UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

AMAZON.COM, INC.,
AMAZON.COM SERVICES LLC, and
AMAZON WEB SERVICES, INC.,
Petitioners,

v.

SOUNDCLEAR TECHNOLOGIES LLC,
Patent Owner.

Case No. IPR2025-01067
U.S. Patent 9,070,374

PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT 9,070,374

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Petitioners Amazon.com, Inc., Amazon.com Services LLC, and Amazon Web Services, Inc. ("Petitioners" or "Amazon") respectfully request *inter partes* review of claims 1-15 of U.S. Patent No. 9,070,374 ("the '374 patent"), which SoundClear Technologies LLC ("Patent Owner" or "PO") purportedly owns.

I. INTRODUCTION

The '374 patent relates to a conventional "communication apparatus," such as a two-way radio, that (1) detects speech, (2) evaluates its quality (i.e., "good" or "bad"), and (3) indicates the result by turning on or off a light. The inventors did not invent any new communication apparatus. Nor did they invent any new way to detect speech, evaluate its quality, or control a light. Instead, the claims merely recite a combination of conventional features that were obvious to those skilled in the art. Accordingly, the Board should institute IPR and cancel the claims.

II. BACKGROUND

A. Indicating Transmission Mode Using a Light Was Known.

By the time of the patent's earliest possible priority date in 2012, it was well known to use lights on communication devices to indicate the device's status or communication mode. (EX-1002 ¶33.) For example, Yeager disclosed a two-way radio (400) that includes an LED (404), a push-to-talk button (406), and a microphone (408):

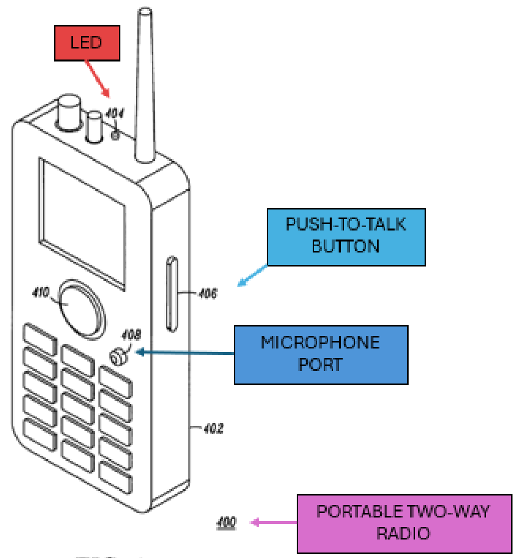


FIG. 4

(EX-1003, Fig. 4[1], 1:43-44, 3:1-11; EX-1002 ¶34.)

Yeager recognized that "[m]ost two-way radios utilize a continuous LED indicator that glows when a carrier signal is being transmitted." (EX-1003, 1:49-57.) Yeager explains that one drawback of such devices is that the user does not know whether the speech message is being transmitted properly, for example, due to a blocked microphone or malfunctioning transducer or circuit. (*Id.*, 1:57-62.) To address that problem, Yeager discloses using a voice activity detector and varying an LED's color and/or intensity to indicate that the device is properly transmitting audio. (*Id.*, 1:65-2:5, 2:15-53, 3:10-11.) Such an LED indicator is "beneficial" because it "gives the user the opportunity to attempt to clear or clean the microphone port area[.]" (*Id.*, 2:54-63; EX-1002 ¶¶35-38.)

[1] Figures herein may be colored or otherwise annotated for clarity.

Another reference, Boillot, disclosed a device that detects speech and determines its quality, e.g., whether the volume of the user's voice is sufficient to overcome ambient noise. (EX-1004 ¶¶[0012]-[0013]; EX-1002 ¶39.) If not, "an indication may be given to the speaker to increase their speaking volume." (EX-1004 ¶[0013].) "For example, a light source such as an LED may be blinked, or flashed, or provided at a certain color to indicate a voicing quality problem." (*Id*.)

Other references similarly disclosed indicating, via LED, the transmission mode and/or quality of a speech signal. (*See, e.g.*, EX-1011 (Rex), Fig. 1 (device includes "speech quality evaluator"), ¶¶[0027]-[0028] ("warning light" is "lit when speech quality is poor"), [0020]; EX-1009 (Garra), Fig. 1A (LED indicates status), ¶¶[0024]-[0025] (flashing LED indicates "receive mode" and solid LED indicates "transmit mode"); EX-1002 ¶¶40-41.)

B. Voice Detection Was Well Known.

Detecting the presence or absence of speech in an audio signal is commonly referred to as Voice Activity Detection ("VAD"). (EX-1002 ¶42.) For decades, VAD has been an important part of many areas of speech processing, including speech coding, speech enhancement, and automatic speech recognition. (*Id.*) For example, the International Telecommunication Union (ITU) Recommendation G.729 Annex B, released in 1996, includes a VAD module for reducing the amount of data to be transmitted during silent periods. (*Id.*; EX-1015, 1; *see generally* EX-1015.)

As another example, Boillot disclosed performing voice detection in a mobile device. Boillot disclosed that a voice encoder ("vocoder") encodes the speech and "determines certain coefficients and parameters of the audio signal on a frame by frame basis." (EX-1004 ¶[0013].) The device detects whether the frame is voiced or not voiced and outputs a "voicing level parameter" that "indicates the degree to which the present frame appears to be voiced content." (*Id.*; EX-1002 ¶43.)

As another example, Visser discloses VAD and its importance in speech processing:

> In a speech processing application (e.g., a voice communications application, such as telephony), it may be desirable to perform accurate *detection of segments of an audio signal that carry speech information*. Such *voice activity detection (VAD)* may be important, for example, in preserving the speech information. Speech coders (also called coder-decoders (codecs) or vocoders) are typically configured to allocate more bits to *encode segments that are identified as speech* than to encode segments that are identified as noise, such that a misidentification of a segment carrying speech information may reduce the quality of that information in the decoded segment.

(EX-1007 ¶[0075] (emphases added); EX-1002 ¶44.)

C. Speech Quality Evaluation Was Known.

Evaluating the quality of speech in an audio signal was also well known by 2012. For example, Boillot discloses that the "voicing level parameter" noted above is compared to a background noise parameter to provide a "voicing quality metric" that "indicates how well the speaker's voice overcomes the ambient noise." (EX-1004 ¶¶[0013]-[0014]; EX-1002 ¶45.)

As another example, Rex disclosed a communication device having a "speech quality evaluator" (43), which quantifies speech quality so the user can be alerted, via a warning light, when it is poor:

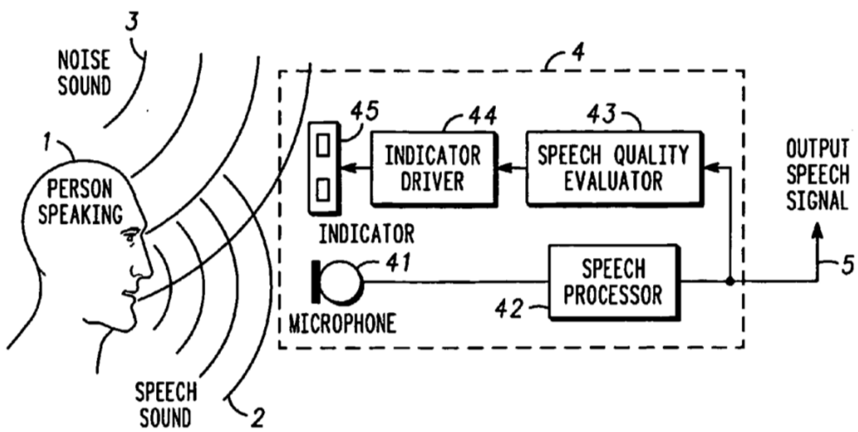


FIG.1

(EX-1011, Fig. 1, ¶¶[0020], [0024]-[0027]; EX-1002 ¶46.)

III. THE '374 PATENT

A. Overview

The '374 patent describes a "communication apparatus," such as a radio, that includes a microphone (201), push-to-talk button (207), and LED indicator (210), among other conventional components:

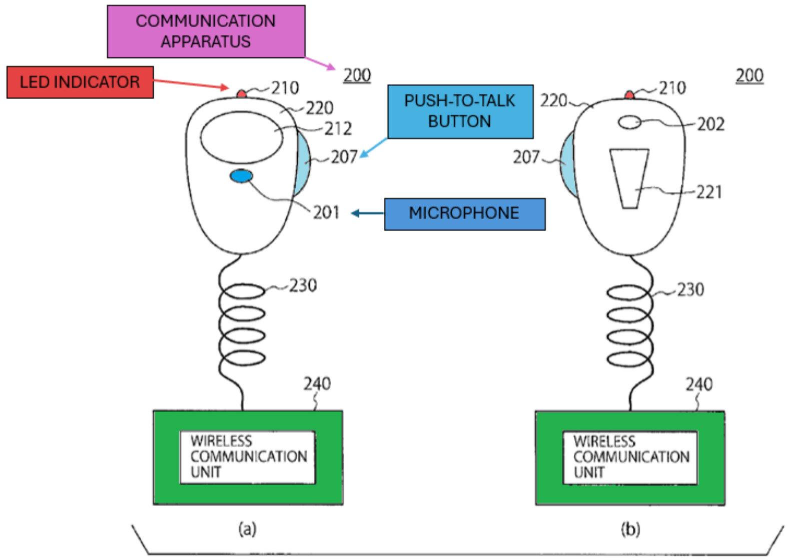


FIG. 3

(EX-1001, Fig. 3, 6:64-7:9; EX-1002 ¶47.)

The patent states there was a demand for "clear voice sounds" when such devices were used in noisy environments. (*Id.*, 1:22-51.) The patent purports to address this problem by flashing a "light-emitting device (LED)" to notify the user when "good quality" speech is picked up. (*Id.*, 5:6-17.)

The device includes an "evaluation unit" that performs two functions: (1) determines whether speech is present; and (2) evaluates the quality of the speech. (*Id.*, 19:23-35.) This information, called "sound pick-up state information," is sent to the LED control unit, which controls the light. (*Id.*, 19:35-40.) The LED may be OFF when the radio is not transmitting, may be ON when the radio is transmitting but there is either no speech or the speech quality is bad, and may be blinking when the radio is transmitting and the speech quality is good:

	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

(*Id.*, Fig. 13; 19:41-43, 2:12-15, 3:8-10.) Alternatively, the blinking LED may indicate poor speech quality. (*Id.*, 39:61-64.) Thus, the purported invention is to use an LED to "notify a user of the speech quality." (*Id.*, 20:51-55; EX-1002 ¶¶47-49.)

B. Prosecution History

The Examiner rejected the as-filed independent claims as obvious. (EX-1012, 45-58.) After the applicant amended the claims to include the "speech-segment determination step" and the "speech-quality evaluation step," and to require that the "sound-pick up determination step" be determined based on the result of the "speech-segment determination step" and "speech-quality evaluation step," the Examiner allowed them. (*Id.*, 34-41, 19-23.) The prior art relied on herein was never submitted to or considered by the Examiner.

IV. STATEMENT OF PRECISE RELIEF REQUESTED

A. Grounds

Petitioners request cancellation of claims 1-15 under 35 U.S.C. §103 as follows:

Ground	Challenged Claims	References
1	1-3, 5, 8-10, 13, 15	Yeager and Boillot
2	4, 7, 11, 14	Yeager, Boillot, and Chen
3	8, 15	Yeager, Boillot, and Vähätalo
4	12	Yeager, Boillot, Chen, and Visser
5	5-6	Yeager, Boillot, and Visser

The Petition is supported by the expert declaration of Richard Stern, Ph.D. (EX-1002; EX-1013.)

B. Status of References as Prior Art

Each reference is prior art under pre-AIA 35 U.S.C. §102(b) because it published more than one year before the patent's effective filing date[2] of February 19, 2013: Vähätalo (1999); Boillot (2007); Yeager (2009); Chen (2009); and Visser (2011). The references are analogous art because they are from the same field as the

[2] Under pre-AIA §102(b), the one-year bar "is measured from the filing date of the earliest application filed in the United States (directly or through the PCT) and not from the dates of earlier filed foreign patent applications." M.P.E.P. §2151. Regardless, the references relied on herein would be prior art even if the '374 patent were entitled to the foreign filing date of February 20, 2012.

’374 patent, e.g., processing and transmitting voice sounds. (EX-1002 ¶22; *see, e.g.*, EX-1001, 1:19-21, 1:55-2:35; EX-1003, 1:11-15, 1:49-2:30, 2:49-53; EX-1004 ¶¶[0001], [0011]; EX-1005 ¶¶[0004], [0011]; EX-1006, 1:43-2:15; EX-1007 ¶¶[0003], [0008]-[0009], [0075], [0084].) They are also pertinent to a particular problem the inventors were focused on, e.g., enhancing and/or indicating the quality of transmitted voice sounds. (*Id.*)

V. LEVEL OF ORDINARY SKILL

A POSITA is “a person of ordinary creativity, not an automaton.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 421 (2007). Here, a POSITA would have had a minimum of a bachelor’s degree in computer engineering, computer science, electrical engineering, or a similar field, and approximately three years of industry or academic experience in a field related to acoustics, speech recognition, speech detection, or signal processing. (EX-1002 ¶¶27-31); *see In re GPAC Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995). Work experience could substitute for formal education and additional education could substitute for work experience. (*Id.*)

VI. CLAIM CONSTRUCTION

No claim terms require construction to resolve the invalidity challenges here. *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co. Ltd.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017); *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803

(Fed. Cir. 1999). For purposes of this proceeding only, Petitioners assume the claims are not invalid under §112.

VII. GROUND 1: CLAIMS 1-3, 5, 8-10, 13, AND 15 WOULD HAVE BEEN OBVIOUS IN VIEW OF YEAGER AND BOILLOT.

Independent claims 1 and 9 are similar but recite a method and apparatus, respectively. Because claim 9 is easier to follow, Petitioner addresses claim 9 first.

A. Claim 9

The preamble recites "[a] communication apparatus." Yeager discloses this because it discloses a two-way push-to-talk radio (400), wherein the PTT button (406) switches the radio between a "transmit mode" and a "receive mode":

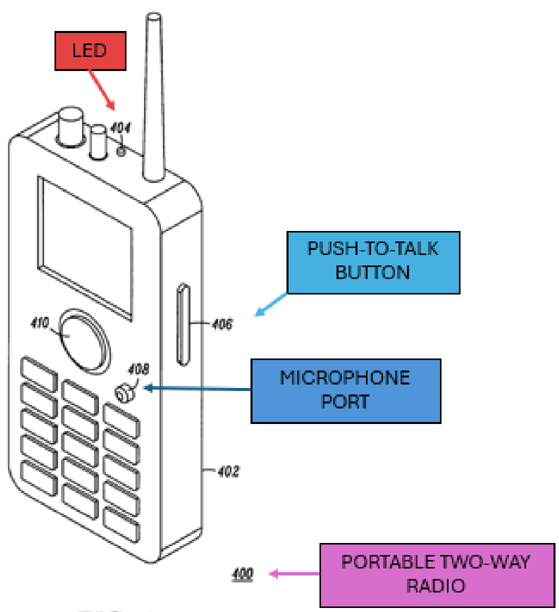


FIG. 4

(EX-1003, Fig. 4; *id.*, 1:43-44, 1:52-2:5, 2:20-3:19, 3:48-58, 4:30-36, 4:50-57, Abstract; EX-1002 ¶52.)

1. 9[a]: Pick-Up Unit

Element 9[a] recites "a first pick-up unit configured to pick up a voice sound." The "pick-up unit" may be a microphone. (EX-1001, 4:1-11, 5:56-61.) Yeager discloses a microphone port (408) to pick up a voice sound. (EX-1003, Fig. 4, 3:6-8; EX-1002 ¶53.)

2. 9[b]: Transmitter Unit

Element 9[b] recites "a transmitter unit configured to transmit the voice sound picked up by the first pick-up unit to outside as a first speech signal."

Yeager's two-way radio transmits audio when the push-to-talk button is pressed and the user speaks into the radio's microphone. (EX-1003, 1:66-67, 2:43-46 (LED varies during "transmit mode" in response to "the transmitted speech signal"), 2:54-59 (audio is "being transmitted"), 3:1-16, Abstract, claim 1 (user speaks "during transmit mode"), Fig. 4 (showing antenna for transmission); EX-1002 ¶55.) Thus, Yeager discloses a transmitter unit for transmitting the voice sound picked upon by the first pick-up unit (microphone 408) to outside as a first speech signal ("transmitted speech signal"). (EX-1002 ¶55.)

Even if Yeager did not expressly disclose a "transmitter unit," Yeager inherently discloses it. Yeager's "communication device" necessarily includes a transmitter unit configured to transmit the voice signal. (*Id.* ¶56.) If Yeager did not have such a transmitter unit, it could not transmit a signal, and therefore could not be a "two-way radio" with a "transmit mode" as Yeager describes. (*Id.*)

Thus, Yeager expressly or inherently discloses this limitation. (*Id.* ¶¶54-57.)

3. 9[c]: Communication-Mode Switching Unit

Element 9[c] recites "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."

In the '374 patent, the "communication-mode switching unit" is a push-to-talk button, which switches between a "transmission mode" and a "standby mode." (EX-1001, 4:37-48, 4:3-5, 4:49-5:5, 6:6-14, 39:24-33; EX-1002 ¶59.)

Yeager discloses a PTT button (406) that switches the two-way radio (400) between a "transmit mode" and a "receive mode" (i.e., standby mode):

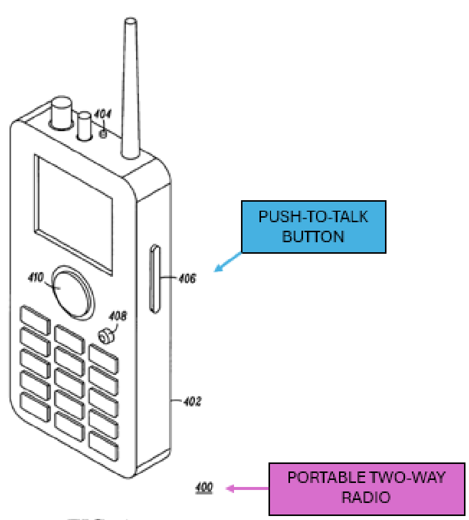


FIG. 4

(EX-1003, Fig. 4, 2:20-24 ("receive mode"), 2:27-30 (referring to "transmit and receive … modes of operation”), 2:44-46 (describing “transmit mode”), 2:46-48 (describing “receive mode”), 3:6-8 (transmit mode results from user “keying up the radio at PTT 406 and speaking into a microphone port 408 of radio 400”), 3:14-16 (LED color indicates transmit-audio mode or receive-audio mode), 3:16-19 (“receive mode”), 3:48-58, 4:30-36, 4:50-57, 1:52-55 (conventional radios have “transmit mode” and “receive mode”); EX-1002 ¶60.)

Thus, Yeager discloses a communication-mode switching unit (e.g., PTT unit) configured to switch a communication mode between a standby mode (e.g., “receive mode”) in which the transmitter unit does not transmit the speech signal and a transmission mode (e.g., “transmit mode”) in which the transmitter unit transmits the speech signal. (EX-1002 ¶¶58-61.)

4. 9[d]: Sound Pick-Up State Determination Unit

Element 9[d] recites “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.”

Other elements in claim 9 specify that this “determination unit” determines a “pick-up state” based on: (1) “the speech quality of the speech signal evaluated by the speech-quality evaluation unit” (element 9[g][ii]); and (2) “a determination result at the speech-segment determination unit” (element 9[h][ii]). Thus, the “sound pick-up state determination unit” may determine the “pick-up state of the voice” by determining whether speech is present and its quality. (EX-1002 ¶63.)

This is consistent with the specification, which describes a "sound pick-up state evaluation unit 1003" that has "a speech-segment determination function and a speech-quality evaluation function … for evaluating [the] sound pick-up state of the speech signal[.]" (EX-1001, 19:23-29; *id.*, 20:26-31, 19:27-20:55, Figs. 4, 12-15; EX-1002 ¶64.) This is shown in Figure 13:

	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

(EX-1001, Fig. 13; 19:27-43, 3:8-10; EX-1002 ¶64.)

Boillot discloses this limitation. First, as discussed in detail below, Boillot discloses a speech segment determination unit. (*Infra* §VII.A.9.) Specifically, Boillot discloses a "vocoder" that determines whether a sound signal includes voice (speech) and outputs a "voicing level parameter." (EX-1004 ¶[0013]; EX-1002 ¶65.)[3] Second, as discussed in detail below, Boillot discloses a speech quality

[3] Yeager also discloses a speech segment determination unit because it discloses a "voice activity detector" in a "vocoder." (EX-1003, 2:50-53; *id.*, 3:20-23; EX-1002 ¶67.)

evaluation unit. (*Infra* §VII.A.7.) Specifically, Boillot discloses comparing the voicing level parameter to a background noise parameter to provide "a voicing quality metric" that indicates "how well the speaker's voice overcomes the ambient noise." (EX-1004 ¶[0013].) Boillot makes a speech-quality determination ("acceptable" or "poor") by comparing the voicing quality to a threshold. (*Id.*, Fig. 2, ¶[0014]; EX-1002 ¶ 65.)

Because Boillot discloses both a speech-segment determination unit (e.g., that determines a "voicing level parameter," *see infra* §§VII.A.9-VII.A.10) and a speech-quality evaluation unit (e.g., that determines a "voice quality metric," *see infra* §§VII.A.7-VII.A.8, VII.A.10), it discloses a sound pick-up state determination unit configured to determine a pick-up state (e.g., speech is present and is acceptable/poor quality) of the voice sound picked up by the first pick-up unit (microphone). (EX-1002 ¶66.)

A POSITA would have been motivated to include Boillot's "sound pick-up state determination" unit—which determines the "sound pick-up state" based on both speech segment detection and speech quality evaluation—in Yeager's radio for many reasons. (EX-1002 ¶¶68-73.)

First, Boillot discloses the benefits of its "sound pick-up determination" unit (with its associated LED). Boillot explains that it "solves the problem of informing communication system users of the voicing quality of the speech signal they are transmitting by determining a voicing quality metric … and [] making the voicing quality metric perceptible to the user." (EX-1004 ¶[0011].) Boillot discloses that, "[i]f the voicing quality metric indicates that the volume of the speaker's voice is not enough to sufficiently overcome the ambient noise, an indication may be given to the speaker to increase their speaking volume. The indication is provided in the form of perceptible feedback, such as, for example, visual …. For example, a light source such as an LED may be blinked, or flashed, or provided at a certain color to indicate a voicing quality problem." (*Id.* ¶[0013].) Thus, a POSITA would have understood that Boillot's sound pick-up state determination would provide improved user feedback to indicate, at least, when the speech quality is acceptable or poor (e.g., speaker's voice is insufficient to overcome ambient noise). (EX-1002 ¶69.)

Second, Yeager teaches that:

> *It would be beneficial for a radio user to know that his or her handset is properly transmitting an audio signal*. Currently, communication devices provide no such indication, and as such, the talker/user has no way of knowing that a speech message is being transmitted properly. Poor speech transmission may be caused by a variety of factors including a blocked microphone port, malfunctioning microphone transducer or improperly tuned circuit. While not all of these factors can be directly addressed by the user, *just knowing that the speech transmission is not operating optimally would allow the user to attempt to correct the problem* or seek alternative means of communication and submit the handset for repair.

(EX-1003, 1:17-28 (emphases added); *id.*, 1:57-62, 2:59-63.) In view of this, a POSITA would have been motivated to include Boillot's speech detection and speech quality evaluation units, and to determine the sound pick-up state, to enable Yeager's device to inform the user of problems beyond blocked or malfunctioning microphones, such as when the microphone is working properly but the speech level is insufficient to overcome ambient noise. (EX-1002 ¶70.)

Third, the combination represents the simple addition of one known element (Boillot's vocoder's speech-segment determination unit and speech quality evaluation unit) to another known element (Yeager's vocoder) to obtain predictable results (a radio with a LED that informs the user when the speech is present but is poor quality). (EX-1002 ¶71); *KSR*, 550 U.S. at 417.

Fourth, the combination uses a known technique (Boillot's speech detection and quality evaluation) to improve a similar device and method (Yeager's radio) in the same way (to determine the state of the input and enable feedback when speech is present but its quality is poor). (*Id.*)

Fifth, the combination applies a known technique (Boillot's sound pick-up state determination, including speech detection and quality evaluation) to a known device and method (Yeager's radio) that is ready for improvement and yields predictable results (a radio that provides visual feedback based on transmission mode, the presence of speech, and its quality). (*Id.*)

Sixth, Yeager discloses that its device already includes a voice activity detector, which demonstrates the foundational capability of processing speech inputs, evaluating them, and providing feedback regarding the transmitted audio modulation level. (EX-1003, 2:26-30, 2:49-53.) Extending this functionality to include evaluating speech quality and indicating when the speaker's voice is insufficient to overcome ambient noise would have been a desirable and predictable variation in view of Boillot's teachings. (EX-1002 ¶72.)

A POSITA would have reasonably expected success in modifying Yeager in this way. Doing so would have been trivial, involving configuring Yeager's vocoder with revised algorithms implementing Boillot's speech detection and quality evaluation. (*Id.* ¶73.)

5. 9[e]: Light Emission Device

Element 9[e] recites "a light emission device configured to emit light."

Yeager discloses this limitation because it discloses "a light emitting diode (LED) 404" coupled to the radio's housing (402):

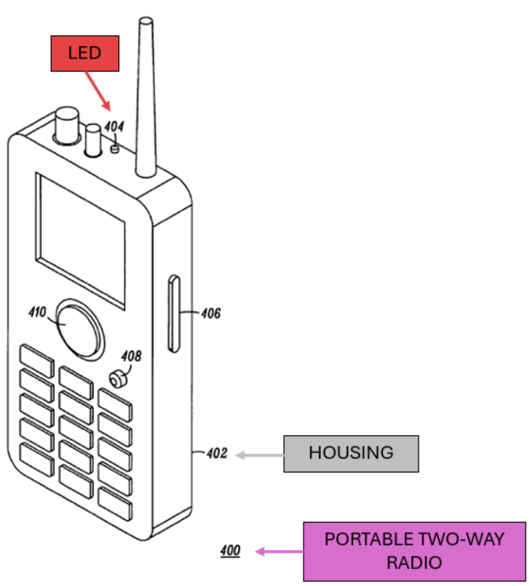


FIG. 4

(EX-1003, Fig. 4, 3:1-4; EX-1002 ¶75.) Boillot also discloses this limitation. (EX-1004 ¶[0013]; EX-1002 ¶76.)

6. 9[f]: Control Unit

Element 9[f] recites "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." This limitation requires the control unit to merely be configured to turn a light ON, OFF, *or* ON-and-OFF based on the communication mode (e.g., transmit or standby) and the result of the sound pick-up state determination unit (e.g., whether speech is detected and its quality). (EX-1002 ¶¶77-78.)

Yeager discloses a control unit configured to control the LED because it discloses controlling the color and/or intensity of the LED, including by a microprocessor or simple audio circuit. (EX-1003, 2:35-39, 2:48-53, 3:20-25, Figs. 2-3; EX-1002 ¶79.) Yeager discloses several embodiments that, when combined with Boillot, render this limitation obvious.

First, Yeager discloses that conventional two-way radios use a red, non-flashing, "continuous LED indicator that glows" when the radio is in transmission mode. (EX-1003, 1:49-52.) A POSITA would have understood that, when such a conventional radio had a single-color LED, that LED would be OFF when in receive mode and ON when in transmit mode. (EX-1002 ¶80.)

Second, Yeager discloses embodiments in which the intensity of a single-color LED is used to indicate to the user that the device is transmitting ("transmit-carrier indicator") and to indicate the volume of the speech signal being transmitted ("transmit-audio feedback"). (EX-1003, Abstract, 1:65-2:1, 3:1-13.) A POSITA would have understood that, when Yeager's device is implemented with a single-color LED, the light would be OFF in receive mode, ON in transmit mode, and its brightness would vary to indicate sound level in transmit mode. (EX-1002 ¶81; EX-1003, 3:1-19.) For example, "a relatively dim LED" may indicate transmission "without audio or very low audio" while a "bright LED" indicates "full or loud audio transmission." (EX-1003, 2:10-20.)

Third, Yeager discloses an embodiment in which a bi-color LED is used to indicate both the transmit mode and audio level during transmit mode. (*Id.*, 2:31-46.) In that embodiment, the LED is ON in transmit mode and an orange light indicates a "silent carrier" (i.e., transmit mode with no speech) and a red light indicates transmit mode and "full modulation" (i.e., that "audio is actually being transmitted"). (*Id.*, 2:31-34, 2:54-59.) A POSITA would have understood that, in this embodiment, the "bi-color LED" would be OFF in receive mode and ON (orange or red) in transmit mode. (EX-1002 ¶82.)

Fourth, Yeager discloses that, while a single LED could be used as a "transmit-carrier" indicator (i.e., that it is in transmit mode) and to provide "transmit-audio" feedback, two separate LEDs could be used. (EX-1003, 3:26-30.) A POSITA would have understood that, in that embodiment, a first LED would turn ON (transmission mode) and OFF (receive mode). The second LED, which provides transmit-audio feedback, would turn ON in transmission mode, OFF in receive mode, and would vary in intensity to indicate the audio level. (EX-1002 ¶83.)

To the extent PO argues that Yeager is limited to an embodiment in which a bi-color LED is red in transmit mode and green in receive mode (*see, e.g.*, EX-1003, 1:52-55, 2:9-34) and therefore does not disclose the light turning OFF in receive mode, that argument fails. Although Yeager discloses such red/green embodiments, the disclosure is not so limited. Yeager makes clear that it is merely describing alternative embodiments that may be implemented "[w]hen the LED is a multi-color LED" and the multi-color LED is used to provide "receive-audio" feedback. (*Id.*, 2:1-3; *see also id.*, Abstract ("*If* LED (200) is a bi-color LED, then receive-audio feedback can *also* be indicated to the user by varying the second color's intensity and/or spectrum.") (emphases added), 3:13-15 (a "malfunction in receive-audio *can also* be indicated … *when LED 404 is a multi-color LED*.") (emphases added), 2:46-48 (LED "*can also* vary in spectrum and or brightness during receive mode"), 3:33-44 (invention not limited to the specific embodiments described).) Indeed, the primary purpose of Yeager's device is to provide an indication that the speech is "being transmitted properly." (*Id.*, 1:17-30.) The invention provides a "user interface … that provides an indication of proper transmit-audio to a user through the transmit-carrier LED." (*Id.*, 1:65-2:1.) It is only "[w]hen the LED is a multi-color LED" that "indications of *both* proper transmit-audio and receive-audio can be provided," but they need not be. (*Id.*, 2:1-3; EX-1002 ¶84.)

Thus, Yeager discloses or renders obvious three embodiments relevant to this limitation: (1) a single-color LED that is turned OFF or ON based on the communication mode (transmit or receive); (2) an improved single-color LED that is turned OFF or ON based on the communication mode and further varies in intensity based on the audio level; and (3) a bi-color LED that is turned OFF or ON based on the communication mode and varies the color (orange/red) based on the audio level. (EX-1002 ¶¶74-85.)

Boillot discloses a control unit, i.e., "controller 112" that controls "user interface functions[,]" which includes an LED. (EX-1004 ¶¶[0012]-[0013], Fig. 1.) As discussed, Boillot discloses determining the pick-up state of the voice sound picked up by the first pick-up unit. (*Supra* §VII.A.4.) Boillot discloses that, where it is determined that speech is present but a "voicing quality problem" exists (EX-1004 ¶[0013]) or voice quality is "poor" (*id.* ¶[0014]), an indication may be provided via a blinking or flashing LED. (*Id.* ¶[0013] ("a light source such as an LED may be blinked, or flashed … to indicate a voicing quality problem”).) Thus, Boillot discloses repeatedly turning the LED ON and OFF based on the communication mode switched by the communication-mode switching unit (e.g., transmit mode), 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 (e.g., speech is present but there is a voicing quality problem). (EX-1002 ¶86.)

This limitation only requires the control unit to control the light so that it is (a) turned off, (b) turned on, *or* (c) repeatedly turned off and on based on the communication mode (transmit/receive) and pick-up state of the voice. (*Id.* ¶87.) Yeager and Boillot together disclose and render obvious this limitation in several ways.

First, it would have been obvious to a POSITA to modify Yeager to incorporate Boillot’s pick-up state determination unit for the reasons stated in limitation 9[d]. (*Supra* §VII.A.4.) Modifying Yeager in that manner would result in Yeager’s controller controlling the LED to turn OFF when not transmitting. (EX-1002 ¶88.) This alone renders this limitation obvious.

Second, modifying Yeager to include Boillot’s pick-up state determination unit would result in Yeager’s controller controlling the LED to turn ON based on the communication mode (transmit) and pick-up state of the voice (speech is present and its quality is good). (*Id.* ¶89.) This also renders this limitation obvious.

Third, it would have been obvious to a POSITA to further modify Yeager so that the controller would control the light so that it is repeatedly turned OFF and ON (blinking or flashing) based on the communication mode (transmit) and the pick-up state of the voice (speech is present but there is a voicing quality problem), as taught by Boillot. (*Id.* ¶90.)

A POSITA would have been motivated to include Boillot's LED blinking or flashing mode to provide user feedback of voicing quality problems to Yeager's two-way radio—in each of the relevant embodiments discussed above—for many reasons. (EX-1002 ¶¶91-98.) First, as noted above, the blinking LED would enhance Yeager's user feedback by indicating "that the volume of the speaker's voice is not enough to sufficiently overcome the ambient noise" and therefore indicate "to the speaker to increase their speaking volume." (EX-1004 ¶[0013]; EX-1002 ¶92.)

Second, Yeager suggests the combination because it discloses that it is beneficial to the user to know, via the LED, that the speech transmission is not optimal. (EX-1003, 1:17-28, *see also id.*, 1:57-62, 2:59-63; EX-1002 ¶93.)

Third, this combination represents the simple addition of one known element (Boillot's blinking mode) to another known element (Yeager's LED) to obtain predictable results (LED indicator that blinks to indicate communication mode and speech quality). (EX-1002 ¶94); *KSR*, 550 U.S. at 417.

Fourth, the combination represents using a known technique (controlling an LED to blink) to improve the operation of the same or similar device (Yeager's LED) in the same way (to indicate a speech quality problem). (*Id.*)

Fifth, the combination applies a known technique (controlling an LED to blink) to a known device and method (Yeager's LED and control thereof) that is ready for improvement and yields predictable results (LED that blinks to indicate speech quality). (*Id.*)

Sixth, Yeager's device, which includes a control unit configured to control the light-emitting device, demonstrates the foundational capability of controlling Yeager's LED. Extending this functionality to include a blinking or flashing mode to provide user feedback of voicing quality problems would have been a desirable and predictable variation in view of Boillot's teachings. (EX-1002 ¶95.)

Seventh, modifying the LED indicator to indicate poor speech quality via blinking, rather than being dimly lit as described in some of Yeager's embodiments, would have been a trivial design choice. Indeed, the '374 patent acknowledges this by stating that the invention is not limited to its specific light indications. (EX-1001, 39:43-50, 39:61-40:2; EX-1002 ¶96.)

Eighth, a POSITA would have understood that using a blinking LED, rather than varying the LED's intensity as Yeager describes, would be easier for the user in many situations. For example, it would be easier for a user to differentiate between a solid LED (when transmitting and speech quality is good) and a blinking LED (when transmitting and speech quality is poor) than it would be to distinguish between varying degrees of brightness. Thus, a blinking LED would be a simple way to clearly indicate to a user that the signal quality is poor. (EX-1002 ¶97.)

A POSITA would have reasonably expected success in modifying Yeager's controller to control the LED in this manner. Doing so would have been trivial, involving configuring Yeager's light emitting control unit with algorithms implementing Boillot's LED blinking or flashing mode to provide user feedback of voicing quality problems. (*Id.* ¶98.)

Thus, this limitation would have been obvious in view of Yeager and Boillot. (*Id.* ¶¶77-99.)[4]

7. 9[g][i]: Speech-Quality Evaluation Unit

Element 9[g][i] recites "a speech-quality evaluation unit configured to evaluate speech quality of the first speech signal to be transmitted by the transmitter unit."

Boillot discloses comparing a voicing level parameter of speech to a background noise parameter to provide "a voicing quality metric" of a speech signal.

[4] To the extent PO incorrectly argues that this claim requires the controller to be configured to turn the light-emitting device OFF, ON, *and* repeatedly ON and OFF, the limitation would have been obvious for the reasons discussed for this limitation and below for claim 13. (*Infra* §VII.C; EX-1002 ¶99.)

(EX-1002 ¶101.) Specifically, Boillot discloses that "[a]s the user of the mobile communication device speaks into the microphone 108, an audio signal is digitized by the audio processor 106 and fed to the vocoder 104 for encoding." (EX-1004 ¶[0013]; EX-1002 ¶101.) The vocoder encodes the speech and "determines certain coefficients and parameters of the audio signal on a frame by frame bases." (*Id.*; *see also* EX-1004, Fig. 4, ¶¶[0008], [0024]; EX-1002 ¶101.) As shown, the speech encoded by the vocoder (104) is provided to the transmitter (102) for transmission:

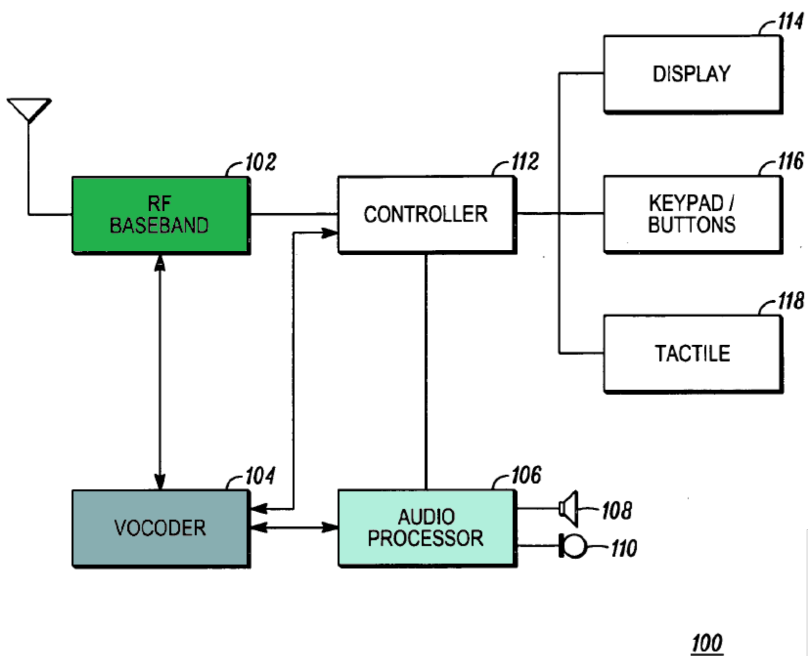


FIG. 1

(EX-1004, Fig. 1, ¶[0003]; EX-1002 ¶101.) "Typically included in the output of the vocoder is a voicing level parameter and a background noise parameter." (EX-1004 ¶[0013].) The voicing level parameter is compared to the background noise parameter to provide a "voicing quality metric" that "indicates how well the speaker's voice overcomes the ambient noise." (*Id.*) Boillot further explains:

> Various other vocoder parameters, depending on the vocoder, may be used to generate the *voicing quality metric*, so long as they relate to how well the speaker's voice overcomes ambient noise. The comparison may be made simply by a ratio of voicing level to background noise, but it is contemplated that these parameters may be scaled or weighted, or even adaptively scaled or weighted depending on the acoustic circumstances. If the *voicing quality metric* indicates that the volume of the speaker's voice is not enough to sufficiently overcome the ambient noise, an indication may be given to the speaker to increase their speaking volume.

(*Id.* ¶[0013] (emphases added); EX-1002 ¶101.)

Boillot's speech-quality evaluation and determination are shown in steps 208 and 210:

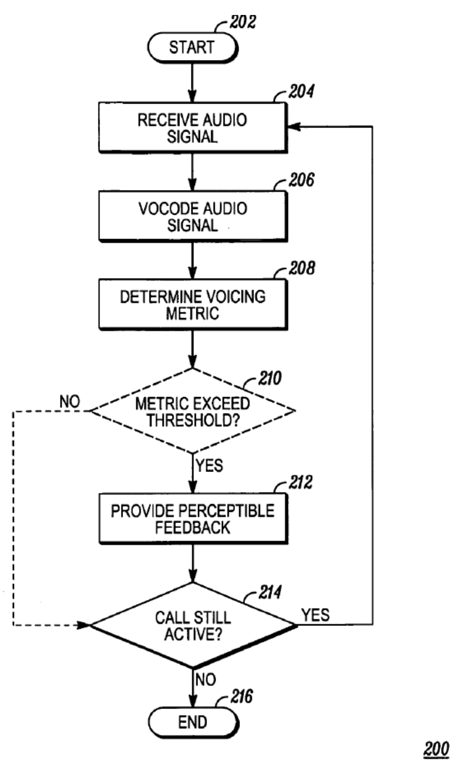


FIG. 2

(EX-1004, Fig. 2; EX-1002 ¶102.) Referring to Figure 2, Boillot explains:

> The output of the vocoder is used to determine a *voicing quality metric* (208)*, such as, for example, a ratio of voicing level to noise. Optionally, a threshold may be implemented (210), and if the voicing quality metric exceeds or meets the threshold criteria*, then the method commences, otherwise the mobile communication device may not provide feedback as the assumption is the voicing quality is acceptable. If the voicing quality is poor, and meets or exceeds the threshold, or if feedback is constantly provided in proportion to voicing quality, the mobile communication device provides perceptible feedback to the user to indicate the user should speak louder (212).

(EX-1004 ¶[0014] (emphases added); EX-1002 ¶102.)

Thus, Boillot discloses this limitation because it discloses a speech-quality evaluation unit (e.g., that determines the voicing quality metric and determines whether it exceeds a threshold) configured to evaluate speech quality of the first speech signal (e.g., the speaker's voice) to be transmitted by the transmitter unit (e.g., transmitter 102). (EX-1002 ¶100-03.)

A POSITA would have been motivated to include Boillot's "speech-quality evaluation unit" in Yeager's two-way radio: first, for reasons similar to those discussed above regarding the motivation to combine Boillot's "sound-pick up determination unit" with Yeager's two-way radio. (*Supra* §VII.A.4.) Specifically, Boillot discloses the benefits of its speech-quality evaluation unit, including improved user feedback to indicate, at least, whether the speech quality is "acceptable" or "poor" (e.g., the volume of the speaker's voice is insufficient to overcome ambient noise), and a POSITA would have been motivated to modify Yeager's device to have such benefits. (*Id.*; EX-1002 ¶104.)

Second, Yeager discloses that it is beneficial to the user to know, via the LED, that the speech transmission is not operating optimally. (EX-1003, 1:17-28, *id.*, 1:57-62, 2:59-63; EX-1002 ¶105.) Thus, a POSITA would have been motivated to include Boillot's speech quality evaluation unit to enable the device to inform the user of problems beyond blocked or malfunctioning microphones (e.g., speech level insufficient to overcome ambient noise). (EX-1002 ¶105.)

Third, the combination represents the simple addition of one known element (Boillot's speech quality evaluation unit) to another known element (Yeager's vocoder) to obtain predictable results (a radio that indicates via the LED that the speech signal is insufficient to overcome ambient noise). (*Id.* ¶106); *KSR*, 550 U.S. at 417.

Fourth, the combination uses a known technique (Boillot's speech quality evaluation) to improve a similar device and method (Yeager's radio) in the same way (to enable feedback regarding speech quality). (*Id.*)

Fifth, the combination applies a known technique (Boillot's speech quality evaluation) to a known device and method (Yeager's radio) that is ready for improvement and yields predictable results (a radio that provides user feedback regarding speech quality). (*Id.*)

Sixth, Yeager includes a voice activity detector, which demonstrates the foundational capability of processing speech inputs and evaluating and providing feedback regarding the transmitted audio modulation level. (EX-1003, 2:26-30, 2:49-53.) Extending this functionality to include user feedback to indicate when the speech quality is poor would have been a desirable and predictable variation in view of Boillot. (EX-1002 ¶107.)

A POSITA would have reasonably expected success in modifying Yeager in this way. Doing so would have been trivial, involving configuring Yeager's processor with revised algorithms implementing Boillot's speech quality evaluation unit. (*Id.* ¶108.)

8. 9[g][ii]: Voice Sound Pick-Up State

Element 9[g][ii] recites "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."

Boillot discloses this limitation because the sound-pick up state determination unit determines the sound-pick-up state of the voice sound picked up by the microphone based on the speech quality of frames containing voiced content evaluated by the speech-quality evaluation unit, e.g., whether the speech quality metric exceeds a threshold, as discussed above. (*Supra* §VII.A.7; EX-1002 ¶109.)

9. 9[h][i]: Speech-Segment Determination Unit

Element 9[h][i] recites "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."

Yeager discloses using a "voice activity detector" in a vocoder to determine whether the signal includes speech. (EX-1003, 2:50-53; *id.*, 3:20-23 ("voice activity detected in a vocoder"); EX-1002 ¶111.) Thus, Yeager discloses determining whether the signal includes a speech segment. (*Id.*)

Even if Yeager did not disclose this limitation, it would have been obvious in view of Boillot. Boillot's vocoder 104 encodes the speech and "determines certain coefficients and parameters of the audio signal on a frame by frame basis." (EX-1004 ¶[0013].) Boillot's device detects whether the frame is voiced (a speech segment) or not voiced:

> Typically included in the output of the vocoder is a voicing level parameter and a background noise parameter. *The voicing level parameter indicates the degree to which the present frame appears to be voiced content*, and may depend on certain characteristics such as pitch, pitch trajectory, periodicity, and so on. *In frames that do not appear to be voiced*, the vocoder may provide a noise estimation corresponding to the non-voiced content. *During periods where the user is not speaking*, the vocoder may output what are referred to as comfort noise frames[.]

(*Id*. (emphases added); EX-1002 ¶112.) Thus, Boillot's vocoder includes a speech-segment determination unit. (*Id.*)

Boillot discloses that the speech signal is transmitted by the transmitter unit. (EX-1004, Fig. 1 (speech provided to transmitter (102) for transmission), ¶[0003]; EX-1002 ¶113.) Thus, Boillot also discloses this limitation. (EX-1002 ¶113.)

A POSITA would have been motivated to include Boillot's "speech-segment determination unit" in Yeager's two-way radio for several reasons. (*Id.* ¶¶114-19.)

First, Boillot discloses the benefits of its "speech-segment determination unit." For example, Boillot discloses that when the "speech-segment determination unit" determines that the segment is not a speech-segment, the vocoder may output "comfort noise frames which provide minimal acoustic content so that the receiving party still 'hears' the user's call because a completely silent frame will often make a listener think the call has been disconnected or interrupted." (EX-1004 ¶[0013].) Thus, a POSITA would have understood that Boillot's "speech-segment determination unit" would provide improved user communication by providing a basis for the vocoder to generate comfort noise frames. (EX-1002 ¶115.)

Second, a POSITA understood that knowing when a segment does not contain speech allows conservation of network bandwidth because the device would not need to transmit unnecessary data during silent periods. (*Id.* ¶116.)

Third, the combination represents the simple addition of one known element (Boillot's speech-segment determination unit (using a vocoder)) to another known element (Yeager's radio having a vocoder) to obtain predictable results (a radio with a speech-segment determination unit). (*Id.* ¶117); *KSR*, 550 U.S. at 417.

Fourth, the combination uses a known technique (Boillot's speech segment determination using a vocoder) to improve a similar device and method (Yeager's radio) in the same way (to determine whether a segment contains speech). (*Id.*)

Fifth, the combination applies a known technique (Boillot's speech segment determination) to a known device and method (Yeager's radio) that is ready for improvement and yields predictable results (determining whether a segment contains speech). (*Id.*)

Sixth, Yeager's radio includes a voice activity detector, which demonstrates the foundational capability of processing speech inputs and evaluating and providing feedback regarding the transmitted audio modulation level. (*E.g.*, EX-1003, 2:26-30, 2:49-53.) Extending this functionality to include Boillot's speech-segment determination would have been a desirable and predictable variation. (EX-1002 ¶118.)

A POSITA would have reasonably expected success in modifying Yeager in this way. Doing so would have been trivial, involving configuring Yeager's vocoder to include the speech-segment determination method from Boillot's vocoder. (*Id.* ¶119.)

10. 9[h][ii]: Transmitted Sound Pick-Up State

Element 9[h][ii] recites "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."

Boillot discloses this element for the same reasons it discloses elements 9[d] and 9[g][i]-9[h][i], as discussed above. (*Supra* §§VII.A.4, VII.A.7-VII.A.9.) Specifically, Boillot discloses a sound pick-up state determination unit (*see supra* §VII.A.4) that 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 (e.g., speech is present, as determined by Yeager's voice activity detector or Boillot's vocoder, which includes a voicing level parameter, *see supra* §VII.A.9) and an evaluation result of the speech-quality evaluation unit (e.g., speech quality is poor, as determined by Boillot's voicing quality metric and comparison to threshold, *see supra* §§VII.A.7-VII.A.8.) (EX-1002 ¶121.)

Accordingly, Yeager and Boillot together disclose or render obvious each limitation of claim 9, and the claim as a whole would have been obvious to a POSITA. (*Id.* ¶¶52-122.)

B. Claim 10

Dependent claim 10 further recites that "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."

As discussed for element 9[f], Yeager discloses or renders obvious—in at least four different ways—that the LED is turned ON if the communication mode is switched into the transmission mode. (*Supra* §VII.A.6.) In each of those embodiments, an LED is turned ON in the transmit mode and, optionally, the LED's intensity or color is varied to indicate the audio level. (*Id.*; *see, e.g.*, EX-1003, 2:10-20 ("a relatively dim LED" may indicate transmission "without audio or very low audio" while a "bright LED" may indicate "full or loud audio transmission"), 2:31-46 (in a bi-color LED, an orange light may indicate "no speech" in transmit mode while a red light may indicate "full modulation" in transmit mode); EX-1002 ¶124.)

As further discussed, Boillot teaches that an indicator LED may be repeatedly turned ON and OFF ("blinked" or "flashed") based on the sound pick-up state determined by sound pick-up state determination unit (e.g., speech is present but quality is poor). (*See supra* §VII.A.6; EX-1004 ¶¶[0013]-[0014]; EX-1002 ¶125.)

A POSITA would have been motivated to combine the teachings of Yeager and Boillot, and to have Yeager's LED (a) turn ON when Yeager's device is switched to the transmission mode (as taught by Yeager) *and* (b) blink or flash based on the "pick-up state" (e.g., the presence of speech and its quality) when the device is in the transmission mode (as taught by Boillot). A POSITA would have been motivated to incorporate these teachings from Boillot into Yeager, and would have had a reasonable expectation of success in doing so, for the reasons previously stated. (*Supra* §VII.A.6; EX-1002 ¶126.)

Controlling the light in the manner required by this claim also would have been obvious to a POSITA because it reflects a trivial design choice. (EX-1002 ¶127.) Indeed, the '374 patent acknowledges this by stating that the invention is not limited to any specific light indications. (EX-1001, 39:43-50, 39:61-40:2 (blinking light may be used to indicate bad speech quality instead of good speech quality).) At a minimum, it would have been obvious to try the claimed light settings because only a limited number of possibilities exist, and these particular design choices would have been obvious given the ubiquity of using LEDs to provide user feedback. (EX-1002 ¶127.) A POSITA would have also had a reasonable expectation of success with this proposed modification because it would have been easy to implement with well-known techniques. (*Id.*)

Accordingly, Yeager and Boillot render obvious the additional limitations of claim 10, and the claim as a whole would have been obvious. (*Id.* ¶¶123-28.)

C. Claim 13

Claim 13 depends from claim 9 and further specifies certain conditions for the LED. Because they are "directed to the content of information conveyed" (e.g., the transmission mode and/or quality of a speech signal) and "merely inform[] people of the claimed information" (via an LED), these conditions constitute printed matter that is not entitled to patentable weight. *C.R. Bard Inc. v. AngioDynamics, Inc.*, 979 F.3d 1372, 1381-82 (Fed. Cir. 2020); *see also Praxair Distrib. v. Mallinckrodt Hosp. Prods. IP Ltd.*, 890 F.3d 1024 (Fed. Cir. 2018); *Lexos Media IP, LLC v. Amazon.com, Inc.*, No. 2:22-CV-00169-JRG, 2023 WL 5723642, at *10-*11 (E.D. Tex. Sept. 5, 2023). However, even if the conditions had patentable weight, they were disclosed by the prior art.

First, claim 13 recites that "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."

Yeager discloses, or at least suggests, that the LED would be OFF when in receive (standby) mode. (*Supra* §VII.A.6.) For example, a POSITA would have understood that, in Yeager's embodiments that use a single-color LED, the LED would be OFF in the receive (standby) mode and ON in the transmit mode. (*Id.*;

EX-1002 ¶131.)

This limitation also would have been obvious to a POSITA for many reasons. First, Yeager discloses or suggests single-color LED embodiments in which the light is turned ON when in transmit mode. (EX-1003, 1:49-52; EX-1002 ¶132.) It would have been obvious to a POSITA that such an LED would be OFF in standby mode, as this was conventional and would avoid confusion. (EX-1002 ¶132.)

Second, Yeager discloses using bi-color LEDs and discloses an embodiment in which an LED is orange or red in the transmit mode. (EX-1003, 2:31-46.) It would have been obvious to a POSITA that the bi-color LED would be OFF in receive (standby) mode because there would be no other option for a bi-color LED. (EX-1002 ¶133.)

Third, it would have been obvious to turn OFF Yeager's LED in standby mode because doing so would have been a simple design choice among a finite number of possibilities. (EX-1002 ¶134.) Indeed, a POSITA would have understood that an LED can generally be operated in only a finite number of ways: (1) on, (2) off, (3) blinking, flashing, or otherwise turning on and off at varying rates, (4) different intensities, and (5) different colors (if a multi-color LED). (*Id.*)

Fourth, Yeager discloses some embodiments where the LED is red in transmit mode and green in receive mode *when a bi-color LED is used*. (*See, e.g.*, EX-1003, 2:1-30.) A POSITA would have understood from Yeager's disclosure that providing an indication in the receive mode is optional. (EX-1002 ¶135.) Thus, it would have been obvious to a POSITA to modify those embodiments such that the light is turned OFF (rather than switched to green) in the receive mode. (*Id.*)

A POSITA would have also reasonably expected success with this proposed modification because it would have been trivial to implement. That is, configuring the LED control unit to turn the LED OFF when the device is in standby mode is simple to implement with well-known techniques. (*Id.* ¶136.)

The next two limitations of claim 13 require that the light is turned ON when the device is in the transmit mode and either no speech is present or the speech signal is "bad." Yeager discloses that the LED is turned ON when the device is in transmit mode and either no speech is present or the speech signal has very low audio. (EX-1003, 2:15-20 ("a relatively dim LED 204 is used to indicate RF transmission *without audio* or *very low audio*") (emphases added).) Yeager further discloses using bi-color LEDs and an embodiment in which the LED is ON in the transmit mode and it is orange when no speech is present but red when speech is present and being transmitted. (*Id.*, 2:31-46, 2:54-59; EX-1002 ¶138.)

Boillot discloses detecting speech and determining a "voicing quality metric" that indicates when the speech quality is "poor" (e.g., insufficient to overcome the ambient noise). (EX-1004 ¶[0014]; EX-1002 ¶139.) Thus, it would have been obvious to a POSITA that Yeager's radio could turn the light ON (as Yeager discloses) when in the transmit mode and Boillot's pick-up state determination unit determines that either there is no speech segment or the voicing quality is "poor." (EX-1002 ¶139.)

The last limitation of claim 13 requires that the light is blinking when the device is in transmit mode and the speech signal is "good." (EX-1002 ¶140.) Yeager discloses using a "bright" LED to indicate louder audio transmission, whereas Boillot discloses using a "blinking" LED to indicate poor quality speech. (*Supra* §VII.A.6.) A POSITA would have been motivated to modify Yeager and use a blinking LED to indicate, in the transmit mode, that the speech signal quality is good (instead of poor) for several reasons. First, whether the blinking LED is used to indicate to the user that the signal is good or bad is a mere design choice, as the patent admits. (EX-1002 ¶¶141-42; EX-1001, 39:43-40:2.) Second, a POSITA would have motivated to use a blinking LED to indicate a good quality speech signal because only a limited number of possibilities exist for indicating whether Boillot's voicing quality metric is satisfactory (e.g., on, off, blinking, intensity). Accordingly, at a minimum, it would have been obvious to try. (EX-1002 ¶143.)

Third, a POSITA would have understood that using a blinking LED, rather than varying the intensity to a "bright" LED, would be easier for the user in many situations. For example, it would be easier for a user to differentiate between Yeager's dimly-lit solid LED (when transmitting but no speech is present or the speech quality is bad) and a blinking LED (when transmitting and speech quality is good) than it would be to distinguish between varying degrees of brightness. Thus, using a blinking LED to represent a good quality speech signal and a dimly lit but constant light to indicate no speech (or poor speech quality) would have been a simple way to clearly indicate the status to a user. (*Id.* ¶144.)

Fourth, this combination (and modification) represents the simple substitution of one known element (Boillot's blinking mode) to another known element (Yeager's bright LED) to obtain predictable results (LED that blinks to indicate communication mode and good speech quality). (EX-1002 ¶145); *KSR*, 550 U.S. at 417. It also uses a known technique (blinking LED) to improve the operation of the same or similar device (Yeager's LED) in the same way (to provide a speech quality indicator). (*Id.*) It also applies a known technique (blinking LED) to a known device and method (Yeager's LED) that is ready for improvement and yields predictable results (an LED that blinks to indicate speech quality). (*Id.*)

A POSITA would have reasonably expected success with this modification because it would have been trivial to implement with well-known techniques. (EX-1002 ¶146.) Indeed, it would merely require using a blinking LED when Boillot's voicing quality metric is below the threshold instead of when it exceeds the threshold. (*Id.*)

Accordingly, Yeager and Boillot render obvious the additional limitations of claim 13, and the claim as a whole would have been obvious. (*Id.* ¶¶129-47.)

D. Claim 15

Claim 15 depends from claim 9 and further recites "wherein the speech-segment determination unit converts the first signal input from the first sound pick-up unit into a signal component in a unit of 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."

The '374 patent explains that a speech-segment determination unit may "analyze[] a spectrum component of the signal component thus converted into the frequency domain to determine whether it is a vowel, consonant, or a noise component based on the analyzed spectrum component." (EX-1001, 7:56-63; *see also id.*, 13:19-24.)

Boillot discloses 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. (*Supra* §VII.A.9.) Boillot further discloses that the "voicing level parameter indicates the degree to which the present frame appears to be voiced content, and may depend on certain characteristics such as *pitch, pitch trajectory, periodicity*, and so on." (EX-1004 ¶[0013] (emphasis added).) A POSITA would have understood Boillot's reference to "pitch," "pitch trajectory," and "periodicity" to disclose, or at least suggest, voice activity detection via spectrum analysis, such as Cepstral analysis (showing periodic structures in the spectrum), harmonics-to-noise ratio (which looks at harmonic peaks in the spectrum), and pitch tracking algorithms (like SWIPE). (EX-1002 ¶150; EX-1014, 83.) This is also recognized by Boillot, which explains that "[i]f the user speaks with more intonation, the pitch track better exhibits characteristic behaviors, such as an *upward frequency sweep* near the end of words." (EX-1004 ¶[0021] (emphasis added); EX-1002 ¶150.)

Accordingly, Boillot discloses or renders obvious the additional limitations of claim 15, and the claim as a whole would have been obvious over Yeager and Boillot. (EX-1002 ¶¶148-51.)

E. Claim 1

Claim 1 is a method claim with limitations corresponding to those in claim 9. (EX-1002 ¶152.) For the reasons explained for claim 9, and further for the reasons below, Yeager and Boillot together disclose or render obvious every limitation of claim 1, and the claim as a whole would have been obvious. (*Id.* ¶¶152-64.)

The preamble recites "[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." If limiting, Yeager discloses such a method. (EX-1002 ¶153.) Yeager discloses a two-way radio (400) having a push-to talk button (406), microphone port (408), and an LED (404) attached to the housing (402):

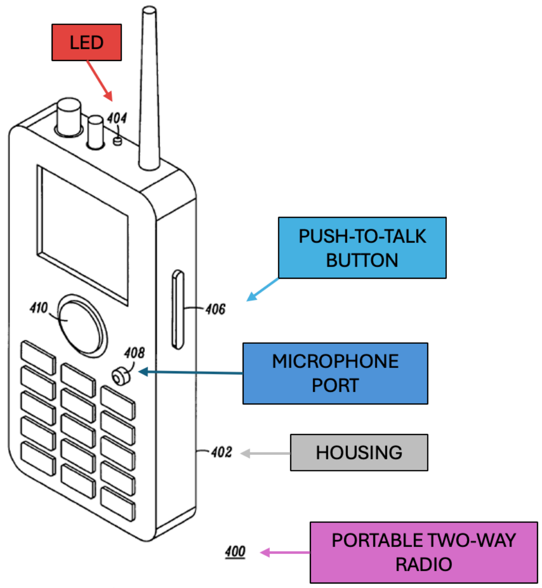


FIG. 4

(EX-1003, Fig. 4, 1:43-44, 3:1-32, 4:6-7, Abstract; EX-1002 ¶153.)

As discussed above for elements 9[e], 9[f], and claim 10, Yeager discloses a method of notifying the user of a used condition (e.g., receive mode, transmit mode, audio level) of the simplex communication apparatus (e.g., two-way radio 400) using the attached LED (e.g., LED 404). (*Supra* §§VII.A.5-VII.A.6, VII.B; EX-1002 ¶154; EX-1003, 1:67-2:10, Fig. 2.) Yeager's radio is a simplex communication apparatus because information is transmitted in either direction, but not simultaneously. (EX-1002 ¶¶32, 154; *see* EX-1016, 18); 47 C.F.R. §2.1. Rather, Yeager's PTT button (406) switches the two-way radio (400) between a "transmit mode" and a "receive mode" (i.e., standby mode). (*Supra* §VII.A.3; EX-1003, 2:20-24, 2:27-

30, 2:44-46, 2:46-48, 3:6-8, 3:14-19, 3:48-58, 4:30-36, 4:50-57, 1:52-55, EX-1002 ¶154.)

1. 1[a]: Communication-Mode Determination Step

Element 1[a] recites "a communication-mode determination step of determining whether a communication mode of the simplex communication apparatus is a transmission mode or a standby mode."

As discussed (*supra* §VII.A.3), Yeager discloses a PTT button (406) that switches the two-way radio between a "transmit mode" and a "receive mode" (i.e., standby mode). (EX-1003, Fig. 4, 2:20-24, 2:27-30, 2:44-46, 2:46-48, 3:6-8, 3:14-16, 3:16-19, 3:48-58, 4:30-36, 4:50-57, 1:52-55; EX-1002 ¶156.) Yeager's device necessarily "determines" the communication mode because it changes the LED based on the mode. (*Supra* §VII.A.6.) Thus, Yeager discloses or renders obvious a communication-mode determination step of determining whether a communication mode of the simplex communication apparatus (Yeager's radio) is a transmission mode or a standby mode. (EX-1002 ¶¶155-56.)

2. 1[b]: Sound Pick-Up State Determination Step

Element 1[b] recites "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."

Yeager and Boillot disclose a "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." (*Supra* §VII.A.4; EX-1002 ¶159.) The "sound pick-up state determination step" of element 1[b] is performed by the "sound pick-up state determination unit" discussed in element 9[d]. (*Id.*) And, as discussed for elements 9[g][i] and 9[h][i], the sound pick-up state determination evaluates the sound carried by a speech signal to be transmitted if the communication mode is the transmission mode. (*Supra* §§VII.A.7, VII.A.9; EX-1002 ¶159.) Similarly, for the reasons discussed below, because the references disclose or render obvious a speech-segment determination step (*infra* §§VII.E.6-VII.E.7) and a speech-quality evaluation step (*infra* §§VII.E.4, VII.E.7), they disclose 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. (EX-1002 ¶159.)

Thus, Yeager and Boillot disclose and render obvious this limitation. (*Id.* ¶¶157-59.)

3. 1[c]: Control Step

Element 1[c] recites "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."

Yeager and Boillot disclose or render obvious this limitation. (*Supra* §VII.A.6; EX-1002 ¶160.)

4. 1[d][i]: Speech-Quality Evaluation Step

Element 1[d][i] recites "a speech-quality evaluation step of evaluating speech quality of the speech signal to be transmitted."

Boillot discloses this step. (*Supra* §VII.A.7; EX-1002 ¶161.) Thus, Yeager and Boillot disclose and render this element obvious for the reasons discussed for element 9[g][i]. (*Id.*)

5. 1[d][ii]: Transmission Mode

Element 1[d][ii] recites that the sound pick-up state "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."

Boillot discloses or renders obvious this element. (*See supra* §§VII.E.2, VII.E.4, VII.A.7; EX-1002 ¶162.)

6. 1[e][i]: Speech-Segment Determination Step

Element 1[e][i] recites "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."

As discussed, Yeager and Boillot disclose this step. (*Supra* §VII.A.9; EX-1002 ¶163.) Thus, Yeager and Boillot disclose and render obvious this element for the same reasons as element 9[h][i]. (*Id.*)

7. 1[e][ii]: Sound Pick-Up State Determination Conditions

Element 1[e][ii] recites that the "sound pick-up state" in 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."

Boillot discloses this element for the reasons discussed above for elements 1[b], 1[d][i]-1[e][i], 9[d], and 9[g][i]-9[h][ii]. (*Supra* §§VII.E.2, VII.E.4-VII.E.6, VII.A.4, VII.A.7-VII.A.10; EX-1002 ¶164.)

Accordingly, Yeager and Boillot together disclose or render obvious every limitation of claim 1, and the claim as a whole would have been obvious. (EX-1002 ¶¶152-65.)

F. Claim 2

Claim 2 corresponds to the limitations of claim 10. (EX-1002 ¶166.) For the reasons discussed for claim 10, Yeager and Boillot disclose or render obvious the additional limitations of claim 2, and the claim as a whole would have been obvious. (*Supra* §VII.B; EX-1002 ¶¶166-67.)

G. Claim 3

Claim 3 depends from claim 1 and further recites that, "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." As discussed, Boillot discloses that in the speech-quality evaluation step, the speech quality ("voicing quality metric") of the speech signal to be transmitted may be based on "a ratio of *voicing level* to background noise," and that "[i]f the voicing quality metric indicates that the *volume* of the speaker's voice is not enough to sufficiently overcome the ambient noise, an indication may be given to the speaker to increase their speaking volume." (EX-1004 ¶[0013] (emphases added); *see supra* §§VII.E.4, VII.A.7; EX-1002 ¶168.) Thus, Boillot discloses the additional limitation in claim 3, and the claim as a whole would have been obvious. (EX-1002 ¶¶168-69.)

H. Claim 5

Claim 5 depends from claim 1 and further recites that "in the speech-segment determination step 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."

As discussed, Boillot and Yeager disclose determining, in the speech-segment determination step, whether or not the speech signal to be transmitted is a speech segment if the communication mode is the transmission mode. (*See supra* §§VII.E.6, VII.A.9; EX-1002 ¶171.) As discussed with respect to Boillot, the vocoder encodes the speech and "determines certain coefficients and parameters of the audio signal on a frame by frame basis." (EX-1004 ¶[0013].) Boillot detects whether the frame is voiced (a speech segment) or not voiced, and generates a "voicing level parameter [that] indicates the degree to which the present frame appears to be voiced content[.]" (*Id.*; EX-1002 ¶171.) Further, as discussed, the output of the vocoder also generates a background noise parameter. (*Id.*) The voicing level parameter of speech is then compared to the background noise parameter to provide "a voicing quality metric that indicates how well the speaker's voice overcomes the ambient noise." (*Id.*) Thus, Boillot discloses evaluating the speech quality of the speech signal (e.g., voicing quality metric of a frame) while the speech signal is being analyzed to determine whether it includes speech (e.g., determining voicing level parameter of another frame in the signal).

To the extent PO argues that this claim element requires the same frame to be evaluated for speech and evaluated for speech quality at the same time, Boillot also discloses this. (EX-1002 ¶172.) Specifically, rather than performing speech-quality evaluation *after* the vocoder outputs the voicing level parameter and background noise parameter, Boillot discloses that "[i]n one embodiment of the invention, *as frames are produced by the vocoder, the voicing quality metric is included in the section field section 404 of the frame[.]*" (EX-1004 ¶[0024] (emphasis added); EX-1002 ¶172.) Thus, a POSITA would have understood that Boillot's vocoder evaluates the speech quality of the signal to be transmitted while the speech signal to be transmitted is being determined as the speech segment because the vocoder outputs—at the same time for the same frame—a voicing level parameter and a voicing quality metric. (EX-1002 ¶172.)

I. Claim 8

Claim 8 depends from claim 1 and corresponds to the limitations of claim 15. (*Id.* ¶174.) Claim 8 would have been obvious for the same reasons as claim 15. (*Id.* ¶¶174-75; *supra* §VII.D.)

VIII. GROUND 2: CLAIMS 4, 7, 11, AND 14 WOULD HAVE BEEN OBVIOUS IN VIEW OF YEAGER, BOILLOT, AND CHEN.

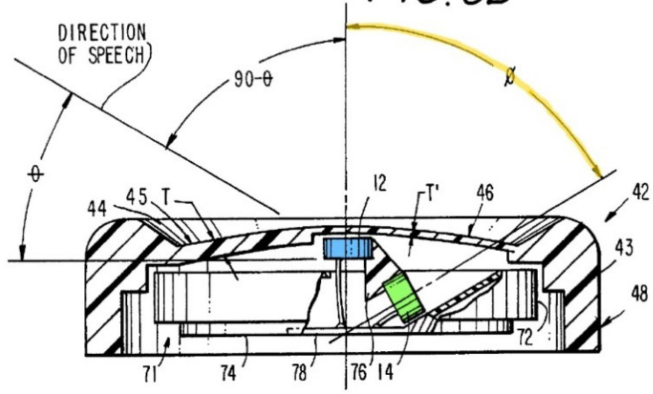
Dependent claims 4, 7, 11, and 14 add limitations relating to the use of a second microphone for noise cancellation.[5] The use of multiple microphones for this purpose was widely known in the art by 2012 (EX-1002 ¶177), as the patent admits:

> [T]here 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.

(EX-1001, 1:29-32.)

It had also been disclosed in many references. For example, in 1998, Andrea disclosed a telephone handset that implements an "active noise reduction system." (EX-1010, 1:19-22.) The handset included "first and second microphones 12 and 14" oriented at an angle (yellow) to each other:

[5] As discussed above, Yeager and Boillot disclose each limitation of the claims from which these claims depend. (*Supra* §VII.)



(*Id.*, Figs. 3B, 3A, 12:31-43, 14:5-32; EX-1002 ¶178.) Andrea disclosed subtracting the second microphone's noise signal from the first microphone's signal to output a denoised signal "representing substantially the speech to the telephone unit." (EX-1010, 12:46-64; EX-1002 ¶178.)

In 2010, Konchitsky disclosed a voice coder for a wireless communication device 30 using two microphones in different locations to perform noise cancellation. (EX-1008, Figs. 3, 5(b), 1:24-35, 2:9-25, 2:59-62, 3:1-3, 5:52-67, 6:17-22, 6:45-52, 11:23-38; EX-1002 ¶179.)

As discussed below, Chen also disclosed this feature. Thus, as the patent admits and these references demonstrate, the additional limitations of these claims were conventional, known to a POSITA, and cannot render the claims patentable.

A. Claim 11

Claim 11 recites that the apparatus of claim 9 further comprises a second microphone ("a second sound-pick up unit configured to pick up a voice sound") and a noise cancellation unit ("a noise cancellation unit configured to perform noise cancellation of 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"). Claim 11 further recites that "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."

Chen discloses a two-microphone arrangement to perform noise cancellation with a noise cancellation module. (EX-1005, Figs. 4, 6, ¶¶[0025], [0055], [0061], [0062]; EX-1002 ¶182.) Chen's Figure 4 shows a functional block diagram of a communication device having a first microphone 201, a second microphone 202, and a signal processor 420:

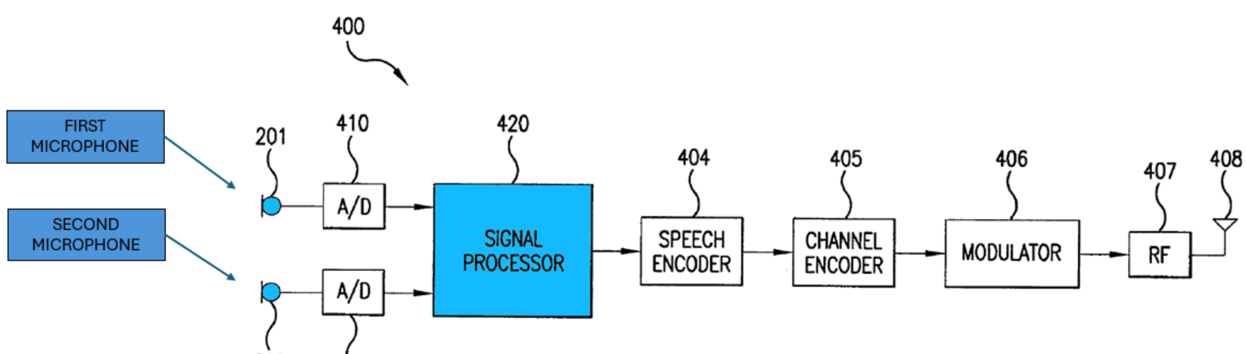


FIG.4

(EX-1005, Fig. 4, ¶¶[0025], [0055], [0061], [0062]; EX-1002 ¶182.) Chen's signal processor 420 "may comprise a background noise cancellation module" 605 (EX-1005 ¶[0061]) as shown in Chen's Figure 6:

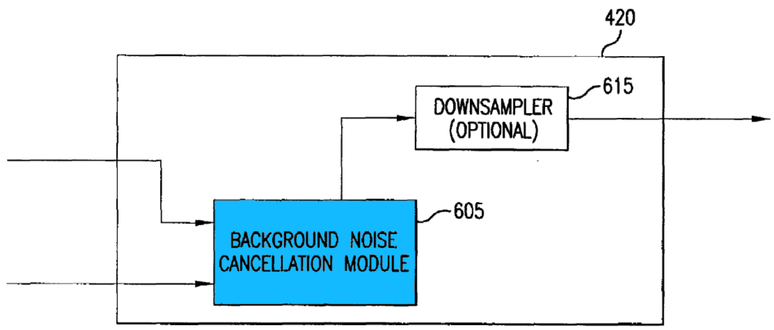


FIG.6

(EX-1005, Fig. 6, ¶[0062].) The "noise cancellation module 605 receives the first and second audio signals output by the first and second microphones 201 and 202, respectively [and] uses the content of the second audio signal to cancel a background noise component present in the first audio signal to produce a third audio signal …. The third audio signal is sent to the rest of the path 400 before being transmitted to the telephone of a far-end user." (*Id.*; *see also id.* ¶¶[0013], [0028], [0063]-[0066], Fig. 7; EX-1002 ¶182.)

Thus, Chen discloses a second sound pick-up unit and the noise cancellation unit recited in claim 11. (EX-1002 ¶183.) It would have been obvious to include these features in Yeager's device, and to evaluate speech quality and transmit the speech after the noise cancellation, for the reasons described below. Thus, Yeager, Boillot, and Chen together disclose and render obvious every limitation of claim 11. (*Id.* ¶¶181-83.)

A POSITA would have been motivated to modify the radio in the Yeager-Boillot combination to include a second microphone and a noise cancellation module, as taught by Chen, and to provide the noise-cancelled signal to Boillot's vocoder for many reasons. (*Id.* ¶¶184-91.)

First, Chen discloses the benefits of using two microphones and a noise cancellation module, namely that it allows the system to better differentiate between a voice component and a background noise component of an audio signal and cancel the background noise. (EX-1005 ¶¶[0006]-[0011]; EX-1002 ¶185.) Chen teaches that this approach "increas[es] the ratio of the voice component to background noise component." (EX-1005 ¶[0017].) A POSITA would have understood that increasing the signal-to-noise ratio (SNR) improves the quality of the transmitted signal. (EX-1002 ¶185.)

Second, Yeager discloses the desirability of improving speech transmission quality. (EX-1003, 1:17-28 ("Poor speech transmission may be caused by a variety of factors…. [J]ust knowing that the speech transmission is not operating optimally would allow the user to attempt to correct the problem."); EX-1002 ¶186.) In view of this disclosure, a POSITA would have been motivated to include Chen's two-microphone arrangement and noise cancellation module to improve the quality of speech transmission. (EX-1002 ¶186.)

Third, Boillot discloses that "[w]hen speech in the acoustic audio signal is mixed with … background noise, the voice coding process becomes less effective, resulting in audio artifacts being mixed in with speech at the listener's equipment."

(EX-1004 ¶[0003]; EX-1002 ¶187.) Consequently, a POSITA would have been motivated to include Chen's two-microphone arrangement and "noise reduction component" to reduce noise and improve the voice coding process. (EX-1002 ¶187.)

Fourth, the combination represents the simple addition of one known element (Chen's second microphone and noise-cancellation module) to another known element (Yeager's single-microphone device) to obtain predictable results (a two-microphone device having improved noise cancellation). (*Id.* ¶188); *KSR*, 550 U.S. at 417.

Fifth, the combination uses a known technique (Chen's two-microphone arrangement with noise cancellation) to improve a similar device and method (Yeager's radio and Boillot's speech evaluation) in the same way (to improve signal quality). (*Id.*)

Sixth, the combination applies a known technique (Chen's noise cancellation using two microphones) to a known device and method (Yeager's radio and Boillot's speech evaluation) that is ready for improvement and yields predictable results (a radio with two microphones and improved signal quality). (*Id.*)

A POSITA would have been motivated to evaluate speech quality *after* the noise reduction step because the purpose of the speech quality evaluation is to determine whether the transmitted speech is of sufficient quality. It would make no sense to evaluate speech quality before improving the speech signal using noise reduction. (EX-1002 ¶189.)

A POSITA would have reasonably expected success in this proposed modification because it would have been easy to implement with well-known techniques. (*Id.* ¶190; *see also* EX-1012, 55 (Examiner noting that "noise cancellation can be easily implemented").)

B. Claim 4

Claim 4 depends from claim 1 and corresponds to the limitations of claim 11. (EX-1002 ¶192.) Claim 4 would have been obvious over Yeager, Boillot, and Chen for the same reasons as claim 11. (*Id.* ¶¶192-93; *supra* §VIII.A.)

C. Claim 7

Claim 7 depends from claim 4 and claim 7's limitations correspond to those in claim 13. (EX-1002 ¶194.) Thus, claim 7 is obvious over Yeager, Boillot, and Chen for the reasons discussed for claims 4 and 13.[6] (*Id.* ¶¶194-95; *supra* §§VIII.B, VII.C.)

D. Claim 14

Claim 14 depends from claim 11 and further recites that "the first and second sound pick-up units are a main microphone and a sub-microphone, respectively, and

[6] Claim 7's additional limitations also lack patentable weight for the same reasons discussed above for claim 13. (*Supra* §VII.C.)

the main microphone and the sub-microphone are arranged at a front face and a rear face of the communication apparatus, respectively."

Chen's first microphone (201) is a main microphone because it is used for picking up mainly a user's voice while the second microphone (202) is used for picking up mainly the surrounding noise:

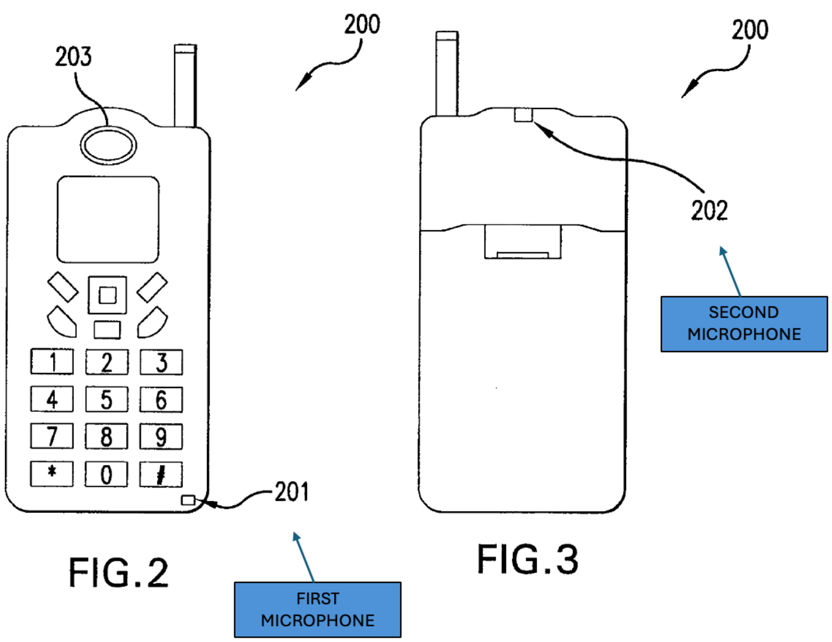


FIG.2 FIG.3

(EX-1005, Figs. 2-3, ¶¶[0051]-[0052] (first microphone located on the "front" so "as to be close to a user's mouth" and second microphone is "located on the back portion … so as to be further away from a user's mouth"), [0053] (amplitude voice picked up by first microphone 201 is greater than amplitude user's voice picked up by second microphone 202); EX-1002 ¶197.)

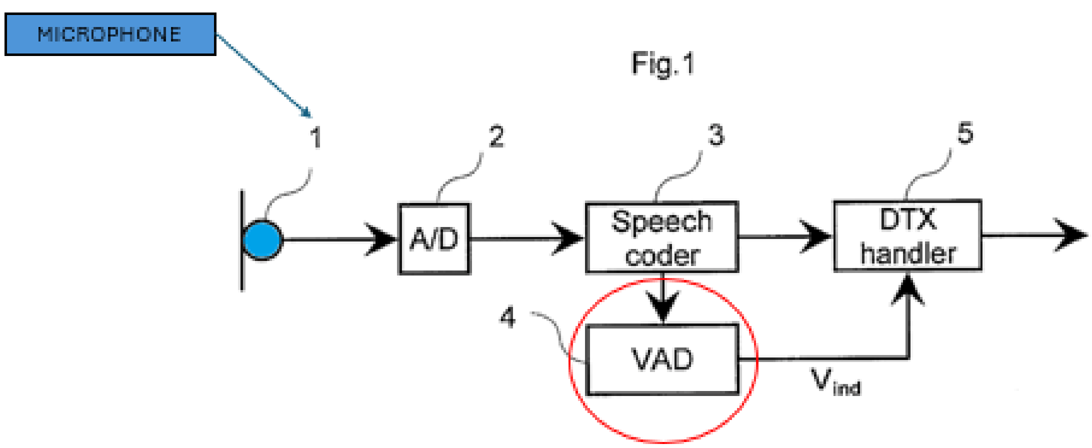
Accordingly, Yeager, Boillot, and Chen together disclose or render obvious every limitation of claim 14, and the claim as a whole would have been obvious. (EX-1002 ¶¶196-98.)

IX. GROUND 3: CLAIMS 8 AND 15 WOULD HAVE BEEN OBVIOUS IN VIEW OF YEAGER, BOILLOT, AND VÄHÄTALO.

As discussed, Yeager and Boillot render claims 8 and 15 obvious. (*Supra* §§VII.I, VII.D.) Those claims would also have been obvious in further view of Vähätalo. (EX-1002 ¶¶199-210.)

A. Claim 15

Vähätalo discloses a voice activity detection device 4:

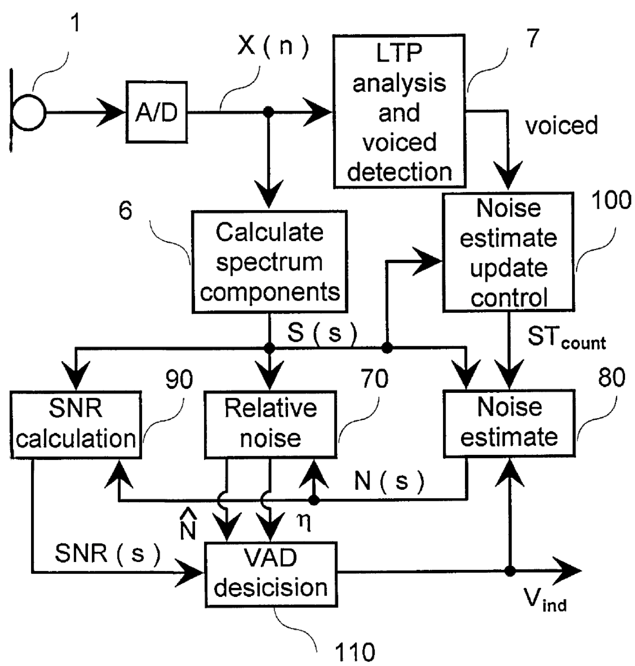


(EX-1006, Fig. 1; 2:21-22, 2:50-52; EX-1002 ¶200.) A signal from a microphone 1 is sampled by an A/D converter such that, for example, "the frame length of the speech coder 3 portion of a speech coder/decoder (codec) is 80 samples, and each speech frame comprises 10 ms of speech." (EX-1006, 2:56-61; EX-1002 ¶200.)

Vähätalo explains that the VAD device 4 "can use the same input frame length as the speech codec 3[.]" (EX-1006, 2:66-3:1; EX-1002 ¶200.)

Vähätalo explains operation of the VAD device with reference to Figure 2, reproduced below. (EX-1006, Fig. 2; 2:23-24, 3:6-26; EX-1002 ¶201.) The "frame is fed into block 6 in which the power *spectrum components* presenting power in predefined bands are calculated. *Components proportional to amplitude or power spectrum of the input frame can be calculated using an FFT*, a filter bank, or using linear predictor coefficients."

Fig.2



(EX-1006, Fig. 2, 3:11-16 (emphases added); EX-1002 ¶201.) The VAD decision 110 is calculated utilizing the spectrum components and signal-to-noise ratios obtained from different frequency bands. (EX-1006, 1:42-57, 3:27-5:6, 6:43-9:20; EX-1002 ¶201.)

Accordingly, Vähätalo discloses the additional limitations of claim 15, namely that a VAD (speech segment determination unit) converts the first signal from the microphone into a signal component of specific length (a frame) in a frequency domain and determines whether the frame carries a voice component or a noise component based on a spectrum component of the signal component thus converted into the frequency domain. (EX-1002 ¶¶200-02.)

A POSITA would have been motivated to include Vähätalo's speech segment detection into Yeager's radio (as modified by Boillot). (*Id.* ¶¶203-08.)

First, Vähätälo discloses that its frequency-based VAD provides a "more accurate and reliable voice activity detection decision." (EX-1006, 1:58-64.) A POSITA would have understood that Vähätalo's VAD would provide an improved voice activity detection decision, and therefore improve, e.g., when the system provides comfort noise frames when the user is not speaking. (EX-1002 ¶204.)

Second, the combination represents the simple addition of one known element (Vähätalo's voice activity detection) to another known element (the Yeager-Boillot device) to obtain predictable results (speech-segment detection using spectral analysis). (*Id.* ¶205); *KSR*, 550 U.S. at 417.

Third, the combination uses a known technique (Vähätalo's VAD) to improve a similar device and method (Boillot's speech-segment detection) in the same way. (*Id.*)

Fourth, the combination applies a known technique (Vähätalo's voice activity detection) to a known device and method (Boillot's speech-segment detection) that is ready for improvement and yields predictable results (speech-segment detection using spectral analysis). (*Id.*)

Fifth, Boillot's device includes a vocoder that detects speech segments, demonstrating the foundational capability of detecting speech segments. (EX-1004 ¶¶[0011]-[0013], Fig. 1; EX-1002 ¶206.) A POSITA would have understood that different voice activity detection algorithms could be used to detect speech segments, and that they have varying capabilities. Thus, using different voice activity algorithms, such as Vähätalo's, would have been an obvious and predictable variation. (EX-1002 ¶206.)

A POSITA would have reasonably expected success in modifying Yeager and Boillot in this way because doing so would have been trivial, involving merely configuring the processor with revised algorithms implementing Vähätalo's voice activity detection. (*Id.* ¶207.)

B. Claim 8

Yeager and Boillot render obvious claim 8. (*Supra* §VII.I.) Claim 8 also would have been obvious over Yeager, Boillot, and Vähätalo for the reasons explained for claim 15. (EX-1002 ¶¶209-10; *supra* §IX.A.)

X. GROUND 4: CLAIM 12 WOULD HAVE BEEN OBVIOUS IN VIEW OF YEAGER, BOILLOT, CHEN, AND VISSER.

Yeager, Boillot, and Chen together disclose or render obvious claim 11. (*Supra* §VIII.A; EX-1002 ¶211.) Claim 12 depends from claim 11 and further recites that the communication apparatus comprises "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."

The '374 patent explains that Figure 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":

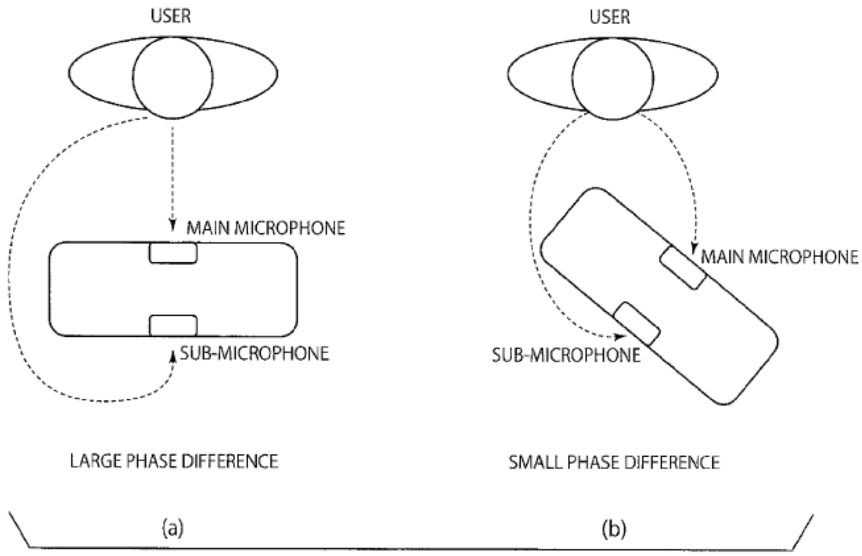


FIG. 8

(EX-1001, Fig. 8, 13:42-14:14; EX-1002 ¶212.) In a "normal used condition" in the orientation shown in (a), "there is a large phase difference between the voice sound that is picked up by the main microphone … and a voice sound that is picked up by the sub-microphone[.]" (EX-1001, 13:46-52.) When the device is "inclined toward a user," as shown in (b), "there is a small phase difference … due to a shorter distance between the user's mouth and the two microphones." (*Id.*, 13:52-57.) The microphone-direction determination unit compares a phase difference between the two microphones with a threshold value, and when the phase difference is smaller than the threshold, it assumes the positional relationship is good. (EX-1001, 13:64-14:9, 14:36-53, Fig. 9; EX-1002 ¶212.) When the phase difference is equal to or larger than the threshold, it assumes the positional relationship is bad. (EX-1001, 14:9-14, 14:54-60; EX-1002 ¶212.) The microphone detection unit outputs the determination result (good or bad) to the speech-quality evaluation unit, which uses the information to determine whether speech quality is good or bad and thereby provide such indication via the LED. (EX-1001, 5:66-6:5, 14:61-67, 16:45-60; Figs. 9, 11; EX-1002 ¶212.)

Visser discloses using two microphones to determine the phase difference of the voice sounds picked up by the two microphones. For example, as shown in Figure 15A, signals from a "primary microphone" and a "secondary microphone" are converted to the frequency domain and fed to a voice activity detector that determines the phase difference between the two signals ("phase difference VAD signal V20"):

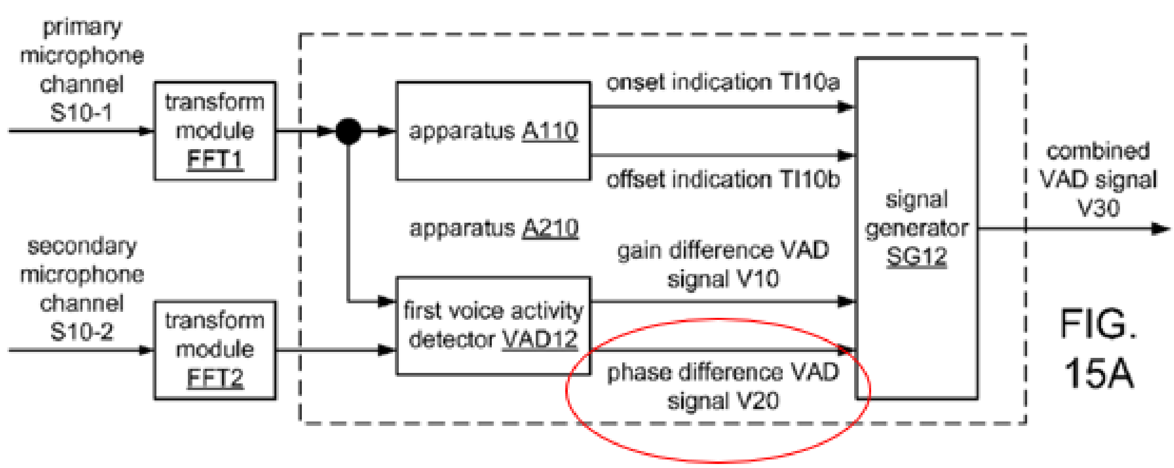


FIG. 15A

(EX-1007, Fig. 15A, ¶[0128] ("VAD signal V20 [ ] based on inter-channel phase differences. In one particular example [ ] phase difference VAD signal V20 is based on differences in the frequency range from 500 to 2500 Hz."); *see also id.* ¶¶[0155]-[0161]; EX-1002 ¶213.)

Visser discloses that phase difference may be used to determine the orientation of the handset (i.e., direction of the main microphone) with respect to the user's mouth:

> It is not uncommon for a user of a portable audio sensing device (e.g., a headset or handset) to use the device in an orientation with respect to the user's mouth (also called a holding position or holding angle) that is not optimal and/or to vary the holding angle during use of the device. Such variation in holding angle may adversely affect the performance of a VAD stage.
>
> One approach to dealing with a variable holding angle is to *detect the holding angle* (for example, using direction of arrival (DoA) estimation, *which may be based on phase difference … between microphones*).

(EX-1007 ¶¶[0169]-[0170] (emphases added); EX-1002 ¶214.) Thus, Visser discloses, or at least suggests, a microphone-direction determination unit configured to determine a direction of a main microphone based on a phase difference. (EX-1002 ¶¶211-14.)

It would have been obvious to a POSITA to combine Visser's teaching of detecting microphone direction based on phase difference with Yeager, Boillot, and Chen, and to modify the combination to indicate to the user (via the speech-quality evaluation unit) that the device is not being oriented optimally for several reasons. (*Id.* ¶¶215-19.)

First, Yeager, Visser, and Boillot each provide motivation. Yeager discloses that "[i]t would be beneficial for a radio user to know that his or her handset is properly transmitting an audio signal," recognizes that "[p]oor speech transmission may be caused by a variety of factors," and recognizes that "just knowing that the speech transmission is not operating optimally would allow the user to attempt to correct the problem." (EX-1003, 1:17-28, *id.*, 1:57-62, 2:59-63.) Visser discloses that the device's orientation "may adversely affect the performance of a VAD stage." (EX-1007 ¶[0169].) And Boillot discloses that "there is a need by which users of communications systems can be informed as to the voicing quality of the speech signal they are transmitting so that preemptive action may be taken to address radio and voice processing issues." (EX-1004 ¶[0004].) In view of these disclosures, a POSITA would have been motivated to modify Yeager's radio to indicate to the user that the device is not being held in the proper orientation to allow the user to adjust orientation, and thereby improve performance. (EX-1002 ¶216.)

Second, the addition of Visser's microphone-direction determination unit represents the simple addition of one known element (microphone-direction determination unit based on phase difference of voice sounds picked up by two microphones) to another known element (the processor in the Yeager-Boillot-Chen combination) to obtain predictable results (a microphone-direction determination unit based on phase difference picked up by two microphones). (*Id.* ¶217); *KSR*, 550 U.S. at 417.

Third, the combination uses a known technique (microphone-direction determination based on phase difference) to improve a similar device and method

(Yeager's radio, as modified by Boillot and Chen) in the same way (using algorithms to determine a phase difference picked up by two microphones). (*Id.*)

Fourth, the combination applies a known technique (determining phase difference) to a known device and method that is ready for improvement and yields predictable results (the ability to indicate to the user that the device is not optimally oriented). (*Id.*)

Fifth, Boillot's device includes a vocoder that outputs parameters of the audio signal on a frame-by-frame basis, and therefore demonstrates the foundational capability of analyzing audio signals. (EX-1004 ¶[0013].) A POSITA would have understood that different algorithms can be used to perform different types of analysis on audio signals. Thus, using algorithms to implement Visser's microphone-direction determination unit, and revising the algorithm to also indicate to the speech-quality evaluation unit that the device is not being held properly would have been an obvious and predictable variation. (EX-1002 ¶218.)

A POSITA would have reasonably expected success in modifying the combination of Yeager, Boillot, and Chen in this way. Doing so would have been trivial, involving configuring the processor with revised algorithms implementing Visser's microphone-direction determination unit and indicating to the speech-quality evaluation unit that the device is not being held properly. (*Id.* ¶219.)

XI. GROUND 5: CLAIMS 5 AND 6 WOULD HAVE BEEN OBVIOUS IN VIEW OF YEAGER, BOILLOT, AND VISSER.

A. Claim 6

Yeager and Boillot render obvious claim 1. (*Supra* §VII.A.) Claim 6 depends from claim 1 and has limitations similar to those in claim 12, except that claim 6 does not include limitations corresponding to claim 11 from which claim 12 depends (noise cancellation using two microphones). (EX-1002 ¶220.) For the reasons explained with respect to Yeager, Boillot, and Visser (not including Chen) in claim 12, claim 6 would have been obvious over those references. (*Id.*) In this combination, the second microphone required by claim 6 is disclosed by Visser as part of its step of determining a direction of the main microphone based on the phase difference of sounds picked up by the first and second microphones, as described above. (*Id.* ¶221.) A POSITA would have reasonably expected success in adding a second microphone to the combination of Yeager and Boillot. (*Id.*) Doing so would have been trivial, as is demonstrated by the ubiquity of communication devices having multiple microphones. (*Id.*)

B. Claim 5

Yeager and Boillot render obvious claim 5. (*See supra* §VII.H.) Claim 5 also would have been obvious in further view of Visser. (EX-1002 ¶¶223-28.)

Visser discloses or renders obvious evaluating the quality of the speech signal (via phase difference, like the '374 patent) while the speech signal to be transmitted is being determined as the speech segment. (EX-1002 ¶226.) Specifically, as explained above, Visser discloses a VAD ("VAD12") that uses two microphones to determine the phase difference of the voice sounds picked up by the two microphones. (*See supra* §X; EX-1007, Fig. 15A, ¶¶[0128], [0169]-[0170]; EX-1002 ¶226.)

It would have been obvious to combine Visser's teaching of detecting microphone direction based on phase difference, while the speech signal to be transmitted is being determined as the speech segment, with Yeager and Boillot, and to modify the combination to also evaluate speech-quality based on the phase difference during speech-segment determination for the same reasons discussed above in Ground 4 (not including reliance on Chen). (*See supra* §X; EX-1002 ¶227.) Further, Boillot suggests the combination because it discloses that "as frames are produced by the vocoder, the voicing quality metric is included in the special field section 404 of the frame[.]") (EX-1004 ¶[0024]; EX-1002 ¶227.) Moreover, as in claim 6, a POSITA would have reasonably expected success in adding a second microphone (disclosed in Visser) to the combination of Yeager and Boillot. (EX-1002 ¶227.) Doing so would have been trivial, as is demonstrated by the ubiquity of communication devices having multiple microphones. (*Id.*)

XII. SECONDARY CONSIDERATIONS OF NONOBVIOUSNESS

Where, as here, a strong *prima facie* obviousness showing exists, secondary considerations may not dislodge the obviousness conclusion. *Leapfrog Enters. v. Fisher-Price, Inc.,* 485 F.3d 1157, 1162 (Fed. Cir. 2007). Petitioners are aware of no evidence supporting a claim for secondary considerations.

XIII. CONCLUSION

Petitioners request the Board institute trial and cancel all challenged claims.[7]

XIV. MANDATORY NOTICES, GROUNDS FOR STANDING, AND FEE PAYMENT

Pursuant to 37 C.F.R. §42.8(a)(1), the mandatory notices identified in 37 C.F.R. §42.8(b) are provided below as part of this Petition.

A. Real Party-In-Interest (37 C.F.R. §42.8(b)(1))

Amazon.com, Inc., Amazon.com Services LLC, and Amazon Web Services, Inc. are the real parties-in-interest.

B. Related Matters (37 C.F.R. §42.8(b)(2))

PO asserted the '374 patent against Petitioners in district court. *SoundClear Technologies LLC v. Amazon.com, Inc. et al.*, No. 1:24-cv-00728 (E.D. Va.). After

[7] Petitioners will address discretionary denial issues if raised by PO. *See* Memorandum from Acting Director Stewart, *Interim Processes for PTAB Workload Management* (March 26, 2025).

intradistrict transfer, that case is now No. 2:24-cv-00320. [8]

If this IPR is instituted and the above proceeding is not stayed, Petitioners hereby stipulate not to pursue in that proceeding any ground of invalidity, against any claim challenged herein, that was raised or reasonably could have been raised in this Petition.

To the best knowledge of Petitioners, the ’374 patent is or has been involved in the following additional proceedings:

Name	Number	Venue	Filed
SoundClear Technologies LLC v. Google LLC	2:24-cv-00321	E.D. Va.	May 1, 2024
Google LLC v. SoundClear Technologies LLC	IPR2025-00344	P.T.A.B.	Feb. 10, 2025

C. Lead and Backup Counsel (37 C.F.R. §42.8(b)(3))

Petitioner provides the following designation of counsel, all of whom are included in Customer No. 20,995 identified in Petitioner’s Power of Attorney.

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[8] On April 7, 2025, Petitioners filed a Motion to Stay Pending IPR in the district court, which PO did not oppose. Thus, a stay is highly likely.

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D. Service Information (37 C.F.R. §42.8(b)(4))

Please direct all correspondence to lead counsel and back-up counsel at the addresses shown above. Petitioner also consents to electronic service by email to BoxSEAZN2L2103LP2@knobbe.com.

E. Grounds for Standing (37 C.F.R. §42.104)

Petitioners certify that the ’374 patent is available for IPR and is not barred or estopped from requesting IPR on the identified grounds. This petition is being filed within one year of service of the original complaint against Petitioners in the district court litigation.

F. Payment of Fees (37 C.F.R. §42.103)

The Office may charge the §42.15(a) fee to Deposit Account No. 11-1410. Review of fifteen claims is requested. Payment for any additional fees due may be charged to the above-referenced Deposit Account.

Respectfully submitted,

KNOBBE MARTENS OLSON & BEAR, LLP

Dated: May 28, 2025

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APPENDIX

Listing of Claims from U.S. 9,070,374	
Claim 1	
1[pre]	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:
1[a]	a communication-mode determination step of determining whether a communication mode of the simplex communication apparatus is a transmission mode or a standby mode;
1[b]	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;
1[c]	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;
1[d]	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
1[e]	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.

Listing of Claims from U.S. 9,070,374	
Claim 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.
Claim 3	
--	The condition notification method according to claim 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.
Claim 4	
--	The condition notification method according to claim 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.
Claim 5	
--	The condition notification method according to claim 1, wherein in the speech-segment determination step 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.

Listing of Claims from U.S. 9,070,374	
Claim 6	
--	The condition notification method according to claim 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.
Claim 7	
--	The condition notification method according to claim 4, 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.
Claim 8	
8[pre]	The condition notification method according to claim 1, wherein the speech-segment determination step includes:
8[a]	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

Listing of Claims from U.S. 9,070,374	
8[b]	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.
Claim 9	
9[pre]	A communication apparatus comprising:
9[a]	a first pick-up unit configured to pick up a voice sound;
9[b]	a transmitter unit configured to transmit the voice sound picked up by the first pick-up unit to outside as a first speech signal;
9[c]	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;
9[d]	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;
9[e]	a light emission device configured to emit light;
9[f]	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;
9[g]	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

Listing of Claims from U.S. 9,070,374	
9[h]	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.
Claim 10	
--	The communication apparatus according to claim 9, 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.
Claim 11	
11[pre]	The communication apparatus according to claim 9 further comprising:
11[a]	a second sound pick-up unit configured to pick up a voice sound; a second sound pick-up unit configured to pick up a voice sound;
11[b]	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,
11[c]	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.

Listing of Claims from U.S. 9,070,374	
Claim 12	
--	The communication apparatus according to claim 11 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.
Claim 13	
--	The communication apparatus according to claim 9, 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.
Claim 14	
--	The communication apparatus according to claim 11, 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.

Listing of Claims from U.S. 9,070,374	
Claim 15	
--	The communication apparatus according to claim 9, 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.

CERTIFICATE OF COMPLIANCE

Pursuant to 37 C.F.R. §42.24(d), the undersigned certifies that this **PETITION FOR INTER PARTES REVIEW OF U.S. PATENT NO. 9,070,374** contains 13,985 words according to the word-processing program used to prepare this paper. The foregoing word count complies with the 14,000-word type-volume limit specified by 37 C.F.R. §42.24(a)(1).

Dated: May 28, 2025

By: *_/Colin B. Heideman /_*
Colin B. Heideman (Reg. No. 61,513)
KNOBBE MARTENS OLSON & BEAR, LLP

CERTIFICATE OF SERVICE

The undersigned hereby certifies that on the date below a copy of this **PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 9,070,374** and **ACCOMPANYING EXHIBITS** are being served on May 28, 2025 via Federal Express overnight mail on counsel of record for U.S. Patent No. 9,070,374 at the Correspondence Address of record below:

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A courtesy copy is also being served via email on counsel for the patent holder in the pending district court litigation:

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