

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
Patent No. 9,070,374

DECLARATION OF RICHARD STERN, PH.D.

<i>Amazon v. SoundClear</i> US Patent 9,070,374 Amazon EX-1002
--

TABLE OF CONTENTS

I.	BACKGROUND -----	1
A.	Experience and Qualifications-----	1
B.	Materials Considered -----	3
II.	APPLICABLE LEGAL STANDARDS -----	4
A.	Claim Construction -----	4
B.	Obviousness-----	6
III.	PERSON OF ORDINARY SKILL IN THE ART -----	10
IV.	TECHNOLOGY BACKGROUND -----	11
A.	Simplex Communication -----	11
B.	Indicating Transmission Mode Using a Light Was Known -----	12
C.	Voice Detection Was Well Known -----	17
D.	Speech Quality Evaluation Was Known -----	19
V.	THE '374 PATENT -----	20
A.	Overview -----	20
B.	Claims -----	21
VI.	CLAIMS 1-15 OF THE '374 PATENT WOULD HAVE BEEN OBVIOUS -----	23
A.	Claims 1-3, 5, 8-10, 13, and 15 Would Have Been Obvious in View of Yeager and Boillot-----	23
1.	Claim 9-----	23
a.	Preamble -----	23
b.	9[a]: First Pick-Up Unit-----	24

c.	9[b]: Transmitter Unit-----	25
d.	9[c]: Communication-Mode Switching Unit-----	26
e.	9[d]: Sound Pick-Up State Determination Unit -----	27
f.	9[e]: Light Emission Device-----	32
g.	9[f]: Control Unit -----	33
h.	9[g][i]: Speech-Quality Evaluation Unit-----	41
i.	9[g][ii]: Voice Sound Pick-Up State -----	46
j.	9[h][i]: Speech-Segment Determination Unit -----	46
k.	9[h][ii]: Transmitted Sound Pick-Up State -----	49
2.	Claim 10 -----	50
3.	Claim 13 -----	53
a.	13[a][i]: Standby -----	53
b.	13[a][ii]-13[a][iii]: Transmit with No or Bad Speech -----	55
c.	13[a][iv]: Transmit with Good Speech-----	56
4.	Claim 15 -----	58
5.	Claim 1 -----	60
a.	Preamble -----	60
b.	1[a]: Communication-Mode Determination Step -----	61
c.	1[b]: Sound Pick-Up State Determination Step -----	62
d.	1[c]: Control Step-----	63

e.	1[d][i]: Speech-Quality Evaluation Step-----	64
f.	1[d][ii]: Transmission Mode -----	64
g.	1[e][i]: Speech-Segment Determination Step -----	64
h.	1[e][ii]: Sound Pick-Up State Determination Conditions -----	65
6.	Claim 2-----	65
7.	Claim 3-----	66
8.	Claim 5-----	66
9.	Claim 8-----	68
B.	Claims 4, 7, 11, and 14 Would Have Been Obvious in View of Yeager, Boillot, and Chen -----	69
1.	Claim 11 -----	72
2.	Claim 4-----	76
3.	Claim 7-----	77
4.	Claim 14 -----	78
C.	Claims 8 and 15 Would Have Been Obvious in View of Yeager, Boillot, and Vähätalo -----	79
1.	Claim 15 -----	79
2.	Claim 8-----	83
D.	Claim 12 Would Have Been Obvious in View of Yeager, Boillot, Chen, and Visser-----	84
E.	Claims 5 and 6 Would Have Been Obvious in View of Yeager, Boillot, and Visser -----	90
1.	Claim 6-----	90
2.	Claim 5-----	91

VII. SECONDARY CONSIDERATIONS OF NONOBVIOUSNESS	93
VIII. CONCLUSION	93

I, Richard Stern, Ph.D., do hereby declare:

1. I am making this declaration at the request of Petitioners Amazon.com, Inc., Amazon.com Services LLC, and Amazon Web Services, Inc. (collectively, “Amazon”). I have been retained by Amazon as a technical expert in this matter.

2. I am being compensated for my work on this case. My compensation does not depend on the content of this Declaration or the outcome of these proceedings. As part of a diversified portfolio, I own shares of Amazon stock. A financial professional manages my portfolio, and I do not. This stock ownership constitutes less than 1 percent of the total portfolio, and does not in any way affect the contents of my opinions in this Declaration.

I. BACKGROUND

A. Experience and Qualifications

3. I am a Professor at Carnegie Mellon University in the Department of Electrical and Computer Engineering, the Department of Computer Science, and the Language Technologies Institute. I have been on the faculty of Carnegie Mellon since 1977.

4. I received the S.B. degree from the Massachusetts Institute of Technology (MIT) in 1970, the M.S. from the University of California, Berkeley, in 1972, and the Ph.D. from MIT in 1977, all in electrical engineering.

5. While I was a graduate student, I worked as a Teaching and Research Assistant in the Department of Electrical Engineering at MIT, from 1973 to 1976. My teaching experience was in the areas of signal processing and acoustics. My research at MIT had been in the area of auditory processing and perception.

6. I am a fellow of the Institute of Electrical and Electronics Engineers (IEEE), the Acoustical Society of America, and the International Speech Communication Association (ISCA). I was the ISCA 2008-2009 Distinguished Lecturer, a recipient of the Allen Newell Award for Research Excellence in 1992, and I served as the General Chair of Interspeech 2006. Interspeech is the world's largest technical conference focused on speech processing and application.

7. Much of my current research is in spoken language systems, where I am particularly concerned with the development of techniques with which automatic speech recognition can be made more robust with respect to changes in environment and acoustical ambience. Among my longstanding work on speech processing are several projects involving speaker identification. Furthermore, as a Professor, I have taught 15 courses, many of which are at the graduate level, in the general areas of signal processing, communication theory, and acoustics.

8. My relevant publications are available on Carnegie Mellon's web site at <http://www.cs.cmu.edu/afs/cs/user/robust/www/papers.html>.

9. I understand a copy of my current curriculum vitae, which lists my publications for the last ten years, is being submitted as Exhibit 1013.

B. Materials Considered

10. In preparing this Declaration, I have considered the following materials:

Exhibit No.	Description
1001	U.S. Patent No. 9,070,374 (“the ’374 patent”)
1003	U.S. Patent No. 7,574,361 (“Yeager”)
1004	U.S. Patent App. Publ. No. 2007/0129022 (“Boillot”)
1005	U.S. Patent App. Publ. No. 2009/0209290 (“Chen”)
1006	U.S. Patent No. 5,963,901 (“Vähätalo”)
1007	U.S. Patent App. Publ. No. 2011/0264447 (“Visser”)
1008	U.S. Patent No. 7,761,106 (“Konchitsky”)
1009	PCT Patent App. Publ. No. WO2011/062703 (“Garra”)
1010	U.S. Patent No. 5,825,897 (“Andrea”)
1011	U.S. Patent App. Publ. No. 2004/0162722 (“Rex”)
1012	Excerpts from the File History of U.S. Patent No. 9,070,374
1014	Excerpt from PHILOS C. LOIZOU, SPEECH ENHANCEMENT, THEORY AND PRACTICE (2007) (“Loizou”)
1015	INTERNATIONAL TELECOMMUNICATION UNION (ITU), RECOMMENDATION G.729 ANNEX B (1996) (“ITU Recommendation”)
1016	Excerpt from INTERNATIONAL TELECOMMUNICATION UNION (ITU), RADIO REGULATIONS (2008) (“ITU Definitions”)

11. I have reviewed the full file history of the '374 patent. I have also relied on my education, training, and experience, and my knowledge of pertinent literature in the field of the '374 patent.

II. APPLICABLE LEGAL STANDARDS

12. I have been asked to provide my opinion as to whether the claims of the '374 patent would have been obvious to a person of ordinary skill in the art at the time of the alleged invention, in view of the prior art.

13. I am an electrical engineer by training and profession. The opinions I am expressing in this report involve the application of my training and technical knowledge and experience to the evaluation of certain prior art with respect to the '374 patent.

14. Although I have been involved as a technical expert in patent matters before, I am not an expert in patent law. Therefore, the attorneys from Knobbe, Martens, Olson & Bear, LLP have provided me with guidance as to the applicable patent law in this matter. The paragraphs below express my understanding of how I must apply current principles related to patent validity to my analysis.

A. Claim Construction

15. It is my understanding that in determining whether a patent claim is obvious in view of the prior art, the Patent Office construes the claim by giving the claim terms their plain and ordinary meaning, as they would have been understood

by a person of ordinary skill in the art at the time of the invention in view of the intrinsic record (patent specification and file history). For the purposes of this review, and to the extent necessary, I have interpreted each claim term in accordance with its plain and ordinary meaning as it would have been understood by a person of ordinary skill in the art at the time of the invention, in view of the intrinsic record. I have been instructed that the time of the invention is February 20, 2012, which I understand to be the earliest claimed priority date of the '374 patent.

16. I understand that a patent and its prosecution history are considered “intrinsic evidence” and are the most important sources for interpreting claim language in a patent. I also understand that in reading the claim, I must not import limitations from the specification into the claim terms; in other words, I must not narrow the scope of the claim terms by implicitly adding disclosed limitations that have no express basis in the claims. The prosecution history of related patents and applications can also be relevant.

17. I understand that sources extrinsic to a patent and its prosecution history (such as dictionary definitions and technical publications) may also be used to help interpret the claim language, but that such extrinsic sources cannot be used to contradict the unambiguous meaning of the claim language that is evident from the intrinsic evidence.

18. Unless expressly stated herein, I have applied the plain and ordinary meaning of the claim terms, which I understand is the meaning that a person of ordinary skill in the art would have given to terms in February 2012 based on a review of the intrinsic evidence.

B. Obviousness

19. It is my understanding that a claim is “obvious” if the claimed subject matter as a whole would have been obvious to a person of ordinary skill in the art at the time of the alleged invention. I understand that an obviousness analysis involves a number of considerations. I understand that the following factors must be evaluated to determine whether a claim would have been obvious: (i) the scope and content of the prior art; (ii) the differences, if any, between each claim of the ’374 patent and the prior art; (iii) the level of ordinary skill in the art in February 2012; and (iv) additional considerations, if any, that indicate that the invention was obvious or not obvious. I understand that these “additional considerations” are often referred to as “secondary considerations” of non-obviousness or obviousness.

20. I also understand that the frame of reference when evaluating obviousness is what a hypothetical person of ordinary skill in the pertinent art would have known in February 2012. I understand that the hypothetical person of ordinary skill is presumed to have knowledge of all pertinent prior art references.

21. It is my understanding that something is “inherent in,” and therefore taught by, the prior art, if it necessarily flows from the explicit disclosure of the prior art. I understand that the fact that a certain result or characteristic *may be* present in the prior art is not sufficient to establish inherency. However, if the result or characteristic is *necessarily* present based upon the explicit disclosure in the prior art, it is inherent in the prior art and is therefore disclosed.

22. I understand that a prior art reference may be a pertinent prior art reference (or “analogous art”) if it is in the same field of endeavor as the patent or if it is pertinent to the problem that the inventors were trying to solve. A reference is reasonably pertinent if it logically would have commended itself to an inventor’s attention in considering the problem at hand. If a reference relates to the same problem as the claimed invention, that supports use of the reference as prior art in an obviousness analysis. Here, all of the references relied on in my obviousness analysis below are in the same field of endeavor as the ’374 patent, e.g., processing and transmission of voice sounds. (E.g., EX-1001 (’374 patent), 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].) The references are also pertinent to a particular problem the inventor was focused on, e.g., enhancing and/or indicating the quality of transmitted voice sounds. (*Id.*)

23. It is my understanding that the law recognizes several rationales for combining references or modifying a reference to show obviousness of claimed subject matter. Some of these rationales include:

- combining prior art elements according to known methods to yield predictable results;
- simple substitution of one known element for another to obtain predictable results;
- a predictable use of prior art elements according to their established functions;
- using known techniques to improve similar devices (methods, or products) in the same way;
- applying a known technique to a known device (method, or product) ready for improvement to yield predictable results;
- choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success (in which case a claim would have been obvious to try);
- known work in one field of endeavor may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations would have been predictable to one of ordinary skill in the art; and

- some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention.

24. I understand that “secondary considerations” must be considered as part of the obviousness analysis when present. I further understand that the secondary considerations may include: (1) a long-felt but unmet need in the prior art that was satisfied by the claimed invention; (2) the failure of others; (3) skepticism by experts; (4) commercial success of a product covered by the patent; (5) unexpected results achieved by the claimed invention; (6) industry praise of the claimed invention; (7) deliberate copying of the invention; and (8) teaching away by others. I also understand that evidence of the independent and nearly simultaneous “invention” of the claimed subject matter by others is a secondary consideration supporting an obviousness determination and may support a conclusion that a claimed invention was within the knowledge of a person of ordinary skill as of February 2012. I am not aware of any evidence of secondary considerations that would suggest that the claims of the ’374 patent would have been nonobvious in February 2012.

25. I understand that when assessing obviousness, using hindsight is impermissible; that is, what is known today or what was learned from the teachings of the patent should not be considered. The patent should not be used as a road map for selecting and combining items of prior art. Rather, obviousness must be considered

from the perspective of a person of ordinary skill at the time the alleged invention was made – February 2012 in this case.

26. I also understand that an obviousness analysis must consider the invention as a whole, as opposed to just a part or element of the invention. I understand this “as a whole” assessment to require showing that one of ordinary skill in the art at the time of invention, confronted by the same problems as the inventor and with no knowledge of the claimed invention, would have selected the elements from the prior art and combined them in the claimed manner.

III. PERSON OF ORDINARY SKILL IN THE ART

27. It is my understanding that when interpreting the claims of the '374 patent and evaluating whether a claim is anticipated or would have been obvious, I must do so based on the perspective of a person of ordinary skill in the art at the relevant priority date. I have been instructed to assume for the purposes of my opinions that the relevant priority date of the '374 patent is February 20, 2012.

28. I understand that in determining the level of ordinary skill in the art, several factors are considered. Those factors may include: (i) the type of problems encountered in the art; (ii) prior art solutions to those problems; (iii) the rapidity with which innovations are made; (iv) the sophistication of the technology; and (v) the educational level of active workers in the field. A person of ordinary skill in the art must have the capability of understanding the scientific and engineering principles

applicable to the pertinent art.

29. Based on my review of the specification and claims of the '374 patent, it is my opinion that a person of ordinary skill in the art 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. Work experience could substitute for formal education and additional formal education could substitute for work experience.

30. My conclusions below that the claims of the '374 patent would have been obvious would remain the same even if the priority date, field of endeavor, or level of ordinary skill were slightly different.

31. I meet the above definition of a person of ordinary skill in the art, and did so as of February 2012. Also, I have worked with persons of ordinary skill in the art through my professional and academic experiences, and I have an understanding of their skill level around February 2012.

IV. TECHNOLOGY BACKGROUND

A. Simplex Communication

32. According to the International Telecommunications Union (ITU), “simplex” communication refers to the communication mode of operation in which information can be transmitted in one direction only, but not in both directions.

(EX-1016 (ITU Definitions), 18.) In other words, such devices take turns transmitting and receiving between each other in a communication channel.

B. Indicating Transmission Mode Using a Light Was Known.

33. By 2012, it was well known to use lights on communication devices to indicate the device's status or communication mode. An example familiar to many of a certain age is the light that would appear on a consumer broadcast receiver in the 1950s and 1960s that would illuminate when it was tuned to an FM station that was broadcasting in stereophonic sound.

34. As another example, Yeager, published in 2009, disclosed a two-way radio (400) that includes an LED (404), a push-to-talk button (406), and a microphone (408):

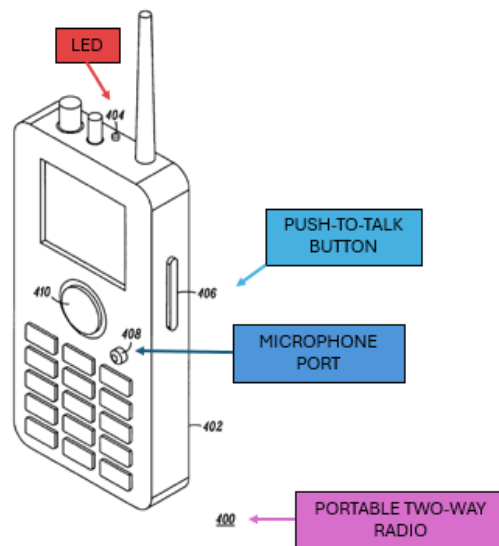
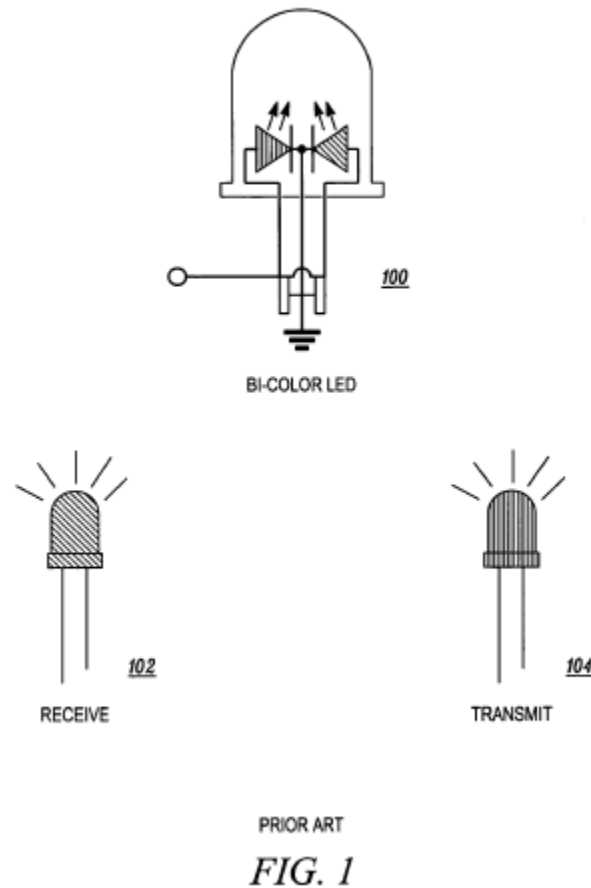


FIG. 4

(EX-1003 (Yeager), Fig. 4¹, 1:43-44, 3:1-11.)

¹ Figures in this Declaration may be colored or otherwise annotated for clarity.

35. Yeager recognized that “[m]ost two-way radios utilize a continuous LED indicator that glows when a carrier signal is being transmitted.” (EX-1003 (Yeager), 1:49-57.) For example, a red light may indicate that the device is in transmit mode and a green light may indicate that the device is in a receive mode. (*Id.*)



(*Id.*, Fig. 1.) 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.)

36. 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. (EX-1003 (Yeager), 1:65-2:5, 2:15-20 (dim LED indicates no or low audio and bright indicates full or loud audio), 2:32-34, 2:50-53, 3:10-11.) Such an LED indicator is “beneficial in the public safety environment, where the likelihood of microphone ports being blocked due to water, mud or other environmental factors is high” as it “gives the user the opportunity to attempt to clear or clean the microphone port area[.]” (*Id.*, 2:54-63.)

37. Figure 2 of Yeager, shown below, discloses a bi-color LED (200) that “varies in intensity relative to the audio modulation level 204, 206, 208 being transmitted through a communication device.”

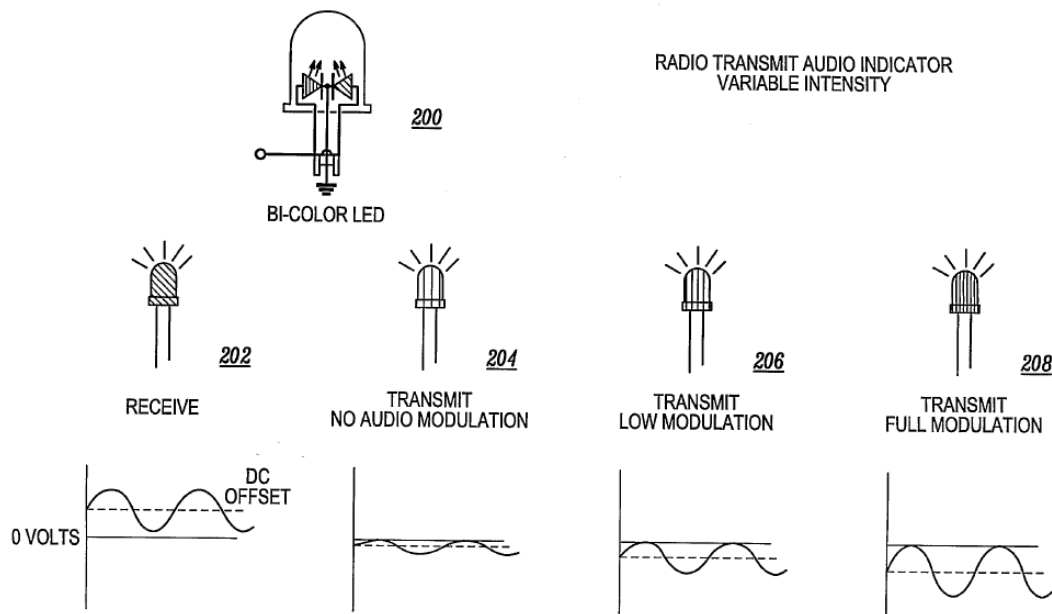


FIG. 2

(EX-1003 (Yeager), Fig. 2, 2:6-30.) The line segments denote variable intensity and hatch patterns denote variation in color/spectrum. (*Id.*, 2:6-8.)

38. Figure 3 of Yeager, shown below, discloses an LED (300) that varies in spectrum 304, 306, 308.

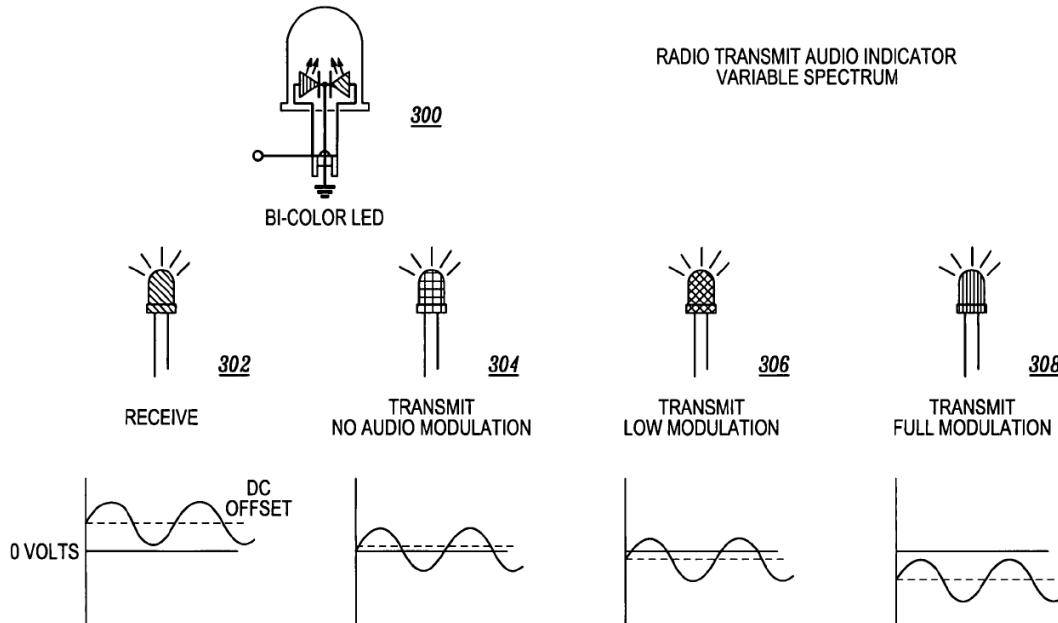


FIG. 3

(EX-1003 (Yeager), Fig. 3, 2:31-47.)

39. Another reference, Boillot, published in 2007, 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 (Boillot) ¶¶[0012]-[0013].) If not, "an indication may be given to the speaker to increase their speaking volume." (*Id.* ¶[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.*)

40. Other references similarly disclosed indicating, via an LED, the transmission mode and/or quality of a speech signal. For example, Rex, published in

2004, disclosed a visual indicator (45), such as a warning light, “which is lit when the speech quality is poor (i.e., below an acceptable threshold level)[.]”)

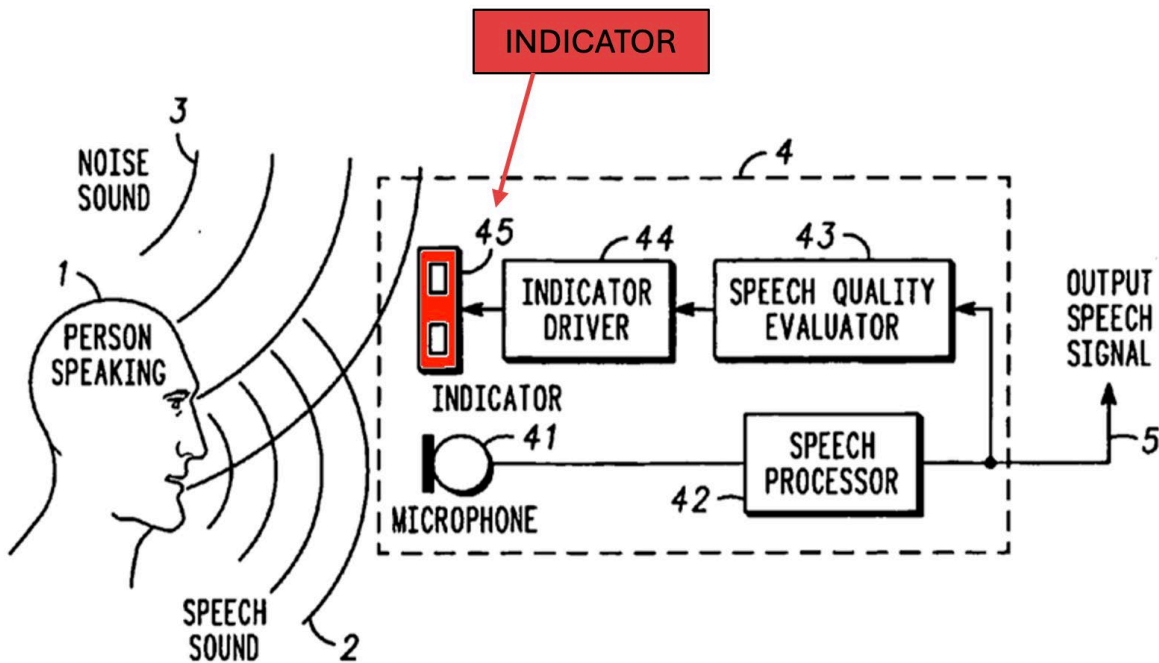
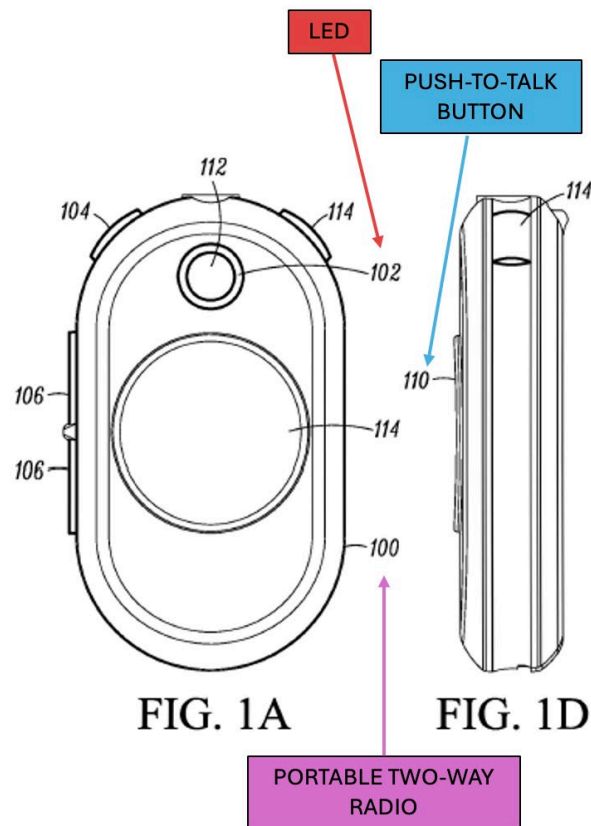


FIG. 1

(EX-1011 (Rex), Fig. 1, ¶¶[0027]-[0028] (a “warning light” is “lit when speech quality is poor”), [0020].)

41. Similarly, Garra, published in 2011, disclosed a portable two-way-radio/communication device (100), shown in Figure 1A and 1D (reproduced below) that has a push-to-talk (PTT) button (110) and an LED (102) to indicate radio status.



(EX-1009 (Garra), Figs. 1A, 1D, Abstract, ¶¶[006], [0015].) Garra disclosed that the LED can be solid, pulsing or blinking, and multicolor. (*Id.*, Figs. 2, 4, ¶¶[0001], [0022], [0024]-[0027].) For example, “a flashing blue LED might indicate a user is currently in the blue channel group. When the user presses the PTT button to transmit, the LED 102 will maintain a solid blue throughout the transmission.” (*Id.*, ¶[0024].)

C. Voice Detection Was Well Known.

42. Detecting the presence or absence of speech in an audio signal is commonly referred to as Voice Activity Detection (“VAD”). For decades, VAD has

been an important part of many areas of speech processing, including speech coding, speech enhancement, and automatic speech recognition. 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. (EX-1015 (ITU Recommendation), 1; *see generally id.*)

43. 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 (Boillot) ¶[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.*)

44. 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 (Visser) ¶[0075] (emphases added).)

D. Speech Quality Evaluation Was Known.

45. 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 (Boillot) ¶¶[0013]-[0014].)

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

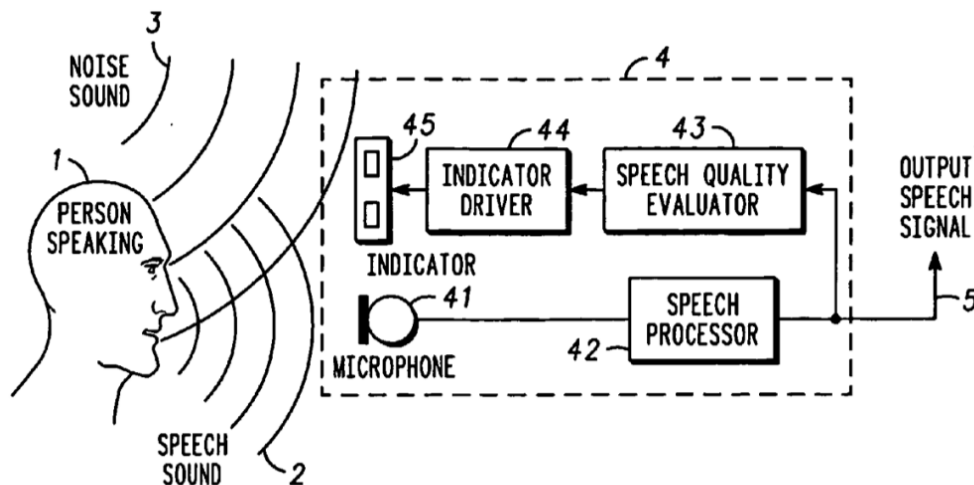


FIG. 1

(EX-1011 (Rex), Fig. 1, ¶¶[0020], [0024]-[0027].)

V. THE '374 PATENT

A. Overview

47. 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:

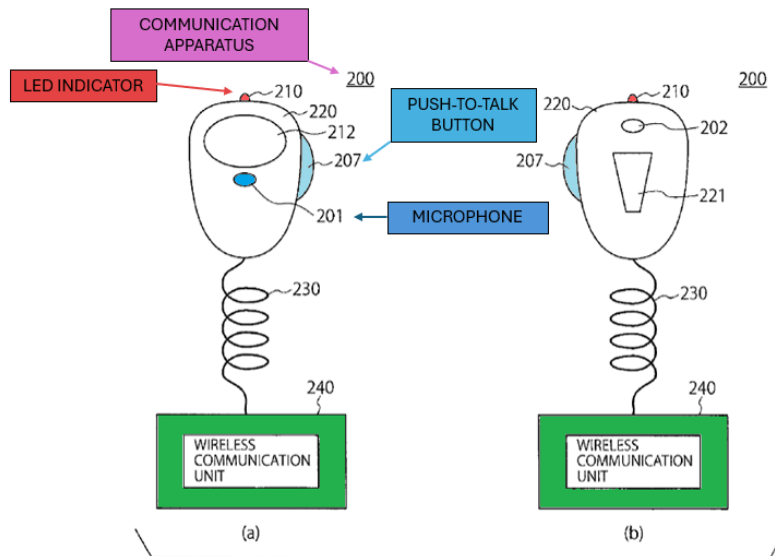


FIG. 3

(EX-1001 ('374 patent), Fig. 3, 6:64-7:9.)

48. The patent states there was a demand for “clear voice sounds” when such devices were used in noisy environments. (EX-1001 ('374 patent), 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.)

49. The device includes an “evaluation unit” that performs two functions: (1) determines whether speech is present; and (2) evaluates the quality of the speech. (EX-1001 ('374 patent), 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.)

B. Claims

50. I have been asked to consider claims 1-15 in this Declaration. Of those, claims 1 and 9 are independent. Claim 9 is representative and recites “[a] communication apparatus comprising” the following elements:

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

- [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;
- [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;
- [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;
- [e] a light emission device configured to emit light;
- [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;
- [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

[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.

VI. CLAIMS 1-15 OF THE '374 PATENT WOULD HAVE BEEN OBVIOUS.

A. Claims 1-3, 5, 8-10, 13, and 15 Would Have Been Obvious in View of Yeager and Boillot.

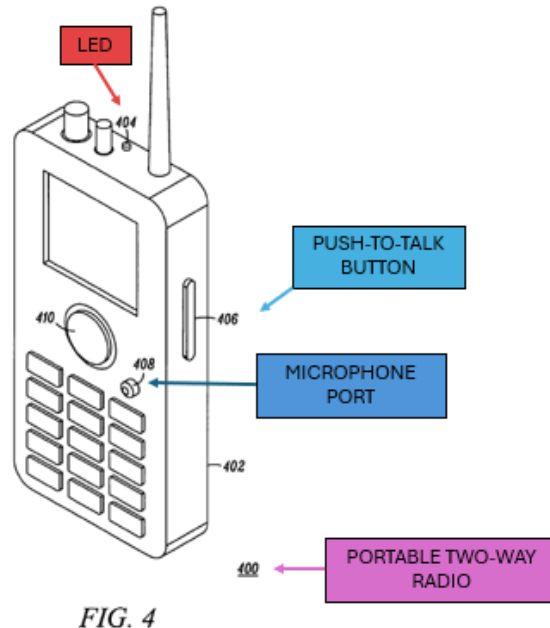
51. For at least the reasons I discuss below, Yeager and Boillot render obvious claims 1-3, 5, 8-10, 13, and 15. I note that independent claims 1 and 9 are similar but recite a method and apparatus, respectively. Because claim 9 is easier to follow, I discuss it and its dependents before claim 1 and its dependents.

1. Claim 9

a. Preamble

52. The preamble of claim 9 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”:



(EX-1003 (Yeager), Fig. 4; *id.*, 1:43-44, 1:52-2:5, 2:20-3:19, 3:48-58, 4:30-36, 4:50-57, Abstract.) Thus, Yeager discloses the preamble of claim 9.

b. 9[a]: First Pick-Up Unit

53. Claim element 9[a] recites “a first pick-up unit configured to pick up a voice sound.” The ’374 patent states that a “pick-up unit” may be a microphone. (EX-1001 (’374 patent), 4:1-11, 5:56-61.) Yeager discloses this claim element because Yeager discloses a microphone port (408) to pick up a voice sound. (EX-1003 (Yeager), Fig. 4, 3:6-8.)

c. 9[b]: Transmitter Unit

54. Claim 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 expressly or inherently discloses this claim element.

55. 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 (Yeager), 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).) 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”).

56. 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. 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.

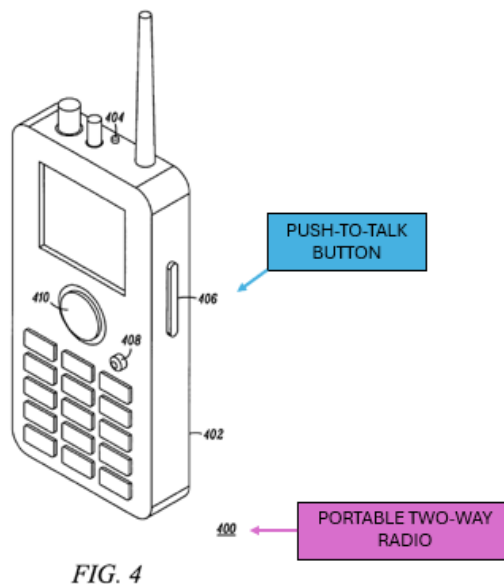
57. Thus, Yeager expressly or inherently discloses this claim element.

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

58. Claim 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.” Yeager discloses this claim element.

59. I note that 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 ('374 patent), 4:37-48, 4:3-5, 4:49-5:5, 6:6-14, 39:24-33.)

60. Yeager discloses the same thing. 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):



(EX-1003 (Yeager), 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”).)

61. 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.

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

62. Claim 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.” Boillot discloses this claim element.

63. I note that other claim elements in claim 9 of the '374 patent 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.

64. This is consistent with the '374 patent's 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 ('374 patent), 19:23-29; *id.*, 20:26-31, 19:27-20:55, Figs. 4, 12-15.) 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

(*Id.*, Fig. 13; 19:27-43, 3:8-10.)

65. Boillot discloses this limitation. First, as I discuss in detail below, Boillot discloses a speech segment determination unit. (See ¶¶110-119, below.) Specifically, Boillot discloses a “vocoder” that determines whether a sound signal includes voice (speech) and outputs a “voicing level parameter.” (EX-1004 (Boillot) ¶[0013].) Second, as I also discuss in detail below, Boillot discloses a speech quality

evaluation unit. (See ¶¶100-108, below.) 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 (Boillot) ¶[0013].) Boillot makes a speech-quality determination (“acceptable” or “poor”) by comparing the voicing quality to a threshold. (*Id.*, Fig. 2, ¶[0014].)

66. Because Boillot discloses both a speech-segment determination unit (e.g., that determines a “voicing level parameter,” *see* ¶¶110-122, below) and a speech-quality evaluation unit (e.g., that determines a “voice quality metric,” *see* ¶¶100-109, 120-122, below), 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).

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

68. A person of ordinary skill in the art 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.

69. 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 (Boillot) ¶[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 person of ordinary skill 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).

70. 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 (Yeager), 1:17-28 (emphases added); *id.*, 1:57-62, 2:59-63.) In view of this, a person of ordinary skill 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.

71. 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). 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). 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).

72. 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 (Yeager), 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.

73. A person of ordinary skill 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.

f. 9[e]: Light Emission Device

74. Claim element 9[e] recites "a light emission device configured to emit light." Yeager and Boillot each disclose this claim element.

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

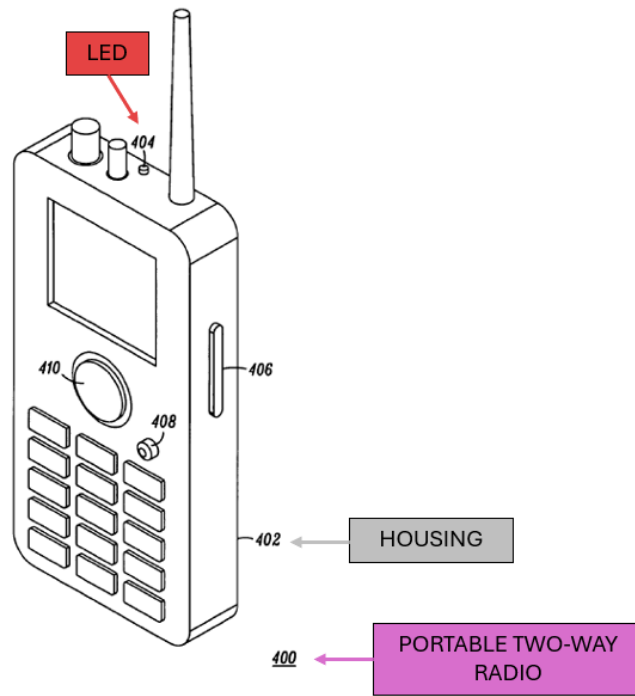


FIG. 4

(EX-1003 (Yeager), Fig. 4, 3:1-4.)

76. Boillot also discloses this limitation because it discloses including “a light source such as an LED[.]” (EX-1004 ¶[0013].)

g. 9[f]: Control Unit

77. Claim 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.” Yeager and Boillot render obvious this claim element.

78. I note that this claim element 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).

79. 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 micro-processor or simple audio circuit. (EX-1003 (Yeager), 2:35-39, 2:48-53, 3:20-25, Figs. 2-3.) Yeager discloses several embodiments that, when combined with Boillot, render this limitation obvious.

80. 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 (Yeager), 1:49-52.) A person of ordinary skill in the art 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.

81. 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 (Yeager), Abstract, 1:65-2:1, 3:1-13.) A person of ordinary skill would have understood that, when Yeager’s device is implemented with a single-color LED, the light would be OFF in the receive mode,

ON in the transmit mode, and its brightness would vary to indicate sound level in the transmit mode. (*Id.*, 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.” (*Id.*, 2:10-20.)

82. 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. (EX-1003 (Yeager), 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 person of ordinary skill 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.

83. 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 (Yeager), 3:26-30.) A person of ordinary skill would have understood that, in that embodiment, a first LED would turn ON (to indicate transmission mode) and OFF (when in 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.

84. I understand the patent owner may argue 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 (Yeager), 1:52-55, 2:9-34) and therefore does not disclose the light turning OFF in receive mode. I disagree. 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.)

85. 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.

86. Boillot discloses a control unit, i.e., “controller 112” that controls “user interface functions[,]” which includes an LED. (EX-1004 (Boillot) ¶¶[0012]-[0013], Fig. 1.) As I discuss above, Boillot discloses determining the pick-up state of the voice sound picked up by the first pick-up unit. (See ¶¶62-73, above.) Boillot discloses that, where it is determined that speech is present but a “voicing quality problem” exists (EX-1004 (Boillot) ¶[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).

87. 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. Yeager and Boillot together disclose and render obvious this limitation in several ways.

88. First, it would have been obvious to a person of ordinary skill to modify Yeager to incorporate Boillot's pick-up state determination unit for the reasons I discuss above for claim element 9[d]. (*See* ¶¶62-73, above.) Modifying Yeager in that manner would result in Yeager's controller controlling the LED to turn OFF when not transmitting. This alone renders this limitation obvious.

89. 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). This also renders this limitation obvious.

90. Third, it would have been obvious to a person of ordinary skill 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.

91. A person of ordinary skill 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 I discuss above—for many reasons.

92. First, as noted above, the blinking LED would enhance user feedback in Yeager 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 (Yeager) ¶[0013].)

93. 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 (Yeager), 1:17-28, *see also id.*, 1:57-62, 2:59-63.)

94. 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 (an LED indicator that blinks to indicate communication mode and speech quality). 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). 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 (an LED that blinks to indicate speech quality).

95. Sixth, Yeager's device, which includes a control unit configured to control the light-emitting device, demonstrates the foundational capability of controlling the 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.

96. 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 ('374 patent), 39:43-50, 39:61-40:2.)

97. Eighth, a person of ordinary skill 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.

98. A person of ordinary skill 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.

99. I understand that PO may argue that this claim element requires the controller to be configured to turn the light-emitting device OFF, ON, *and* repeatedly ON and OFF. In that case, this claim element would have been obvious for the reasons I discuss above for this element and below for claim 13. (See ¶¶77-98, above; ¶¶129-147, below.)

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

100. Claim 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 this claim element.

101. Boillot discloses comparing a voicing level parameter of speech to a background noise parameter to provide “a voicing quality metric” of a speech signal. 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 (Boillot) ¶[0013].) The vocoder encodes the speech and “determines certain coefficients and parameters of the audio signal on a frame by frame bases.” (*Id.*; *see also id.*, Fig. 4, ¶¶[0008], [0024].) As shown, the speech encoded by the vocoder (104) is provided to the transmitter (102) for transmission:

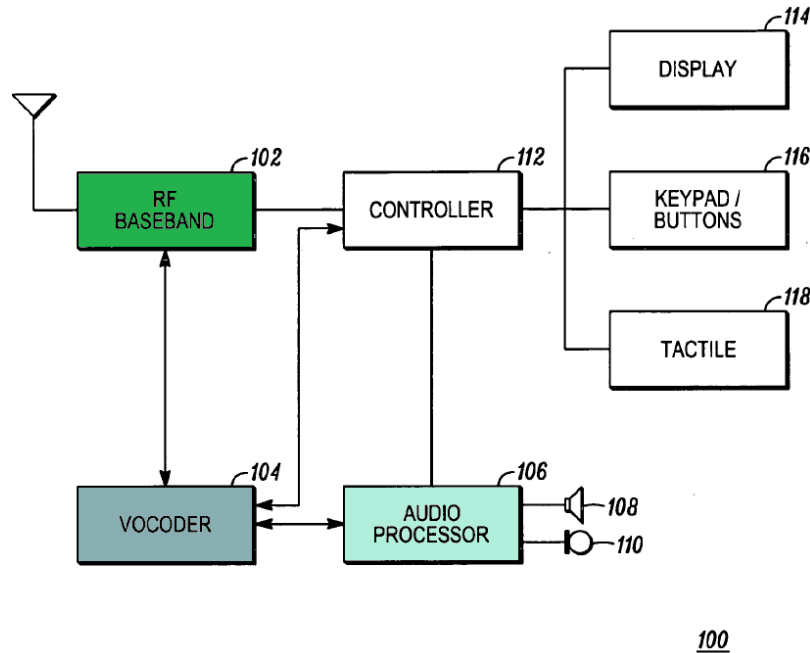


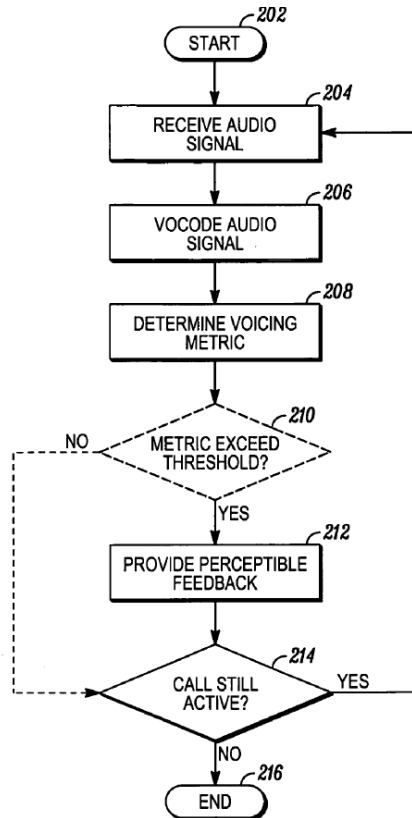
FIG. 1

(*Id.*, Fig. 1, ¶[0003].) “Typically included in the output of the vocoder is a voicing level parameter and a background noise parameter.” (*Id.* ¶[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).)

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



200

FIG. 2

(EX-1004 (Boillot), Fig. 2.) 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).

(*Id.* ¶[0014] (emphases added).)

103. 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).

104. A person of ordinary skill in the art would have been motivated to include Boillot’s “speech-quality evaluation unit” in Yeager’s two-way radio: first, for reasons similar to those I discuss above regarding the motivation to combine Boillot’s “sound-pick up determination unit” with Yeager’s two-way radio. (*See* ¶¶62-73, above.) 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 person of ordinary skill would have been motivated to modify Yeager’s device to have such benefits. (*Id.*)

105. 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 (Yeager), 1:17-28, *id.*, 1:57-62, 2:59-63.) Thus, a person of ordinary skill 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, such as when the microphone is working properly but the speech level is insufficient to overcome ambient noise.

106. 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). 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). 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).

107. Sixth, Yeager's device 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 (Yeager), 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.

108. A person of ordinary skill in the art 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.

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

109. Claim 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 claim element 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 I discuss above. (*See* ¶¶100-108, above.)

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

110. Claim 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 and Boillot disclose or render obvious this claim element.

111. Yeager discloses using a “voice activity detector” in a vocoder to determine whether the signal includes speech. (EX-1003 (Yeager), 2:50-53; *id.*, 3:20-23 (“the transmit-audio feedback can be obtained by voice activity detected in a vocoder in a digital mode of operation”).) Thus, Yeager discloses determining whether the signal includes a speech segment.

112. This claim element also would have been obvious in view of Boillot. Boillot discloses that vocoder 104 encodes the speech and “determines certain coefficients and parameters of the audio signal on a frame by frame basis.” (EX-1004 (Boillot) ¶[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).) Thus, Boillot’s vocoder includes a speech-segment determination unit.

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

114. A person of ordinary skill in the art would have been motivated to include Boillot’s “speech-segment determination unit” in Yeager’s two-way radio for several reasons.

115. 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 (Boillot) ¶[0013].) Thus, a person of ordinary skill 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.

116. Second, a person of ordinary skill 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.

117. 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). 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). 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).

118. Sixth, Yeager discloses that its 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 (Yeager), 2:26-30, 2:49-53.) Extending this functionality to include Boillot’s speech-segment determination would have been a desirable and predictable variation.

119. A person of ordinary skill 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.

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

120. Claim 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 claim element.

121. Boillot discloses this element for the same reasons it discloses claim elements 9[d] and 9[g][i]-9[h][i], as I discuss above. (*See* ¶¶62-73, 100-119, above.) Specifically, Boillot discloses a sound pick-up state determination unit (*see* ¶¶62-73, above) 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* ¶¶110-119, above) 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* ¶¶100-109, above.)

122. Accordingly, for at least the reasons I discuss above, Yeager and Boillot together disclose or render obvious each limitation of claim 9, and therefore render claim 9 obvious as a whole.

2. Claim 10

123. Claim 10 depends from claim 9 and 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.” Yeager and Boillot disclose or render obvious this claim element.

124. As I discuss above for claim 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. (*See* ¶¶77-99, above.) 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 (Yeager), 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).)

125. As I also discuss above for limitation 9[f], 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* ¶¶77-99, above; EX-1004 (Boillot) ¶¶[0013]-[0014].)

126. A person of ordinary skill in the art 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 person of ordinary skill 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 I discuss above. (*See* ¶¶77-99, above.)

127. Controlling the light in the manner required by this claim also would have been obvious to a person of ordinary skill because it reflects a trivial design choice. Indeed, the ’374 patent acknowledges this by stating that the invention is not limited to any specific light indications. (EX-1001 (’374 patent), 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. A person of ordinary skill 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.

128. Accordingly, for at least the reasons I discuss above, Yeager and Boillot together disclose or render obvious each limitation of claim 10, and therefore render claim 10 obvious as a whole.

3. Claim 13

129. Claim 13 depends from claim 9 and further specifies certain conditions for the LED. Yeager and Boillot disclose or render obvious the additional claim elements of claim 13.

a. 13[a][i]: Standby

130. Claim element 13[a][i] recites that “the light-emitting device is turned off if the communication mode is the standby mode.”

131. As I discuss above for claim element 9[f], Yeager discloses, or at least suggests, that the LED would be OFF when in receive (standby) mode. (See ¶¶77-99, above.) For example, a person of ordinary skill in the art 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.*)

132. This limitation also would have been obvious to a person of ordinary skill 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 (Yeager), 1:49-52.) It would have been obvious to a person of ordinary skill that such an LED would be OFF in standby mode, as this was conventional and would avoid confusion.

133. 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 (Yeager),

2:31-46.) It would have been obvious to a person of ordinary skill that the bi-color LED would be OFF in receive (standby) mode because there would be no other option for a bi-color LED.

134. 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. Indeed, a person of ordinary skill 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).

135. 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 (Yeager), 2:1-30.) A person of ordinary skill in the art would have understood from Yeager's disclosure that providing an indication in the receive mode is optional. Thus, it would have been obvious to a person of ordinary skill to modify those embodiments such that the light is turned OFF (rather than switched to green) in the receive mode.

136. A person of ordinary skill would have also had a reasonable expectation of 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.

b. 13[a][ii]-13[a][iii]: Transmit with No or Bad Speech

137. Claim element 13[a][ii] recites that “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.” Claim element 13[a][iii] recites that “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.”

138. 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 (Yeager), 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.)

139. 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 (Boillot) ¶[0014].) Thus, it would have been obvious to a person of ordinary skill in the art 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.”

c. 13[a][iv]: Transmit with Good Speech

140. Claim element 13[a][iv] recites that “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.”

141. As I discuss above, Yeager discloses using a “bright” LED to indicate louder audio transmission, whereas Boillot discloses using a “blinking” LED to indicate poor quality speech. (*See* ¶¶77-99, above.) A person of ordinary skill 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.

142. 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-1001 (’374 patent), 39:43-40:2.)

143. Second, a person of ordinary skill 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.

144. Third, a person of ordinary skill 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.

145. 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). 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). 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).

146. A person of ordinary skill would have reasonably expected success with this modification because it would have been trivial to implement with well-known techniques. 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.

147. Accordingly, for at least the reasons I discuss above, Yeager and Boillot together disclose or render obvious each limitation of claim 13, and therefore render claim 13 obvious as a whole.

4. Claim 15

148. 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." Boillot discloses or renders obvious this claim element.

149. I note that 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 (’374 patent), 7:56-63; *see also id.*, 13:19-24.)

150. 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. (See ¶¶110-119, above.) 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 (Boillot) ¶[0013] (emphasis added).) A person of ordinary skill in the art 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-1014 (Loizou), 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 (Boillot) ¶[0021] (emphasis added).)

151. Accordingly, for at least the reasons I discuss above, Yeager and Boillot together disclose or render obvious each limitation of claim 15, and therefore render claim 15 obvious as a whole.

5. Claim 1

152. Claim 1 is a method claim with limitations corresponding to those in claim 9. For the reasons I discuss above for claim 9, as cross-referenced below, and further in view of 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.

a. Preamble

153. The preamble of claim 1 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.” Yeager discloses this. 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):

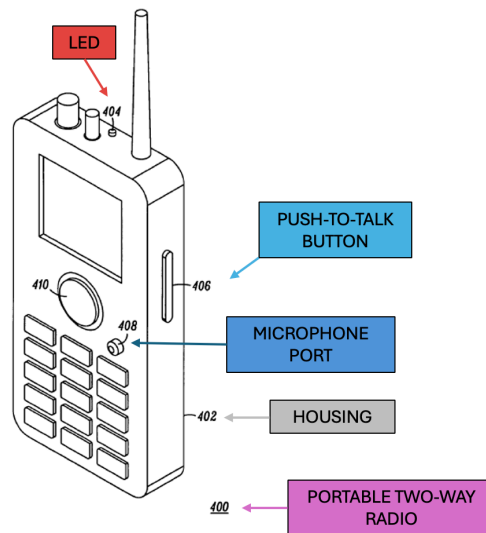


FIG. 4

(EX-1003 (Yeager), Fig. 4, 1:43-44, 3:1-32, 4:6-7, Abstract.)

154. As I discuss above for claim 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). (See ¶¶74-99, 123-128, above; EX-1003 (Yeager), 1:67-2:10, Fig. 2.) Yeager’s radio is a simplex communication apparatus because information is transmitted in either direction, but not simultaneously. (See ¶32, above.) Rather, Yeager’s PTT button (406) switches the two-way radio (400) between a “transmit mode” and a “receive mode” (i.e., standby mode). (See ¶¶58-61, above; EX-1003 (Yeager), 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.)

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

155. Claim 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.” Yeager discloses or renders obvious this claim element.

156. As I discuss above (see ¶¶58-61, above), 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 (Yeager), 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.) Yeager’s device necessarily “determines” the communication mode because it changes the LED

based on the mode. (See ¶¶77-99, above.) 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.

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

157. Claim 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 or render obvious this claim element.

158. As I discuss below, claim element 1[d][ii] states that 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 claim element 1[e][ii] states that in 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.” Thus, the “sound pick-up state determination step” in claim element 1[b] may determine the “pick-up state of a sound carried by a speech signal,” if the communication mode

is in transmission mode, by determining whether speech is present and the speech quality.

159. As I discuss above, 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.” (*See* ¶¶62-73, above.) 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 I also discuss above for claim 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. (*See* ¶¶100-108, 110-119, above.) Similarly, for the reasons I discuss below, because the references disclose or render obvious a speech-segment determination step (*see* ¶¶163-165, below) and a speech-quality evaluation step (*see* ¶¶161, 164-165, below), 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.

d. 1[c]: Control Step

160. Claim 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 claim element for the reasons I discuss above for claim element 9[f]. (See ¶¶77-99, above.)

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

161. Claim element 1[d][i] recites “a speech-quality evaluation step of evaluating speech quality of the speech signal to be transmitted.” Yeager and Boillot disclose or render obvious this claim element for the reasons I discuss above for element 9[g][i]. (See ¶¶100-108, above.)

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

162. Claim 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.” Yeager and Boillot disclose or render obvious this claim element for the reasons I discuss above for elements 1[b], 1[d][i], and 9[g][i]. (See ¶¶157-159, 161, 100-108, above.)

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

163. Claim 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.” Yeager and Boillot disclose or render obvious this claim element for the reasons I discuss above for element 9[h][i]. (See ¶¶110-119, above.)

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

164. Claim 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 I discuss above for elements 1[b], 1[d][i]-1[e][i], 9[d], and 9[g][i]-9[h][ii]. (See ¶¶157-159, 161-163, 62-73, 100-122, above.)

165. Accordingly, for at least the reasons I discuss above, Yeager and Boillot together disclose or render obvious each limitation of claim 1, and therefore render claim 1 obvious as a whole.

6. Claim 2

166. Claim 2 depends from claim 1 and further recites that “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.” I note that this claim recites equivalent limitations to those recited in claim 10. (See ¶123, above.) Thus, Yeager and Boillot disclose or render obvious the additional claim element of claim 2 for the reasons I discuss above for claim 10. (See ¶¶123-128, above.)

167. Accordingly, for at least the reasons I discuss above, Yeager and Boillot together disclose or render obvious each limitation of claim 2, and therefore render claim 2 obvious as a whole.

7. Claim 3

168. 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.” Boillot discloses this claim element because, as I discuss above, it 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 (Boillot) ¶[0013] (emphases added); *see* ¶¶161, 100-108, above.)

169. Accordingly, for at least the reasons I discuss above, Yeager and Boillot together disclose or render obvious each limitation of claim 3, and therefore render claim 3 obvious as a whole.

8. Claim 5

170. 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.” Boillot and Yeager disclose or render obvious this claim element.

171. As I discuss above, 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 ¶¶163, 110-119, above.) As I also discuss above 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 (Boillot) ¶[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.*) Further, 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).

172. I understand the patent owner may argue 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. 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 (Boillot) ¶[0024] (emphasis added).) Thus, a person of ordinary skill in the art 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.

173. Accordingly, for at least the reasons I discuss above, Yeager and Boillot together disclose or render obvious each limitation of claim 5, and therefore render claim 5 obvious as a whole.

9. Claim 8

174. Claim 8 depends from claim 1 and further recites that the speech-segment determination step includes “a frequency conversion step of converting a signal

input from a sound pick-up unit provided for the simplex communication apparatus into a signal component in unit of a specific length in a frequency domain” and “a sound determination step of determining whether the signal input from the sound pick-up unit carries a voice component or a noise component based on a spectrum component of the signal component thus converted into the frequency domain. I note that this claim recites equivalent limitations to those recited in claim 15. (*See* ¶148, above.) Thus, Yeager and Boillot disclose or render obvious the additional claim elements of claim 8 for the reasons I discuss above for claim 15. (*See* ¶¶148-151, above.)

175. Accordingly, for at least the reasons I discuss above, Yeager and Boillot together disclose or render obvious each limitation of claim 8, and therefore render claim 8 obvious as a whole.

B. Claims 4, 7, 11, and 14 Would Have Been Obvious in View of Yeager, Boillot, and Chen.

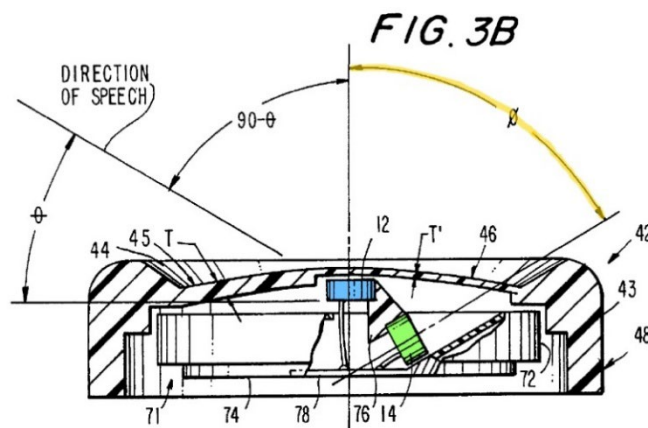
176. Claims 4, 7, 11, and 14 depend, directly or indirectly, from claims 1 or 9. As I discuss above, Yeager and/or Boillot disclose or render obvious each limitation of claims 1 and 9. (*See* ¶¶152-165, 52-122, above.) Claims 4, 7, 11, and 14 would have been obvious in further view of Chen for at least the reasons I discuss below.

177. Claims 4, 7, 11, and 14 add limitations relating to the use of a second microphone for noise cancellation. The use of multiple microphones for this purpose was widely known in the art by 2012, as the '374 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.

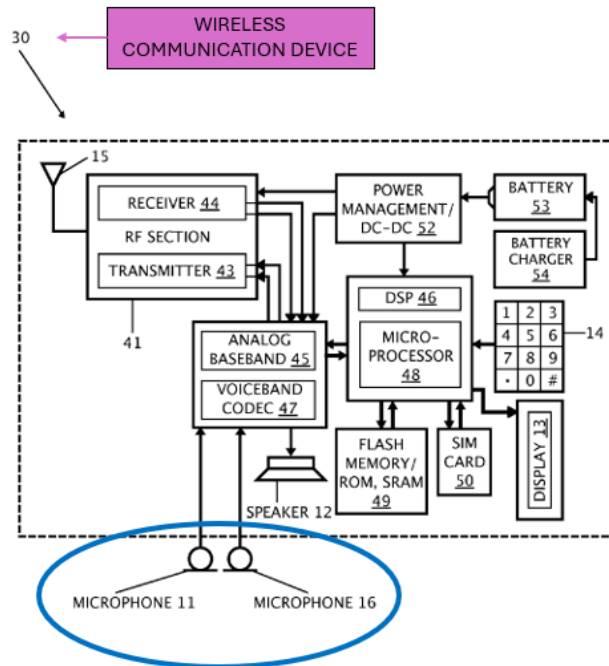
(EX-1001 ('374 patent), 1:29-32.)

178. This 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 (Andrea), 1:19-22.) The handset included “first and second microphones 12 and 14” oriented at an angle (yellow) to each other:



(*Id.*, Figs. 3B, 3A, 12:31-43, 14:5-32.) 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.” (*Id.*, 12:46-64.)

179. In 2010, Konchitsky disclosed a voice coder for a wireless communication device 30 using two microphones in different locations to perform noise cancellation:



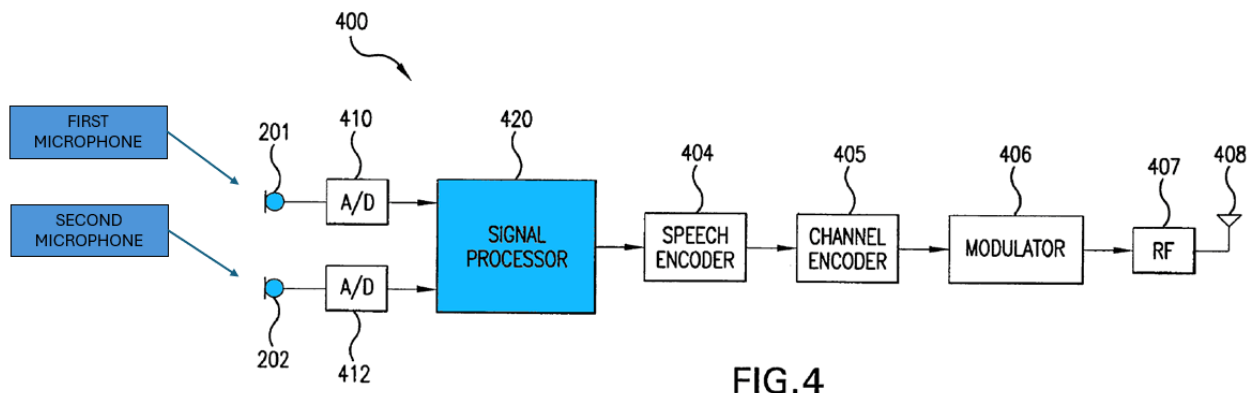
(EX-1008 (Konchitsky), Fig. 3 (excerpt), 1:24-35, 2:9-25, 2:59-62, 5:52-67.) A “noise reduction component utilizes both microphone inputs 11 and 16 to achieve noise reduction before it feeds the noise reduced signal 29 to the voice band codec.” (*Id.*, 6:17-22 (emphasis added); *id.*, Fig. 5(b), 3:1-3.) Cancellation of the noise component of the signal from the first microphone is achieved using the noise component of the signal from the second microphone. (*Id.*, 5:59-67, 6:45-52, 11:23-38 (claim 1); *see also id.*, 8:4-8.)

180. As I discuss below, Chen also disclosed this feature. Thus, as the '374 patent admits and these references demonstrate, the additional limitations of these claims were conventional and known to a person of ordinary skill in the art.

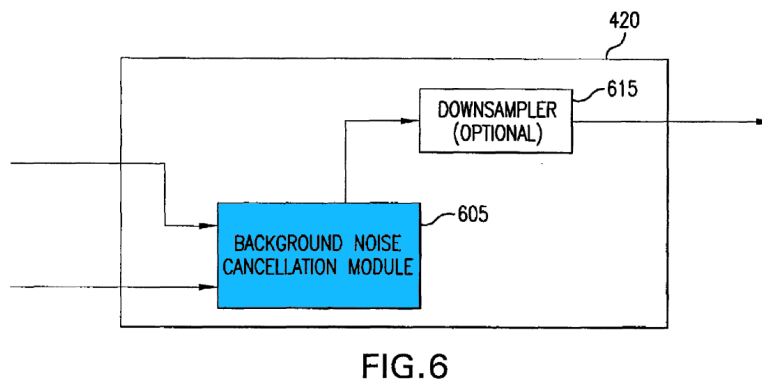
1. Claim 11

181. Claim 11 depends from claim 9 and further recites “a second sound pick-up unit configured to pick up a voice sound,” “a noise cancellation unit configured to perform noise cancellation to the first speech signal input from the first sound pick-up unit by using a second speech signal input from the second sound pick-up unit,” and 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 or renders obvious these additional claim elements.

182. Chen discloses a two-microphone arrangement to perform noise cancellation with a noise cancellation module. (EX-1005 (Chen), Figs. 4, 6, ¶¶[0025], [0055], [0061], [0062].) 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:



(*Id.*, Fig. 4, ¶¶[0025], [0055], [0061], [0062].) Chen’s signal processor 420 “may comprise a background noise cancellation module” 605 (*id.* ¶[0061]) as shown in Chen’s Figure 6:



(*Id.*, 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.)

183. Thus, Chen discloses a second sound pick-up unit and the noise cancellation unit recited in claim 11. 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 I discuss below. Thus, Yeager, Boillot, and Chen together disclose and render obvious every limitation of claim 11.

184. A person of ordinary skill 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.

185. 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 (Chen) ¶¶[0006]-[0011].) Chen teaches that this approach "increas[es] the ratio of the voice component to background noise component." (*Id.* ¶[0017].) A person of ordinary skill would have understood that increasing the signal-to-noise ratio (SNR) improves the quality of the transmitted signal.

186. Second, Yeager discloses that it is desirable to improve the quality of speech transmission. (EX-1003 (Yeager), 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.").)

In view of this disclosure, a person of ordinary skill would have been motivated to include Chen’s two-microphone arrangement and noise cancellation module to improve the quality of speech transmission.

187. 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 (Boillot) ¶[0003].) Consequently, a person of ordinary skill would have been motivated to include Chen’s two-microphone arrangement and “noise reduction component” to reduce noise and improve the voice coding process.

188. 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). 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). 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).

189. A person of ordinary skill 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.

190. A person of ordinary skill would have had a reasonable expectation of success in this proposed modification because it would have been easy to implement with well-known techniques. (*See* EX-1012 ('374 patent file history), 55 (Examiner noting that “noise cancellation can be easily implemented”).)

191. Accordingly, for at least the reasons I discuss above, Yeager, Boillot, and Chen together disclose or render obvious each limitation of claim 11, and therefore render claim 11 obvious as a whole.

2. Claim 4

192. Claim 4 depends from claim 1 and further recites “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.” I note that this claim recites equivalent limitations to those recited in claim 11. (*See* ¶181, above.) Thus, Yeager,

Boillot, and Chen disclose or render obvious the additional claim element of claim 4 for the reasons I discuss above for claim 11. (See ¶¶181-191, above.)

193. Accordingly, for at least the reasons I discuss above, Yeager, Boillot, and Chen together disclose or render obvious each limitation of claim 4, and therefore render claim 4 obvious as a whole.

3. Claim 7

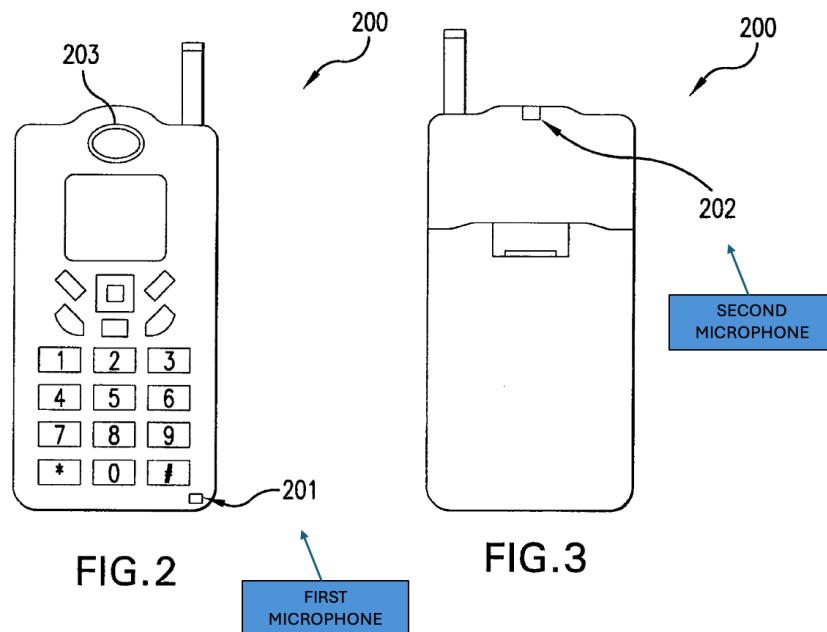
194. Claim 7 depends from claim 4 and further recites that “in the control step, the light-emitting device is turned off if the communication mode is the standby mode, the light-emitting device is turned on if the communication mode is the transmission mode and if the speech signal to be transmitted 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.” I note that this claim recites equivalent limitations to those recited in claim 13. (See ¶¶129-147, above.) Thus, Yeager and Boillot disclose or render obvious the additional claim elements of claim 7 for the reasons I discuss above for claim 13. (*Id.*)

195. Accordingly, for at least the reasons I discuss above, Yeager, Boillot, and Chen together disclose or render obvious each limitation of claim 7, and therefore render claim 7 obvious as a whole.

4. Claim 14

196. 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 the main microphone and the sub-microphone are arranged at a front face and a rear face of the communication apparatus, respectively.” Chen discloses or renders obvious the additional claim element of claim 14.

197. 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:



(EX-1005 (Chen), 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).)

198. Accordingly, for at least the reasons I discuss above, Yeager, Boillot, and Chen together disclose or render obvious each limitation of claim 14, and therefore render claim 14 obvious as a whole.

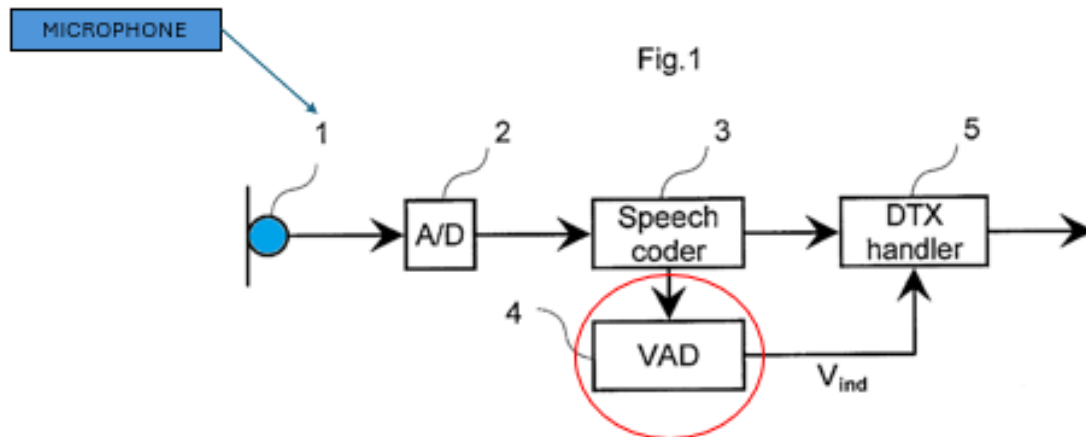
C. Claims 8 and 15 Would Have Been Obvious in View of Yeager, Boillot, and Vähätalo.

199. As I discuss above, Yeager and/or Boillot disclose or render obvious each limitation of claims 8 and 15. (*See* ¶¶174-175, 148-151, above.) Those claims would also have been obvious in further view of Vähätalo for at least the reasons I discuss below.

1. Claim 15

200. 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

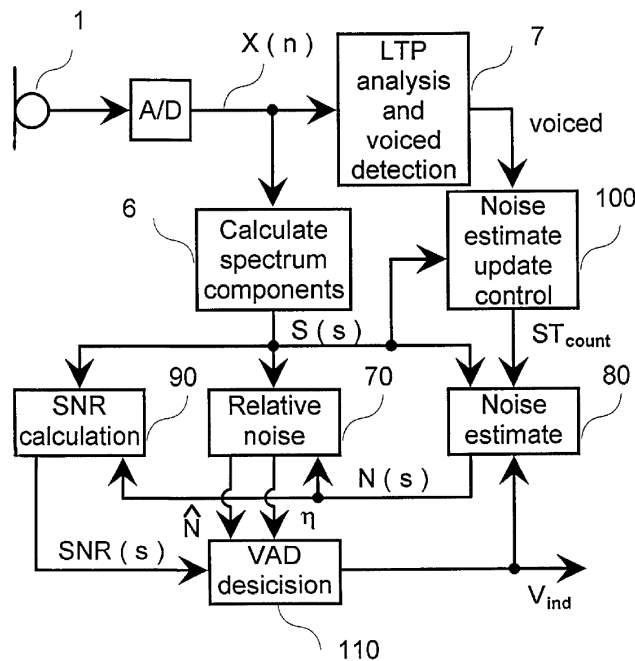
the frequency domain.” Vähätalo discloses this claim element. Vähätalo discloses a voice activity detection device 4:



(EX-1006 (Vähätalo), Fig. 1; 2:21-22, 2:50-52.) 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.” (*Id.*, 2:56-61.) Vähätalo explains that the VAD device 4 “can use the same input frame length as the speech codec 3[.]” (*Id.*, 2:66-3:1.)

201. Vähätalo explains operation of the VAD device with reference to Figure 2, reproduced below. (EX-1006 (Vähätalo), Fig. 2; 2:23-24, 3:6-26.) 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



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

202. 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.

203. A person of ordinary skill in the art would have been motivated to include Vähätalo’s speech segment detection into Yeager’s radio (as modified by Boillot) for several reasons.

204. First, Vähätalo discloses that its frequency-based VAD provides a “more accurate and reliable voice activity detection decision.” (EX-1006 (Vähätalo), 1:58-64.) A person of ordinary skill 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.

205. 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). 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. 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).

206. Fifth, Boillot’s device includes a vocoder that detects speech segments, demonstrating the foundational capability of detecting speech segments. (EX-1004

(Boillot), ¶¶[0011]-[0013], Fig. 1.) A person of ordinary skill 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.

207. A person of ordinary skill 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.

208. Accordingly, for at least the reasons I discuss above, Yeager, Boillot, and Vähätalo together disclose or render obvious each limitation of claim 15, and therefore render claim 15 obvious as a whole.

2. Claim 8

209. Claim 8 depends from claim 1 and further recites that the speech-segment determination step includes “a frequency conversion step of converting a signal input from a sound pick-up unit provided for the simplex communication apparatus into a signal component in unit of a specific length in a frequency domain” and “a sound determination step of determining whether the signal input from the sound pick-up unit carries a voice component or a noise component based on a spectrum component of the signal component thus converted into the frequency domain. I

note that this claim recites equivalent limitations to those recited in claim 15. (*See* ¶200, above.) Thus, Yeager, Boillot, and Vähätalo disclose or render obvious the additional claim elements of claim 8 for the reasons I discuss above for claim 15. (*See* ¶¶200-208, above.)

210. Accordingly, for at least the reasons I discuss above, Yeager, Boillot, and Vähätalo together disclose or render obvious each limitation of claim 8, and therefore render claim 8 obvious as a whole.

D. Claim 12 Would Have Been Obvious in View of Yeager, Boillot, Chen, and Visser.

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.” As I discuss above, Yeager, Boillot, and/or Chen disclose or render obvious each limitation of claim 11. (*See* ¶¶181-191, above.) Claim 12 would have been obvious in further view of Visser for at least the reasons I discuss below.

212. 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”:

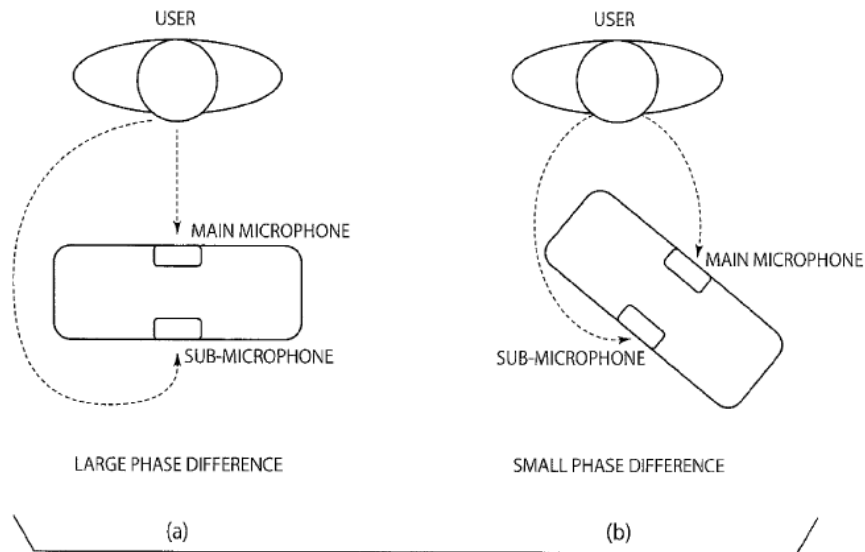
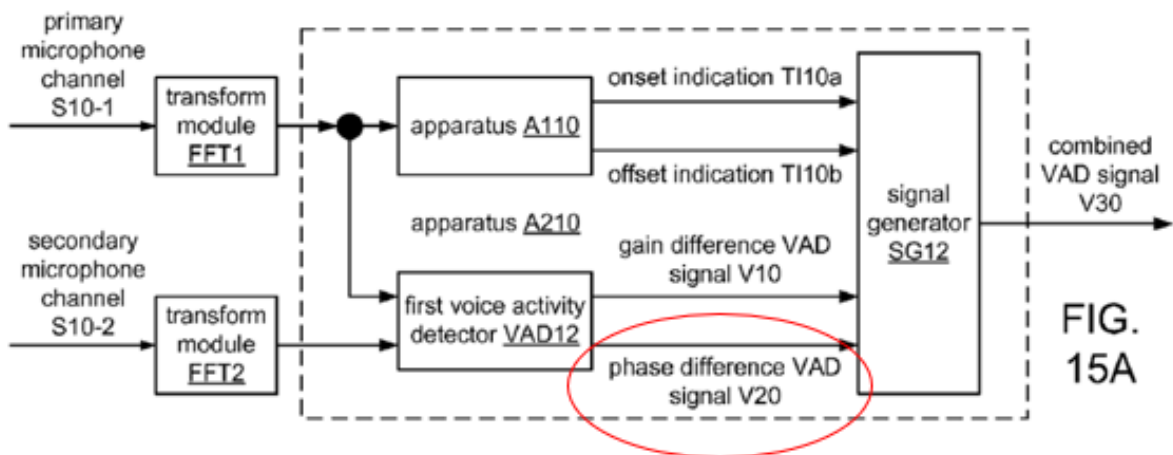


FIG. 8

(EX-1001 ('374 patent), Fig. 8, 13:42-14:14.) 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[.]” (*Id.*, 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. (*Id.*, 13:64-14:9, 14:36-53, Fig. 9.) When the phase difference is equal to or larger than the threshold, it assumes the positional relationship is bad. (*Id.*, 14:9-14, 14:54-60.) 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. (*Id.*, 5:66-6:5, 14:61-67, 16:45-60, Figs. 9, 11.)

213. 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”):



(EX-1007 (Visser), 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].)

214. 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 (Visser) ¶¶[0169]-[0170] (emphases added).) 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.

215. It would have been obvious to a person of ordinary skill in the art 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.

216. 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 (Yeager), 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 (Visser) ¶[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 (Boillot) ¶[0004].) In view of these disclosures, a person of ordinary skill 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.

217. 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). 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). 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).

218. 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 (Boillot) ¶[0013].) A person of ordinary skill 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.

219. A person of ordinary skill 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.

E. Claims 5 and 6 Would Have Been Obvious in View of Yeager, Boillot, and Visser.

1. Claim 6

220. Claim 6 depends from claim 1 and further recites “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.” I note that this claim recites equivalent limitations to the additional limitations recited in claim 12. (*See* ¶211, above.) However, claim 6 does not include limitations equivalent to those recited in claim 11, from which claim 12 depends (e.g., noise cancellation using two microphones). Thus, Yeager, Boillot, and Visser disclose or render obvious the additional claim elements of claim 6 for the reasons I discuss above for claim 12 (apart from any discussion regarding Chen). (*See* ¶¶211-219, above.)

221. I note that 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 I discuss above. (*See* ¶213, above.) A person of ordinary skill in the art would have reasonably expected success in adding a second microphone to the combination of Yeager and Boillot. Doing so would have been trivial, as is demonstrated by the ubiquity of communication devices having multiple microphones.

222. Accordingly, for at least the reasons I discuss above, Yeager, Boillot, and Visser together disclose or render obvious each limitation of claim 6, and therefore render claim 6 obvious as a whole.

2. Claim 5

223. As I discuss above, Yeager and/or Boillot disclose or render obvious each limitation of claim 5. (*See* ¶¶170-173, above.) Claim 5 would also have been obvious in further view of Visser for at least the reasons I discuss below.

224. 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.”

225. I note that the '374 patent discloses an embodiment wherein “while the speech-segment determination unit is determining that the first speech signal input from the microphone is a speech segment, the microphone-direction determination unit detects the direction of the main microphone ... based on the phase difference.” (EX-1001 ('374 patent), 13:29-38.) The microphone detection unit outputs the determination result to the speech-quality evaluation unit, which uses the information to determine whether speech quality is good or bad. (*Id.*, 5:66-6:5, 14:61-67, 16:45-60; Figs. 9, 11.)

226. 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. Specifically, as I discuss 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* ¶¶211-219, above; EX-1007 (Visser), Fig. 15A, ¶¶[0128], [0169]-[0170].)

227. 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 I discuss above for claim 12 (not including reliance on Chen). (*See* ¶¶211-219, above.) 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 (Boillot) ¶[0024].) Moreover, as in claim 6, a person of ordinary skill would have reasonably expected success in adding a second microphone (disclosed in Visser) to the combination of Yeager and Boillot. Doing so would have been trivial, as is demonstrated by the ubiquity of communication devices having multiple microphones.

228. Accordingly, for at least the reasons I discuss above, Yeager, Boillot, and Visser together disclose or render obvious each limitation of claim 5, and therefore render claim 5 obvious as a whole.

VII. SECONDARY CONSIDERATIONS OF NONOBVIOUSNESS

229. I am not aware of any secondary considerations of nonobviousness. If the patent owner identifies any alleged evidence of secondary considerations in the future, I reserve the right to respond to that information.

VIII. CONCLUSION

230. For the foregoing reasons, it is my opinion that claims 1-15 of the '374 patent would have been obvious to a person of ordinary skill in the art at the time of the alleged invention in view of the prior art discussed above.

231. I reserve the right to supplement my opinions in the future to address or respond to any issues that the patent owner may raise, as well as new information

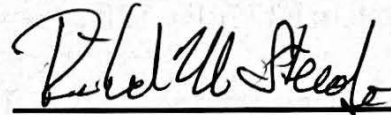
Amazon.com, Inc. v. SoundClear Technologies LLC
Declaration of Richard Stern, Ph.D. – Patent 9,070,374

including, but not limited to, any claim constructions advanced by the patent owner or adopted by the Board in the Institution Decision, and respond to any alleged secondary considerations as they become available to me.

Amazon.com, Inc. v. SoundClear Technologies LLC
Declaration of Richard Stern, Ph.D. – Patent 9,070,374

I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Executed on 5/28/25 at Pittsburgh, PA.


Richard Stern, Ph.D.