patent practitioners associated with Customer Number 26360

Domestic Applications for which benefit is claimed - None.

A proper domestic benefit claim must be provided in an Application Data Sheet in order to constitute a claim for domestic benefit. See 37 CFR 1.76 and 1.78.

Foreign Applications (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see <http://www.uspto.gov> for more information.)

JAPAN JP 2012-034192 02/20/2012

JAPAN JP 2012-034189 02/20/2012

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The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 13/770,236**

Projected Publication Date: 08/22/2013

Non-Publication Request: No

Early Publication Request: No

Title

AUDIO INPUT APPARATUS, COMMUNICATION APPARATUS AND CONDITION NOTIFICATION METHOD

Preliminary Class

381

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
13/770,236	02/19/2013	Masaya KONISHI	KYO.P0221

26360

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CONFIRMATION NO. 4369

POA ACCEPTANCE LETTER



OC000000059783158

Date Mailed: 03/12/2013

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 02/19/2013.

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.

/ewondimu/

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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875						Application or Docket Number 13/770,236	
APPLICATION AS FILED - PART I							
(Column 1)		(Column 2)		SMALL ENTITY		OTHER THAN SMALL ENTITY	
FOR	NUMBER FILED	NUMBER EXTRA	RATE(\$)	FEE(\$)		RATE(\$)	FEE(\$)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	390
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	620
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	250
TOTAL CLAIMS (37 CFR 1.16(i))	20	minus 20 = *				x 62 =	0.00
INDEPENDENT CLAIMS (37 CFR 1.16(h))	3	minus 3 = *				x 250 =	0.00
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$310 (\$155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						0.00
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0.00
			TOTAL			TOTAL	1260
* If the difference in column 1 is less than zero, enter "0" in column 2.							
APPLICATION AS AMENDED - PART II							
(Column 1)		(Column 2)		(Column 3)		SMALL ENTITY	
AMENDMENT A	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)		RATE(\$)
	Total (37 CFR 1.16(i))	*	Minus **	=	x =		x =
	Independent (37 CFR 1.16(h))	*	Minus ***	=	x =		x =
	Application Size Fee (37 CFR 1.16(s))						
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
				TOTAL ADD'L FEE			TOTAL ADD'L FEE
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AMENDMENT B	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)		RATE(\$)
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	Independent (37 CFR 1.16(h))	*	Minus ***	=	x =		x =
	Application Size Fee (37 CFR 1.16(s))						
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
				TOTAL ADD'L FEE			TOTAL ADD'L FEE
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UTILITY PATENT APPLICATION TRANSMITTAL <i>(Only for new nonprovisional applications under 37 CFR 1.53(b))</i>	Attorney Docket No.	KYO.P0221
	First Inventor	Masaya KONISHI
	Title	AUDIO INPUT APPARATUS, COMMUNICATION APPARATUS AND CONDITION NOTI
	Express Mail Label No.	

APPLICATION ELEMENTS <i>See MPEP chapter 600 concerning utility patent application contents.</i>	ADDRESS TO: Commissioner for Patents P.O. Box 1450 Alexandria VA 22313-1450
1. ☐ Fee Transmittal Form. (PTO/SB/17 or equivalent) 2. ☐ Applicant claims small entity status. See 37 CFR 1.27. 3. ☒ Specification. [Total Pages <u>81</u>] Both the claims and abstract must start on a new page (For information on the preferred arrangement, see MPEP § 608.01(a)) 4. ☒ Drawing(s). (35 U.S.C. 113) [Total Sheets <u>28</u>] 5. Inventor's Oath or Declaration. [Total Sheets <u>2</u>] (Including substitute statements under 37 CFR 1.64 and assignments serving as an oath or declaration under 37 CFR 1.63(e)) a. ☒ Newly executed (original or copy) b. ☐ A copy from a prior application (37 CFR 1.63(d)) 6. ☒ Application Data Sheet. *See Note below. See 37 CFR 1.76 (PTO/AIA/14 or equivalent) 7. ☐ CD-ROM or CD-R. in duplicate, large table or Computer Program (Appendix) ☐ Landscape Table on CD 8. Nucleotide and/or Amino Acid Sequence Submission. (if applicable, items a. – c. are required) a. ☐ Computer Readable Form (CRF) b. ☐ Specification Sequence Listing on: i. ☐ CD-ROM or CD-R (2 copies); or ii. ☐ Paper c. ☐ Statements verifying identity of above copies	ACCOMPANYING APPLICATION PARTS 9. ☐ Assignment Papers. (cover sheet & document(s)) Name of Assignee _____ 10. ☐ 37 CFR 3.73(c) Statement. ☒ Power of Attorney. (when there is an assignee) 11. ☐ English Translation Document. (if applicable) 12. ☒ Information Disclosure Statement. (PTO/SB/08 or PTO-1449) ☒ Copies of citations attached 13. ☐ Preliminary Amendment. 14. ☐ Return Receipt Postcard. (MPEP § 503) (Should be specifically itemized) 15. ☐ Certified Copy of Priority Document(s). (if foreign priority is claimed) 16. ☐ Nonpublication Request. Under 35 U.S.C. 122(b)(2)(B)(i). Applicant must attach form PTO/SB/35 or equivalent. 17. ☐ Other: _____

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AUDIO INPUT APPARATUS, COMMUNICATION APPARATUS AND CONDITION NOTIFICATION METHOD

CROSS-REFERENCE TO RELATED APPLICATIONS

5 This application is based on and claims the benefit of
priority from the prior Japanese Patent Application Nos.
2012-034192 filed on February 20, 2012 and 2012-034189
filed on February 20, 2012, the entire content of which is
incorporated herein by reference.

10

BACKGROUND OF THE INVENTION

The present invention relates to an audio input apparatus, a
communication apparatus and a condition notification method.

15 An audio input apparatus that is a typical example of
transceivers for commercial use is often used in an environment of
much noise, such as a factory and a construction site. There is
thus a demand for communication with clear voice sounds even in
such a noisy environment by suppressing noise components
included in a speech signal obtained through a microphone.

20 In order to meet the demand, there is a known audio input
apparatus having an active noise-cancellation function using a main
microphone for mainly picking up voice sounds and a
sub-microphone for mainly picking up the surrounding noise.

25 In order to enhance the active noise-cancellation function in
such a known audio input apparatus, it is preferable that a main
microphone is oriented towards the user's mouth with an
appropriate distance. In the case of a headset microphone (a
close-talking microphone), a comparatively constant positional
relationship is kept between the microphone and the user's mouth.
30 On the other hand, in the case of a handset microphone, the
positional relationship between a microphone held by a user and
the user's mouth changes depending on how the user is using the
handset microphone.

35 Moreover, it may happen that a handset microphone is
used in a bad input condition of voice sounds for use in noise
cancellation when it is held on the user's shoulder, a user talks into

the microphone at a fairly long distance, etc. When a handset microphone is used in such a manner, it may happen that more voice sounds are picked by a sub-microphone than by a main microphone, which cancel a speech signal obtained through the main microphone, with the noise-cancellation function, resulting in transmission of unclear voice sounds.

SUMMARY OF THE INVENTION

A purpose of the present invention is to provide an audio input apparatus, a communication apparatus and a condition notification method that achieve transmission of clear voice sounds with an effective noise-cancellation function.

The present invention provides a condition notification method for notifying a used condition of a simplex communication apparatus by using a light-emitting device attached to the simplex communication apparatus, the method comprising: a communication-mode determination step of determining whether a communication mode of the simplex communication apparatus is a transmission mode or a standby mode; a sound pick-up state determination step of determining a sound pick-up state of a sound carried by a speech signal to be transmitted if the communication mode is the transmission mode; and a control step of controlling the light-emitting device so that the light-emitting device is turned off, turned on or repeatedly turned on and off based on determination results of the communication-mode determination step and the sound pick-up state determination step.

Moreover, the present invention provides a communication apparatus comprising: a first pick-up unit configured to pick up a voice sound; a transmitter unit configured to transmit the voice sound picked up by the first pick-up unit to outside as a first speech signal; a communication-mode switching unit configured to switch a communication mode between a standby mode in which the transmitter unit does not transmit the speech signal and a transmission mode in which the transmitter unit transmits the speech signal; a sound pick-up state determination unit

configured to determine a pick-up state of the voice sound picked up by the first pick-up unit; a light emission device configured to emit light; and a control unit configured to control the light-emitting device so that the light-emitting device is turned off, turned on or repeatedly turned on and off based on the communication mode switched by the communication-mode switching unit, and the pick-up state of the voice sound picked up by the first pick-up unit and determined by the sound pick-up state determination unit.

Furthermore, the present invention provides an audio input apparatus comprising: a first sound pick-up unit; a second sound pick-up unit; a noise-cancellation processing unit configured to perform noise cancellation to a first speech signal input from the first sound pick-up unit by using a second speech signal input from the second sound pick-up unit; a speech-quality evaluation unit configured to evaluate speech quality of a speech signal after the noise cancellation at the noise-cancellation processing unit; and an evaluation-result notification unit configured to notify an evaluation result at the speech-quality evaluation unit.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a block diagram schematically showing the configuration of a communication apparatus according to a first embodiment of the present invention;

FIG. 2 is a flowchart showing an operation of the communication apparatus according to the first embodiment of the present invention;

FIG. 3 is a view showing the exterior appearance of a communication apparatus (a noise cancellation microphone) with a front view (a) and a rear view (b), according to a second embodiment of the present invention;

FIG. 4 is a block diagram schematically showing the configuration of the communication apparatus according to the second embodiment of the present invention;

FIG. 5 is a flowchart showing a speech-quality evaluation process according to the second embodiment of the present invention;

FIG. 6 is a table listing communication modes, speech-quality evaluation results, and LED states;

FIG. 7 is a block diagram schematically showing the configuration of a communication apparatus according to a third second embodiment of the present invention;

FIG. 8 is a view illustrating a direction-to-phase relationship of a communication apparatus with respect to a user;

FIG. 9 is a flowchart showing a microphone-direction determination process for a main microphone according to the third embodiment of the present invention;

FIG. 10 is a flowchart showing a noise-cancellation effect evaluation process according to the third embodiment of the present invention;

FIG. 11 is a flowchart showing an overall evaluation process concerning the speech quality according to the third embodiment of the present invention;

FIG. 12 is a block diagram schematically showing the configuration of an audio input apparatus (a communication apparatus) according to a fourth embodiment of the present invention;

FIG. 13 is a table listing communication modes, sound pick-up state evaluation results, and LED states under control by a light-emission control unit;

FIG. 14 is a flowchart showing a light-emission control process according to the fourth embodiment of the present invention;

FIG. 15 is a block diagram schematically showing the configuration of an audio input apparatus (a communication apparatus) according to a fifth embodiment of the present invention;

FIG. 16 is a block diagram schematically showing the configuration of an audio input apparatus according to a sixth embodiment of the present invention;

FIG. 17 is a flowchart showing an operation of the audio input apparatus according to the sixth embodiment of the present invention;

5 FIG. 18 is a block diagram schematically showing the configuration of an audio input apparatus according to a seventh embodiment of the present invention;

FIG. 19 is a flowchart showing a noise-cancellation effect evaluation process according to the seventh embodiment of the present invention;

10 FIG. 20 is a block diagram schematically showing the configuration of an audio input apparatus according to an eighth embodiment of the present invention;

FIG. 21 is a view illustrating a direction-to-phase relationship of an audio input apparatus with respect to a user;

15 FIG. 22 is a flowchart showing a microphone-direction determination process for a main microphone according to the eighth embodiment of the present invention;

FIG. 23 is a flowchart showing a noise-cancellation effect evaluation process according to the eighth embodiment of the present invention;

FIG. 24 is a flowchart showing an overall evaluation process concerning the speech quality according to the eighth embodiment of the present invention;

25 FIG. 25 is a view showing the exterior appearance of a noise cancellation microphone (an audio input apparatus) with a front view (a) and a rear view (b), according to a ninth embodiment of the present invention;

FIG. 26 is a block diagram schematically showing the configuration of the noise cancellation microphone according to the ninth embodiment of the present invention;

FIG. 27 is a table listing communication modes, speech-quality evaluation results, and LED states according to the ninth embodiment of the present invention; and

35 FIG. 28 is a flowchart showing a speech-quality evaluation process according to the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Varies embodiments according the present invention will be explained with reference to the attached drawings. Throughout the drawings, the elements the same as or
5 analogous to each other are given the same reference signs or numerals with no repeated explanation thereof for brevity.

[First Embodiment]

FIG. 1 is a block diagram schematically showing the configuration of a simplex communication apparatus 100 according
10 to a first embodiment of the present invention.

As shown in FIG. 1, the communication apparatus 100 is provided with a sound pick-up unit (a main microphone) 101, a transmitter unit 102, a speech-quality evaluation unit 103, a PTT (Push To Talk) unit 104 as a communication-mode switching unit, a
15 light-emission control unit 105, and a light-emitting device (LED) 106.

The sound pick-up unit 101 is a microphone attached to the communication apparatus 100, for picking up a voice sound. On picking up a voice sound, the sound pick-up unit 101 generates a
20 first speech signal that is output to the transmitter unit 102 and the speech-quality evaluation unit 103.

The transmitter unit 102 performs speech coding to the first speech signal according to need and transmits a second speech signal (the speech-coded first speech signal) to another
25 communication apparatus (not shown). The transmitter unit 102 transmits the second speech signal to another communication apparatus when it receives a transmission-mode signal from the PTT unit 104 while the PTT unit 104 is being pushed as described later.

The speech-quality evaluation unit 103 evaluates the speech quality of the second speech signal to be transmitted by the transmitter unit 102 based on the first speech signal input from the sound pick-up unit 101. Then, the speech-quality evaluation unit 103 outputs a speech-quality signal that indicates an evaluation
30 result (an evaluated speech quality of the second speech signal) to the light-emission control unit 105. In the first embodiment, the
35

speech-quality evaluation unit 103 evaluates the speech quality of the second speech signal to be transmitted by the transmitter unit 102 by determining the volume level of a voice sound picked up by the sound pick-up unit 101. When the volume level of a voice sound picked up by the sound pick-up unit 101 is lower than a specific reference level, it is determined that the voice sound cannot be clearly heard by a person who receives the second speech signal at his or her communication apparatus, hence evaluated as a bad speech quality.

10 The PTT unit 104 is a communication-mode switching unit to switch the transmission of the second speech signal from the transmitter unit 102. In detail, the PTT unit 104 switches a communication mode of the communication apparatus 100 between a transmission mode in which the transmitter unit 102 transmits the second speech signal and a standby mode in which the transmitter unit 102 does not transmit the second speech signal. When the PTT unit 104 is pushed, the operation mode, that is the communication mode, of the communication apparatus 100 is switched from the standby mode to the transmission mode for transmission of the second speech signal.

20 The standby mode is defined as a mode in which the communication apparatus 100 can detect a signal transmitted from another communication apparatus even if no transmitted signal is being received. In other words, the standby mode includes a reception waiting mode and a reception mode in which the communication apparatus 100 is receiving a radio wave. Moreover, the standby mode is defined as a mode in which the communication apparatus 100 performs no operation when the apparatus 100 is only for transmission use with no reception function. Accordingly, the standby mode is defined as these various modes, however, one requirement is that, in the standby mode, the transmitter unit 102 is not transmitting a speech signal. When the communication apparatus 100 is in-vehicle use, it is provided with a speaker.

35 The PTT unit 104 is, more in detail, a communication-mode switch attached to a main body of the communication apparatus

100. When a user starts talking, the user pushes the PTT unit 104 to switch the communication mode from the standby mode (a default mode) to the transmission mode. When the PTT unit 104 is pushed, a transmission-mode signal indicating that the communication mode has been switched from the standby mode to the transmission mode is output to the transmitter unit 102 and the light-emission control unit 105.

The light-emission control unit 105 controls a light emission state of the light-emitting device 106 to notify a user of a used condition of the communication apparatus 100 (that is, how the communication apparatus 100 is being used). The light-emitting device 106 is attached to the main body of the communication apparatus 100, that is an LED (Light Emitting Diode) in this embodiment. Based on the speech-quality signal output from the speech-quality quality unit 103, that indicates the speech quality and the transmission-mode signal output from the PTT unit 104, that indicates the transmission mode, the light-emission control unit 105 controls the light emission state of the light-emitting device 106.

The operation of the communication apparatus 100 will be explained with a flowchart shown in FIG. 2.

The light-emission control unit 105 determines whether the current communication mode is the transmission mode (step S101). If the PTT unit 104 is not pushed so that no transmission-mode signal is input, it is determined that the current communication mode is the standby mode (No in step S101). Thus, the light-emission control unit 105 turns off the light-emitting device 106 with no drive current supplied thereto (step S102). On the other hand, if the PTT unit 104 is pushed so that the transmission-mode signal is input, it is determined that the current communication mode is the transmission mode (Yes in step S101), then, the speech-quality evaluation unit 103 performs a speech-quality evaluation process (step S103).

Based on an evaluation result indicated by the speech-quality signal from the speech-quality evaluation unit 103, the light-emission control unit 105 determines whether a speech

signal to be transmitted by the transmitter unit 102 has a good speech quality (step S104). In other words, it is determined whether the speech-quality signal input from the speech-quality evaluation unit 103 indicates a good speech quality or bad speech quality.

As a result of step S104, if the speech quality is good (Yes in step S104), the light-emission control unit 105 repeatedly turns on and off the light-emitting device 106 with a drive current supplied thereto (step S105). On the other hand, if the speech quality is bad (No in step S104), the light-emission control unit 105 turns on the light-emitting device 106 with a drive current supplied thereto (step S106).

As described above, based on the communication mode switched by the PTT unit 104 and the speech-quality evaluation result at the speech-quality evaluation unit 103, the light-emission control unit 105 controls the light-emitting device 106 so that the light-emitting device 106 becomes in one of the three states: a turn-off state, a repeated turn-on-and-off state, and a turn-on state. With the three states of the light-emitting device 106, a used condition of the communication apparatus 100 is notified to a user. When the user visually recognizes the turn-on state of the light-emitting device 106, the user recognizes that the current speech quality is bad and takes an action to improve the speech quality, such as, bringing the microphone (the sound pick-up unit) 101 close to his or her mouth.

As described above, according to the first embodiment, in the simplex communication apparatus 100 that performs communication with switching of the communication mode between the transmission mode and the standby mode, it is achieved to notify a user of whether a voice incoming direction, a direction in which the user is talking into the microphone (the sound pick-up unit) 101, is good or bad and also whether the speech quality of a speech signal to be transmitted is good or bad. The notification can be achieved with the light-emitting device 106 (LED) attached to the main body of the communication apparatus 100.

In detail, as described above, the communication apparatus 100 in the first embodiment is provided with the PTT unit 104 (the communication-mode switching unit) for switching the communication mode between the standby mode and the transmission mode. When the PTT unit 104 is pushed, the light-emission control unit 105 controls the light-emitting device 106 to become the turn-on state that indicates the transmission mode from the turn-off state that indicates the standby mode. Moreover, based on a speech-quality evaluation result, the light-emission control unit 105 controls the light-emitting device 106 to become the repeated turn-on-and-off state that indicates a good speech quality from the turn-on state that indicates a bad speech quality, thereby notifying a user of a used condition of the communication apparatus 100. Accordingly, the user can take an action to improve the used condition of the communication apparatus 100 so that the speech quality of his or her voice sound can have a good speech quality when transmitted.

The communication apparatus 100 shown in FIG. 1 may be provided with a receiver unit for receiving a speech signal transmitted from another communication apparatus when the PTT unit 104 is not pushed so that the communication apparatus 100 is in the standby mode. In this case, a speech signal received by the receiver unit is decoded and given off by a speaker.

[Second Embodiment]

If a transmission apparatus is used in an environment of much noise, it may occur that, even if the volume level of a voice sound picked up a microphone is high enough, the speech quality gets worse because the voice sound is drowned out by the surrounding noise. In this case, it cannot be said that the volume level adequately represents the speech quality. Thus, there is a problem in that, even if the volume level exceeds a threshold level and an LED does not indicate a bad speech quality (if the transmission apparatus is equipped with an LED like the light-emitting device 106 in FIG. 1), a transmitted voice sound has a bad speech quality due to much noise, resulting in that a person

who receives the transmitted voice sound has a difficulty in hearing the voice sound.

Such a problem is remarkable, especially, in digital wireless transmission of a voice sound. When a voice sound is transmitted, it undergoes speech coding in bandwidth compression. However, 5 the speech coding is not performed well due to the surrounding noise, which results in a bad speech quality in the voice sound.

In order to solve such a problem discussed above, a communication apparatus according to a second embodiment has a feature in that the speech quality of a voice sound to be 10 transmitted is notified to a user of the communication apparatus to instruct improvement in a used condition of the communication apparatus, thereby improving speech quality.

FIG. 3 is a view showing the exterior appearance of a communication apparatus 200 (a noise cancellation microphone) 15 with a front view (a) and a rear view (b), according to the second embodiment of the present invention.

The communication apparatus 200 is provided with a noise cancellation microphone unit 220 and a wireless communication unit 240 connected to each other with a cord 230. The noise 20 cancellation microphone unit 220 in this embodiment corresponds to an audio input apparatus equipped mainly with microphones. Provided on the front face of the noise cancellation microphone unit 220 are a main microphone 201 (a first sound pick-up unit) and a speaker 212. Provided on the rear face of the noise-cancellation microphone unit 220 are a sub-microphone 202 (a second sound pick-up unit) and a belt clip 221 for holding the noise-cancellation microphone unit 220 by a belt. Provided at the top and the side 25 faces of the noise-cancellation microphone unit 220 are an LED 210 and a PTT unit 207, respectively. 30

The configuration of the communication apparatus 200 will be explained with reference to FIG. 4 that is a block diagram schematically showing the configuration of the communication apparatus according to the second embodiment of the present 35 invention.

The communication apparatus 200 is provided with a main microphone 201 (a first sound pick-up unit), a sub-microphone 202 (a second sound pick-up unit), a speech-segment determination unit 203, a noise-cancellation processing unit 204, a noise suppressor unit 205, a wireless transmitter unit 206, PTT unit (a communication-mode switching unit) 207, a speech-quality evaluation unit 208, an LED control unit 209, an LED 210, a wireless receiver unit 211, and a speaker 212 (a sound emission unit).

The main microphone 201 is a microphone attached to the noise-cancellation microphone unit 220 of the communication apparatus 200, for picking up a voice sound. A speech signal (a first speech signal) obtained by the main microphone 201 based on the voice sound is output to the speech-segment determination unit 203, the noise-cancellation processing unit 204, and the speech-quality evaluation unit 208. The sub-microphone 202 is also a microphone attached to the noise-cancellation microphone unit 220 of the communication apparatus 200, for picking up a voice sound. A speech signal (a second speech signal) obtained by the sub-microphone 202 is output to the noise-cancellation processing unit 204 and the speech-quality evaluation unit 208.

The main microphone 201 corresponds to a first sound pick-up unit for picking up mainly a user's voice sound, hence provided on the front face of the noise-cancellation microphone unit 220 as shown in (a) of FIG. 3. The sub-microphone 202 corresponds to a second sound pick-up unit for picking up mainly the surrounding noise for use in a noise cancellation process, hence provided on the rear face of the noise-cancellation microphone unit 220 as shown in (b) of FIG. 3. The arrangements of the main microphone 201 and the sub-microphone 202 on the front and rear faces, respectively, of the cancellation microphone unit 220 as shown in FIG. 3 is the best arrangement for an excellent noise cancellation effect, although the sub-microphone 202 may be provided on the side or bottom face of the noise cancellation microphone unit 220, or inside the microphone unit 220.

The speech-segment determination unit 203 performs speech segment determination based on a first speech signal input from the main microphone 201, to detect a speech segment that corresponds to a duration in which a user is taking into the communication apparatus 200. In detail, the speech-segment determination unit 203 converts the first speech signal input from the main microphone 201 into a signal component in unit of a specific length in the frequency domain and analyzes a spectrum component of the signal component thus converted into the frequency domain to determine whether it is a vowel, a consonant, or a noise component based on the analyzed spectrum component. The speech-segment determination unit 203 outputs a speech-segment indication signal that indicates a speech segment to the noise-cancellation processing unit 204 and the speech-quality evaluation unit 208.

The noise-cancellation processing unit 204 performs a noise cancellation process (noise-component suppressing process) based on the first and second speech signals input from the main microphone 201 and the sub-microphone 202, respectively. In detail, the noise-cancellation processing unit 204 is equipped with an adaptive filter to generate a reversed-phase component of a noise component mixed into a voice component at the main microphone 201, as a noise cancellation signal, based on a voice sound picked up by the sub-microphone 202. Then, the noise-cancellation processing unit 204 adds the first speech signal input from the main microphone 201 and the noise cancellation signal to suppress a noise component mixed into a voice component at the main microphone 201. A speech signal after the noise cancellation is output to the noise suppresser 205 and the speech-quality evaluation unit 208. In this embodiment, the noise-cancellation processing unit 204 performs the noise cancellation process to the first speech signal input from the main microphone 201 for each frame of a specific constant duration (256 samples, for example). A speech signal that has undergone the noise cancellation process, so that its noise component has been suppressed, is referred to as a noise-cancelled signal, hereinafter.

The noise suppressor unit 205 suppresses a noise component other than a voice component that appears on the frequency axis of the noise-cancelled signal input from the noise-cancellation processing unit 204. Then, the noise suppressor unit 205 returns a noise-component-suppressed signal into the time domain and outputs the signal to the wireless transmitter unit 206.

The wireless transmitter unit 206 performs speech coding to the signal from the noise suppressor unit 205 and modulates the signal after the speech coding with a carrier wave and transmits the signal to another wireless communication apparatus or the like.

In the following description, the noise suppressor unit 205 and the wireless transmitter unit 206 are referred to as a communication unit according to need.

The PTT unit 207 switches the operation of the wireless transmitter unit 206 between transmission and non-transmission of the noise-cancelled signal. In detail, the PTT unit 207 switches a communication mode of the communication apparatus 200 between a transmission mode in which the wireless transmitter unit 206 transmits a speech signal and a standby mode in which the wireless transmitter unit 206 is in a waiting mode for the transmission of a speech signal. A reception mode in which the wireless receiver unit 211 receives a speech signal transmitted from another communication apparatus is included in the standby mode mentioned above. When a user wants to receive a signal, the user switches the communication mode to the standby mode using the PTT unit 207. With the PTT unit 207, either one of the transmission mode and the standby mode is selected as the communication mode of the communication apparatus 200. When the user talks into the communication apparatus 200, the user pushes the PTT unit 207 to switch the communication mode from the standby mode to the transmission mode. Then, a transmission-mode signal indicating that the communication mode has been switched from the standby mode to the transmission mode is output to the wireless transmitter unit 206, the LED control unit 209, and the wireless receiver unit 211.

The speech-quality evaluation unit 208 evaluates the speech quality of the noise-cancelled signal input from the noise-cancellation processing unit 204 that is a speech signal to be transmitted from the wireless transmitter unit 206. Then, the
 5 speech-quality evaluation unit 208 outputs a speech-quality signal that indicates an evaluation result of speech quality to the LED control unit 209.

In this embodiment, the speech-quality evaluation unit 208 determines whether the speech quality of a speech signal to be
 10 transmitted from the wireless transmitter unit 206 is good or bad according to various factors, such as, a noisy environment or not, noise cancellation at the noise-cancellation processing unit 204 effective or not, and so on.

The speech-quality evaluation unit 208 may determine
 15 whether the noise cancellation is effective or not based on the level of attenuation of the first speech signal from the main microphone 201, that has undergone the noise cancellation process at the noise-cancellation processing unit 204. In this case, the speech-quality evaluation unit 208 calculates the level of
 20 attenuation of the first speech signal from the main microphone 201 after the noise cancellation process and determines that the noise cancellation is effective when the level of attenuation is equal to or higher than a specific threshold level. In detail, the speech-quality evaluation unit 208 compares average power of the
 25 first speech signal before the noise cancellation process and average power of a speech signal (noise-cancelled signal) after the noise cancellation process to determine whether the noise cancellation is effective based on a comparison result. This technique is based on the fact that a sound picked up by the main
 30 microphone 201 is a mixture of a user's voice sound and the surrounding noise and, if there is a specific level of attenuation or higher, it can be determined that the surrounding noise has been effectively suppressed.

The LED control unit 209 that corresponds to the
 35 light-emission control unit 105 in FIG. 1 supplies a drive current to the LED (a light-emitting device) 201 to control its light emission

state, based on the transmission-mode signal and the speech-quality signal from the PTT unit 207 and the speech-quality evaluation unit 208, respectively.

5 The wireless receiver unit 211 receives a speech signal transmitted from another communication apparatus. While receiving the transmission-mode signal from the PTT unit 207, the wireless receiver unit 211 does not receive a speech signal because the current communication mode is the transmission mode. The wireless receiver unit 211 decodes a received speech signal and
10 outputs the decoded speech signal to the speaker 212. The speaker 212 outputs the decoded speech signal as a voice sound.

Explained next is a speech-quality evaluation process performed by the communication apparatus 200 with respect to a flowchart of FIG. 5.

15 The speech-segment determination unit 203 performs a speech-segment determination process to determine whether a user is talking into the communication apparatus 200 based on the first speech signal input from the main microphone 201 (step S201). If no speech segment is detected (No in step S201), the
20 process returns to step S201 to continue the speech-segment determination process. On the other hand if a speech segment is detected (Yes in step S201), the speech-quality evaluation unit 208 performs the following signal-power calculation process (steps S202 to S204).

25 Firstly, the speech-quality evaluation unit 208 calculates average power per frame of the second speech signal input from the sub-microphone 202 (step S202). Then, the speech-quality evaluation unit 208 calculates average power per frame of the first speech signal input from the main microphone 201 before the noise
30 cancellation process (step S203). Next, the speech-quality evaluation unit 208 calculates average power per frame of the noise-cancelled signal input from the noise-cancellation processing unit 204 after the noise cancellation process (step S204).

35 Thereafter, the speech-quality evaluation unit 208 determines whether the average power per frame of the second

speech signal obtained in step S202 is equal to or higher than a specific threshold level Pth1 (step S205).

If it is determined that the average power per frame of the second speech signal is not equal to or higher than the threshold level Pth1 (No step S205), it is determined that the speech quality is good (step S208). This evaluation is based on a presumption that if the average power per frame of the second speech signal is lower than the threshold level Pth1, the communication apparatus 200 is being used in a quiet environment because a sound picked up by the sub-microphone 202 is mainly the surrounding noise. Therefore, it can be determined that the speech quality is good without affected by the surrounding noise.

On the other hand, if it is determined that the average power per frame of the second speech signal is equal to or higher than the threshold level Pth1 (Yes in step S205), the speech-quality evaluation unit 208 compares the average power per frame of the first speech signal before the noise cancellation process obtained in step S203 and the average power per frame of the noise-cancelled signal after the noise cancellation process obtained in step S204 (step S206).

If it is determined that a power ratio of the noise-cancelled signal to the first speech signal is higher than a specific threshold level Pth2 (No in step S206), it is determined that the speech quality is bad (step S209). This evaluation is based on a presumption that if the power ratio is higher than the threshold level Pth2, the surrounding noise has a specific power or more and there is no variation in the power before and after the noise cancellation process, and hence the noise cancellation is not effective.

On the other hand, if it is determined that the power ratio of the noise-cancelled signal to the first speech signal is equal to or lower than the threshold level Pth2 (Yes in step S206), the speech-quality evaluation unit 208 determines whether the average power per frame of the noise-cancelled signal after the noise cancellation process is equal to or higher than a specific threshold level Pth3 (step S207).

If it is determined that the average power per frame of the noise-cancelled signal is not equal to or higher than the threshold level Pth3 (No in step S207), it is determined that the speech quality is bad (step S209). This evaluation is based on a presumption that if the average power per frame of the noise-cancelled signal is lower than the threshold level Pth3, a user's voice sound is also affected by the noise cancellation process, so that the speech quality is bad and hence it is difficult for the user's voice sound to be clearly heard at another communication apparatus when the voice sound is transmitted thereto.

On the other hand, if it is determined that the average power per frame of the noise-cancelled signal is equal to or higher than the threshold level Pth3 (Yes in step S207), it is determined that a preferable sound level is maintained and hence the speech quality is good (step S208).

The good evaluation result in step S208 or the bad evaluation result in step S209 is output to the LED control unit 209, as the speech-quality signal indicating the speech quality.

In the same manner as shown in FIG. 2 in first embodiment, the LED control unit 209 determines whether the current communication mode is the transmission mode based on the transmission-mode signal from the PTT unit 207. Moreover, in the same manner as shown in FIG. 2, the light-emission control unit 105 determines whether a speech signal to be transmitted by the transmitter unit 102 has a good speech quality based on an evaluation result indicated by the speech-quality signal from the speech-quality evaluation unit 103.

Based on a table shown in FIG. 6 that lists communication modes, speech-quality evaluation results, and LED states, the LED control unit 209 controls LED 210, as follows.

When the PTT unit 207 is pushed so that the communication mode is the transmission mode and the speech quality is evaluated as good, the LED control unit 209 supplies a drive current to the LED 210 to put the LED 210 in a repeated turn-on-and-off state that indicates a normal transmission mode with a good speech quality.

On the other hand, when the PTT unit 207 is pushed so that the communication mode is the transmission mode and the speech quality is evaluated as bad, the LED control unit 209 supplies a drive current to the LED 210 to put the LED 210 in a turn-on state that indicates the necessity of improvement in speech quality. Moreover, when the PTT unit 207 is pushed so that the communication mode is the transmission mode, however, no speech-quality signal is input, the LED control unit 209 supplies a drive current to the LED 210 to put the LED 210 in a turn-on state that indicates the transmission mode. There is a case in which the speech-segment determination unit 203 does not detect a speech segment if no speech-quality signal is input. In this case, the speech-quality evaluation process shown in FIG. 5 does not start so that the speech-quality evaluation unit 208 does not output a speech-quality signal to the LED control unit 209. When the PTT unit 207 is pushed to output the transmission mode, however, no speech-quality signal is input, the LED control unit 209 supplies a drive current to the LED 210 to put the LED 210 in a turn-on state that indicates that although the communication mode is the transmission mode, a user is not talking into the communication apparatus 200 which is a duration of a non-speech segment.

As described above, in this embodiment, the emission state of the LED 210 during a non-speech segment in the transmission mode and the emission state of the LED 210 during a speech segment with a bad speech quality in the transmission mode are controlled in the same manner, that is, the LED 210 is put in a turn-on state in both cases. This LED control technique makes a user visually recognize that his or her voice sound is not appropriately input to the communication apparatus 200.

When a user visually recognizes that the emission state of the LED 210 is not switched from the turn-on state to the repeated turn-on-and-off state although the user is talking into the communication apparatus 200, the user recognizes that the communication apparatus 200 is not used appropriately. Then, the user tries to change the turn-on state of the LED 210 to the repeated turn-on-and-off state by changing the way of holding the

main microphone 201, the direction in which the user is talking into the main microphone 201, the distance between the user's mouth to the main microphone 201, etc. Accordingly, with the change in emission state of the LED 210, the user can be instructed to
5 improve the use of the communication apparatus 200, thereby improving the speech quality of a speech signal to be transmitted to another communication apparatus.

On the other hand, when the PTT unit 207 is not pushed, so that the communication mode is not the transmission mode but the
10 standby mode, the LED control unit 209 supplies no drive current to the LED 210 so that the LED 210 remains in the turn-off state.

As described above, the communication apparatus according to the second embodiment is provided with the two microphones and has the noise cancellation function to a speech
15 signal to be transmitted so that a user's voice sound is not drown out by the surrounding noise, thereby achieving transmission of a clear sound to another communication apparatus even if the level of the surrounding noise is high.

Nevertheless, even if a communication apparatus is
20 equipped with a noise cancellation function, it could happen that the noise cancellation function does not work effectively so that it causes a bad speech quality to a speech signal to be transmitted to another communication apparatus. Especially, in the case of a simplex communication apparatus that cannot perform
25 transmission and reception at the same time, no information of a bad speech quality can be sent from another communication apparatus while a user is talking into the simplex communication apparatus. It could therefore happen that the user is continuously talking into the simplex communication apparatus without
30 recognizing a bad speech quality.

In order to solve such a problem discussed above, in the communication apparatus 200 according to the second
embodiment, the speech quality to be felt by a person who receives a voice sound transmitted from the communication
35 apparatus 200 is assumed based on the determination of whether the noise cancellation function is working effectively with the

combination of determination on the average power of speech signals from the main microphone and the sub-microphone, and the power ratio of the noise-cancelled signal to the speech signal from the main microphone. Then, if it is determined that the speech quality requires improvement, the LED 210 can be used effectively to notify a user of the necessity of improvement in speech quality.

[Third Embodiment]

The communication apparatus 200 according to the second embodiment performs the speech quality evaluation depending on whether the noise cancellation function is working effectively. With this technique, it is possible to perform more reliable speech quality evaluation than speech quality evaluation based on the main-microphone volume level.

However, there are cases in which the communication apparatus 200 according to the second embodiment erroneously determines that the noise cancellation function is working effectively even if it is not working effectively. One case is that the main microphone 201 of the noise cancellation microphone unit 220 (FIG. 3) of the communication apparatus 200 is not positioned in front of a user. In this case, it could happen that the voice component of a user's voice sound is picked up at a higher level by the sub-microphone 202 provided on the rear face of the noise-cancellation microphone unit 202 as shown in (b) of FIG. 3, in addition to the main microphone 201. The noise-cancellation processing unit 204 (FIG. 4) performs the noise cancellation process by using a signal from the sub-microphone 202 as a reference signal. Thus, in the above case, it could happen that a voice component picked up by the sub-microphone 202 is erroneously determined as a noise component, so that a voice component which should remain is inevitably eliminated from a speech signal output from the main microphone 201.

Moreover, in the above case, if there is an intense noise source in front of a user, instead of the noise-cancellation microphone unit 220 as shown in (a) of FIG.3, a noise component from the noise source is picked by the main microphone 201, and

hence the level of signal power of a noise-cancelled signal output from the noise-cancellation processing unit 204 may exceed a threshold level. Thus, it could happen that through the evaluations in steps S205 to S207, it is erroneously determined
 5 that the speech quality is good, as a final result.

In order to solve such a problem discussed above, the present invention provides a communication apparatus as a third embodiment that evaluates the speech quality reliably and notifies an evaluation result to a user, even in the cases discussed above.

10 FIG. 7 is a block diagram schematically showing the configuration of a communication apparatus 300 according to the third second embodiment of the present invention.

As shown in FIG. 7, the communication apparatus 300 is provided with a speech-segment determination unit 303, a
 15 microphone-direction determination unit 313, and a speech-quality evaluation unit 308 that is equipped with a noise-cancellation effect evaluation unit 314 and an overall evaluation unit 315, in addition to the units 201, 202, 204, 205, 206, 207, 209, 210, 211, and 212 that correspond to those shown in FIG. 4, respectively. The
 20 communication apparatus 300 has the same exterior appearance as the communication apparatus 200 as shown in FIG. 3.

The speech-segment determination unit 303 determines whether or not a first speech signal input from the main microphone 201 is a speech segment of a user's voice sound by
 25 way of spectrum analysis with conversion of the first speech signal into a signal component in unit of a specific length in the frequency domain. The speech-segment determination unit 303 outputs a result of speech segment determination to the noise-cancellation processing unit 204, the microphone-direction determination unit
 30 313, and the noise-cancellation effect evaluation unit 314.

While the speech-segment determination unit 303 is determining that the first speech signal input from the main microphone 201 is a speech segment, the microphone-direction determination unit 313 detects a phase difference between the first
 35 speech signal output from the main microphone 201 and a second speech signal output from the sub-microphone 202. Then, the

microphone-direction determination unit 313 detects a direction of the main microphone 201 (a main-microphone direction, hereinafter) with respect to a user based on the phase difference. Then, the microphone-direction determination unit 313 outputs a determination result on the main-microphone direction to the overall evaluation unit 315, as a first evaluation result.

FIG. 8 is a view illustrating a direction-to-phase relationship of the communication apparatus 300 with respect to a user, or a phase difference between voice sounds depending on the main-microphone direction.

As shown in (a) of FIG. 8, when a user faces the communication apparatus 300 at the front side with the main microphone 201 attached thereto, in a normal used condition, there is a large phase difference between a voice sound that is picked up by the main microphone 201 through a straight path and a voice sound that is picked up by the sub-microphone 202 through a roundabout path. On the other hand, as shown in (b) of FIG. 8, when the communication apparatus 300 is inclined toward a user, there is a small phase difference between voice sounds picked up by the main microphone 201 and the sub-microphone 202 due to a shorter distance between the user's mouth and the two microphones. In particular, when the main microphone 201 attached to the communication apparatus 300 at the front side is inclined toward a user at 90 degrees, the distances from the user's mouth to the main microphone 201 and to the sub-microphones 202 are almost equal to each other, so that the phase difference is almost zero.

Under consideration of the change in phase difference depending on the positional relationship between a user and the communication apparatus 300 discussed above, the microphone-direction determination unit 313 compares a phase difference detected between the first and second speech signals output from the main microphone 201 and the sub-microphone 202, respectively, with a specific threshold value. When the phase difference is smaller than the specific threshold value, the microphone-direction determination unit 313 assumes that the

main-microphone direction is not toward a user, such as shown in (b) of FIG. 8 and determines that the user is not using the communication apparatus 300 appropriately. On the other hand, when the phase difference is equal to or larger than the specific threshold value, the microphone-direction determination unit 313 assumes that the main-microphone direction is toward a user, such as shown in (a) of FIG. 8, and determines that the user is using the communication apparatus 300 appropriately.

The noise-cancellation effect evaluation unit 314 determines whether the noise cancellation function of the noise-cancellation processing unit 204 is working effectively and outputs an evaluation result to the overall evaluation unit 315, as a second evaluation result.

The overall evaluation unit 315 performs overall evaluation of: the average power of the second speech signal from the sub-microphone 202 in the same manner as the speech-quality evaluation unit 208 described with respect to FIG. 5; the first evaluation result from the microphone-direction determination unit 313; and the second evaluation result from the noise-cancellation effect evaluation unit 314, to determine the speech quality of a speech signal to be transmitted from the wireless transmitter unit 206. The speech quality of a voice sound comprehensively determined by the overall evaluation unit 315 is output to the LED control unit 209, as a speech-quality signal, for emission control of the LED 210.

Explained next is a microphone-direction determination process performed by the microphone-direction determination unit 313, with respect to a flowchart of FIG. 9.

The microphone-direction determination unit 313 compares the phases of first and second speech signals input from the main microphone 201 and the sub-microphone 202, respectively, to detect a phase difference therebetween (step S301). Then, the microphone-direction determination unit 313 compares the phase difference between the first and second speech signals with a specific threshold value to determine whether the phase difference is equal to or larger than the specific threshold value (step S302).

The comparison of phase difference is done based on the fact that the change in orientation of the main microphone 201 directly reflected in the phase difference as discussed with reference to FIG. 8.

5 If the phase difference is equal to or larger than the specific threshold value (Yes in step S302), the microphone-direction determination unit 313 assumes that the positional relationship between the main microphone 201 and the user's mouth is good, such as shown in (a) of FIG. 8, and determines that the user is
10 using the communication apparatus 300 appropriately. On the other hand, if the phase difference is smaller than the specific threshold value (No in step S302), the microphone-direction determination unit 313 assumes that the positional relationship between the main microphone 201 and the user's mouth is bad,
15 such as shown in (b) of FIG. 8, and determines that the user is using the communication apparatus 300 inappropriately.

 Then, the microphone-direction determination unit 313 outputs a determination result obtained in step S303 or S304 to the overall evaluation unit 315 of the speech-quality evaluation
20 unit 308, as a first determination result that indicates whether or not the main-microphone direction is appropriate, that is, whether or not the communication apparatus 300 is used appropriately.

 Explained next is a noise-cancellation effect evaluation process performed by the noise-cancellation effect evaluation unit
25 314, with respect to a flowchart of FIG. 10.

 The noise-cancellation effect evaluation unit 314 is in a waiting mode to receive a speech-segment indication signal that is generated by the speech-segment determination unit 303 when it determines that a first speech signal input from the main
30 microphone 201 is a speech segment (step S311). When the speech-segment indication signal is input (Yes in step S311), the noise-cancellation effect evaluation unit 314 performs step S312, whereas if not (No in step S311), it is still in the waiting mode to receive the speech-segment indication signal.

35 In step S312, the noise-cancellation effect evaluation unit 314 calculates average power of a first speech signal from the main

microphone 201 for one frame before the noise-cancellation processing unit 204 performs the noise cancellation process per one frame (step S312). Next, the noise-cancellation effect evaluation unit 314 calculates average power of a noise-cancelled signal from the noise-cancellation processing unit 204 (step S313).

Thereafter, the noise-cancellation effect evaluation unit 314 compares the average power of the first speech signal before the noise cancellation process and the average power of the noise-cancelled signal after the noise cancellation process to determine whether an average power ratio of the noise-cancelled signal to the first speech signal is equal to or lower than a threshold level Pth2 (step S314).

If the average power ratio is higher than the threshold level Pth2 (No in step S314), the noise-cancellation effect evaluation unit 314 determines that the noise cancellation function is not working effectively (step S317). On the other hand, if the average power ratio is equal to or lower than the threshold level Pth2 (Yes in step S314), the noise-cancellation effect evaluation unit 314 determines whether the average power of the noise-cancelled signal is equal to or higher than a threshold level Pth3 (step S315).

If the average power of the noise-cancelled signal is lower than the threshold level Pth3 (No in step S315), the noise-cancellation effect evaluation unit 314 determines that the noise cancellation function is not working effectively (step S317). On the other hand, if the average power of the noise-cancelled signal is equal to or higher than the threshold level Pth3 (Yes in step S315), the noise-cancellation effect evaluation unit 314 determines that the noise cancellation function is working effectively (step S316).

Then, the noise-cancellation effect evaluation unit 314 outputs an evaluation result in step S316 or S317 to the overall evaluation unit 315, as a second determination result (step S318).

As described above, the noise-cancellation effect evaluation unit 314 determines whether or not the noise cancellation function is working effectively by using the signals before and after the noise cancellation process performed by the noise-cancellation

processing unit 204. In this embodiment, if it is determined that the noise cancellation function is working effectively, it means that a surrounding-noise component is effectively eliminated from a speech signal that is a mixture of a voice component and the surrounding-noise component so that much of the voice component remains in the speech signal.

Therefore, when a surrounding-noise component is effectively eliminated from a speech signal by the noise cancellation process, signal power P_{nc} of a speech signal after the noise cancellation process is lower than signal power P_{ic} of a speech signal before the noise cancellation process by the degree of signal power of a surrounding-noise component. Accordingly, the determination of whether or not the noise cancellation function is working effectively is made by comparing the signal power P_{ic} and P_{nc} before and after the noise cancellation process, as explained below.

There are two ways for the noise-cancellation effect evaluation unit 314 to determine whether or not the noise cancellation function is working effectively.

One way is to determine whether the signal power P_{in} and P_{nc} meet either the following relational expression (1-a) or (1-b):

$$(1-a) (P_{nc}/P_{in}) < P_{th2}$$

$$(1-b) (P_{nc}-P_{in}) > P_{th2}' \quad (P_{th2}' \neq P_{th2})$$

Another way is, after the evaluation with the relational expression (1-a) or (1-b) is performed, to determine whether the signal power P_{nc} meets the following relational expression (2):

$$(2) P_{nc} > P_{th3}$$

With the relational expression (2), it can be determined whether a voice component that has to remain in a speech signal has been eliminated from the speech signal, in addition to a surrounding-noise component.

Explained next is an overall evaluation process performed by the overall evaluation unit 315, with respect a flowchart of FIG. 11.

The overall evaluation unit 315 calculates average power per frame of the second speech signal input from the

sub-microphone 202 (step S321). Then, the overall evaluation unit 315 determines whether the average power per frame of the second speech signal is equal to or higher than a specific threshold level Pth1 (step S322).

5 If it is determined that the average power per frame of the second speech signal is not equal to or higher than the threshold level Pth1 (No step S322), it is determined that the speech quality is good (step S327). This evaluation is based on a presumption
10 that if the average power per frame of the second speech signal is lower than the threshold level Pth1, the communication apparatus 300 is being used in a quiet environment because a sound picked up by the sub-microphone 202 is mainly the surrounding noise. Therefore, it can be determined that the speech quality is good without affected by the surrounding noise.

15 On the other hand, if it is determined that the average power per frame of the second speech signal is equal to or higher than the threshold level Pth1 (Yes in step S322), the overall evaluation unit 315 receives the first determination result from the microphone-direction determination unit 313 (step S323). Then,
20 the overall evaluation unit 315 determines whether the first evaluation result shows a good result (step S324). If the first evaluation result shows a bad result (No step S324) that indicates a bad positional relationship between the main microphone 201 and the user's mouth as discussed with respect to (b) of FIG. 8,
25 the overall evaluation unit 315 determines that the speech quality is bad (step S328). On the other hand, if the first evaluation result shows a good result (Yes in step S324), the overall evaluation unit 315 receives the second evaluation result from the noise-cancellation effect evaluation unit 314 (step S325).

30 Then, the overall evaluation unit 315 determines whether the second evaluation result shows a good result (step S326). If the second evaluation result shows a bad result (No in step S326) that indicates that the noise cancellation function is not working effectively, the overall evaluation unit 315 determines that the
35 speech quality is bad (step S328). On the other hand, if the second evaluation result shows a good result (Yes in step S326),

that is, the noise cancellation function is working effectively, the overall evaluation unit 315 determines that the speech quality is good (step S327). Then, the overall evaluation unit 315 outputs a speech-quality signal that carries information on the result in step
 5 S327 or S328 to the LED control unit 209 (step S329).

The noise-cancellation effect evaluation unit 314 may perform the noise-cancellation effect evaluation process only when the noise cancellation process is performed or should be performed. For example, the noise-cancellation effect evaluation unit 314 may
 10 perform the noise-cancellation effect evaluation process when the second speech signal from the sub-microphone 202 has power equal to or higher than a specific level or a flag is set to indicate that the noise cancellation process is being performed. The noise-cancellation processing unit 204 may perform the noise
 15 cancellation process when the second speech signal has power equal to or higher than a specific level. The noise-cancellation processing unit 204 may also perform the noise cancellation process depending on a voice incoming direction of a voice sound based on the phase difference between the first and second speech
 20 signals.

Explained next is an operation of the LED control unit 209 with respect the flowchart shown in FIG. 2 because the operation of the LED control unit 209 of the third embodiment is similar to that of the light-emission control unit 105 of the first embodiment.

25 The LED control unit 209 checks the current communication mode at a specific interval of, for example, 1/30 seconds, to determine whether the communication mode has been switched to the transmission mode through the PTT unit 207 pushed by a user (step S101). If the PTT unit 207 has not been pushed so that the
 30 current communication mode has been set to the standby mode (No in step S101), the LED control unit 209 turns off the light-emitting device 106 with no a drive current supplied thereto (step S102). On the other hand, if the PTT unit 207 has been pushed so that the current communication mode has been set to
 35 the transmission mode (Yes in step S101), the LED control unit 209 receives the speech-quality signal from the overall evaluation unit

315 (step S103) to check the speech quality indicated by the speech-quality signal (step S104). If the speech quality is good (Yes in step S104), the LED control unit 209 repeatedly turns on and off the LED 210 with a drive current supplied thereto (step S105). On the other hand, if the speech quality is bad (No in step S104), the light-emission control unit 105 turn on the light-emitting device 106 with a drive current supplied thereto (step S106).

As described above, in the communication apparatus 300 according to the third embodiment, an LED emission state is controlled with overall evaluation of the noise cancellation effect and the main-microphone direction, to effectively notify a user of the speech quality.

[Fourth Embodiment]

FIG. 12 is a block diagram schematically showing the configuration of an audio input apparatus 1000 according to a fourth embodiment of the present invention.

The audio input apparatus 1000 is provided with a sound pick-up unit 1001, a transmitter unit 1002, a sound pick-up state evaluation unit 1003, a transmission instruction unit 1004, a light-emission control unit 1005, and a light emission unit 1006. The units 1001, 1002, 1005, and 1006 correspond to the units 101, 102, 105, and 107 shown in FIG.1, respectively.

The sound pick-up unit 1001 picks up a voice sound and generates a speech signal that is output to the transmitter unit 102 and the sound pick-up state evaluation unit 1003. The transmitter unit 102 transmits the speech signal to another communication apparatus while it is receiving a transmission instruction signal from the transmission instruction unit 1004.

The sound pick-up state evaluation unit 1003 evaluates a sound pick-up state of a speech signal to be transmitted from the transmitter unit 1002 based on the speech signal input from the sound pick-up unit 1001. The sound pick-up state to be evaluated by the sound pick-up state evaluation unit 1003 is a feature of the speech signal to be transmitted from the transmitter unit 1002, based the result of determination of a speech segment and

evaluation of speech quality. The sound pick-up state evaluation unit 1003 outputs sound pick-up state information that indicates an evaluation result of the sound pick-up state to the light-emission control unit 1005.

5 The transmission instruction unit 1004 instructs the transmitter unit 1002 to transmit a speech signal. The transmission instruction unit 1004 is connected to a PTT switch. When the PTT switch is pushed, the transmission instruction unit 1004 outputs a transmission instruction signal to the transmitter
10 unit 1002 and the light-emission control unit 1005. When the transmission instruction unit 1004 outputs the transmission instruction signal to the transmitter unit 1002, the communication mode of the audio input apparatus 1000 is switched from the standby mode in which the transmitter unit 1002 does not transmit
15 a speech signal to the transmission mode in which the transmitter unit 1002 transmits a speech signal.

 The light-emission control unit 1005 controls the emission state of the light emission unit 1006 to notify a user of how the audio input apparatus 1000 is being used concerning the positional
20 relationship between the user and microphones as discussed with respect to FIG. 8. The light emission unit 1006 in this embodiment is an LED attached to the main frame of the audio input apparatus 1000. The light-emission control unit 1005 controls the emission state of the LED (light emission unit) 1006
25 based on the transmission instruction signal from the transmission instruction unit 1004 and the sound pick-up state information from the sound pick-up state evaluation unit 1003. In detail, the light-emission control unit 1005 turns on the LED 1006 if the transmission instruction signal is input, a speech segment is
30 detected, and the speech quality is lower than a specific threshold level. Moreover, the light-emission control unit 1005 repeatedly turns on and off the LED 1006 if the transmission instruction signal is input, a speech segment is detected, and the speech quality is equal to or higher the specific threshold level. However, the
35 light-emission control unit 1005 turns off the LED 1006 if no transmission instruction signal is input.

As described above, the audio input apparatus 1100 is provided with the sound pick-up unit 1001 for picking up a voice sound to generate a speech signal, the transmitter unit 1002 for transmitting the speech signal, the transmission instruction unit 1004 for instructing the transmitter unit 1002 to transmit the speech signal, the sound pick-up state evaluation unit 1003 for evaluating a sound pick-up state of the speech signal to be transmitted by the transmitter unit 1002, and the light-emission control unit 1005 for controlling the emission state of the light emission unit 1006. In this embodiment, the light emission unit 1006 is an LED, so that the light-emission control unit 1005 controls the emission state of the LED 1006, among the turn-on state, the turn-off state, and the repeated turn-on-and-off state, based on the sound pick-up state evaluated by the sound pick-up state evaluation unit 1003.

The sound pick-up state evaluation unit 1003 may be equipped with a volume-level measuring device for measuring the volume level of a speech signal input from the sound pick-up unit 1001, as a sound pick-up state of a speech signal to be transmitted from the transmitter unit 1002 to be evaluated. In this case, the light-emission control unit 1005 controls the emission state of the LED 1006 in the following three ways. While the transmission instruction unit 1004 is not instructing the transmitter unit 1002 to transmit a speech signal, the light-emission control unit 1005 turns off the LED 1006. While the transmission instruction unit 1004 is instructing the transmitter unit 1002 to transmit a speech signal, however, the volume level of this speech signal is lower than a specific reference level, the light-emission control unit 1005 turns on the LED 1006. Moreover, while the transmission instruction unit 1004 is instructing the transmitter unit 1002 to transmit a speech signal and the volume level of this speech signal is equal to or higher than the reference level, the light-emission control unit 1005 repeatedly turns on and off the LED 1006.

Control of the emission state of the LED 1006 by the light-emission control unit 1005 will be described in detail.

For the emission-state control, the sound pick-up state evaluation unit 1003 has a speech-segment determination function and a speech-quality evaluation function, like the speech-segment determination unit 203 and the speech-quality evaluation unit 208, respectively, shown in FIG. 4, for evaluating a sound pick-up state of the speech signal to be transmitted by the transmitter unit 1002. In detail, for sound pick-up state evaluation, the sound pick-up state evaluation unit 1003 determines whether a signal input from the sound pick-up unit 1001 is a speech segment. Moreover, for sound pick-up state evaluation, the sound pick-up state evaluation unit 1003 evaluates the speech quality of a speech segment to be transmitted from the transmitter unit 1002. The results of speech-segment determination and speech-quality evaluation are output to the light-emission control unit 1005, as speech-segment information and speech-quality information, respectively, which are expressed as sound pick-up state information in FIG. 12.

FIG. 13 is a table listing communication modes, sound pick-up state evaluation results, and LED states under control by the light-emission control unit 1005. FIG. 14 is a flowchart showing a light-emission control process to be performed by the light-emission control unit 1005. The light-emission control process will be described with reference to FIGS. 13 and 14.

The light-emission control unit 1005 determines per frame whether a transmission instruction signal is input from the transmission instruction unit 1004 (step S1001). If no transmission instruction signal is input (No in step S1001), the light-emission control unit 1005 determines that the PTT switch connected to the transmission instruction unit 1004 is not pushed so that the transmission instruction unit 1004 does not output a transmission instruction signal, hence the audio input apparatus 1000 is in the standby mode. Then, the light-emission control unit 1005 turns off the LED 1006 as shown in No. 1 of FIG. 13 (step S1002).

On the other hand, if a transmission instruction signal is input (Yes in step S1001), the light-emission control unit 1005 determines whether the speech segment information input from

the sound pick-up state evaluation unit 1003 indicates a speech segment (step S1003). If the speech segment information does not indicate a speech segment (No in step S1003), the light-emission control unit 1005 determines that the PTT switch is being pushed so that the transmission instruction unit 1004 outputs a transmission instruction signal, hence the audio input apparatus 1000 is in the transmission mode, however, a user is not talking into the audio input apparatus 1000. Then, the light-emission control unit 1005 turns on the LED 1006 as shown in No. 2 of FIG. 13 (step S1004).

On the other hand, if the speech segment information indicates a speech segment (Yes in step S1003), the light-emission control unit 1005 determines whether the speech quality information input from the sound pick-up state evaluation unit 1003 indicates a good speech quality (step S1005). If the speech quality is not good (No in step S1005), the light-emission control unit 1005 determines that, although a user is talking into the audio input apparatus 1000, the used condition of the audio input apparatus 1000 discussed with respect to FIG. 8 is not appropriate so that a good speech quality is not maintained. Then, the light-emission control unit 1005 turns on the LED 1006 as shown in No. 3 of FIG. 13 (step S1006). On the other hand, if the speech quality is good (Yes in step S1005), the light-emission control unit 1005 determines that the used condition of the audio input apparatus 1000 is appropriate so that a good speech quality is maintained. Then, the light-emission control unit 1005 repeatedly turns on and off as shown in No. 4 of FIG. 13 (step S1007).

As described above, in the audio input apparatus (the communication apparatus) 1000 according to the fourth embodiment, the sound pick-up state evaluation unit 1003 determines whether a signal input from the sound pick-up unit 1001 is a speech segment and evaluates the speech quality of a speech signal to be transmitted from the transmitter unit 1002, to evaluate a sound pick-up state. With the evaluation of a sound pick-up state, the light-emission control unit 1005 controls the LED 1006 in the manner described below.

When the transmission instruction unit 1004 does not instruct the transmitter unit 1002 to transmit a speech signal, the light-emission control unit 1005 turns off the LED 1006. When the transmission instruction unit 1004 instructs the transmitter unit 1002 to transmit a speech signal, however, a signal input from the sound pick-up unit 1001 is not a speech segment, the light-emission control unit 1005 turns on the LED 1006. When the transmission instruction unit 1004 instructs the transmitter unit 1002 to transmit a speech signal, a signal input from the sound pick-up unit 1001 is a speech segment, and the speech quality is lower than a specific threshold level, the light-emission control unit 1005 turns on the LED 1006. Moreover, when the transmission instruction unit 1004 instructs the transmitter unit 1002 to transmit a speech signal, a signal input from the sound pick-up unit 1001 is a speech segment, and the speech quality is equal to or higher than the specific threshold level, the light-emission control unit 1005 repeatedly turns on and off the LED 1006.

As described above, the light-emission control unit 1005 controls the emission state of the light emission unit 1006 (that is the on-off state of the LED) according to the light-emission control process shown in FIG. 14, to properly notify a user of the speech quality.

[Fifth Embodiment]

FIG. 15 is a block diagram schematically showing the configuration of an audio input apparatus (a communication apparatus) 2000 according to a fifth embodiment of the present invention.

The audio input apparatus 1200 is provided with a first sound pick-up unit 1021, a second sound pick-up unit 1022, a noise-cancellation processing unit 1007, a noise suppressor unit 1008, a transmitter unit 1002, a transmission instruction unit 1004, a sound pick-up state evaluation unit 1003, a light-emission control unit 1005, and a light emission unit 1006. The sound pick-up state evaluation unit 1003 has a noise-cancellation effect evaluation unit 1010, a microphone-direction determination unit

1011, a speech-quality evaluation unit 1012, and a speech-segment determination unit 1009.

5 The basic configuration of the audio input apparatus 2000 is the same as the audio input apparatus 1000 of the fourth embodiment shown in FIG. 12. However, the audio input apparatus 2000 has the noise-cancellation processing unit 1007 and the noise suppressor unit 1008 for a noise suppression process in the time and frequency domain, respectively, to improve the speech quality of a speech signal to be transmitted.

10 The noise-cancellation processing unit 1007 and the noise suppressor unit 1008 correspond to the noise-cancellation processing unit 204 and the noise suppressor unit 205, respectively, shown in FIG. 4, hence the explanation of the units 1007 and 1008 being omitted. Moreover, the noise-cancellation effect evaluation unit 1010, the microphone-direction determination unit 1011, the speech-quality evaluation unit 1012, and the speech-segment determination unit 1009 correspond to the noise-cancellation effect evaluation unit 314 (FIG. 7), the microphone-direction determination unit 313 (FIG. 7), the speech-quality evaluation unit 103 (FIG. 1), and the speech-segment determination unit 203 (FIG. 4), respectively, hence the explanation of the units 1009 to 1012 being omitted.

25 In the fifth embodiment, the light-emission control unit 1005 receives both of speech-segment and speech-quality information from the sound pick-up state evaluation unit 1003, for control of the light emission unit 1006. However, as a variation to the fifth embodiment, the sound pick-up state evaluation unit 1003 may perform speech-segment determination only (with no speech-quality evaluation) so that the light-emission control unit 1005 can control the light emission unit 1006 based on the speech-segment information only. Moreover, as another variation to the fifth embodiment, the sound pick-up state evaluation unit 1030 may output information on the volume of a speech signal obtained by the first sound pick-up unit 1021 so that the light-emission control unit 1005 can control the light emission unit 1006 based on the volume information.

[Sixth Embodiment]

FIG. 16 is a block diagram schematically showing the configuration of an audio input apparatus 1100 according to a sixth embodiment of the present invention.

5 The audio input apparatus 1100 is provided with a first sound pick-up unit 1101, a second sound pick-up unit 1102, a noise-cancellation processing unit 1103, a speech-quality evaluation unit 1104, and an evaluation-result notification unit 1105.

10 The first sound pick-up unit 1101 is a microphone attached to the audio input apparatus 1100 to pick up a voice sound. A speech signal (a first speech signal) obtained by the first sound pick-up unit 101 based on the voice sound is output to the noise-cancellation processing unit 1103. The second sound
15 pick-up unit 1102 is also a microphone attached to the audio input apparatus 1100 to pick up a voice sound. A speech signal (a second speech signal) obtained by the second sound pick-up unit 1102 based on the voice sound is also output to the noise-cancellation processing unit 1103.

20 The first sound pick-up unit 1101 corresponds to a main microphone for picking up mainly a user's voice sound, hence provided on the front face of the audio input apparatus 1100. The second sound pick-up unit 1102 corresponds to a sub-microphone for picking up mainly the surrounding noise for use in a noise
25 cancellation process, hence provided on the rear face of the audio input apparatus 1100. The arrangements of the first sound pick-up unit (the main microphone) 1101 and the second sound pick-up unit (the sub-microphone) 1102 on the front and rear faces, respectively, of the audio input apparatus 1100 is the best
30 arrangement for an excellent noise cancellation effect, although the second sound pick-up unit 1102 may be provided on the side or bottom face of the audio input apparatus 1100, or inside the audio input apparatus 1100.

35 The noise-cancellation processing unit 1103 performs a noise-cancellation process (a noise-component suppression process) based on the first speech signal and the second speech

signal (used as a reference signal) input from the main microphone 1101 and the sub-microphones 1102, respectively.

In this embodiment, the noise-cancellation processing unit 1103 performs the noise cancellation process to the first speech
 5 signal input from the main microphone 1101 for each frame of a specific constant duration (256 samples, for example). In detail, the noise-cancellation processing unit 1103 is equipped with an adaptive filter to generate a reversed-phase component of a noise
 10 component mixed into a voice component at the main microphone 1101, as a noise cancellation signal, based on a voice sound picked up by the sub-microphone 1102. Then, the noise-cancellation processing unit 1103 adds the first speech signal input from the main microphone 1101 and the noise cancellation signal to
 15 suppress a noise component mixed into a voice component at the main microphone 1101. A speech signal after the noise cancellation is output to the speech-quality evaluation unit 1104.

The speech-quality evaluation unit 1104 evaluates the speech quality of the noise-cancelled signal input from the noise-cancellation processing unit 1103 and outputs an evaluation
 20 result to the evaluation-result notification unit 1105. The speech-quality evaluation unit 1104 evaluates the speech quality of the noise-cancelled signal based on whether the noise cancellation is effective or not at the noise-cancellation processing unit 1103.

The speech-quality evaluation unit 1104 may determine
 25 whether the noise cancellation is effective or not based on the level of attenuation of the first speech signal from the main microphone 1101, that has undergone the noise cancellation process at the noise-cancellation processing unit 1103. In this case, the speech-quality evaluation unit 1104 calculates the level of
 30 attenuation of the first speech signal from the main microphone 1101 after the noise cancellation process and determines that the noise cancellation is effective when the level of attenuation is equal to or higher than a specific threshold level. In detail, the speech-quality evaluation unit 1104 compares average power of a
 35 first speech signal before the noise cancellation process and average power of a first speech signal after the noise cancellation

process to determine whether the noise cancellation is effective based on a comparison result.

The evaluation-result notification unit 1105 notifies a user of the evaluation result input from the speech-quality evaluation unit 1104 as to whether the speech quality is good or bad. The speech-quality evaluation unit 1104 evaluates the speech quality of the noise-cancelled signal based on whether the noise cancellation is effective or not at the noise-cancellation processing unit 1103. Therefore, actually, the evaluation-result notification unit 1105 notifies a user of whether the noise cancellation is effective or not at the noise-cancellation processing unit 1103.

The evaluation-result notification unit 1105 may visually notify a user of whether the speech quality is good or not, or may notify a user of the speech quality with a warning sound through a speaker. Moreover, the evaluation-result notification unit 1105 may be equipped with a vibration element to notify a user, with vibration, of whether the noise cancellation is effective or not.

However, in this embodiment, it is supposed that the audio input apparatus 1100 is used in an environment in which physical laborers work under heavy surrounding noise, so that the notification of speech quality to a user is made visually, not by means of sounds that may not be heard due to the surrounding noise or by means of vibration that may not be sensed by a user if the user is moving violently. In other words, in this embodiment, the evaluation-result notification unit 1105 has a visual means, such as an LED to be turned on and off, that indicates whether the noise cancellation function is effectively working or not.

The operation of the audio input apparatus 1100 will be explained with a flowchart shown in FIG. 17.

The noise-cancellation processing unit 1103 performs a noise cancellation process based on a first speech signal and a second speech signal input from the main microphone 1101 and the sub-microphone 1102, respectively (step S1101). In detail, the noise-cancellation processing unit 1103 performs a process, per frame, of adding a reversed-phase component of a noise component mixed into a voice component at the main microphone

1101, generated based on the second speech signal input from the sub-microphone 1102, to the first speech signal input from the main microphone 1101. With this process, a noise component mixed with the first speech signal at the main microphone 1101 is suppressed. A noise-cancelled signal is output to the speech-quality evaluation unit 1104.

Then, the speech-quality evaluation unit 1104 evaluates the speech quality of a speech signal after the noise cancellation (step S1102). In detail, the speech-quality evaluation unit 1104 compares average power P_{in} of the first speech signal input from the main microphone 1101 before the noise cancellation and average power P_{nc} of the noise-cancelled signal from the noise-cancellation processing unit 1103 after the noise cancellation and, based on the comparison, determines whether the noise cancellation function of the noise-cancellation processing unit 1103 is effectively working. For example, the speech-quality evaluation unit 1104 may determine that the speech quality is good because of effective noise cancellation if the level of attenuation ($P_{in}-P_{nc}$) caused by the noise cancellation is equal to or higher than a first specific threshold level P_{th} that is a criterion level on the noise cancellation effect. Moreover, the speech-quality evaluation unit 1104 may determine that the speech quality is good because of effective noise cancellation if the power ratio (P_{in}/P_{nc}) is equal to or higher than a second specific threshold level P_{th}' that is another criterion level on the noise cancellation effect. Any other techniques can be used as long as the speech quality can be properly evaluated.

If the speech quality is evaluated as good (Yes in step S1102), the process returns to step S1101 to continue the noise cancellation. On the other hand, if the speech quality is evaluated as bad (No in step S1102), that is, the noise-cancellation function is not working effectively, hence a good speech quality is not obtained, the evaluation-result notification unit 1105 notifies a user of the bad result of evaluation (step S1103).

The main purpose for the evaluation-result notification unit 1105 to notify a user of a result of evaluation is instructing the user

of the correct way of holding the microphone, which results in enhanced noise cancellation effect and in transmission of a clear voice sound. Therefore, the notification of a result of evaluation to a user from the evaluation-result notification unit 1105 means the notification of a used condition to a user as to whether the audio input apparatus 1100 is being used appropriately.

As described above, the audio input apparatus 1100 according to the sixth embodiment has the notification (alarm) mechanism of notifying of a used condition to a user as to whether it is being used appropriately. With this notification (alarm) mechanism, a user can know whether the noise cancellation function is working effectively. When the user notices that the noise cancellation function is not working effectively, the user can change the way of holding the audio input apparatus 1100 (or the microphone), the distance between the microphone and user's mouth etc. to make the noise cancellation function work effectively so that a clear voice sound can be transmitted.

Accordingly, the audio input apparatus 1100 according to the sixth embodiment leads a user to hold a microphone in a correct manner so that the noise cancellation function can work at a maximum level to transmit a clear voice sound even in a noisy environment. Therefore, the user can check whether the user's voice sound is clearly transmitted.

Moreover, the audio input apparatus 1100 in this embodiment can be used for training workers on how to correctly use a noise cancellation microphone to which the present invention can be applied.

In known noise cancellation microphones, there is no way to know the range of distance and angle with respect to the user's mouth for appropriate use. Thus, there are problems such that a user talks into the microphone at a too close distance in order to transmit a clear voice sound, a user continues talking even if a clear voice sound is not transmitted due to ineffective noise cancellation which results in miscommunication, and so on.

On the other hand, as described above, the audio input apparatus 1100 according to the sixth embodiment can solve such problems and provide high utility in various environments.

In detail and as described above, the noise-cancellation processing unit 1103 performs the noise-cancellation process based on the first and second speech signals input from the main microphone 1101 and the sub-microphones 1102, respectively. More in detail, based on the second speech signal input from the sub-microphone 1102, the noise-cancellation processing unit 1103 generates a reversed-phase component of a noise component mixed into a voice component at the main microphone 1101 and adds the reversed-phase component to the first speech signal input from the main microphone 1101 in the noise cancellation process.

Then, the speech-quality evaluation unit 1104 evaluates the noise cancellation effect at the noise-cancellation processing unit 1103 and the evaluation-result notification unit 1105 notifies a user of the result of evaluation at the speech-quality evaluation unit 1104.

In detail, the speech-quality evaluation unit 1104 determines whether the noise cancellation function of the noise-cancellation processing unit 1103 is working effectively. If it is determined that the noise cancellation function is working effectively, the evaluation-result notification unit 1105 notifies a user that the noise cancellation function is working effectively so that the speech quality is good.

The speech-quality evaluation unit 1104 determines whether the noise cancellation function is working effectively by comparing the average power before and after the noise cancellation.

The speech-quality evaluation unit 1104 may determine that the noise cancellation function is working effectively if the following relational expression (3) is satisfied

$$P_{in} - P_{nc} > P_{th} \dots (3)$$

in which P_{in} is the average power of the first speech signal input from the main microphone 1101 before the noise cancellation, P_{nc} is the average power of the noise-cancelled signal input from the

noise-cancellation processing unit 1103 after the noise cancellation, and Pth is a first specific threshold level that is a criterion level on the noise cancellation effect.

Moreover, the speech-quality evaluation unit 1104 may
5 determine that the noise cancellation function is working effectively if the following relational expression (4) is satisfied

$$P_{in}/P_{nc} > P_{th}' \dots (4)$$

in which P_{in}/P_{nc} is the power ratio before and after the noise
cancellation, and P_{th}' is a second specific threshold level that is
10 another criterion level on the noise cancellation effect.

In the sixth embodiment, the evaluation-result notification
unit 1105 has a visual means, such as an LED to be turned on and
off, that indicates whether the noise cancellation function is
working effectively or not. Not only that, the evaluation-result
15 notification unit 1105 may be equipped with a liquid crystal display
or the like to indicate whether the noise cancellation function is
working effectively or not. Moreover, the evaluation-result
notification unit 1105 may be equipped with a vibration means,
such as a vibrator, so that a user can know whether the noise
20 cancellation is effective or not when the user feels vibration while
holding the audio input apparatus 1100.

Furthermore, the evaluation-result notification unit 1105
may be provided with a notification mechanism that notifies a user
only when the noise cancellation is effective and hence the speech
25 quality is good, as a result of evaluation at the speech-quality
evaluation unit 1104. With this notification mechanism, the user
can know that the used condition of the audio input apparatus
1100 is not good if there is no notification.

[Seventh Embodiment]

30 Described next is an audio input apparatus 1200 according
to a seventh embodiment of the present invention, which has a
power saving function in comparison with the audio input
apparatus 1100 of the sixth embodiment. In the audio input
apparatus 1100, the speech-quality evaluation unit 1104 performs
35 an average-power calculation process, a comparison process, etc.,
which are relatively power consuming processes, in order for the

evaluation-result notification unit 1105 to notify a user of whether noise cancellation is being effective. However, the notification with such power consuming processes is useless while a user is not talking into the audio input apparatus 1100. The audio input apparatus 1200 in the seventh embodiment is provided with a new configuration to solve such a problem.

FIG. 18 is a block diagram schematically showing the configuration of the audio input apparatus 1200 according to the seventh embodiment of the present invention.

The audio input apparatus 1200 is provided with a first sound pick-up unit 1101 (a main microphone), a second sound pick-up unit 1102 (a sub-microphone), a noise-cancellation processing unit 1203, a speech-quality evaluation unit 1204, an evaluation-result notification unit 1205, a speech-segment determination unit 1206, a noise suppresser unit 1207, and a transmitter unit 1208. The evaluation-result notification unit 1205 has a light-emission control unit 1209 and a light-emitting device 1210 for visual notification.

The speech-segment determination unit 1206 detects a speech segment by speech segment determination based on a first speech signal input from the main microphone 1101. In detail, the speech-segment determination unit 1206 converts the first speech signal input from the main microphone 1101 into a signal component in unit of a specific length in the frequency domain and analyzes a spectrum component of the signal component thus converted into the frequency domain to determine whether it is a vowel, a consonant, or a noise component. The speech-segment determination unit 1206 outputs a speech-segment indication signal that indicates a speech segment to the noise-cancellation processing unit 1203 and the speech-quality evaluation unit 1204.

The noise-cancellation processing unit 1203 performs a noise cancellation process based on the first and second speech signals input from the main microphone 1101 and the sub-microphone 1102, respectively, in the same manner as the noise-cancellation processing unit 1103 shown in FIG. 16. Then, the noise-cancellation processing unit 1203 outputs a

noise-cancelled signal to the speech-quality evaluation unit 1204 and the noise suppressor unit 1207.

5 The speech-quality evaluation unit 1204 evaluates the speech quality of the noise-cancelled signal input from the noise-cancellation processing unit 1203 by using the speech-segment indication signal input from the speech-segment determination unit 1206. In this embodiment, the speech-quality evaluation unit 1204 performs speech quality evaluation while a speech segment is being detected at the speech-segment determination unit 1206. The speech-quality evaluation unit 1204
10 outputs an evaluation result that is the information indicating the speech quality of the noise-cancelled signal to the light-emission control unit 1209 of the evaluation-result notification unit 1205.

Moreover, the speech-quality evaluation unit 1204
15 determines whether the noise cancellation function of the noise-cancellation processing unit 1203 is working effectively and also determines whether a power level of the noise-cancelled signal is equal to or higher than a specific threshold level. With these evaluation and determination, the speech-quality evaluation unit
20 1204 evaluates the speech quality of a noise-cancelled signal reliably, that is to be transmitted from the transmitter unit 1208.

The light-emission control unit 1209 is a driver for driving the light-emitting device 1210 by outputting a drive current thereto in accordance with the information indicating the speech quality of
25 the noise-cancelled signal input from the speech-quality evaluation unit 1204. With the drive current, the light-emission control unit 1209 turns on or repeatedly turns on and off the light-emitting device 1210 to notify a user of speech quality. The light-emitting device 1210 may be an LED. In this case, the light-emission
30 control unit 1209 repeatedly turns on and off the LED 1210 to notify a user of speech quality when it receives information indicating a good or bad speech quality from the speech-quality evaluation unit 1204.

The noise suppressor unit 1207 suppresses a noise
35 component other than a voice component that appears on the frequency axis of the noise-cancelled signal input from the

noise-cancellation processing unit 1203. Then, the noise suppressor unit 1207 returns a noise-component-suppressed signal into the time domain and outputs the signal to the transmitter unit 1208. The transmitter unit 1208 performs speech coding to the signal from the noise suppressor unit 205 and transmits the signal to a receiver apparatus or the like.

Explained next is an operation of the audio input apparatus 1200 with respect to a flowchart of FIG. 19.

The speech-segment determination unit 1206 performs a speech-segment determination process to determine whether a user is talking into the audio input apparatus 1200 based on the first speech signal input from the main microphone 1101 (step S1201). If no speech segment is detected (No in step S1202), the process returns to step S1201 to continue the speech-segment determination process. On the other hand if a speech segment is detected (Yes in step S1202), the process moves onto step S1203.

The speech-quality evaluation unit 1204 calculates average power per frame of the first speech signal input from the main microphone 1101 when the noise-cancellation processing unit 1203 performs a noise-cancellation process for each frame (step S1203). Then, the speech-quality evaluation unit 1204 calculates average power of the noise-cancelled signal input from the noise-cancellation processing unit 1203 (step S1204).

Next, the speech-quality evaluation unit 1204 compares the average power of the first speech signal before the noise cancellation process and the average power of the noise-cancelled signal after the noise cancellation process (step S1205).

If it is determined that the power ratio of the noise-cancelled signal to the first speech signal is equal to or higher than a specific first threshold level, (No in step S1205), it is determined that the noise cancellation function is not working effectively, and hence the speech quality of the noise-cancelled signal is bad (step S1207).

On the other hand, if it is determined that the power ratio of the noise-cancelled signal to the first speech signal is lower than the first threshold level (Yes in step S1205), the speech-quality

evaluation unit 1204 determines whether the average power of the noise-cancelled signal is equal to or higher than a specific threshold level (step S1206).

5 If it is determined that the average power of the noise-cancelled signal is lower than the second threshold level (No in step S1206), it is determined that the speech quality of the noise-cancelled signal is bad (step S1207). On the other hand, if it is determined that the average power of the noise-cancelled signal is equal to or higher than the second threshold level (Yes in step
10 S1206), it is determined that the speech quality of the noise-cancelled signal is good with an appropriate voice level (step S1208).

The speech-quality evaluation unit 1204 outputs an evaluation result (obtained in step S1207 or S1208) that is
15 information indicating the speech quality of the noise-cancelled signal to the light-emission control unit 1209 of the evaluation-result notification unit 1205 (step S1209) for notification of the speech quality through the light-emitting device 1210.

As described above, the audio input apparatus 1200 in the
20 seventh embodiment is provided further with the speech-segment determination unit 1206 that detects a speech segment based on the first speech signal input from the main microphone 1101, in comparison with the audio input apparatus 1100 in the sixth embodiment. Then, the speech-quality evaluation unit 1204
25 performs speech quality evaluation while a speech segment is being detected at the speech-segment determination unit 1206.

With this configuration described above, unnecessary power consumption is prevented, which otherwise occurs due to unnecessary operation at the speech-quality evaluation unit 1204
30 while a user is not talking into the audio input apparatus 1200. Moreover, with the configuration described above, it does not occur that the evaluation-result notification unit 1105 makes false notification to a user on a used condition of the main microphone 1101 while no speech segment is being detected.

35 The speech-segment determination unit 1206 may be provided with a frequency converter for converting the first speech

signal input from the main microphone 1101 into a signal component in unit of a specific length in the frequency domain and a speech determiner for determining whether the first speech signal carries a voice component or a noise component based on a spectrum component obtained by frequency conversion, for speech segment determination. The speech determiner may determine whether the sound carried by the first speech signal is a vowel, a consonant, or a noise component.

Moreover, as described above, the speech-quality evaluation unit 1204 employs two evaluation criteria as to whether the noise cancellation function of the noise-cancellation processing unit 1203 works effectively and as to whether a speech signal after the noise cancellation has a signal level equal to or higher than a specific threshold level, for speech quality evaluation. With these two evaluation criteria, the speech-quality evaluation unit 1204 can evaluate the speech quality reliably to the extent that a recipient of a voice of a user of the audio input apparatus 1200 actually feels and can properly notify the user of the evaluation through the evaluation-result notification unit 1205.

Under the evaluation criteria, the speech-quality evaluation unit 1204 calculates the power ratio of the noise-cancelled signal to the first speech signal input from the main microphone 1101 during a speech segment and compares the power ratio to a specific threshold level to determine whether the sound level after the noise cancellation to the sound level at the main microphone 1101 is equal to or higher than a certain level. With this comparison, it is determined whether the user's mouth is close enough to the main microphone 1101. Then, the speech-quality evaluation unit 1204 notifies the user of an evaluation result through the evaluation-result notification unit 1205 while the user is talking into the main microphone 1101. When the light-emitting device 1210 of the evaluation-result notification unit 1205 is an LED, the notification can be made with repeated turn-on and -off of the LED.

In the seventh embodiment, the speech-quality evaluation unit 1204 determines whether the noise cancellation function is working effectively based on a noise-cancelled signal output from

the noise-cancellation processing unit 1203 and then evaluates the speech quality as the final evaluation. However, the evaluation technique is not limited to this. For example, the speech-quality evaluation unit 1204 may evaluate the speech quality of a signal
5 from the noise suppresser unit 1207 after the noise suppression on the frequency axis.

[Eighth Embodiment]

Described next is an audio input apparatus 1300 according to an eighth embodiment of the present invention, that features
10 more reliable evaluation capability for notification than the audio input apparatus 1200 of the seventh embodiment.

In the audio input apparatus 1200 of the seventh embodiment, the speech-quality evaluation unit 1204 may sometimes erroneously evaluate the noise cancellation effect even
15 if the noise cancellation function of the noise-cancellation processing unit 1203 is not working effectively. The erroneous evaluation of the noise cancellation effect may occur, for example, while a user is talking into the audio input apparatus 1200 that is not oriented in an appropriate direction to the user so that the
20 user's voice sound is also input to the sub-microphone 1102 at a high level if provided at the rear face of the audio input apparatus 1200 with respect to the main microphone 1101 provided at the front face thereof.

The noise-cancellation processing unit 1203 performs the
25 noise cancellation process using a signal from the sub-microphone 1102 as a reference signal. Therefore, the noise-cancellation processing unit 1203 may erroneously treat a voice component input to the sub-microphone 102 as a noise component so that a voice component input to the main microphone 1101 which should
30 remain is also inevitably suppressed. Suppose that there is an intense noise source in front of the audio input apparatus 1200 that is not oriented in an appropriate direction to the user. In this case, it may happen that a noise component from the noise source remains after the noise cancellation process so that the signal level
35 of a noise-cancelled signal goes beyond a threshold level which

results in that the speech quality is erroneously evaluated as good and notified to the user.

It is achieved in the eighth embodiment that the audio input apparatus 1300 evaluates the speech quality reliably even in such a case discussed above and properly notifies a user of the speech quality evaluation.

FIG. 20 is a block diagram schematically showing the configuration of the audio input apparatus 1300 according to the eighth embodiment of the present invention.

The audio input apparatus 1300 is provided with a first sound pick-up unit 1101 (a main microphone), a second sound pick-up unit 1102 (a sub-microphone), a noise-cancellation processing unit 1203, a speech-quality evaluation unit 1304, an evaluation-result notification unit 1205, a speech-segment determination unit 1206, a noise suppresser unit 1207, a transmitter unit 1208, a microphone-direction determination unit 1311, and a noise-cancellation effect evaluation unit 1312. The evaluation-result notification unit 1205 has a light-emission control unit 1209 and a light-emitting device 1210 for visual notification.

While the speech-segment determination unit 1206 is determining that a first speech signal input from the main microphone 201 is a speech segment, the microphone-direction determination unit 1311 detects a phase difference between voice sounds picked by the main microphone 1101 and the sub-microphone 1102 and determines the direction of the main microphone 1101 (a main-microphone direction, hereinafter) with respect to a user based on the phase difference. The microphone-direction determination unit 1311 outputs a determination result on the main-microphone direction to the speech-quality evaluation unit 1304.

FIG. 21 is a view illustrating a direction-to-phase relationship of the audio input apparatus 1300 with respect to a user, or a phase difference of voice sounds depending on the main-microphone direction.

As shown in (a) of FIG. 21, when a user faces the audio input apparatus 1300 at the front side with the main microphone

1101 attached thereto, in a normal used condition, there is a large phase difference between a voice sound that is picked up by the main microphone 1101 through a straight path and a voice sound that is picked up by the sub-microphone 1102 through a roundabout path. On the other hand, as shown in (b) of FIG. 21, when the audio input apparatus 1300 is inclined toward a user, there is a small phase difference between voice sounds picked up by the main microphone 1101 and the sub-microphone 1102 due to a shorter distance between the user's mouth and the two microphones. In particular, when the main microphone 1101 attached to the audio input apparatus 1300 at the front side is inclined toward a user at 90 degrees, the distances from the user's mouth to the main microphone 1101 and to the sub-microphones 1102 are almost equal to each other, so that the phase difference is almost zero.

Under consideration of the change in phase difference depending on the positional relationship between a user and the audio input apparatus 1300 discussed above, the microphone-direction determination unit 1311 compares a phase difference detected between the first and second speech signals output from the main microphone 1101 and the sub-microphone 1102, respectively, with a specific threshold value. When the phase difference is smaller than the specific threshold value, the microphone-direction determination unit 1311 assumes that the main-microphone direction is not toward a user, such as shown in (b) of FIG. 21 and determines that the user is not using the audio input apparatus 1300 appropriately. On the other hand, when the phase difference is equal to or larger than the specific threshold value, the microphone-direction determination unit 1312 assumes that the main-microphone direction is toward a user, such as shown in (a) of FIG. 21, and determines that the user is using the audio input apparatus 1300 appropriately.

The noise-cancellation effect evaluation unit 1312 determines whether the noise cancellation function of the noise-cancellation processing unit 1203 is working effectively based on a noise-cancelled signal input from the noise-cancellation

processing unit 1203. In detail, the noise-cancellation effect evaluation unit 1312 determines whether the noise cancellation function is working effectively based on average power P_{in} of the first speech signal input from the main microphone 1101 before the noise cancellation and average power P_{nc} of the noise-cancelled signal from the noise-cancellation processing unit 1203 after the noise cancellation. For example, the noise-cancellation effect evaluation unit 1312 may determine that the noise cancellation function is working effectively if the following relational expression (5) is satisfied

$$P_{in} - P_{nc} > P_{th} \dots (5)$$

in which P_{th} is a threshold level of attenuation that is a criterion level on the noise cancellation effect. Moreover, the noise-cancellation effect evaluation unit 1312 determines whether the signal power of a speech signal after noise cancellation (a noise-cancelled signal) is equal to or higher than a specific threshold level. The noise-cancellation effect evaluation unit 1312 outputs two determination results described above to the speech-quality evaluation unit 1304.

The speech-quality evaluation unit 1304 evaluates the speech quality of the noise-cancelled signal based on the determination result output from the microphone-direction determination unit 1311 and the two determination results output from the speech-quality evaluation unit 1304. In detail, the speech-quality evaluation unit 1304 determines that the speech quality of the noise-cancelled signal is good: when the determination result output from the microphone-direction determination unit 1311 shows that the main microphone 1101 is oriented toward a user; and when the two determination results output from the speech-quality evaluation unit 1304 show that the noise cancellation function is working effectively and the signal power of the noise-cancelled signal is equal to or higher than the specific threshold level. The speech-quality evaluation unit 1304 outputs a speech-quality evaluation signal that indicates an evaluation result to the evaluation-result notification unit 1105, as information indicating the speech quality.

Explained next is a microphone-direction determination process performed by the microphone-direction determination unit 1311, with respect to a flowchart of FIG. 22.

The microphone-direction determination unit 1311
 5 compares the phases of first and second speech signals input from the main microphone 1101 and the sub-microphone 1102, respectively, to detect a phase difference therebetween (step S1301). Then, the microphone-direction determination unit 1311 compares the phase difference between the first and second
 10 speech signals with a specific threshold value to determine whether the phase difference is smaller than the specific threshold value (step S1302). The comparison of phase difference is done based on the fact that the change in orientation of the main microphone 1102 is directly reflected in the phase difference as discussed with
 15 reference to FIG. 21.

If the phase difference is equal to or larger than the specific threshold value (No in step S1302), the microphone-direction determination unit 1311 assumes that the positional relationship between the main microphone 1101 and the user's mouth is good,
 20 such as shown in (a) of FIG. 21, and determines that the user is using the audio input apparatus 1300 appropriately. On the other hand, if the phase difference is smaller than the specific threshold value (Yes in step S1302), the microphone-direction determination unit 1311 assumes that the positional relationship between the
 25 main microphone 1101 and the user's mouth is bad, such as shown in (b) of FIG. 21, and determines that the user is using the audio input apparatus 1300 inappropriately.

Then, the microphone-direction determination unit 1311 outputs a determination result obtained in step S1303 or S1304 to
 30 the speech-quality evaluation unit 1304 (step S1305), as a first determination result that indicates whether or not the main-microphone direction is appropriate, that is, whether or not the audio input apparatus 1300 is used appropriately.

Explained next is a noise-cancellation effect evaluation
 35 process performed by the noise-cancellation effect evaluation unit 1312, with respect to a flowchart of FIG. 23.

The noise-cancellation effect evaluation unit 1312 is in a waiting mode to receive a speech-segment indication signal that is generated by the speech-segment determination unit 1206 when it determines that a first speech signal input from the main microphone 1101 is a speech segment (step S1311). When the speech-segment indication signal is input (Yes in step S1311), the noise-cancellation effect evaluation unit 1312 performs step S1312, whereas if not (No in step S1311), it is still in the waiting mode to receive the speech-segment indication signal. Steps S1312 to S1315 are the same as or analogous to steps S1203 to S1206 shown in FIG. 19, and the hence the explanation thereof is omitted for brevity.

The noise-cancellation effect evaluation unit 1312 determines that the noise cancellation function is not working effectively (step S1316) in either one of the following two cases: if it is determined that the power ratio of the noise-cancelled signal to the first speech signal is equal to or higher than a specific first threshold level, (No in step S1314); and if it is determined that the power ratio of the noise-cancelled signal to the first speech signal is lower than a specific second threshold level (No in step S1315).

On the other hand, the noise-cancellation effect evaluation unit 1312 determines that the noise cancellation function is working effectively (step S1317) if it is determined that the average power of the noise-cancelled signal is equal to or higher than the second threshold level (Yes in step S1315).

The speech-quality evaluation unit 1312 outputs an evaluation result obtained in step S1316 or S1317 to the speech-quality evaluation unit 1304 (step S1318), as a second determination result that is information indicating whether or not the noise cancellation function is working effectively.

Explained next is a speech-quality evaluation process performed by the speech-quality evaluation unit 1304, with respect to a flowchart of FIG. 24.

The first determination result obtained through the process shown in FIG. 22 is input from the microphone-direction determination unit 1311 to the speech-quality evaluation unit 1304

(step S1321). Then, the speech-quality evaluation unit 1304 determines whether the first determination result shows that the positional relationship between the main microphone 1101 and the user's mouth is good (step S1322).

5 If the first determination result shows that the positional relationship between the main microphone 1101 and the user's mouth is bad (No in step S1322), the speech-quality evaluation unit 1304 instructs the evaluation-result notification unit 1205 to make warning (step S1323) by turning on the light-emitting device
10 1210.

 On the other hand, if the first determination result shows that the positional relationship between the main microphone 1101 and the user's mouth is good (Yes in step S1322), the second determination result obtained through the process shown in FIG.
15 23 is input from the noise-cancellation effect evaluation unit 1312 to the speech-quality evaluation unit 1304 (step S1324).

 If the second determination result shows that the noise cancellation function is not working effectively (No in step S1325), the speech-quality evaluation unit 1304 instructs the
20 evaluation-result notification unit 1205 to make warning (step S1326) by turning on the light-emitting device 1210.

 On the other hand, if the second determination result shows that the noise cancellation function is working effectively (Yes in step S1325), the speech-quality evaluation unit 1304
25 determines that the speech quality is good (step S1327) and instructs the evaluation-result notification unit 1205 to notify a user of a good speech quality. The good speech quality may be set as the default so that the evaluation-result notification unit 1205 needs not to notify anything. In the case of this default
30 setting, when the evaluation-result notification unit 1205 is not notifying anything while a user is talking into the audio input apparatus 1300, it means that the speech quality is good.

 The warning made by the evaluation-result notification unit 1205 in step S1323 or S1326 is to call user's attention to make the
35 user notice that the audio input apparatus 1300 is not being used in a good used condition. A user then notices that a clear voice

sound is not being transmitted and tries to change the position or orientation of the main microphone 1101 to improve the speech quality. With this change, if both of the first and second determination results become good, the warning is stopped and
5 then the user notices that the audio input apparatus 1300 is being used in a good used condition.

As described above, the audio input apparatus 1300 in the eighth embodiment evaluates the speech quality by determining whether the main microphone 1101 is oriented towards an
10 appropriate direction and also whether the noise cancellation function is working effectively. Therefore, more reliable speech quality evaluation is achieved with checking the used condition using the phase difference between voice sounds input to the main microphone 1101 and the sub-microphone 1102, in addition to the
15 noise-cancellation effect determination which otherwise leads to erroneous evaluation if this determination only is employed.

The purpose of using the microphone-direction determination unit 1311 concerning the orientation of the main microphone 1101, in addition to the noise-cancellation effect
20 evaluation unit 1312, is to raise the evaluation accuracy in a noisy environment. More important purpose of using the microphone-direction determination unit 1311 is, however, to instruct a user on how to hold the main microphone 1101 (or the audio input apparatus 1300) appropriately.

25 In detail, the noise-cancellation effect evaluation unit 1312 may not perform reliable evaluation, for example, in a quiet environment with small surrounding noise. Instruction on how to hold the main microphone 1101 appropriately may not always be done in an environment with the surrounding noise. Moreover, the
30 noise cancellation function may work effectively even if a user does not hold the main microphone 1101 appropriately, which depends on the environment. Under consideration of these factors, the warning based on microphone-direction determination is prioritized than the warning based on noise-cancellation effect evaluation as
35 shown in FIG. 24, for the purpose to instruct a user on how to hold the main microphone 1101 in an appropriate manner.

When a negative result is given by either the microphone-direction determination unit 1311 or the noise-cancellation effect evaluation unit 1312, the evaluation-result notification unit 1205 makes warning through the light-emitting device 1210 (such as an LED) to instruct a user on correct holding of the main microphone 1101. The microphone-direction determination process and the noise-cancellation effect evaluation process shown in FIGS. 22 and 23, respectively, can be repeated at a very short interval (such as 1/30 seconds). In this case, the evaluation-result notification unit 1205 may be equipped with a function of keeping the same mode for a certain time so that a user can easily notice, thereby enhancing a notification effect.

[Ninth Embodiment]

Described next is an audio input apparatus according to a ninth embodiment of the present invention, which is a noise cancellation microphone having a simplex wireless transmission function, equipped with a switch attached to a noise cancellation microphone unit for switching between transmission and reception.

Moreover, the audio input apparatus in the ninth embodiment is a dual-microphone type audio input apparatus having a microphone on each of the front and rear faces, with an active noise-cancellation function. In detail, the audio input apparatus in the ninth embodiment is a noise cancellation microphone for transmission of a clear voice sound with cancellation of a signal of the surrounding noise that is mixed with user's voice sound by using speech signals input through two microphones. In a normal arrangement, a main microphone and a sub-microphone are provided on the front face (that faces a user) and the rear face of the audio input apparatus, respectively, for mainly picking up the user's voice sound and the surrounding noise, respectively.

FIG. 25 is a view showing the exterior appearance of the audio input apparatus (a noise cancellation microphone) 1400 with a front view (a) and a rear view (b), according to the ninth embodiment of the present invention.

The audio input apparatus 1400 is provided with a noise-cancellation microphone unit 1420 and a wireless communication unit 1440 connected to each other with a cord 1430. The noise-cancellation microphone unit 1420 is equipped with a
5 main microphone 1401 for mainly picking up a user's voice sound and a speaker 1421 on the front face, an LED on the upper face, and a PTT unit 1422 on the side face. Moreover, the noise-cancellation microphone unit 1420 is equipped with a
10 sub-microphone 1402 for mainly picking up the surrounding noise and a belt clip 1423 for holding the microphone unit 1420 by a belt on the rear face.

FIG. 26 is a block diagram schematically showing the configuration of the audio input apparatus (the noise cancellation microphone) 1400 according to the ninth embodiment of the
15 present invention. In FIG. 26, the units the same as or analogous to those shown in FIG. 20 are given the same reference numerals and the explanation thereof is omitted for brevity.

A wireless transmitter unit 1408 and a wireless receiver unit 1413 are installed in the wireless communication unit 1440.
20 The transmitter unit 1408 performs speech coding to a speech signal after the noise suppression by the noise suppressor unit 1207 according to need and transmits a speech-coded signal by wireless transmission. The wireless receiver unit 1413 receives a speech signal transmitted by wireless transmission and outputs the
25 received speech signal to the speaker 1421. The speaker 1421 outputs the speech signal as a voice sound.

The PTT unit 1422 is a switch attached to the noise-cancellation microphone unit 1420 for switching a communication mode between the transmission mode and the
30 standby mode. When a user talks into the audio input apparatus 1400 for sending a message, the user pushes the PTT unit 1422 to switch the communication mode from the standby mode to the transmission mode. While the user is pushing the PTT unit 1422, the audio input apparatus 1400 is in the transmission mode
35 entirely, with each unit shown in FIG. 26 related to the transmission mode being working while the wireless receiver unit

1413 being in the waiting mode. While the PTT unit 1422 is being pushed, the PTT unit 1422 outputs a transmission-mode signal that indicates the transmission mode to an overall evaluation unit 1412.

5 The overall evaluation unit 1412 outputs a signal based on a speech-quality evaluation signal that indicates an evaluation result input from a speech-quality evaluation unit 1304 and the transmission-mode signal that indicates the transmission mode input from the PTT unit 1422, to a light-emission control unit (an LED driver) 1409 of an evaluation-result notification unit 1405. In
10 other words, the overall evaluation unit 1412 makes an overall determination of how the light-emission control unit 1409 should control an LED 1410 of the evaluation-result notification unit 1405.

FIG. 27 is a table listing communication modes, speech-quality evaluation results, and LED states. As shown in
15 FIG. 27, the LED driver 1409 drives the LED 1410 in the following manner. The LED driver 1409 repeatedly turns on and off the LED 1410 while the PTT unit 1422 is being pushed to put the audio input apparatus 1400 in the transmission mode and the speech quality is good. The LED driver 1409 turns on the LED 1410 while
20 the PTT unit 1422 is being pushed to put the audio input apparatus 1400 in the transmission mode and the speech quality is bad, thereby calling user's attention to make the user notice that the audio input apparatus 1400 is not being used in a good condition. Moreover, the LED driver 1409 turns on the LED 1410 while the
25 PTT unit 1422 is being pushed to put the audio input apparatus 1400 in the transmission mode but no speech signal is input thereto. On the other hand, the LED driver 1409 turns off the LED 1410 with no drive current supplied thereto while the PTT unit 1422 is not pushed.

30 As described above, the audio input apparatus (the noise cancellation microphone) 1400 according to the ninth embodiment of the present invention is a simplex wireless transmission apparatus equipped with the PTT unit 1422 that is to be pushed to switch the communication mode from the standby mode to the
35 transmission mode. It is preferable that a user can distinguish between the standby mode and the transmission mode. For this

reason, there is provided the light-emission control unit (the LED driver) 1409 that turns on the LED 1410 while the PTT unit 422 is being pushed to put the communication mode into the transmission mode and turns off the LED 1410 during the standby mode.

5 Moreover, it is preferable to notify a user who is talking into the audio input apparatus (the noise cancellation microphone) 1400 of whether or not a high-quality voice sound is being transmitted. In other words, it is preferable to notify the user of an evaluation result on whether or not the speech quality is good.
10 In the case of an LED notification device, there is a demand for a smaller number of LEDs in view of the environment in which the audio input apparatus 1400 is to be used, the cost which should be reduced by using a smaller number of parts, etc. Therefore, it is preferable that one and the same LED indicates whether the
15 communication mode is the transmission mode and also whether the speech quality is good. Under consideration of these factors, the light-emission control unit (the LED driver) 1409 has a control function of switching the single LED 1410 between a turned-on state and a turned-off state.

20 As shown in FIG. 27, the ninth embodiment employs an evaluation-result notification method in which the LED 1410 is turned on during the transmission mode by pushing the PTT unit 1422 and, particularly, the LED 1410 is repeatedly turned on and turned off during which the speech quality is evaluated as good.
25 This evaluation-result notification method can make a user feel that the audio input apparatus (the noise cancellation microphone) 1400 reacts to the user's talking.

 Concerning the method of speech quality evaluation performed by the evaluation speech-quality evaluation unit, there
30 are several ways in addition to those described above, that are applicable in the present invention.

 One method of speech quality evaluation will be explained with a flowchart shown in FIG. 28.

35 After performing steps S1411 to S1413 in the similar manner as steps S1311 to S1313 shown in FIG. 23, the average power of a second speech signal from a sub-microphone is

calculated (step S1414). The power obtained in step S1414 can be considered a noise power. It is then determined whether the average power of the second speech is equal to or higher than a specific threshold level (step S1415). If it is determined that the average power of second speech is lower than the specific threshold level (No in step S1415), the environment is considered to be quiet with a fairly small noise, thereby the speech quality being evaluated as good (step S1418).

On the other hand, if it is determined that the average power of the second speech is equal to or higher than the specific threshold level (Yes in step S1415), the environment is considered to be noisy, so that it is required that the average power ratio of a noise-cancelled signal after the noise cancellation process to a first speech signal from a main microphone be equal to or lower than a specific threshold level by the noise cancellation process. Then, in step S1416, comparison is made between the average power of the first speech signal and that of the noise-cancelled signal to determine whether the noise cancellation process is being performed effectively, which is followed by step S1417 that is performed in the similar manner as step S207 shown in FIG. 5.

With the method shown in FIG. 28, it is achieved to perform reliable speech quality evaluation under consideration of a noisy environment.

Moreover, a noise-cancellation necessity determination unit may be provided in the present invention to determine whether the noise-cancellation process is necessary at the noise-cancellation processing unit. In detail, there is case in which a voice sound can rather be transmitted clearly without the noise-cancellation process in a quiet environment.

Under consideration of the case mentioned above, the noise-cancellation necessity determination unit calculates the average power of a speech signal obtained at the second sound pick-up unit (the sub-microphone) and compares the average power and a specific threshold value. Then, the noise-cancellation necessity determination unit determines that the noise-cancellation process is necessary due to the surrounding noise if the average

power is equal to or higher than the specific threshold level. On the other hand, the noise-cancellation necessity determination unit determines that the noise-cancellation process is not necessary if the average power is lower than the specific threshold level.

- 5 Based on the determination at the noise-cancellation necessity determination unit, the noise-cancellation processing unit performs the noise cancellation process.

A flag may be prepared for indicating a result of determination at the noise-cancellation necessity determination unit to determine whether or not the noise-cancellation process is necessary. If a flag is set to indicate that the noise-cancellation process is necessary, the noise-cancellation processing unit may perform the noise cancellation process.

10 Moreover, another flag may be prepared for indicating whether or not the noise-cancellation process is being performed. If a flag is set to indicate that the noise-cancellation process is being performed, the speech-quality evaluation unit may evaluate the speech quality. In this configuration, the speech-quality evaluation unit determines that the speech quality is good if the flag is cleared to indicate that the noise-cancellation process is not being performed. This is because, when the noise-cancellation process is not being performed, the average power of a speech signal obtained at the second sound pick-up unit (the sub-microphone) is lower than the specific threshold value and hence the environment is considered to be quiet. On the other hand, the speech-quality evaluation unit evaluates the speech quality such as shown in FIG. 23 if the flag is set to indicate that the noise-cancellation process is being performed. With the configuration described above, reliable speech quality is achieved with lower power consumption.

Concerning the determination of whether or not the noise-cancellation process is necessary, the technique of determination is not limited to the comparison between the average power of a speech signal obtained at the second sound pick-up unit (the sub-microphone) and a specific threshold value. For example, the noise-cancellation necessity determination unit

may determine whether or not the noise-cancellation process is necessary in accordance with a voice incoming direction detected based on the phase difference between the first and second speech signals from the first and second sound pick-up units, respectively.

5 As described in detail, according to the present invention, improvement in speech quality is achieved with the prevention of misrecognition of the communication mode through notification to a user of the current communication mode (the state of a voice sound being transmitted) in a simplex communication apparatus
10 for which the communication mode is switched between the transmission mode and the standby mode.

 For example, in the case of a hand microphone equipped with an LED, whether a voice sound is drowned out by the surrounding noise depends on how a user is holding the
15 microphone, the distance between the user's mouth to the microphone, the level of voice sound, etc. In order to solve such a problem, the communication apparatus according to the present invention is provided with the determination unit for determining whether a user's voice sound is being clearly transmitted based on
20 the information on the noise cancelation process, the information on a voice sound, etc. Moreover, the communication apparatus according to the present invention is provided with the light-emission control unit for controlling an LED to repeatedly turns on and off, turns on or turns off the LED based on the
25 information on whether a voice sound is being transmitted under determination by the determination unit. With the configuration described above, the overall evaluation of speech quality can be notified to a user by means of the LED that is repeatedly turned on and off, turned on or turned off almost in synchronism with user's
30 talking.

 When the speech quality of a voice sound being transmitted is good, the light-emission control unit may repeatedly turn on and off the LED at high speed to enhance the speech-quality notification function. The high-speed LED switching achieves
35 speech quality notification almost in synchronism with user's talking so that the user feels almost no out-of-timing between

talking and notification. Moreover, the light-emission control unit may turn on the LED continuously when the speech quality is bad during a speech segment to instruct a user to use the communication apparatus in an appropriate manner, thereby
5 transmitting a clear voice sound.

With the speech-quality notification function described above, the present invention can be applied to training in use of a noise cancellation microphone at the first time.

As described above, the present invention is applicable to a
10 dual-microphone type wireless communication apparatus having the active noise-cancellation function. However, the present invention is not limited thereto. For example, the present invention can be applied to a wired communication apparatus, a sound pick-up apparatus such as a noise cancellation microphone,
15 etc. Moreover, a plurality of sub-microphone may be provided for picking up noises for noise cancellation.

As described above in each embodiment, the present invention achieves transmission of clear voice sounds with the enhanced noise-cancellation function by instructing a user to use a
20 noise cancellation microphone correctly. In other words, the purpose of speech quality notification by means of an LED or the like is not indicating the performance of noise cancellation but instructing a user to use a noise cancellation microphone correctly.

This is because there is a problem to be solved that is the
25 effect of noise cancellation depends on how a user holds a microphone, the distance between the user's mouth and the microphone, etc. in a dual-microphone type wireless communication apparatus having the active noise-cancellation function, an external microphone of a wireless communication
30 apparatus, etc.

In detail, different from a close-talking microphone attached to a headset or the like, a microphone attached to a wireless communication apparatus, a hand microphone connected thereto, etc. may have a problem such that the microphone is
35 oriented at an angle of almost 90 degrees to the user's mouth or is distant therefrom too much. In such a case, enough voice sounds

do not reach a main microphone while noise components increase relatively, hence noise cancellation ineffective even if performed. Moreover, a user may talk into a microphone while the microphone is being attached to the user's shoulder, chest, etc. so that the user can use both hands freely. In such a case, the performance of noise cancellation is lowered than when a user is holding a microphone in an appropriate manner.

In order to solve such a problem discussed above, in the present invention, the speech quality is evaluated, in other words, it is determined whether a user is holding a microphone in an appropriate manner, using information on the speech or non-speech segment, the level of attenuation by noise cancellation, the microphone orientation based on the phase difference between two microphones, etc. thereby instructing a user of a correct way of holding a microphone.

As described above, the present invention employs a signal processing technique to evaluate the speech quality, in other words, to determine whether a user is holding a microphone in an appropriate manner so that the noise cancellation function can work effectively.

The signal processing technique achieves appropriate processing even if the noise cancellation function is not working effectively in such case where a noise source exists behind a user who is talking into a microphone, the frequency characteristics of a noise component is close to that of a voice component, etc.

In detail, in some of the embodiments described above, there are two determination units. The first determination unit determines whether the noise cancellation function is working effectively. If it is determined that the noise cancellation function is not working effectively, through the notification unit, a warning is given so that a user can change the way of holding a microphone in an appropriate manner. The determination of effectiveness of the noise cancellation function is performed with information indicating whether an input speech signal is a speech segment or not for each certain length (a frame in the embodiments) and

information on the level of attenuation of a noise component after the noise cancellation to the input speech signal.

The second determination unit determines whether the user's mouth and a main microphone have an appropriate positional relationship based on the phase difference between input signals from the main microphone and sub-microphone. If it is determined that the user's mouth and the main microphone do not have an appropriate positional relationship, in other words, the main microphone is not oriented towards the user, through the notification unit, a warning is given so that a user can change the way of holding the main microphone in an appropriate manner. The determination at the second determination unit concerning the positional relationship based on the phase difference may be achieved by detecting the incoming direction of a voice sound to be picked up by the main microphone.

In the embodiments of the present invention, the light-emission control unit turns on the light-emitting device (LED) while the PTT unit is being pushed during a non-speech segment, in other words, in the case where the user's voice sound is not detected by the speech-segment determination unit. In detail, based on whether the PTT unit is being pushed or not, the light-emission control unit turns on or off the light-emitting device (LED). More in detail, the light-emission control unit turns on the light-emitting device (LED) when the communication mode is the transmission mode in which the transmission unit transmits a speech signal. On the other hand, the light-emission control unit turns off the light-emitting device (LED) when the communication mode is the standby mode in which the transmission unit does not transmit a speech signal. Moreover, the light-emission control unit repeatedly turns on and off the light-emitting device (LED) when the speech-segment determination unit determines that an input speech signal is a speech segment and when the speech-quality evaluation unit determines that a speech signal to be transmitted from the transmission unit has a good speech quality.

As described, the communication apparatus according to the present invention is provided with a first sound pick-up unit for

picking up a voice sound, a transmission unit for transmitting the voice sound to outside as a speech signal, a speech-segment determination unit for determining whether or not the voice sound is a speech segment, a communication-mode switching unit for
 5 switching the communication mode between the transmission mode in which the transmitter unit transmits the speech signal and the standby mode in which the transmitter unit does not transmit the speech signal, a speech-quality evaluation unit for evaluating the speech quality of the speech signal to be transmitted from the
 10 transmission unit while the speech-segment determination unit is determining that the voice sound is a speech segment, a light-emitting device for emitting light, and a light-emission control unit for controlling the light-emitting device. The communication apparatus according to the present invention may also be provided
 15 with a receiver unit for receiving a speech signal transmitted from outside.

In this configuration, the light-emission control unit turns off the light-emitting device when the communication mode is the standby mode. The light-emission control unit turns on the
 20 light-emitting device when the communication mode is the transmission mode. Moreover, the light-emission control unit repeatedly turns on and off the light-emitting device when the communication mode is the transmission mode and when the speech signal to be transmitted has a good speech quality.

25 With the configuration described above, a user can feel that the communication apparatus is not responding to user's talking in an appropriate manner if the light-emitting device (LED) is turned on even when the user is talking into the communication apparatus while the user is pushing the PTT unit (the communication-mode
 30 switching unit). With the light-emitting device (LED), the communication apparatus can clearly notify a user who is talking into the communication apparatus that the transmission of a clear voice sound is not being performed.

It is preferable that the emission state (turn-on/-off) of the
 35 light-emitting device (LED) is the same between the case where the communication mode is the transmission mode and an input

voice sound is not a speech segment and the case where the communication mode is the transmission mode and an input voice sound is a speech segment but the speech quality is not good. With this configuration, it is achieved to properly notify a user of whether a clear voice sound is being transmitted.

It is further understood by those skilled in the art that the foregoing description is a preferred embodiment of the disclosed device or method and that various changes and modifications may be made in the invention without departing from the spirit and scope thereof.

The light-emission control unit controls the light-emitting device (LED) in the following manner in the embodiments, however, the present invention is not limited thereto. In detail, in the embodiments, the light-emission control unit controls the light-emitting device (LED) in a manner to: repeatedly turn on and off the light-emitting device (LED) if the noise cancellation function is working effectively during a speech segment and if a voice sound now being transmitted has a good speech quality; turn on the light-emitting device (LED) if the noise cancellation function is working effectively during a speech segment, however, if a voice sound now being transmitted has a bad speech quality; and turn off the light-emitting device (LED) if no voice sound is being transmitted.

For example, different from the embodiments, the light-emission control unit may repeatedly turn on and off the light-emitting device (LED) if a voice sound now being transmitted has a bad speech quality. On the other hand, the light-emission control unit may turn on the light-emitting device (LED) if a voice sound now being transmitted has a good speech quality. Also in this modification, the light-emission control unit turns off the light-emitting device (LED) if no voice sound is being transmitted.

As described above, an audio input apparatus according to the present invention may be provided with a first sound pick-up unit, a second sound pick-up unit, a noise-cancellation processing unit for performing noise cancellation to a first speech signal input from the first sound pick-up unit by using a second speech signal

input from the second sound pick-up unit, a speech-quality evaluation unit for evaluating the speech quality of a speech signal after the noise cancellation at the noise-cancellation processing unit, and an evaluation-result notification unit for notifying an evaluation result at the speech-quality evaluation unit.

In the audio input apparatus according to the present invention, the speech-quality evaluation unit may evaluate the speech quality of the speech signal after the noise cancellation based on whether the noise cancellation is working effectively. In this case, the speech-quality evaluation unit may determine that the speech quality of the speech signal after the noise cancellation is good if it is determined that the noise cancellation is working effectively as a result of comparison between the first speech signal before the noise cancellation and the speech signal after the noise cancellation and if average power of the speech signal after the noise cancellation is equal to or higher than a specific threshold level.

In the audio input apparatus according to the present invention, the speech-quality evaluation unit may compare the first speech signal before the noise cancellation and the speech signal after the noise cancellation to determine whether the noise cancellation is working effectively, thereby determining that the speech quality of the speech signal after the noise cancellation is good if it is determined that the noise cancellation is working effectively.

In the audio input apparatus according to the present invention, the speech-quality evaluation unit may determine that the speech quality of the speech signal after the noise cancellation is good if the difference between average power of the first speech signal before the noise cancellation and average power of the speech signal after the noise cancellation is equal to or higher than a specific threshold level.

In the audio input apparatus according to the present invention, the speech-quality evaluation unit may determine that the speech quality of the speech signal after the noise cancellation is good if a ratio of average power of the speech signal after the

noise cancellation to average power of the first speech signal before the noise cancellation is equal to or lower than a specific threshold level.

5 In the audio input apparatus according to the present invention, the noise-cancellation processing unit may perform the noise cancellation by suppressing a noise component carried by the first speech signal input from the first sound pick-up unit based on the second speech signal input from the second sound pick-up unit. In this case, the noise-cancellation processing unit may perform
10 the noise cancellation by generating a reversed-phase component of the noise component carried by the first speech signal input from the first sound pick-up unit based on the second speech signal input from the second sound pick-up unit and add the generated reversed-phase component to the first speech signal input from the
15 first sound pick-up unit.

In the audio input apparatus according to the present invention, the evaluation-result notification unit may be provided with a light-emitting device for emitting light and a light-emission control unit for controlling the light-emitting device, wherein the
20 evaluation-result notification unit notifies the evaluation result by turning on or repeatedly turning on and off the light-emitting device based on the evaluation result at the speech-quality evaluation.

The audio input apparatus according to the present
25 invention may further be provided with a speech-segment determination unit for determining whether or not the first speech signal input from the first sound pick-up unit is a speech segment, wherein the speech-quality evaluation unit evaluates the speech quality of the speech signal after the noise cancellation at the
30 noise-cancellation processing unit while the speech-segment determination unit is determining that the first speech signal is the speech segment. In this case, the speech-segment determination unit may convert the first speech signal input from the first sound pick-up unit into a signal component in unit of a specific length in a
35 frequency domain and analyzes a spectrum component of the signal component thus converted into the frequency domain to

determine whether it is the speech segment based on the frequency component.

In the audio input apparatus according to the present invention, the first and sound pick-up units may be a main microphone and a sub-microphone, respectively, and the main microphone and the sub-microphone may be arranged at a front face and a rear face of the audio input apparatus, respectively. In this case, the audio input apparatus may further be provided with a microphone-direction determination unit for determining a direction of the main microphone based on a phase difference between the first and second speech signals output from the main microphone and the sub-microphone, respectively, wherein the speech-quality evaluation unit evaluates the speech quality of the speech signal after the noise cancellation at the noise-cancellation processing unit based on the direction of the main microphone determined by microphone-direction determination unit. The microphone-direction determination unit may detect the phase difference between the first and second speech signals output from the main microphone and the sub-microphone, respectively, to determine whether or not the phase difference is equal to or larger than a specific threshold value, wherein the speech-quality evaluation unit evaluates the speech quality of the speech signal after the noise cancellation at the noise-cancellation processing unit based on the determination at the microphone-direction determination unit.

Moreover, as described above, an audio input apparatus according to the present invention may be provided with a first sound pick-up unit, a second sound pick-up unit, a noise-cancellation processing unit for performing noise cancellation to a first speech signal input from the first sound pick-up unit by using a second speech signal input from the second sound pick-up unit, a speech-quality evaluation unit for evaluating the speech quality of a speech signal after the noise cancellation at the noise-cancellation processing unit, a transmitter unit for transmitting the speech signal after the noise cancellation, an evaluation-result notification unit for notifying an evaluation result

at the speech-quality evaluation unit, a receiver unit for receiving a speech signal, and a sound emission unit for emitting a sound based on the speech signal received by the receiver unit.

5 The audio input apparatus according to the present invention may further be provided with a communication-mode switching unit for switching a communication mode into a transmission mode in which the transmitter transmits the speech signal after the noise cancellation, wherein the evaluation-result notification unit notifies that the speech quality of the speech signal
10 after the noise cancellation is good while the communication mode is being switched into the transmission mode.

Furthermore, as described above, a condition notification method for an apparatus having at least a first microphone and a second microphone may be provided with the steps of picking up
15 sounds at the first and second microphones, respectively, performing noise cancellation to the sound picked up at the first microphone by using the sound picked up at the second microphone, evaluating the speech quality of the sound after the noise cancellation, and notifying a condition of the apparatus based
20 on a result of the evaluation.

Moreover, the processes and methods described above in the several embodiments can be achieved with a computer program stored in a storage medium such as a ROM of a main processor. A program that includes various commands for
25 executing each of the processes and methods described above can be stored in various types of non-transitory computer readable media and installed in a computer. The non-transitory computer readable media include tangible storage media. The non-transitory computer readable media applicable in this invention
30 include magnetic storage media such as a flexible disk, a magnetic tape, and a hard disk drive, magneto-optical storage media (such as a magneto-optical disk), CD-ROM (Read Only Memory) , CD-R, CD-RW, semiconductor memories such as a mask ROM, PROM (Programmable ROM), EPROM (Erasable PROM), a flash memory,
35 and RAM (Random Access Memory).

Moreover, a program that includes various commands for executing each of the processes and methods described above may be installed in a computer by using various types of transitory computer readable media that include an electric signal, an optical
5 signal, and an electro-magnetic wave. The program can be installed in a computer by means of such a transitory computer readable medium through a wired communication channel such as a cable and an optical fiber or a wireless communication channel.

As described above in detail, the present invention can
10 provide an audio input apparatus, a communication apparatus and a condition notification method that achieve transmission of clear voice sounds with an effective noise-cancellation function.

WHAT IS CLAIMED IS:

1. A condition notification method for notifying a used condition of a simplex communication apparatus by using a light-emitting device attached to the simplex communication apparatus, the method comprising:

a communication-mode determination step of determining whether a communication mode of the simplex communication apparatus is a transmission mode or a standby mode;

a sound pick-up state determination step of determining a sound pick-up state of a sound carried by a speech signal to be transmitted if the communication mode is the transmission mode; and

a control step of controlling the light-emitting device so that the light-emitting device is turned off, turned on or repeatedly turned on and off based on determination results of the communication-mode determination step and the sound pick-up state determination step.

2. The condition notification method according to claim 1, wherein, in the control step, the light-emitting device is turned on if the communication mode is the transmission mode whereas the light-emitting device is repeatedly turned on and off based on the sound pick-up state determined in the sound pick-up state determination step if the communication mode is the transmission mode.

3. The condition notification method according to claim 1 further comprising a speech-quality evaluation step of evaluating speech quality of the speech signal to be transmitted, wherein, in the sound pick-up state determination step, the sound pick-up state of the sound carried by the speech signal to be transmitted is determined if the communication mode is the transmission mode based on the speech quality of the speech signal evaluated by speech-quality evaluation step.

4. The condition notification method according to claim 3, wherein, in the speech-quality evaluation step, the speech quality of the speech signal to be transmitted is evaluated based on a volume level of a sound to be picked up.

5. The condition notification method according to claim 3 further comprising a speech-segment determination step of determining whether or not the speech signal to be transmitted is a speech segment if the communication mode is the transmission mode, wherein, in the sound pick-up state determination step, the sound pick-up state of the sound carried by the speech signal to be transmitted if the communication mode is the transmission mode is determined based on a determination result of the speech-segment determination step and an evaluation result of the speech-quality evaluation step.

6. The condition notification method according to claim 3 further comprising a noise cancellation step of performing noise cancellation to a first speech signal input from a first sound pick-up unit by using a second speech signal input from a second sound pick-up unit, the first and second sound pick-up units being provided for the simplex communication apparatus, wherein, speech quality of a speech signal after the noise cancellation is evaluated in the speech-quality evaluation step.

7. The condition notification method according to claim 3 further comprising a speech-segment determination step of determining whether or not the speech signal to be transmitted is a speech segment if the communication mode is the transmission mode, wherein, in the speech-quality evaluation step, the speech quality of the speech signal to be transmitted is evaluated while the speech signal to be transmitted is being determined as the speech segment.

8. The condition notification method according to claim 3 further comprising a microphone-direction determination step of

determining a direction of a main microphone based on a phase difference of sounds picked up by a first sound pick-up unit and a second sound pick-up unit both provided for the simplex communication apparatus, the first sound pick-up unit including the main microphone, wherein, in the speech-quality evaluation step, the speech quality of the speech signal to be transmitted is evaluated based on the direction of the main microphone thus determined in the microphone-direction determination step.

9. The condition notification method according to claim 6, wherein, in the control step, the light-emitting device is turned off if the communication mode is the standby mode, the light-emitting device is turned on if the communication mode is the transmission mode and if the speech signal to be transmitted is not the speech segment, the light-emitting device is turned on if the communication mode is the transmission mode and if the speech signal to be transmitted is the speech segment, and if the speech quality of the speech signal to be transmitted is evaluated as bad, and the light-emitting device is repeatedly turned on and off if the communication mode is the transmission mode and if the speech signal to be transmitted is the speech segment, and if the speech quality of the speech signal to be transmitted is evaluated as good.

10. The condition notification method according to claim 5, wherein the speech-segment determination step includes:

a frequency conversion step of converting a signal input from a sound pick-up unit provided for the simplex communication apparatus into a signal component in unit of a specific length in a frequency domain; and

a sound determination step of determining whether the signal input from the sound pick-up unit carries a voice component or a noise component based on a spectrum component of the signal component thus converted into the frequency domain.

11. A communication apparatus comprising:
a first pick-up unit configured to pick up a voice sound;
a transmitter unit configured to transmit the voice sound picked up by the first pick-up unit to outside as a first speech signal;
a communication-mode switching unit configured to switch a communication mode between a standby mode in which the transmitter unit does not transmit the speech signal and a transmission mode in which the transmitter unit transmits the speech signal;
a sound pick-up state determination unit configured to determine a pick-up state of the voice sound picked up by the first pick-up unit;
a light emission device configured to emit light; and
a control unit configured to control the light-emitting device so that the light-emitting device is turned off, turned on or repeatedly turned on and off based on the communication mode switched by the communication-mode switching unit, and the pick-up state of the voice sound picked up by the first pick-up unit and determined by the sound pick-up state determination unit.
12. The communication apparatus according to claim 11, wherein the light-emitting device is turned on if the communication mode is switched into the transmission mode whereas the light-emitting device is repeatedly turned on and off based on the pick-up state determined by the sound pick-up state determination unit if the communication mode is switched into the transmission mode.
13. The communication apparatus according to claim 11 further comprising a speech-quality evaluation unit configured to evaluate speech quality of the first speech signal to be transmitted by the transmitter unit, wherein the sound pick-up state determination unit determines the sound pick-up state of the voice sound picked up by the first sound pick-up unit based

on the speech quality of the speech signal evaluated by the speech-quality evaluation unit.

14. The communication apparatus according to claim 13 further comprising a speech-segment determination unit configured to determine whether or not the first speech signal to be transmitted by the transmitter unit is a speech segment, wherein, the sound pick-up state determination unit determines the sound pick-up state of the sound to be transmitted as the first speech signal based on a determination result at the speech-segment determination unit and an evaluation result at the speech-quality evaluation unit.

15. The communication apparatus according to claim 13 further comprising:

- a second sound pick-up unit configured to pick up a voice sound;

- a noise cancellation unit configured to perform noise cancellation to the first speech signal input from the first sound pick-up unit by using a second speech signal input from the second sound pick-up unit,

- wherein the transmitter unit transmits a speech signal after the noise cancellation by the noise cancellation unit and the speech-quality evaluation unit evaluates speech quality of the speech signal after the noise cancellation.

16. The communication apparatus according to claim 15 further comprising a microphone-direction determination unit configured to determine a direction of a main microphone based on a phase difference of the voice sounds picked up the first and second sound pick-up units, respectively, the first sound pick-up unit including the main microphone, wherein, the speech-quality evaluation unit evaluates the speech quality of the speech signal to be transmitted by the transmitter unit based on the direction of the main microphone thus determined by the microphone-direction determination unit.

17. The communication apparatus according to claim 14, wherein the control unit controls the light-emitting device so that the light-emitting device is turned off if the communication mode is the standby mode, the light-emitting device is turned on if the communication mode is the transmission mode and if the speech signal to be transmitted is not the speech segment, the light-emitting device is turned on if the communication mode is the transmission mode, if the speech signal to be transmitted is the speech segment, and if the speech quality of the speech signal to be transmitted is evaluated as bad, and the light-emitting device is repeatedly turned on and off if the communication mode is the transmission mode, if the speech signal to be transmitted is the speech segment, and if the speech quality of the speech signal to be transmitted is evaluated as good.

18. The communication apparatus according to claim 15, wherein the first and second sound pick-up units are a main microphone and a sub-microphone, respectively, and the main microphone and the sub-microphone are arranged at a front face and a rear face of the communication apparatus, respectively.

19. The communication apparatus according to claim 14, wherein the speech-segment determination unit converts the first signal input from the first sound pick-up unit into a signal component in unit of a specific length in a frequency domain and determines whether the first signal carries a voice component or a noise component based on a spectrum component of the signal component thus converted into the frequency domain.

20. An audio input apparatus comprising:
a first sound pick-up unit;
a second sound pick-up unit;

a noise-cancellation processing unit configured to perform noise cancellation to a first speech signal input from the first sound pick-up unit by using a second speech signal input from the second sound pick-up unit;

a speech-quality evaluation unit configured to evaluate speech quality of a speech signal after the noise cancellation at the noise-cancellation processing unit; and

an evaluation-result notification unit configured to notify an evaluation result at the speech-quality evaluation unit.

ABSTRACT OF THE DISCLOSURE

The used condition of a simplex communication apparatus is notified with a light-emitting device attached to the communication apparatus. It is determined whether a communication mode of the simplex communication apparatus is a transmission mode or a standby mode. A sound pick-up state of a sound carried by a speech signal to be transmitted is determined if the communication mode is the transmission mode. The light-emitting device is controlled so that it is turned off, turned on or repeatedly turned on and off based on determination results of the communication-mode determination and the sound pick-up state determination.

1 / 28

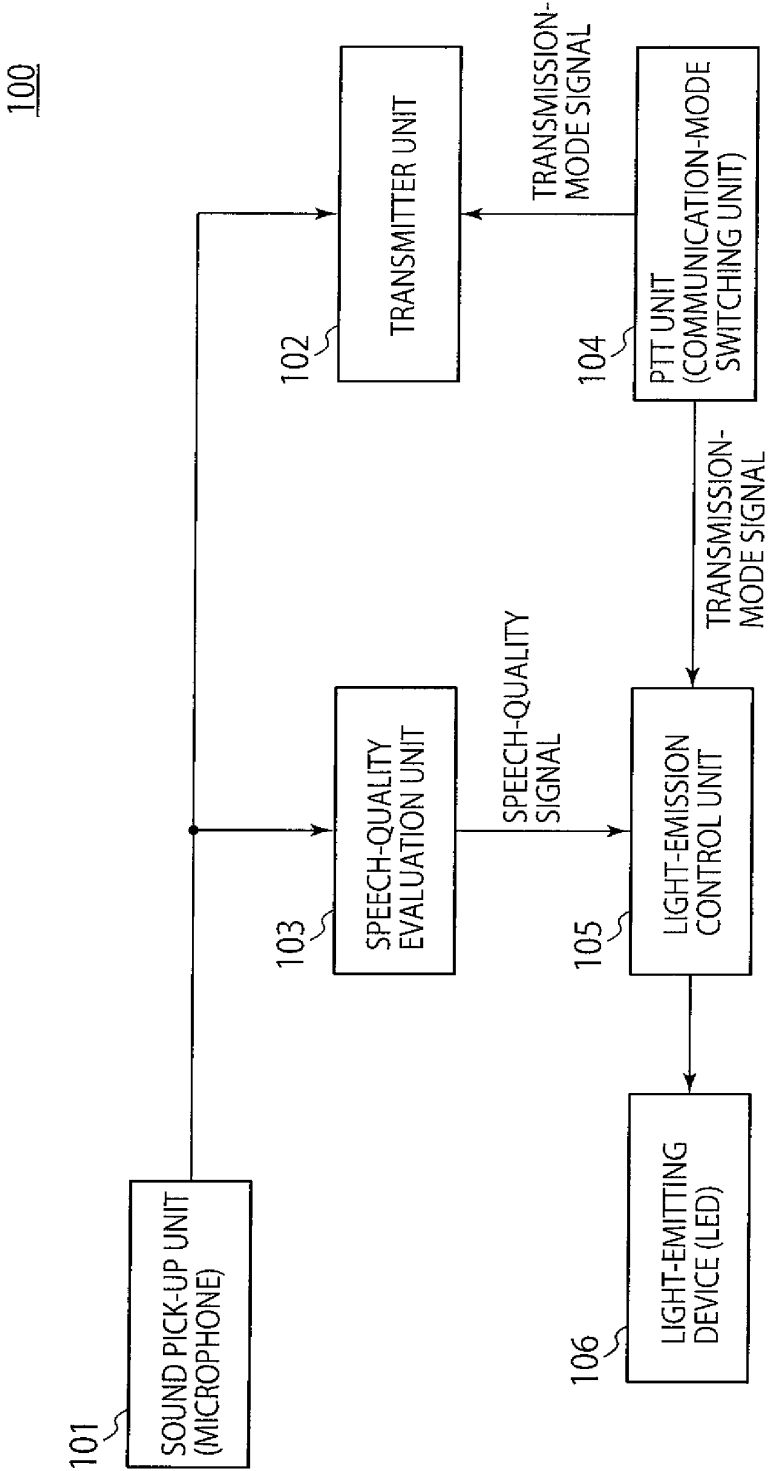


FIG. 1

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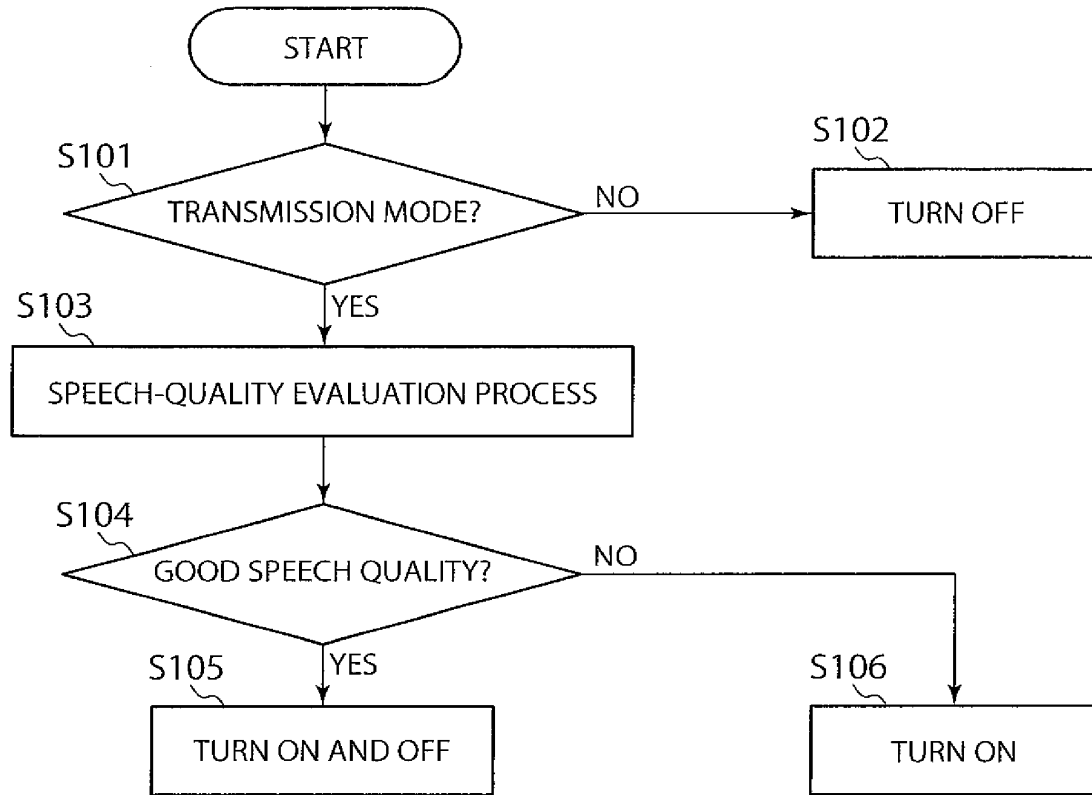


FIG. 2

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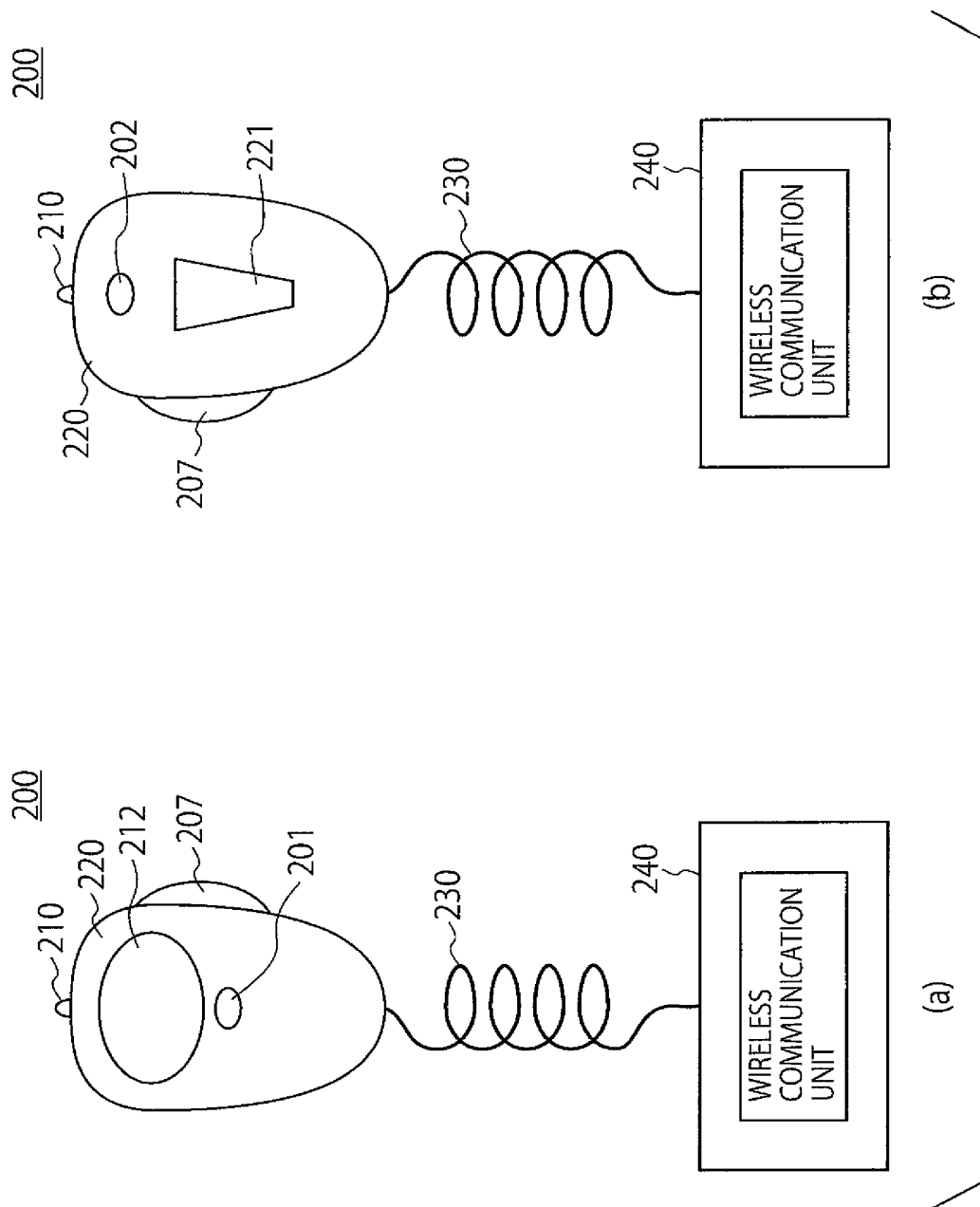


FIG. 3

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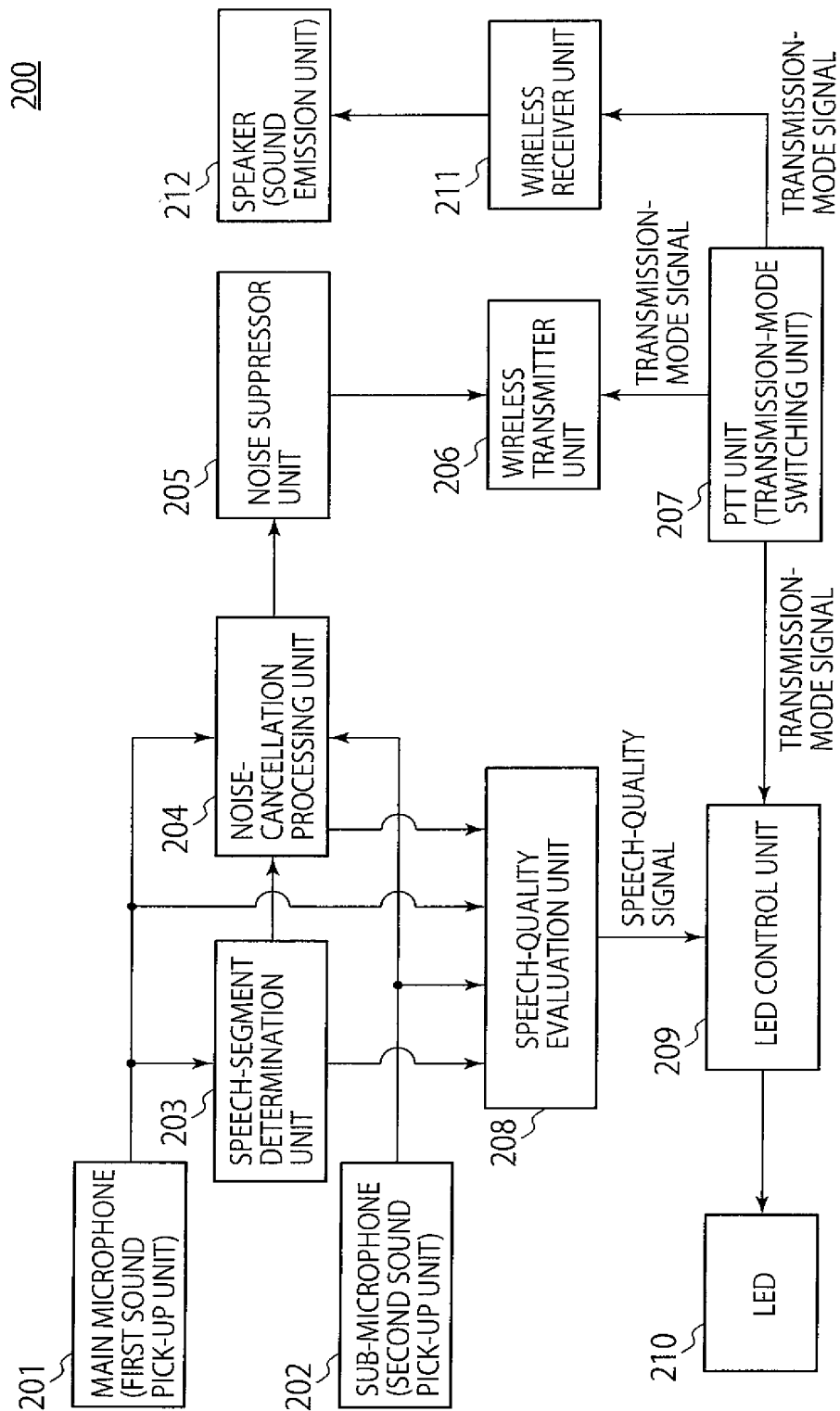


FIG. 4

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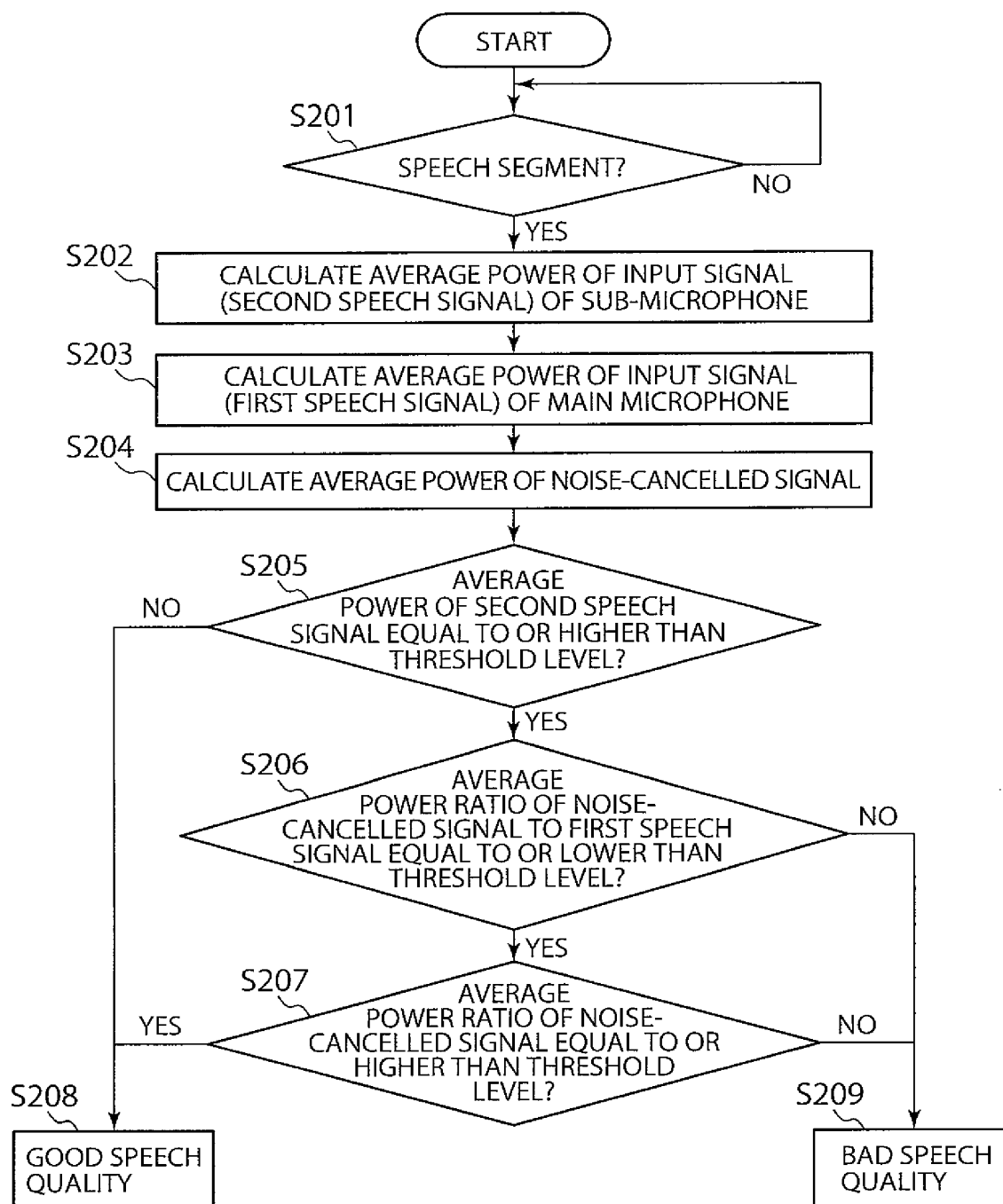


FIG. 5

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	TRANSMISSION-MODE SIGNAL (FROM PTT UNIT)	SPEECH-QUALITY SIGNAL (FROM SPEECH-QUALITY DETERMINATION UNIT)	LED STATE
No1	TRANSMISSION MODE (PTT UNIT PUSHED)	GOOD SPEECH QUALITY	TURN ON AND OFF
No2		BAD SPEECH QUALITY	TURN ON
No3		NO SIGNAL	TURN ON
No4	RECEPTION MODE (PTT UNIT NOT PUSHED)	NO SIGNAL	TURN OFF

FIG.6

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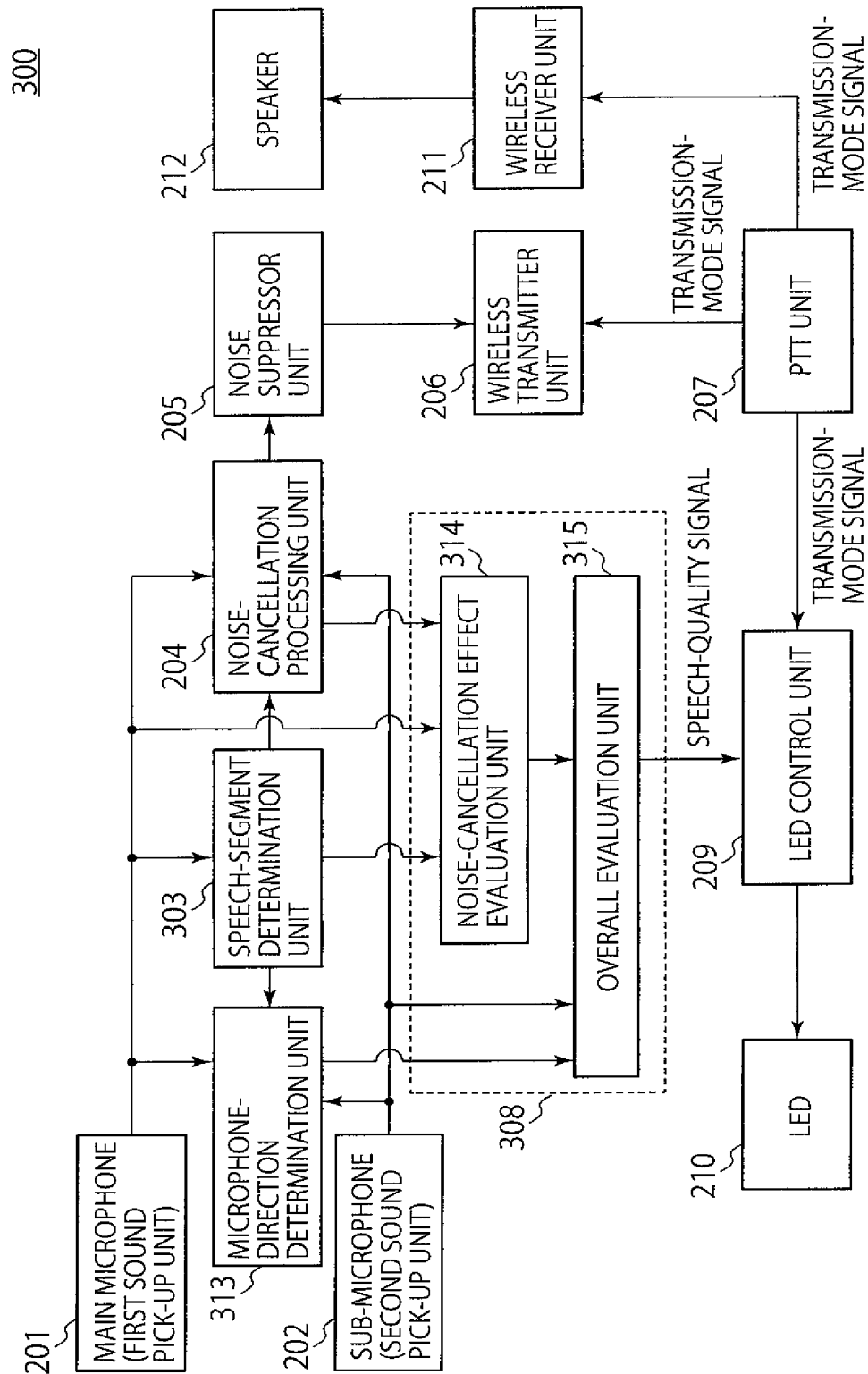


FIG. 7

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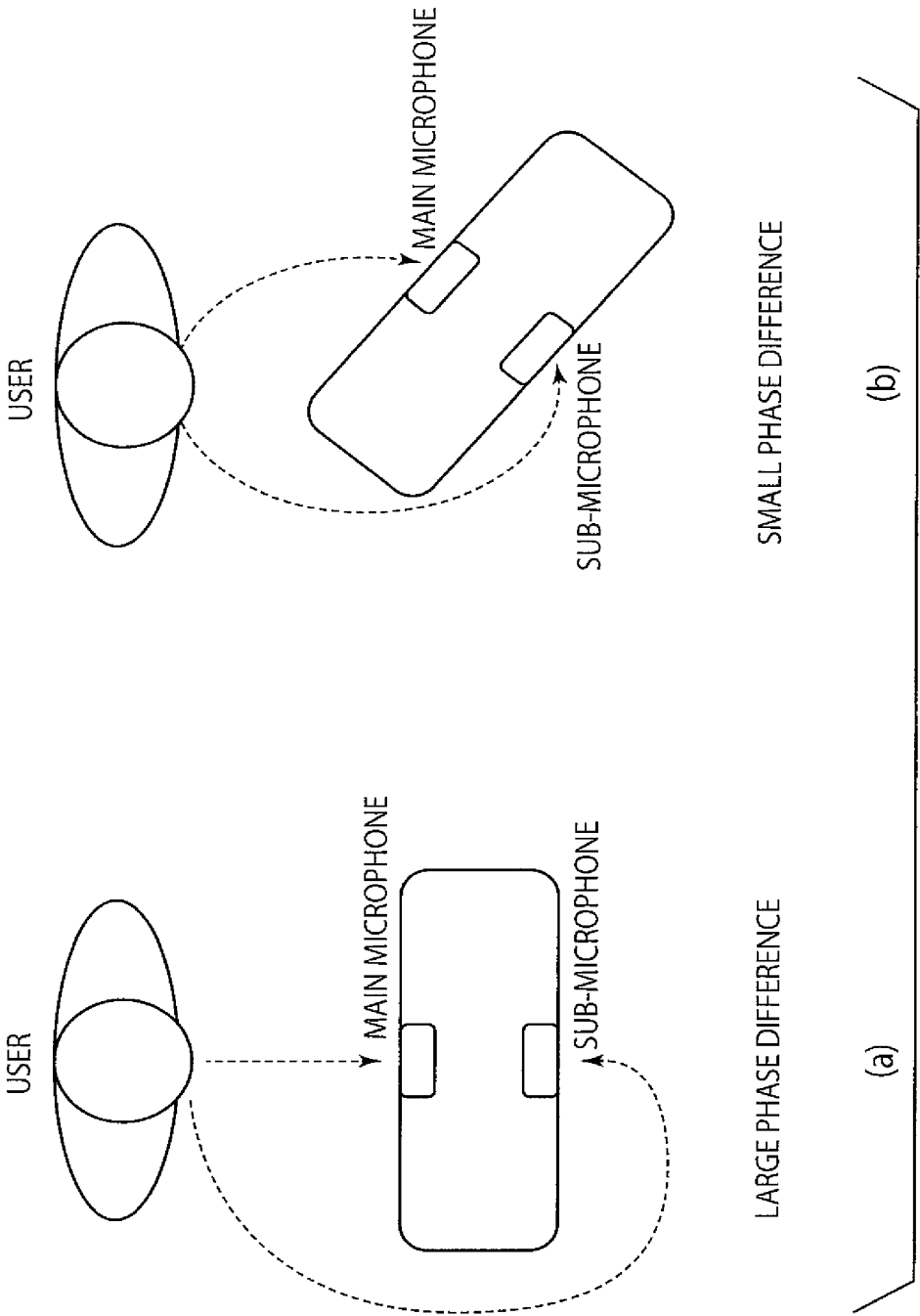


FIG. 8

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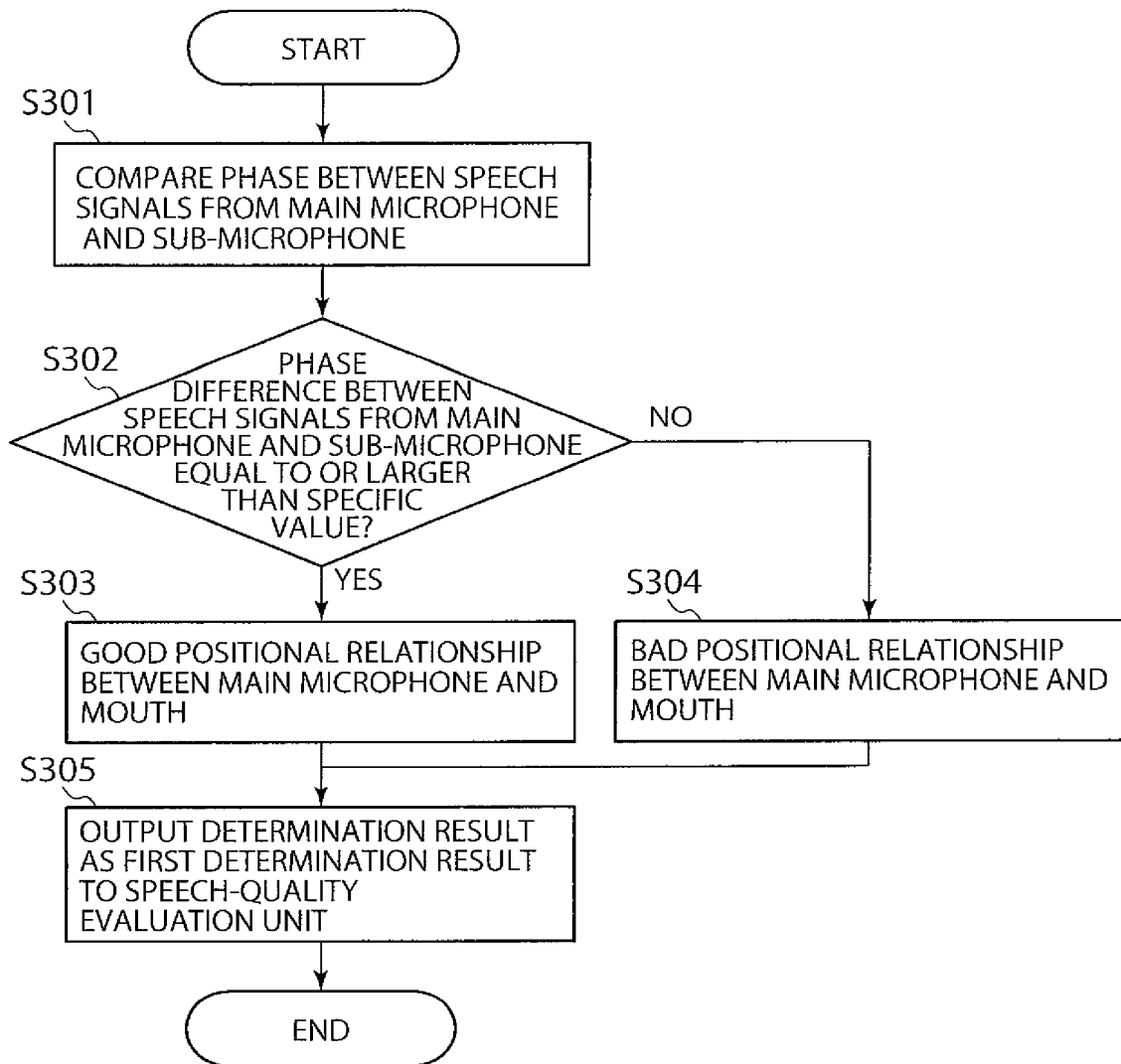


FIG. 9

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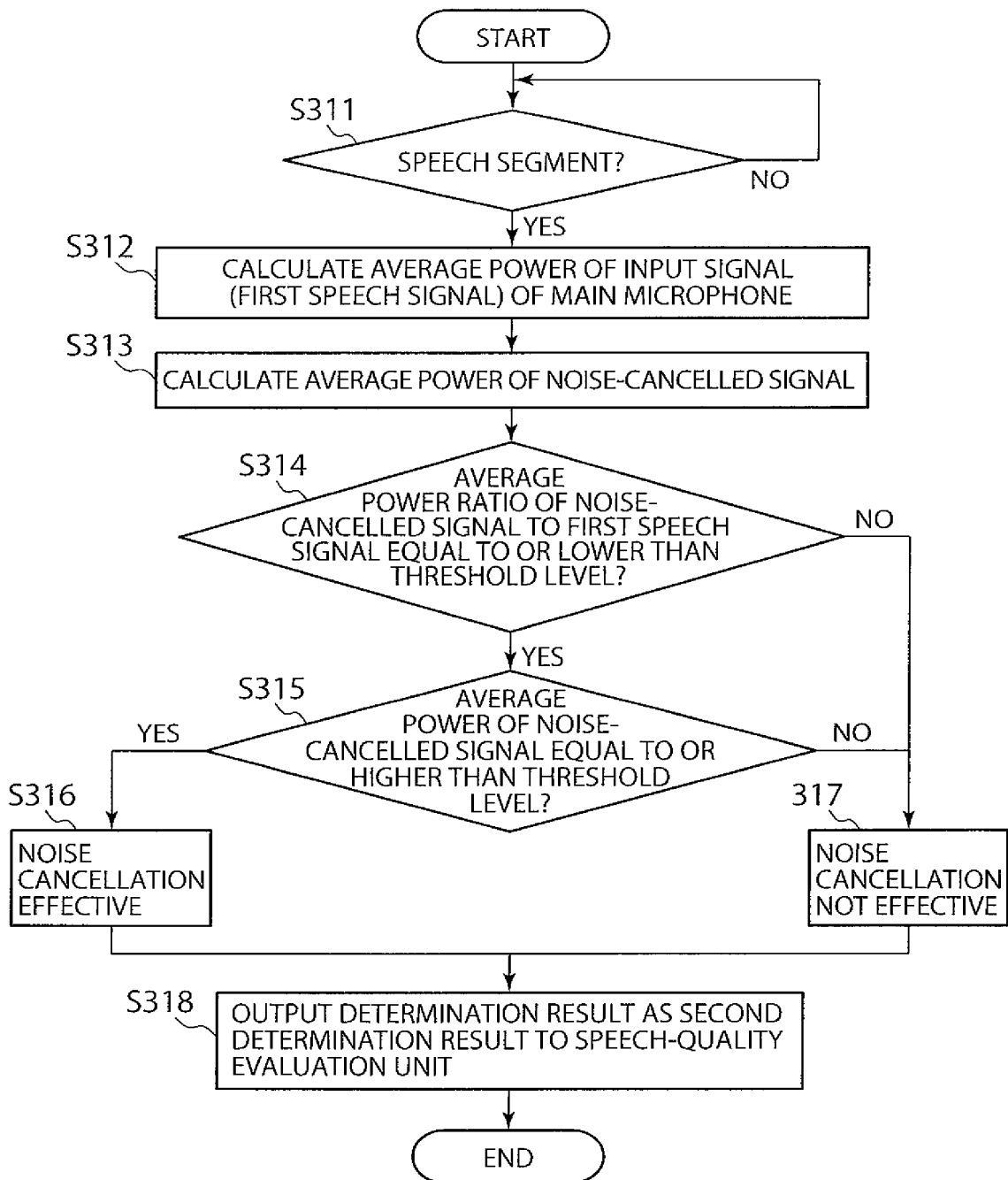


FIG. 10

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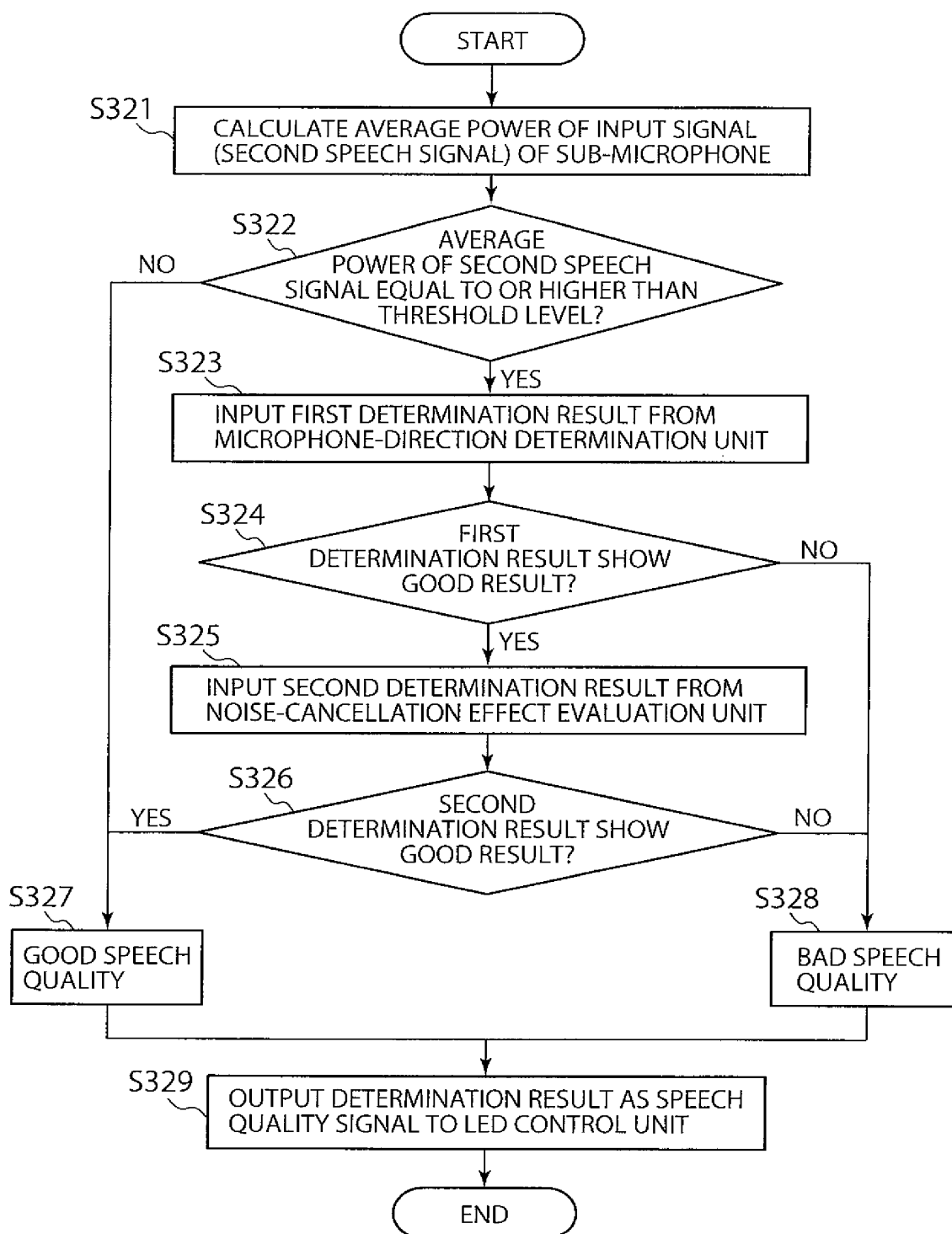


FIG. 11

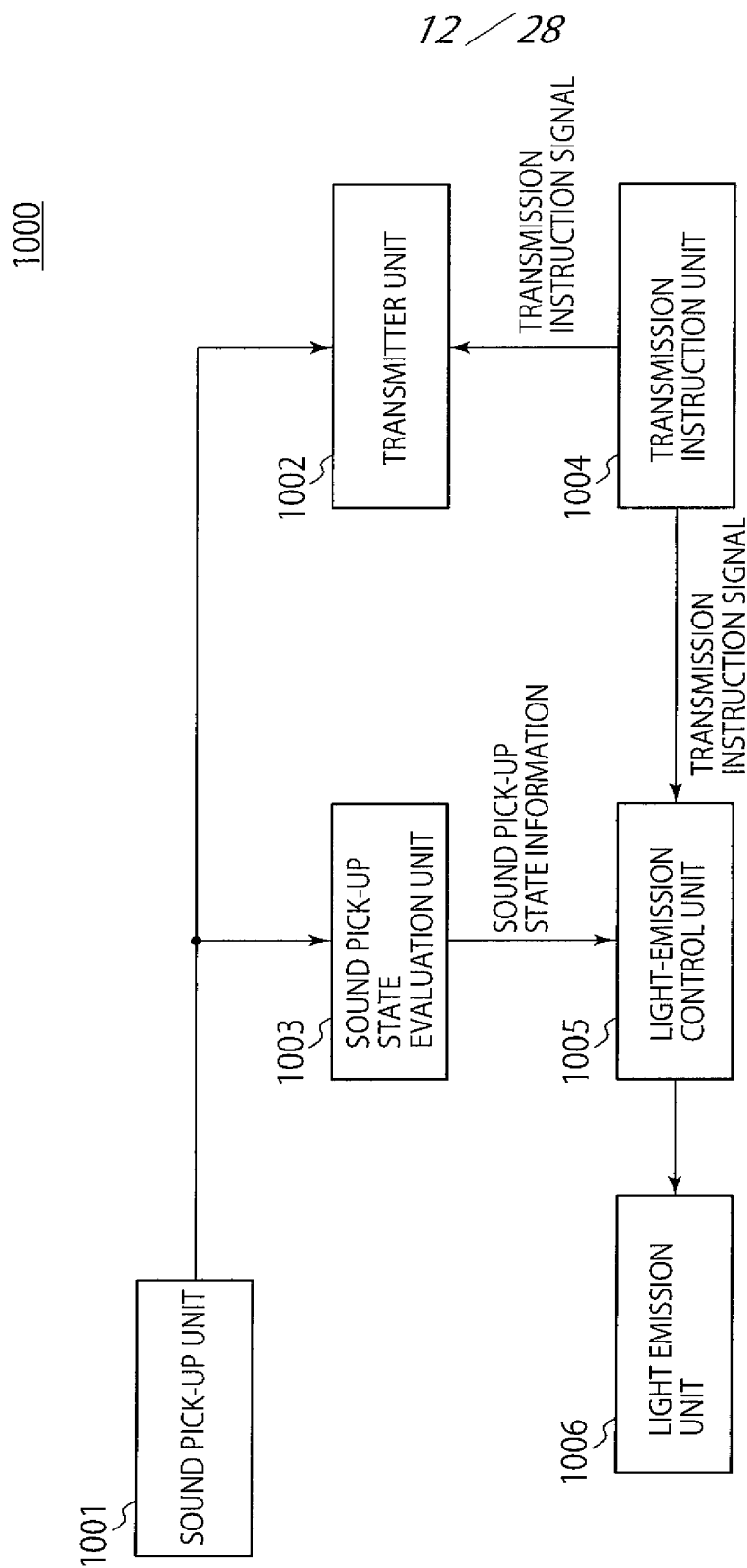


FIG. 12

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	COMMUNICATION MODE	SOUND PICK-UP STATE DETERMINATION		LED STATE
		SPEECH SEGMENT DETERMINATION	SPEECH QUALITY DETERMINATION	
No1	STANDBY MODE (NO TRANSMISSION INSTRUCTION SIGNAL INPUT)	NO DETERMINATION	NO DETERMINATION	TURN OFF
No2	TRANSMISSION MODE (INPUT TRANSMISSION INSTRUCTION SIGNAL)	NON-SPEECH SEGMENT	NO DETERMINATION	TURN ON
No3		SPEECH SEGMENT	BAD SPEECH QUALITY	TURN ON
No4			GOOD SPEECH QUALITY	TURN ON AND OFF

FIG. 13

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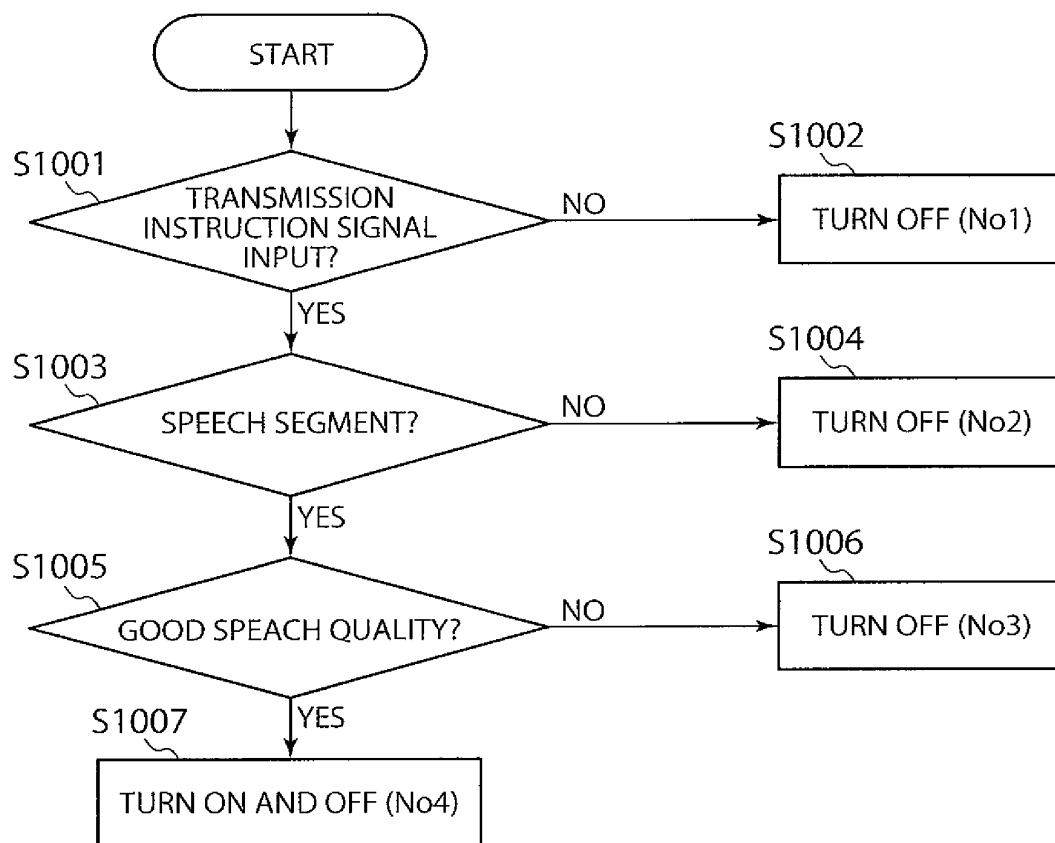


FIG. 14

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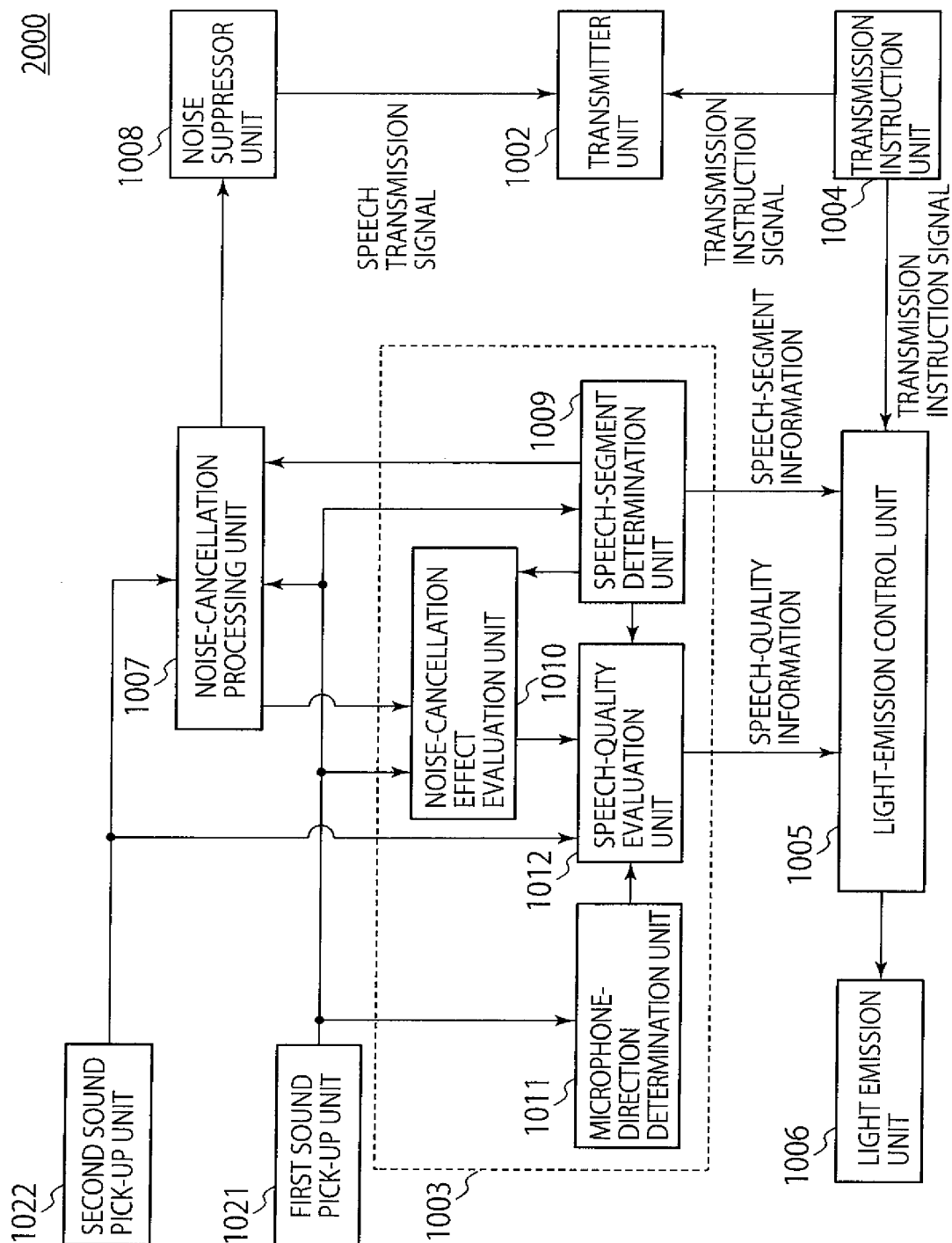


FIG. 15

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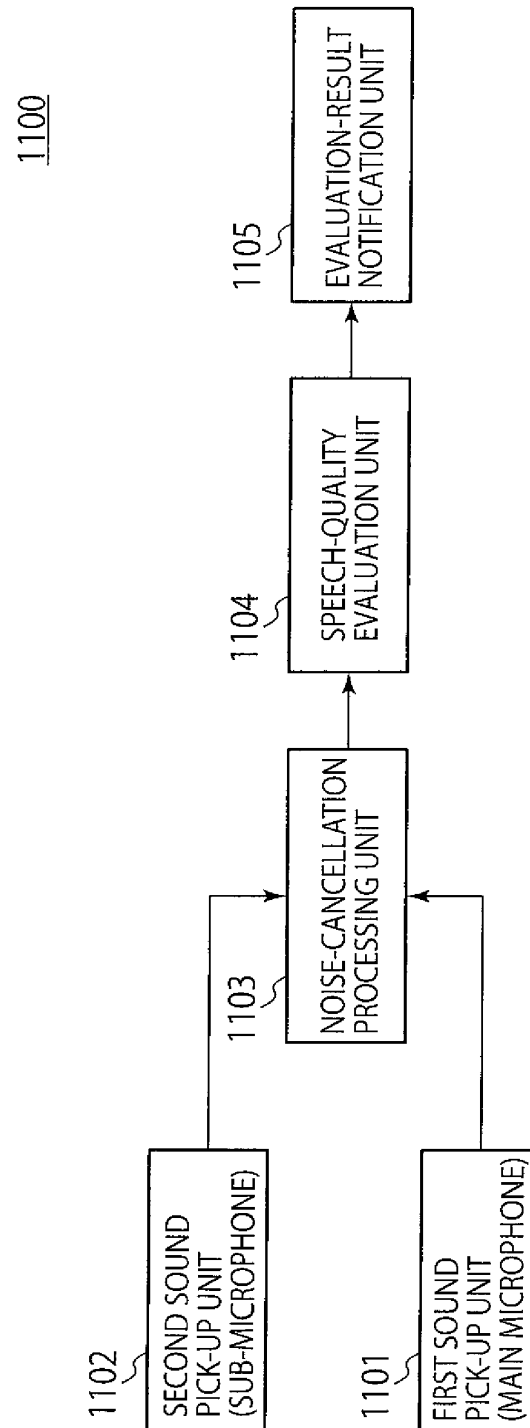


FIG. 16

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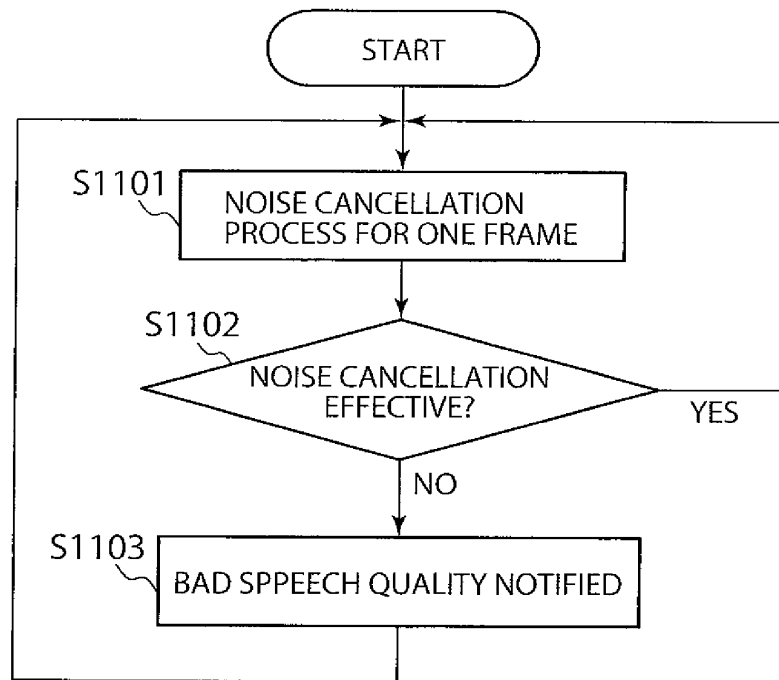


FIG. 17

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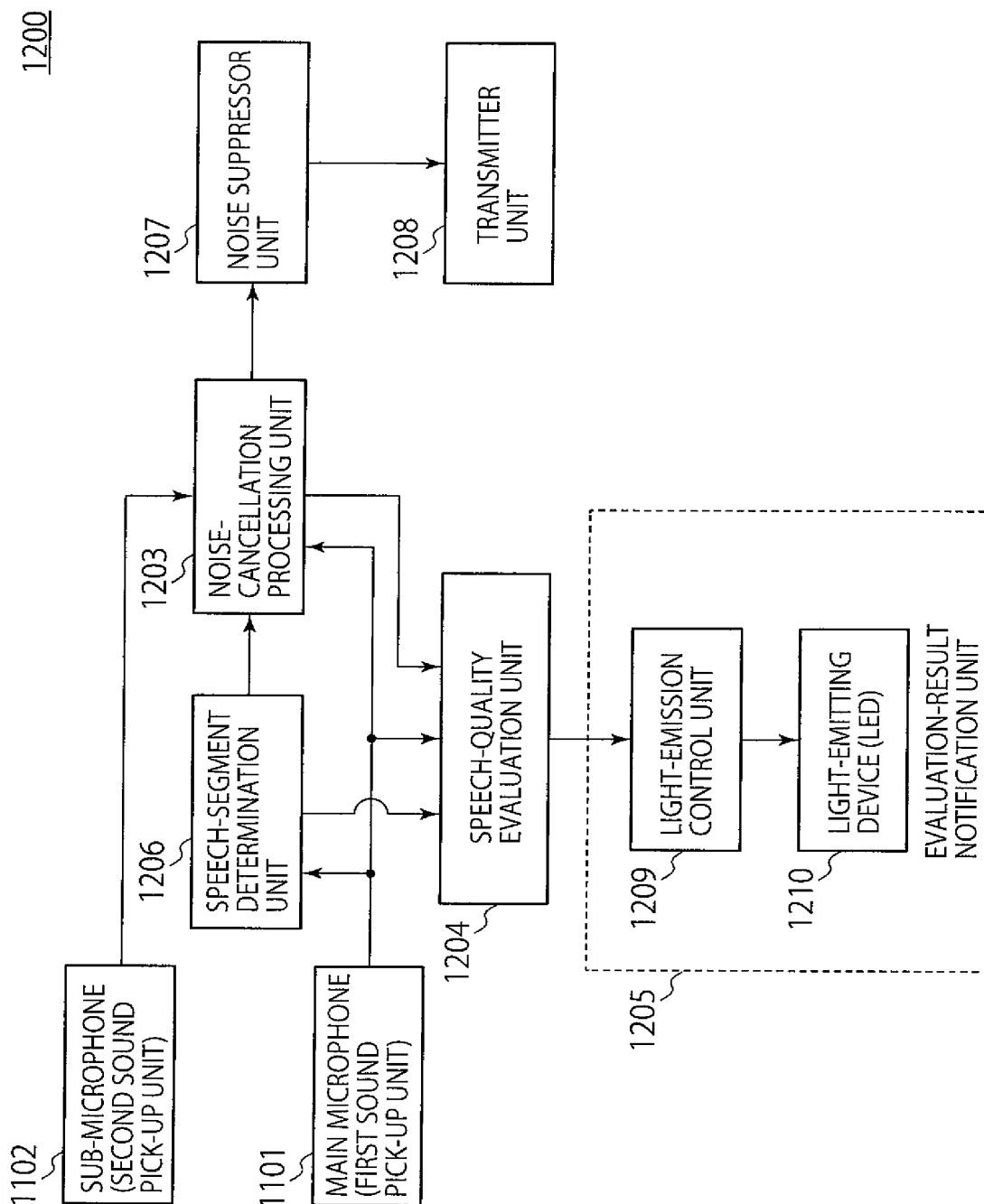


FIG. 18

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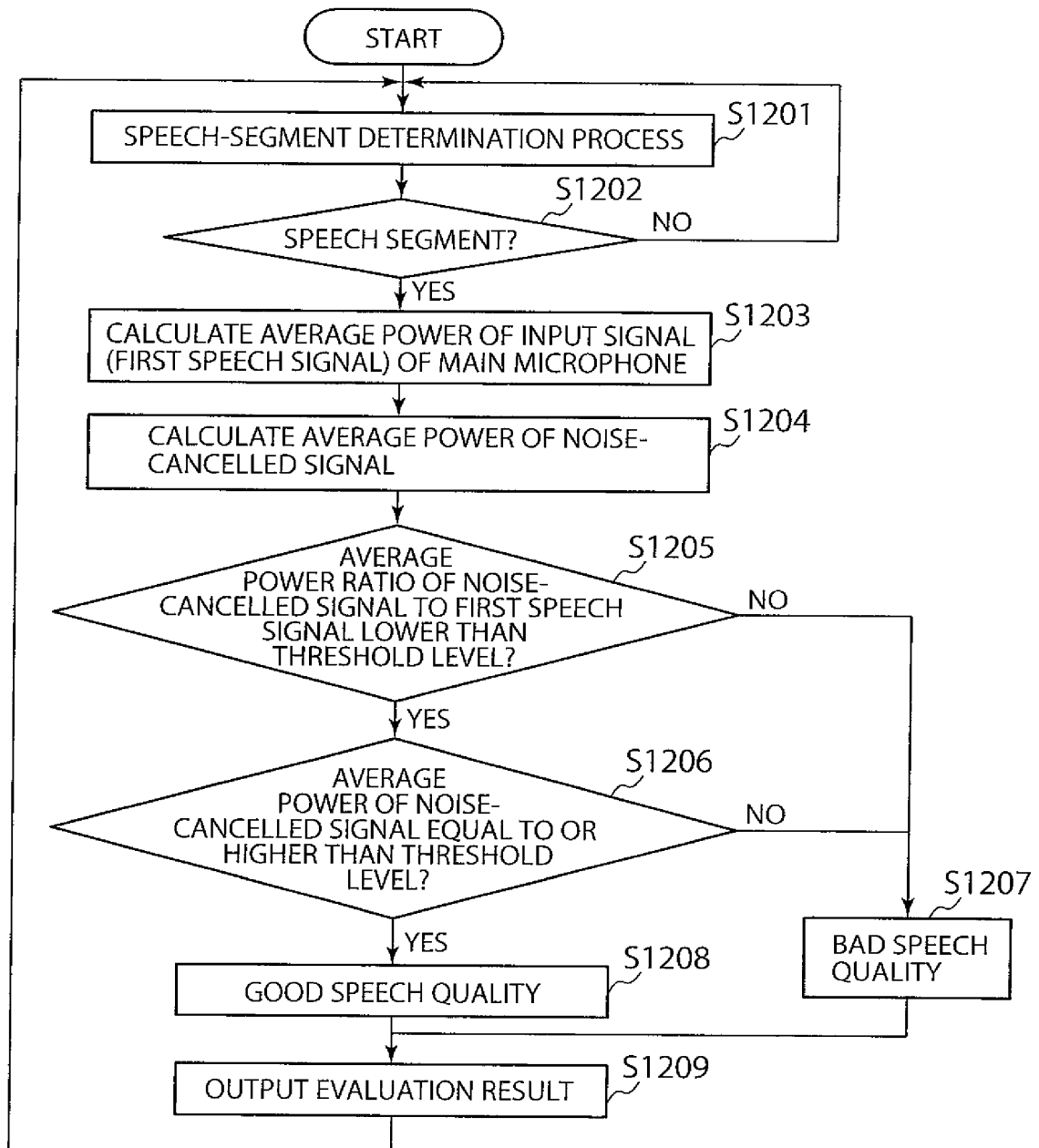


FIG. 19

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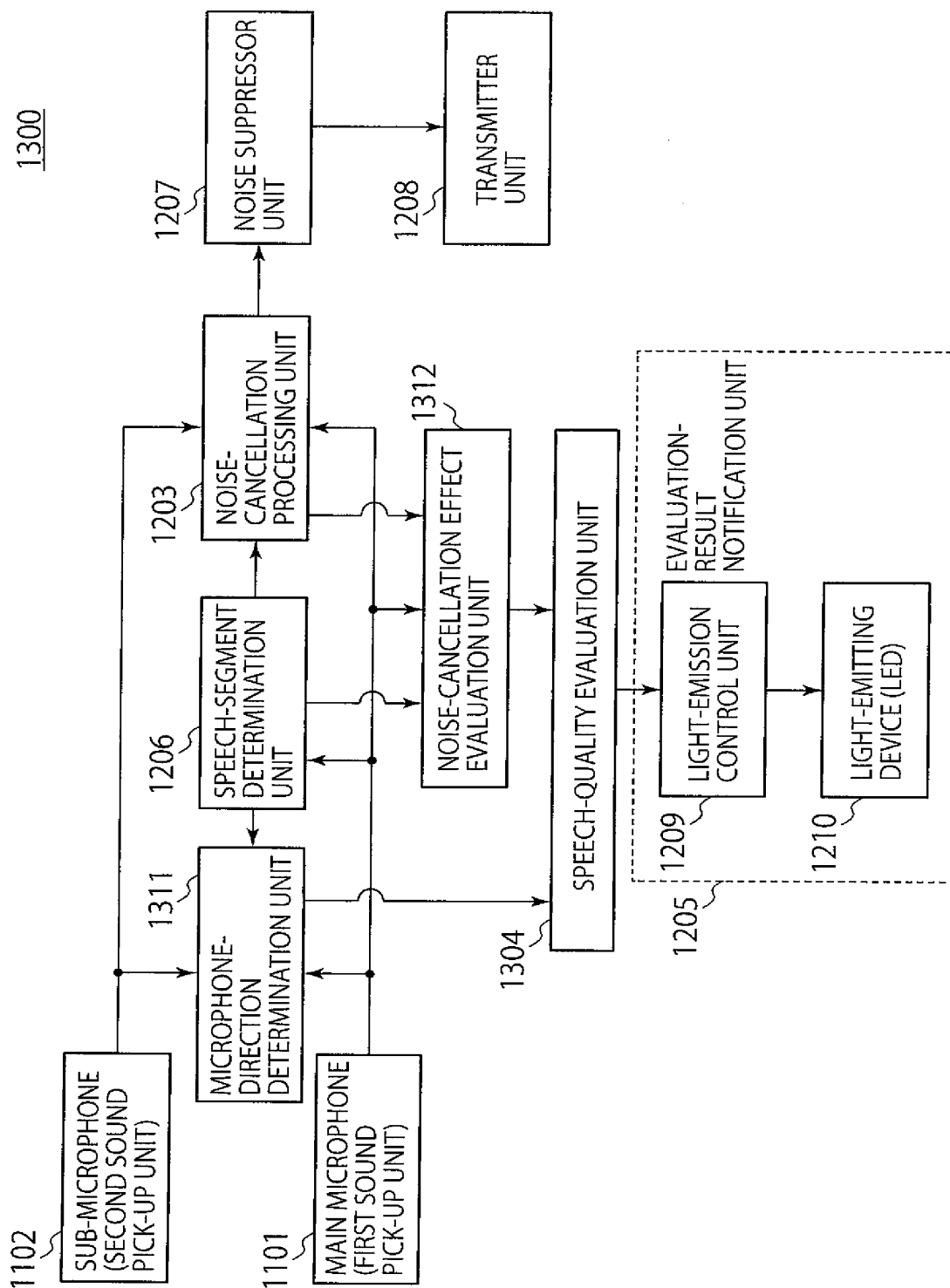


FIG. 20

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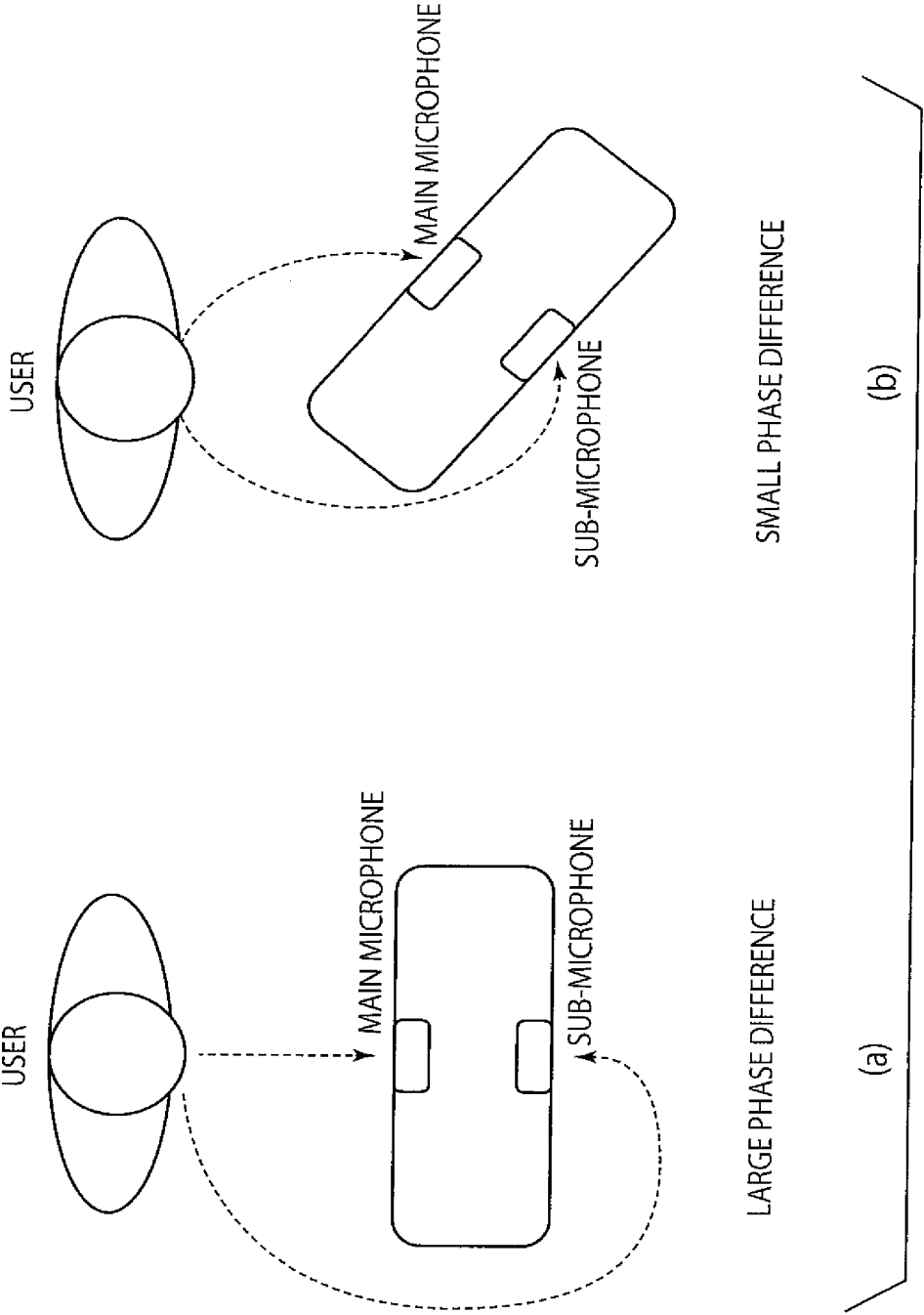


FIG. 21

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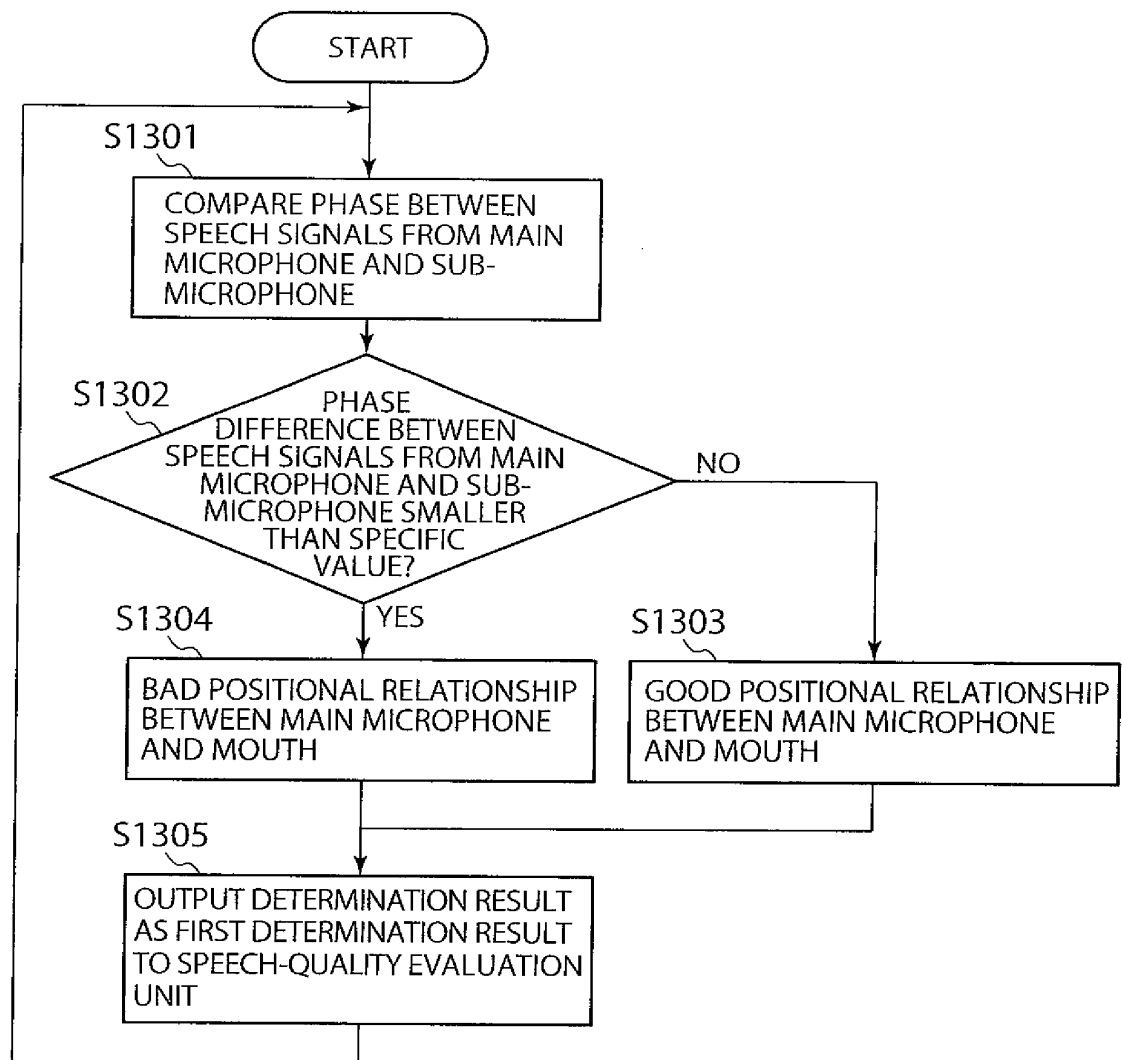


FIG. 22

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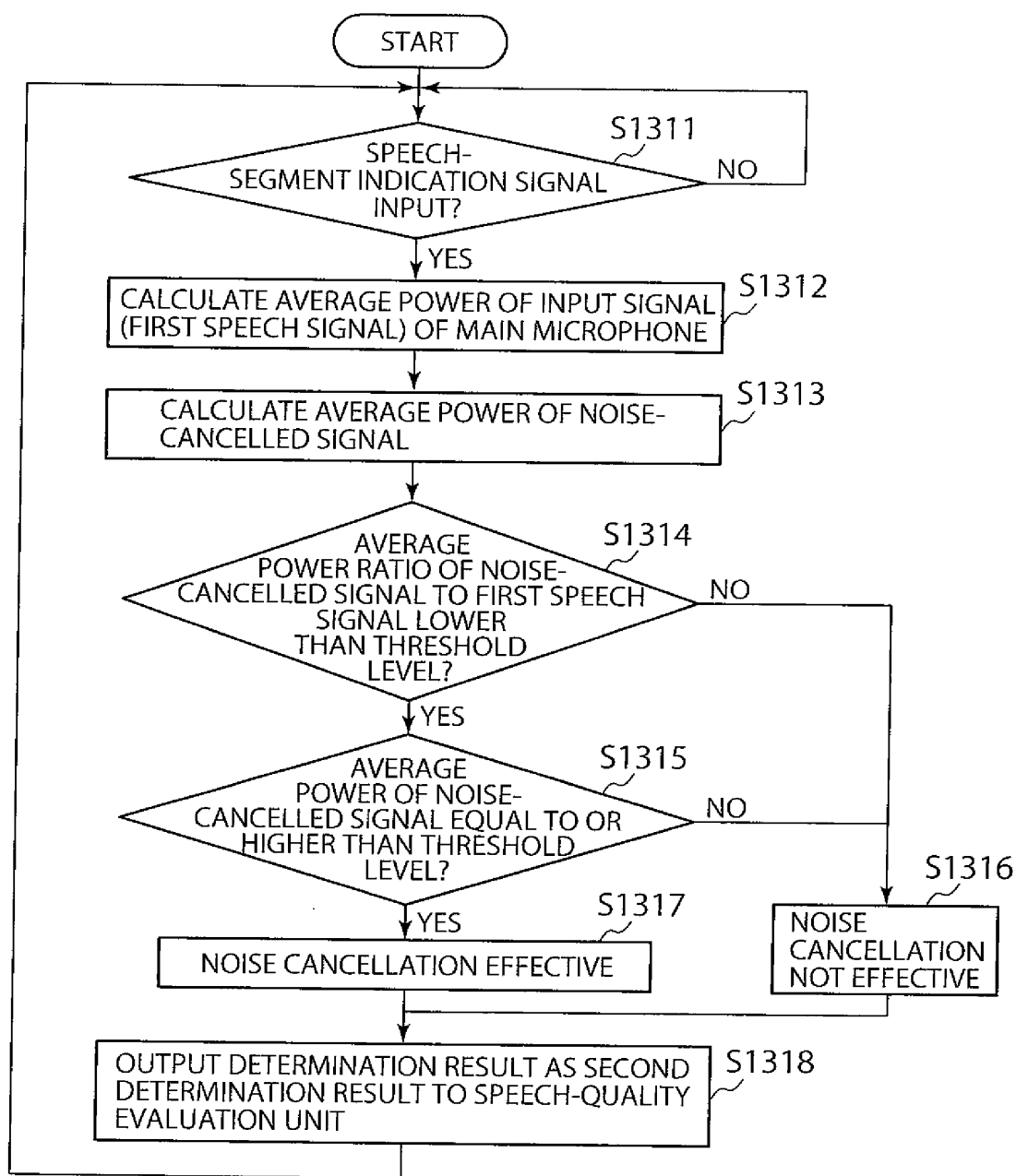


FIG. 23

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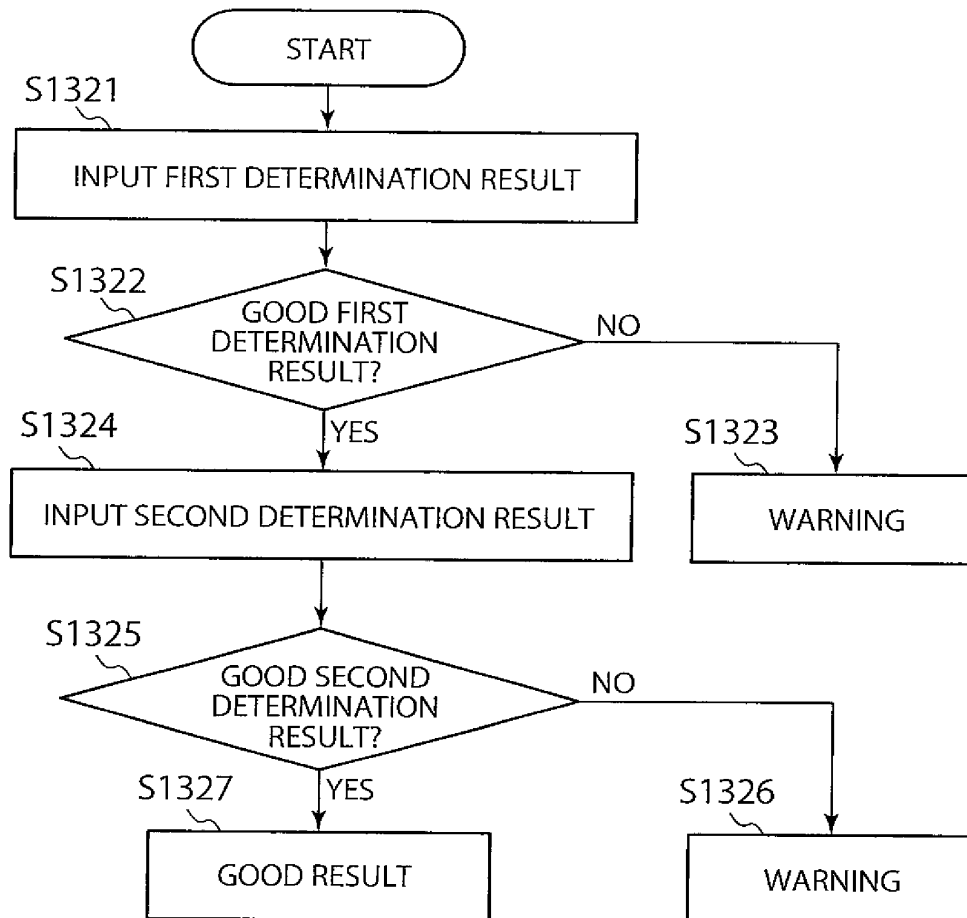


FIG. 24

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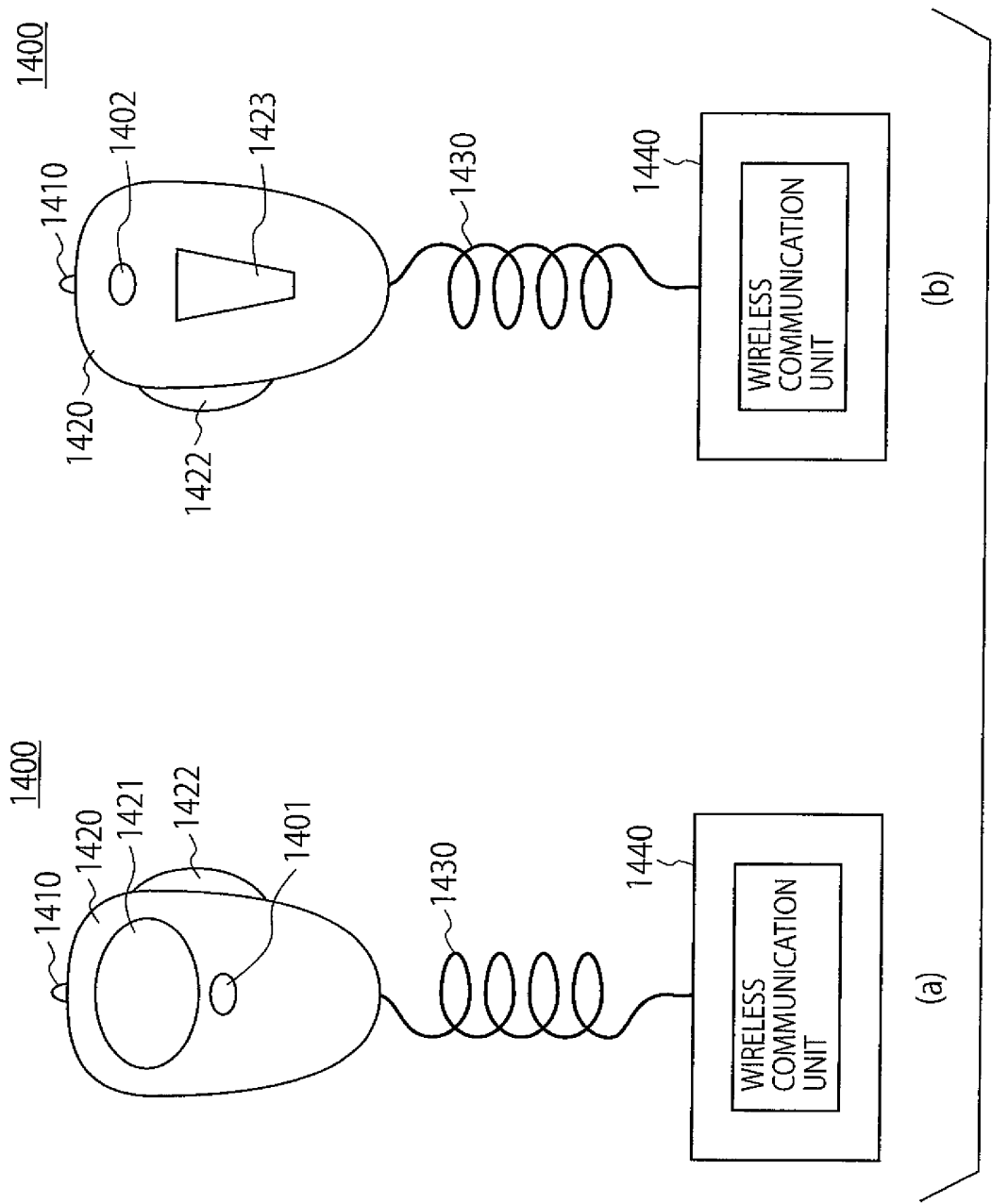


FIG. 25

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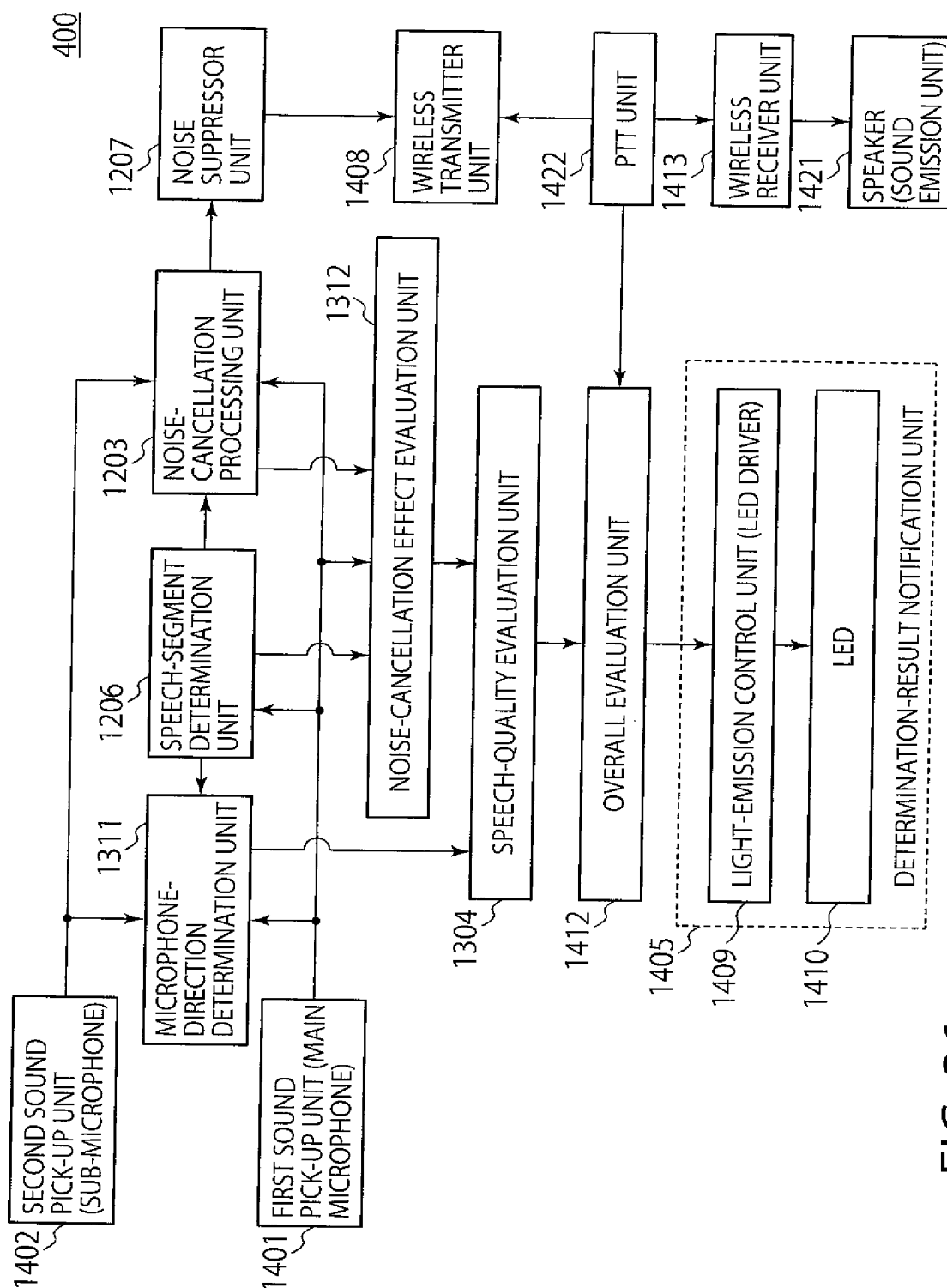


FIG. 26

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	TRANSMISSION MODE INFORMATION (FROM PTT UNIT)	SPEECH-QUALITY DETERMINATION INFORMATION (FROM SPEECH-QUALITY DETERMINATION UNIT)	LED STATE
No1	TRANSMISSION MODE (PTT UNIT PUSHED)	GOOD SPEECH QUALITY	TURN ON AND OFF
No2		BAD SPEECH QUALITY	TURN ON
No3		NO SIGNAL	TURN ON
No4	STANDBY MODE (PTT UNIT NOT PUSHED)	NO SIGNAL	TURN OFF

FIG. 27

28 / 28

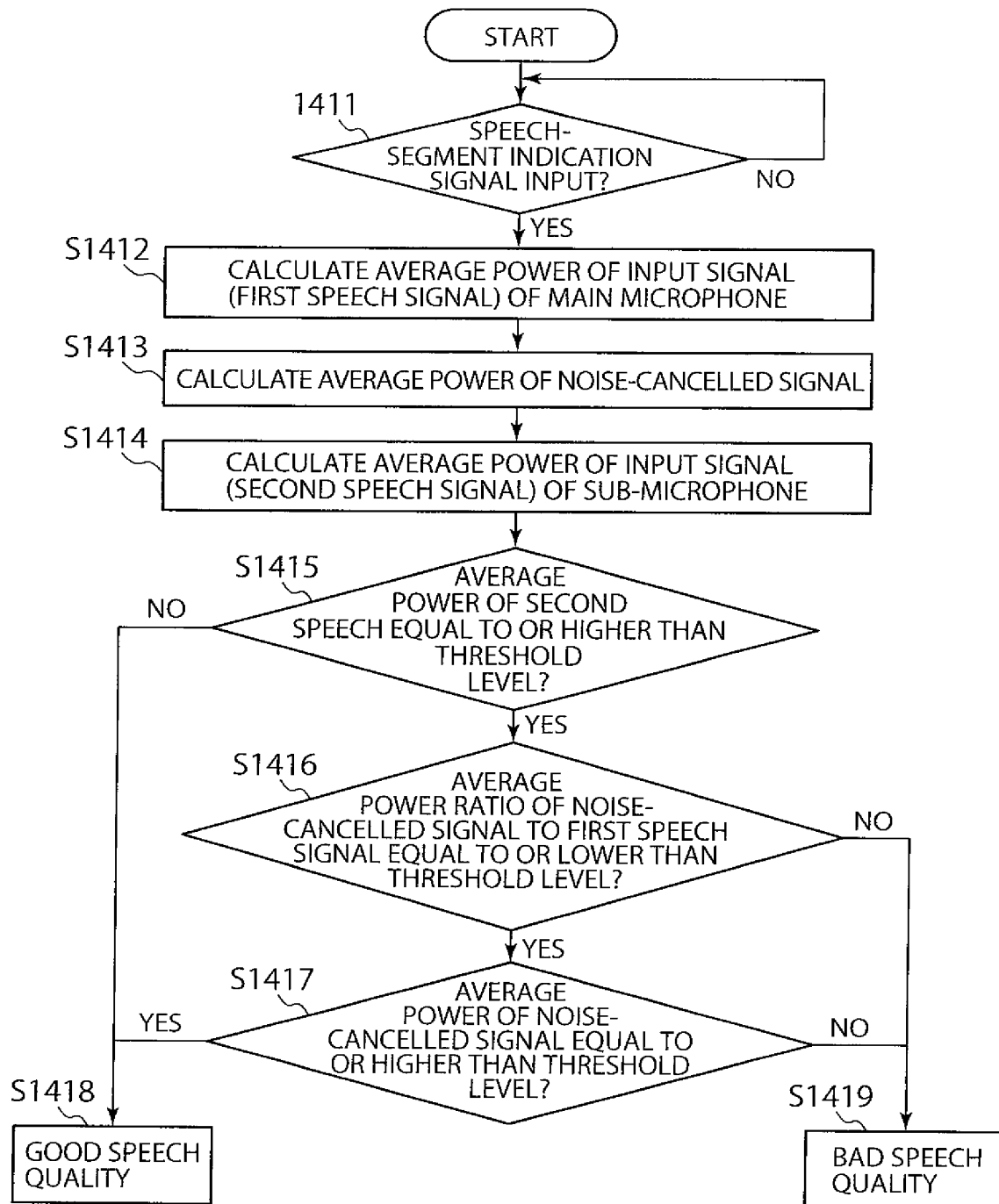


FIG. 28

**DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN
APPLICATION DATA SHEET (37 CFR 1.76)**

Title of Invention	AUDIO INPUT APPARATUS, COMMUNICATION APPARATUS AND CONDITION NOTIFICATION METHOD
As the below named inventor, I hereby declare that: This declaration is directed to: ☒ The attached application, or ☐ United States application or PCT international application number _____ filed on _____ The above-identified application was made or authorized to be made by me. I believe that I am the original inventor or an original joint inventor of a claimed invention in the application. I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both. 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. LEGAL NAME OF INVENTOR Inventor: <u>Tatsuya ONODA</u> Date (Optional): <u>01/31/2013</u> Signature: <u>Tatsuya Onoda</u> Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form. Use an additional PTO/AIA/01 form for each additional inventor.	

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. 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 1 minute 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.

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.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	KYO.P0221
		Application Number	
Title of Invention	AUDIO INPUT APPARATUS, COMMUNICATION APPARATUS AND CONDITION NOTIFICATION METHOD		
The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76. This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.			

Secrecy Order 37 CFR 5.2

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)
--

Inventor Information:

Inventor 1					Remove
Legal Name					
Prefix	Given Name	Middle Name	Family Name	Suffix	
	Masaya		KONISHI		
Residence Information (Select One) ☐ US Residency ☒ Non US Residency ☐ Active US Military Service					
City	Yokohama-Shi, Kanagawa-Ken		Country of Residence	JP	
Mailing Address of Inventor:					
Address 1		c/o JVC KENWOOD Corporation, IP Department			
Address 2		12, Moriya-Cho 3-Chome, Kanagawa-Ku			
City	Yokohama-Shi, Kanagawa-Ken		State/Province		
Postal Code			Country	JP	
Inventor 2					Remove
Legal Name					
Prefix	Given Name	Middle Name	Family Name	Suffix	
	Tatsuya		ONODA		
Residence Information (Select One) ☐ US Residency ☒ Non US Residency ☐ Active US Military Service					
City	Yokohama-Shi, Kanagawa-Ken		Country of Residence	JP	
Mailing Address of Inventor:					
Address 1		c/o JVC KENWOOD Corporation, IP Department			
Address 2		12, Moriya-Cho 3-Chome, Kanagawa-Ku			
City	Yokohama-Shi, Kanagawa-Ken		State/Province		
Postal Code			Country	JP	
All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the Add button. Add					

Correspondence Information:

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.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	KYO.P0221
		Application Number	
Title of Invention	AUDIO INPUT APPARATUS, COMMUNICATION APPARATUS AND CONDITION NOTIFICATION METHOD		

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ An Address is being provided for the correspondence information of this application.

Customer Number	26360		
Email Address	eggreive@rennerkenner.com	Add Email	Remove Email

Application Information:

Title of the Invention	AUDIO INPUT APPARATUS, COMMUNICATION APPARATUS AND CONDITION NOTIFICATION METHOD		
Attorney Docket Number	KYO.P0221	Small Entity Status Claimed	☐
Application Type	Nonprovisional		
Subject Matter			
Suggested Class (if any)		Sub Class (if any)	
Suggested Technology Center (if any)			
Total Number of Drawing Sheets (if any)	28	Suggested Figure for Publication (if any)	

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32). Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.			
Please Select One:	☒ Customer Number	☐ US Patent Practitioner	☐ Limited Recognition (37 CFR 11.9)
Customer Number	26360		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, or 365(c) or indicate National Stage entry from a PCT application. Providing this information in the application data sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.	
Prior Application Status	Remove

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.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	KYO.P0221
		Application Number	
Title of Invention	AUDIO INPUT APPARATUS, COMMUNICATION APPARATUS AND CONDITION NOTIFICATION METHOD		
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the Add button.			Add

Foreign Priority Information:

This section allows for the applicant to claim benefit of foreign priority and to identify any prior foreign application for which priority is not claimed. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55(a).

			Remove
Application Number	Country i	Filing Date (YYYY-MM-DD)	Priority Claimed
JP 2012-034189	JP	2012-02-20	☒ Yes ☐ No
			Remove
Application Number	Country i	Filing Date (YYYY-MM-DD)	Priority Claimed
JP 2012-034192	JP	2012-02-20	☒ Yes ☐ No
Additional Foreign Priority Data may be generated within this form by selecting the Add button.			Add

Authorization to Permit Access:

☒ Authorization to Permit Access to the Instant Application by the Participating Offices
If checked, the undersigned hereby grants the USPTO authority to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the World Intellectual Property Office (WIPO), and any other intellectual property offices in which a foreign application claiming priority to the instant patent application is filed access to the instant patent application. See 37 CFR 1.14(c) and (h). This box should not be checked if the applicant does not wish the EPO, JPO, KIPO, WIPO, or other intellectual property office in which a foreign application claiming priority to the instant patent application is filed to have access to the instant patent application. In accordance with 37 CFR 1.14(h)(3), access will be provided to a copy of the instant patent application with respect to: 1) the instant patent application-as-filed; 2) any foreign application to which the instant patent application claims priority under 35 U.S.C. 119(a)-(d) if a copy of the foreign application that satisfies the certified copy requirement of 37 CFR 1.55 has been filed in the instant patent application; and 3) any U.S. application-as-filed from which benefit is sought in the instant patent application. In accordance with 37 CFR 1.14(c), access may be provided to information concerning the date of filing this Authorization.

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

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.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	KYO.P0221
		Application Number	
Title of Invention	AUDIO INPUT APPARATUS, COMMUNICATION APPARATUS AND CONDITION NOTIFICATION METHOD		

Applicant 1		Remove	
If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.			
Clear			
☒ Assignee	☐ Legal Representative under 35 U.S.C. 117	☐ Joint Inventor	
☐ Person to whom the inventor is obligated to assign.		☐ Person who shows sufficient proprietary interest	
If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:			
Name of the Deceased or Legally Incapacitated Inventor :			
If the Applicant is an Organization check here. ☒			
Organization Name	JVC KENWOOD Corporation		
Mailing Address Information:			
Address 1	12, Moriya-Cho 3-Chome, Kanagawa-Ku		
Address 2			
City	Yokohama-Shi, Kanagawa-Ken	State/Province	
Country ⁱ	JP	Postal Code	
Phone Number		Fax Number	
Email Address			
Additional Applicant Data may be generated within this form by selecting the Add button. Add			

Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Assignee 1
Complete this section only if non-applicant assignee information is desired to be included on the patent application publication in accordance with 37 CFR 1.215(b). Do not include in this section an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest), as the patent application publication will include the name of the applicant(s).
Remove
If the Assignee is an Organization check here. ☐

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	KYO.P0221
		Application Number	
Title of Invention	AUDIO INPUT APPARATUS, COMMUNICATION APPARATUS AND CONDITION NOTIFICATION METHOD		

Prefix	Given Name	Middle Name	Family Name	Suffix
Mailing Address Information:				
Address 1				
Address 2				
City		State/Province		
Country i		Postal Code		
Phone Number		Fax Number		
Email Address				
Additional Assignee Data may be generated within this form by selecting the Add button. Add				

Signature:

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications					
Signature	/EDWARD G. GREIVE/			Date (YYYY-MM-DD)	2013-02-19
First Name	EDWARD	Last Name	GREIVE	Registration Number	24726
Additional Signature may be generated within this form by selecting the Add button. Add					

This collection of information is required by 37 CFR 1.76. 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 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet 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.**

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.

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TRANSMITTAL FOR POWER OF ATTORNEY TO ONE OR MORE REGISTERED PRACTITIONERS

NOTE: This form is to be submitted with the Power of Attorney by Applicant form (PTO/AIA/82B or equivalent) to identify the application to which the Power of Attorney is directed, in accordance with 37 CFR 1.5. If the Power of Attorney by Applicant form is not accompanied by this transmittal form or an equivalent, the Power of Attorney will not be recognized in the application.

Application Number			
Filing Date			
First Named Inventor	Masaya KONISHI		
Title	AUDIO INPUT APPARATUS, COMMUNICATION APPARATUS AND CONDITION NOTIFICATION METHOD		
Art Unit			
Examiner Name			
Attorney Docket Number	KYO.P0221		
SIGNATURE of Applicant or Patent Practitioner			
Signature	/EDWARD G. GREIVE/	Date	February 19, 2013
Name	EDWARD G. GREIVE	Telephone	(330) 376-1242
Registration Number	24,726		
NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications.			
☐ *Total of _____ forms are submitted.			

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. 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 3 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.

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.

POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in the attached transmittal letter.

- ☒ I hereby appoint Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A or equivalent):

26360

OR

- ☐ I hereby appoint Practitioner(s) named below as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A or equivalent):

Name	Registration Number	Name	Registration Number

Please recognize or change the correspondence address for the application identified in the attached transmittal letter to:

- ☒ The address associated with the above-mentioned Customer Number.

OR

- ☐ The address associated with Customer Number:

OR

☐ Firm or Individual Name

Address:

City:

State:

Zip:

Country:

Telephone:

Email:

I am the Applicant:

- ☐ Inventor or Joint Inventor
- ☐ Legal Representative of a Deceased or Legally Incapacitated Inventor
- ☒ Assignee or Person to Whom the Inventor is Under an Obligation to Assign
- ☐ Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document)

SIGNATURE of Applicant for Patent

Signature:

Date:

Name:

Telephone:

Title and Company:

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. Submit multiple forms for more than one signature, see below.

- ☐ Total of _____ forms are submitted.

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. 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 3 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 impact 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.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In the application of	)	CUSTOMER NO. 26360
	)	
Masaya KONISHI	)	
and Tatsuya ONODA	)	
	)	
Serial No.:	)	ELECTRONICALLY FILED
	)	FEBRUARY 19, 2013
Filed:	)	
	)	
For: AUDIO INPUT APPARATUS,	)	
COMMUNICATION APPARATUS)	)	
AND CONDITION	)	
NOTIFICATION METHOD	)	

INFORMATION DISCLOSURE STATEMENT

37 CFR §§ 1.97, 1.98

COMMISSIONER FOR PATENTS

Alexandria, VA 22313-1450

Sir:

Pursuant to 37 CFR §1.97 encouraging the filing of an Information Disclosure Statement, the Applicants hereby submit the following in compliance with the duty of disclosure as set forth in 37 CFR §1.56.

Information or art known to the Applicants and having an extent of relevance to the present application has been listed on Form PTO/SB/08a attached hereto. It includes four (4) foreign patent documents. The Applicants have employed Form PTO/SB08a for the purposes of convenience of the Office and the Examiner.

No representation is made that a specific search has been made, that the information is pertinent to the claimed subject matter, that the information is non-cumulative, or that the information represents the only or the best information. The Applicants do not admit that any of the information they have provided is necessarily prior to their invention but rather that it is information of which they are aware and that they believe should be provided to the Office in fulfillment of their duty of disclosure. Any question that may arise regarding priority of a specific reference shall be resolved during prosecution.

Notwithstanding the foregoing, for any publication of an unknown date, Applicants acknowledge that it is prior to their invention.

It is the position of the Applicants that none of the art provided herein accomplishes the objects of the present invention. The Applicants believe that the claims of the subject application are patentably distinct over the art of record. In the event the Examiner would care to discuss any of the foregoing more specifically, the undersigned attorney would welcome a telephone call.

Respectfully submitted,

/EDWARD G. GREIVE/

Edward G. Greive, Reg. No. 24,726
Renner, Kenner, Greive, Bobak, Taylor & Weber
First National Tower, Suite 400
106 S. Main Street
Akron, Ohio 44308-1412
Telephone: (330) 376-1242

Attorney for Applicants

February 19, 2013

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		
	Filing Date		
	First Named Inventor	Masaya KONISHI	
	Art Unit		
	Examiner Name		
	Attorney Docket Number	KYO.P0221	

U.S.PATENTS						Remove
Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1					

If you wish to add additional U.S. Patent citation information please click the Add button.

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U.S.PATENT APPLICATION PUBLICATIONS						Remove
Examiner Initial*	Cite No	Publication Number	Kind Code ¹	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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Examiner Initial*	Cite No	Foreign Document Number ³	Country Code ² j	Kind Code ⁴	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T ⁵
	1	2000-106588	JP		2000-04-11	BROTHER IND LTD		☒
	2	2004-120717	JP		2004-04-15	MARANTZ JAPAN INC		☒
	3	2010-28531	JP		2010-02-04	HITACHI LTD		☒

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		
	Filing Date		
	First Named Inventor	Masaya KONISHI	
	Art Unit		
	Examiner Name		
	Attorney Docket Number	KYO.P0221	

	4	2010-279043	JP		2010-12-09	TOSHIBA CORP		☒
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If you wish to add additional Foreign Patent Document citation information please click the Add button **Add**

NON-PATENT LITERATURE DOCUMENTS							Remove
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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T ⁵
	1		☐

If you wish to add additional non-patent literature document citation information please click the Add button **Add**

EXAMINER SIGNATURE			
---------------------------	--	--	--

Examiner Signature		Date Considered	
--------------------	--	-----------------	--

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

¹ See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. ² Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). ³ For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. ⁴ Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. ⁵ Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		
	Filing Date		
	First Named Inventor	Masaya KONISHI	
	Art Unit		
	Examiner Name		
	Attorney Docket Number	KYO.P0221	

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☐ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature		Date (YYYY-MM-DD)	
Name/Print		Registration Number	

This collection of information is required by 37 CFR 1.97 and 1.98. 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 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: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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.

Electronic Patent Application Fee Transmittal				
Application Number:				
Filing Date:				
Title of Invention:		AUDIO INPUT APPARATUS, COMMUNICATION APPARATUS AND CONDITION NOTIFICATION METHOD		
First Named Inventor/Applicant Name:		Masaya KONISHI		
Filer:		Edward G. Greive/Patricia Oakes		
Attorney Docket Number:		KYO.P0221		
Filed as Large Entity				
Utility under 35 USC 111(a) Filing Fees				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Utility application filing	1011	1	390	390
Utility Search Fee	1111	1	620	620
Utility Examination Fee	1311	1	250	250
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				1260

Electronic Acknowledgement Receipt

EFS ID:	14989243
Application Number:	13770236
International Application Number:	
Confirmation Number:	4369
Title of Invention:	AUDIO INPUT APPARATUS, COMMUNICATION APPARATUS AND CONDITION NOTIFICATION METHOD
First Named Inventor/Applicant Name:	Masaya KONISHI
Customer Number:	26360
Filer:	Edward G. Greive/Patricia Oakes
Filer Authorized By:	Edward G. Greive
Attorney Docket Number:	KYO.P0221
Receipt Date:	19-FEB-2013
Filing Date:	
Time Stamp:	14:24:06
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	\$1260
RAM confirmation Number	985
Deposit Account	180987
Authorized User	GREIVE, EDWARD G.

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal of New Application	UtilityPatentApplTransmittalKYOp0221.pdf	96081	no	2
			19dae426918b293fa793f0b3e5883a137cf6d3f3		
Warnings:					
Information:					
2		SpecificationKYOp0221.pdf	4119946	yes	81
			718ce355a989fde9b42cd0446f4812a04e3358a		
	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Specification		1	73	
	Claims		74	80	
	Abstract		81	81	
Warnings:					
Information:					
3	Drawings-only black and white line drawings	DrawingsKYOp0221.pdf	417800	no	28
			87701fcbd2b8cd7cafee262d01776a88d6930c5		
Warnings:					
Information:					
4	Oath or Declaration filed	DeclarationKONISHIKyop0221.pdf	68974	no	1
			5c4eb7d588208c112df08faf5f896c455a077216		
Warnings:					
Information:					
5	Oath or Declaration filed	DeclarationONODAKyop0221.pdf	69258	no	1
			32dfebb95c40e1c7ab5606bab0c4c4df870f6f0b		
Warnings:					
Information:					
6	Application Data Sheet	ApplicationDataSheetKYOp0221.pdf	1437086	no	6
			5579a50d8de2d4fbd12305652bc0c008773ba05		
Warnings:					
Information:					

7	Power of Attorney	POAkyop0221.pdf	86527	no	2
			3d8a0a08b59fdb0dc9f35681f82aa4b9bcf44369		
Warnings:					
Information:					
8	Transmittal Letter	IDSkyop0221.pdf	44067	no	2
			665f10cae02212b576623c00076f74a6c8923dd1		
Warnings:					
Information:					
9	Information Disclosure Statement (IDS) Form (SB08)	SB08aIDScitationKYOp0221.pdf	611928	no	4
			0febfb35e5192544e03b27740c109a28e7961e3d		
Warnings:					
Information:					
A U.S. Patent Number Citation or a U.S. Publication Number Citation is required in the Information Disclosure Statement (IDS) form for autoloading of data into USPTO systems. You may remove the form to add the required data in order to correct the Informational Message if you are citing U.S. References. If you chose not to include U.S. References, the image of the form will be processed and be made available within the Image File Wrapper (IFW) system. However, no data will be extracted from this form. Any additional data such as Foreign Patent Documents or Non Patent Literature will be manually reviewed and keyed into USPTO systems.					
10	Foreign Reference	JP2000106588.pdf	582704	no	9
			723d094e0b39d940725e68183df0bf9ae97290a6		
Warnings:					
Information:					
11	Foreign Reference	JP2004120717.pdf	877322	no	15
			ed9b029ff78e78721e25297ee698955ba9eb488a		
Warnings:					
Information:					
12	Foreign Reference	JP201028531.pdf	1648003	no	35
			54d76c03cf58fd4815486cd03fcfe667d8dc1ea		
Warnings:					
Information:					
13	Foreign Reference	JP2010279043.pdf	1086987	no	18
			096dd94ff47d9b2e80be0ef6035a5513deb e055c		
Warnings:					
Information:					
14	Fee Worksheet (SB06)	fee-info.pdf	33153	no	2
			fcfbcb4ed676f1bab117e02bfe0da74962f567c		
Warnings:					
Information:					
Total Files Size (in bytes):			11179836		

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New Applications Under 35 U.S.C. 111

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.

National Stage of an International Application under 35 U.S.C. 371

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.

New International Application Filed with the USPTO as a Receiving Office

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.

**DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN
APPLICATION DATA SHEET (37 CFR 1.76)**

Title of Invention	AUDIO INPUT APPARATUS, COMMUNICATION APPARATUS AND CONDITION NOTIFICATION METHOD
As the below named inventor, I hereby declare that: This declaration is directed to: ☒ The attached application, or ☐ United States application or PCT international application number _____ filed on _____. The above-identified application was made or authorized to be made by me. I believe that I am the original inventor or an original joint inventor of a claimed invention in the application. I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both. 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.	
LEGAL NAME OF INVENTOR Inventor: <u>Masaya KONISHI</u> Date (Optional): <u>01/29/2013</u> Signature: <u>Masaya Konishi</u>	
Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form. Use an additional PTO/AIA/01 form for each additional inventor.	

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. 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 1 minute 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.