

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD., SAMSUNG ELECTRONICS,
AMERICA, INC., and HARMAN INTERNATIONAL INDUSTRIES, INC.

Petitioners

v.

STATON TECHIYA, LLC,

Patent Owner

Case IPR2024-01031

U.S. Patent No. 11,659,315

**DECLARATION OF NATAHANIEL POLISH, PH.D. IN SUPPORT
OF PETITION FOR INTER PARTES REVIEW
OF U.S. PATENT NO. 11,659,315**

Samsung et al. v. Techiya IPR2024-01031 Exhibit 1002
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I, Nathaniel Polish declare that:

I. ASSIGNMENT

1. I have been retained on behalf of Samsung Electronics Co., Ltd. and Samsung Electronics America, Inc. (together “Samsung”) to offer technical opinions related to U.S. Patent No. 11,659,315 (“the ’315 patent”) (EX1001¹). I understand that Samsung is requesting that the Patent Trial and Appeal Board (“PTAB” or “Board”) institute an *inter partes* review (“IPR”) proceeding of the ’315 patent.

2. I have been asked to provide my independent analysis of the ’315 patent based on the prior art publications cited in this declaration.

3. I am not and never have been, an employee of Samsung or Harman. I received no compensation for this declaration beyond my normal hourly compensation based on my time actually spent analyzing the ’315 patent, the prior art publications cited below, and issues related thereto, and I will not receive any added compensation based on the outcome of any IPR or other proceeding involving the ’315 patent.

¹ Where appropriate, I refer to exhibits I understand will be attached to the petition for inter partes review of the ’315 patent (the “Petition”).

II. QUALIFICATIONS

4. I am over the age of 18 and am competent to write this declaration. I have personal knowledge, or have developed knowledge, of these technologies based upon education, training, or experience of the matters set forth herein.

5. I am an independent consultant. All of my opinions stated in this declaration are based on my own personal knowledge and professional judgment. In forming my opinions, I have relied on my knowledge and experience in acoustics, signal processing, design of headsets and sound production equipment, and representations of acoustic sounds.

6. A copy of my current curriculum vitae, which details my education and professional and academic experience, is included as Ex. 1003 in this proceeding. The following provides an overview of some of my experience that is relevant to the matters set forth in this declaration.

7. I have a Ph.D. in Computer Science from Columbia University. In fact, I hold the following four degrees from Columbia, spanning the years 1980 to 1993:

- Ph.D. in Computer Science, May 1993, Thesis: Mixed Distance Measures for the Optimization of Concatenative Vocabularies in Speech Synthesis;
- M.Phil. in Computer Science, December 1989;
- M.S. in Computer Science, December 1987; and

- B.A. in Physics, Columbia College, May 1984.

8. For over thirty years, I have run a computer technology development firm that I co-founded, called Daedalus Technology Group. My primary business activity is the development of computer-related products. This activity involves understanding the business objectives of customers, designing products to suit their needs, and supervising the building, testing, and deployment of these products. I develop hardware and software as well as supervise others who do so.

9. Also, from time to time I found other companies in order to pursue particular product opportunities. I develop and ultimately sell these companies. Most of my business activity, however, is as a consulting product developer. From time to time I have also served as an expert witness on computer and software related cases. I am a named inventor on eight United States patents and am a member of several professional societies, including the IEEE and ACM.

10. I have extensive experience in several areas relevant to this case. My doctoral work was in the area of computer speech. As part of that work I developed signal processing systems and algorithms to filter and manipulate sound, especially speech. That work gave me strong practical insight into such topics as voice activity detection, digital mixing of audio and speech, as well as the general problems of digital filtering of speech signals.

11. Much of my professional work over the past thirty years has been as a computer technology product developer. Several of those products involved technologies closely related to the topics in the patent at issue in the current matter, including digital audio systems and associated signal processing. One product in particular was for a company called HeadGear in the later 1990s. That product involved developing a set of headphones that mixed ambient music from an outdoor concert with wirelessly delivered audio content. Under my supervision, the firm developed prototype versions of this product.

12. In addition to this work for HeadGear, the firm also designed and developed, under my supervision, a number of products or systems for delivering digital audio and performing associated signal processing. Between 1982-1991, the firm designed and built, under my supervision, all parts of four generations of interactive voice editing systems for The Dun & Bradstreet Corporation. These editing systems produced output used in an extensive, high quality speech synthesis system that was part of a larger information delivery system. The systems were built on networks of computers in a variety of programming languages and systems. The systems involved interactive user interfaces, screen windows, signal processing, and voice file systems.

13. Between 1995-1997, the firm also designed and developed, under my supervision, a series of products to deliver digital video and audio materials

over wide-area internet using consumer grade computers. These products were developed for Instant Video Technologies, Inc. and designed to fit within their existing patent portfolio. There were also new aspects of the technology that resulted in a new patent for the company.

14. In 2000, I also supervised the development, design, and deployment of an industrial strength interactive voice response (IVR) system that allows users to access streaming media via their cell phones. This system supported up to 96 streams on a single chassis and was designed for a company called Savos. Under my supervision, the firm developed for this system the web-based content management system and interface for customizable user preferences.

15. In addition to the products and systems described above, I have also developed many other systems that utilize various signal processing techniques, including both speech recognition and speech synthesis. In the late 1990s, I started a company named Soliloquy to commercialize my technology in the area of speech access to databases. That work resulted in a patent. I have also developed a number of systems that use speech recognition to control system functions. One of the more amusing systems that I developed for a client was a talking golf club.

16. Through these and other experiences, I am very familiar with the technologies at issue in this matter.

III. SUMMARY OF CONCLUSIONS FORMED

17. This Declaration explains the conclusions that I have formed based on my analysis. To summarize those conclusions:

- Ground 1A: *Doclo* and *Beasley* render obvious claims 1-3
- Ground 1B: *Doclo*, *Beasley*, and *Goldstein* render obvious claims 4-8
- Ground 1C: *Doclo*, *Beasley*, and *Darbut* render obvious claims 1-3
- Ground 1D: *Doclo*, *Beasley*, *Darbut*, and *Goldstein* render obvious claims 4-8
- Ground 2A: *Asada* renders obvious claims 1-5 and 8
- Ground 2B: *Asada* and *Goldstein* render obvious claims 4-7
- Ground 2C: *Asada* and *Usher* render obvious claims 1-5 and 8
- Ground 2D: *Asada*, *Usher*, and *Goldstein* render obvious claims 4-7

IV. LEVEL OF ORDINARY SKILL IN THE ART

18. I have been informed by Petitioners' counsel that a person having ordinary skill in the art ("POSITA") is a hypothetical person who is presumed to have the skill and experience of an ordinary worker in the field at the time of the priority date of the challenged patent. With respect to Grounds 1A-1D, I have been asked to assume that the priority date is December 17, 2012. With respect to Grounds 2A-2D, I have been asked to assume that the priority date is no

earlier than March 24, 2021. In my opinion, the level of ordinary skill in the art is the same whether the priority date is December 17, 2012, or March 24, 2021.

19. Based on my knowledge and experience in the field and my review of the '315 patent and file history, I believe that a person having ordinary skill in the art in this matter would have had a Bachelor's of Science degree (or equivalent) in electrical engineering, computer science, or a similar field and two years of experience in the design of digital audio systems and associated signal processing such as voice and or speech processing and/or acoustic pattern recognition. A person having ordinary skill in the art could have also obtained similar knowledge and experience through other means.

20. Based on my experiences, I have at least the skills of a person having ordinary skill in the art as well as a good understanding of the capabilities of a person having ordinary skill in the art. To be clear, all of my opinions in this declaration are from the perspective of one of ordinary skill in the art as I have defined it here during the relevant timeframe.

V. LEGAL PRINCIPLES

21. I am not an attorney and offer no legal opinions, but in the course of my work, I have had experience studying and analyzing patents and patent claims from the perspective of a person skilled in the art.

22. For the purposes of this declaration, I have been informed about certain aspects of the law that are relevant to forming my opinions. My understanding of the law is as follows.

23. Petitioners' counsel has informed me that for the prior art to inherently disclose a claimed limitation, the prior art need not expressly disclose the limitation, so long as the claimed limitation necessarily flows from a disclosure in the prior art. I also understand that it is acceptable to examine evidence outside the prior art reference (extrinsic evidence) in determining whether a feature, while not expressly discussed in the reference, is necessarily present in that reference.

24. Petitioners' counsel has informed me that a patent claim can be considered to have been obvious to a person having ordinary skill in the art at the time the application was filed. I am informed that this means that, even if all of the requirements of a claim are not found in a single prior art reference, the claim is not patentable if the differences between the subject matter in the prior art and the subject matter in the claim would have been obvious to a person having ordinary skill in the art at the time of the invention.

25. I have been informed by Petitioners' counsel that a determination of whether a claim would have been obvious should be based upon several factors, including, among others:

- the level of ordinary skill in the art at the time the application was filed;
- the scope and content of the prior art; and
- what differences, if any, existed between the claimed invention and the prior art.

26. I have been informed by Petitioners' counsel that a single reference can render a patent claim obvious if any differences between that reference and the claims would have been obvious to a person having ordinary skill in the art. Alternatively, I understand that the teachings of two or more references may be combined in the same way as disclosed in the claims, if such a combination would have been obvious to one having ordinary skill in the art. In determining whether a combination based on either a single reference or multiple references would have been obvious, it is appropriate to consider, among other factors:

- whether the teachings of the prior art references disclose known concepts combined in familiar ways, and when combined, would yield predictable results;
- whether a person having ordinary skill in the art could implement a predictable variation, and would see the benefit of doing so;
- whether the claimed elements represent one of a limited number of known design choices, and would have a reasonable expectation of success by those skilled in the art;

- whether a person having ordinary skill would have recognized a reason to combine known elements in the manner described in the claim;
- whether there is some teaching or suggestion in the prior art to make the modification or combination of elements claimed in the patent; and
- whether the innovation applies a known technique that had been used to improve a similar device or method in a similar way.

27. I have been informed by Petitioners' counsel that one of ordinary skill in the art has ordinary creativity and is not an automaton. Petitioners' counsel has also informed me that in considering obviousness, obviousness may not be determined using the benefit of hindsight, including hindsight derived from the patent being considered.

28. I further understand that a hypothetical person having ordinary skill in the art is assumed to know and to have all relevant prior art in the field of endeavor covered by the patent at issue. I have been informed that there are two criteria for determining whether prior art is analogous and thus can be considered prior art: (1) whether the art is from the same field of endeavor, regardless of the problem addressed, and (2) if the reference is not within the field of the patentee's endeavor, whether the reference still is reasonably pertinent to the particular problem with which the patentee is involved. I have also been informed that the field of endeavor of a patent is not limited to the

specific point of novelty, the narrowest possible conception of the field, or the particular focus within a given field. I have also been informed that a reference is reasonably pertinent if, even though it may be in a different field from that of the patentee's endeavor, it is one which, because of the matter with which it deals, logically would have commended itself to a patentee's attention in considering their problem.

29. I further understand that, in making a determination as to whether the claimed invention would have been obvious to a person having ordinary skill, the Board may consider certain objective factors if they are present, such as: commercial success of products practicing the claimed invention; long-felt but unsolved need; teaching away; unexpected results; copying; and praise by others in the field. These factors are generally referred to as "secondary considerations" or "objective indicia" of nonobviousness. I understand, however, that for such objective evidence to be relevant to the obviousness of a claim, there must be a causal relationship (called a "nexus") between the claim and the evidence and that this nexus must be based on a novel element of the claim rather than something in the prior art. I also understand that even when they are present, secondary considerations may be unable to overcome primary evidence of obviousness (such as motivation to combine with predictable results) that is sufficiently strong.

30. I have been informed by Petitioners' counsel that for a patent claim in a later-filed application to be entitled to the priority date of an earlier-filed application, the specification of the earlier-filed application must adequately support the patent claim of the later-filed application. This means that the specification of the earlier-filed application must provide an adequate written description of the invention claimed in the later-filed application.

31. I have been informed by Petitioners' counsel that the written description requirement is met if the applicant conveys in the specification with reasonable clarity to those skilled in the art that he or she possessed the claimed invention as of the filing date of the application. An applicant shows that one is "in possession" of the invention by describing the invention, with all its claimed limitations, not merely that which makes it obvious. A description that merely renders the later-filed claim obvious is not sufficient. One may satisfy the written description requirement with words, structures, figures, diagrams, and/or formulas that fully set forth the claimed invention. Although the exact terms of the claim need not be recited verbatim in the specification, the specification must contain an equivalent description of the claimed subject matter.

32. I am also informed that the failure to include in the written description aspects of the claimed invention that would be routinely known and understood by one of ordinary skill in the art when the application was filed will

not be fatal to the validity of the claim if such aspects are inherent to what was disclosed. To be inherent, the missing descriptive matter must necessarily be present in the specification such that one skilled in the art would recognize such a disclosure.

VI. MATERIALS CONSIDERED

33. My analysis and conclusions set forth in this declaration are based on my educational background and experiences in the field (see Section II). Based on my knowledge and experience, I believe that I am considered to be an expert in the field. Also, based on my knowledge and experience, I understand and know of the capabilities of persons of ordinary skill in the field since the 1990s, and I mentored, participated in organizations, and worked closely with many such persons in the field during that time frame.

34. As part of my independent analysis for this declaration, I have considered the following: the background knowledge/technologies that were commonly known to persons of ordinary skill in this art during the time before the earliest claimed priority date for the '315 patent; my own knowledge and experiences gained from my work experience in the field of the '315 patent and related disciplines; and my experience in working with others involved in this field and related disciplines.

35. In addition, I have analyzed the following publications and materials:

- U.S. Patent 11,659,315 (EX1001)
- File History of U.S. Patent 11,659,315 (EX1004)
- U.S. Provisional Application 61/737,932 (EX1005)
- U.S. Application 16/266,829 (“’829App”) (EX1006)
- U.S. Publication 2011/0026724 (“*Doclo*”) (EX1010)
- U.S. Publication 2006/0153394 (“*Beasley*”) (EX1011)
- U.S. Publication 2007/0014423A1 (“*Darbut*”) (EX1012)
- U.S. Publication 2018/0115818 (“*Asada*”) (EX1013)
- U.S. Publication 2014/0270200 (“*Usher*”) (EX1014)
- WO2009023633 (“*Goldstein*”) (EX1015)
- U.S. Patent 7,903,825 (“*Melanson*”) (EX1016)
- U.S. Publication 2007/0027676A1 (“*Chambers*”) (EX1017)
- U.S. Publication 2007/0172087A1 (“*Olsen*”) (EX1018)
- U.S. Publication 2004/0202340A1 (“*Armstrong*”) (EX1019)
- U.S. 6,826,286 (“*Arndt*”) (EX1020)
- U.S. 5,862,065 (“*Muthusamy*”) (EX1021)
- U.S. Publication 2008/0107297A1 (“*Fischer*”) (EX1022)
- U.S. Publication 2006/0018496A1 (“*Niederdrank*”) (EX1023)

- U.S. 5,826,064 (“*Loring*”) (EX1024)
- Blattner et al., “Earcons and Icons: Their structure and Common Design Principles,” *Human-Computer Interaction*, Vol. 4 at 11-44 (1989) (“*Blattner*”) (EX1025)
- U.S. Publication 2007/0127660A1 (“*Roberts*”) (EX1026)
- U.S. 6,760,754 (“*Isaacs*”) (EX1027)
- U.S. 2014/0166122A1 (“*Goldstein-122*”) (EX1028)
- U.S. Publication 2015/0170645A1 (“*DiCenso*”) (EX1029)
- U.S. Publication 2018/0160211 (“*Kirsch*”) (EX1030)
- Sumit Basu et al., *Smart Headphones: Enhancing Auditory Awareness Through Robust Speech Detection and Source Localization*, 5 IEEE INT’L CONF. ON ACOUSTICS SPEECH & SIGNAL PROCESSING PROC. 3361 (2001) (“*Basu*”) (EX1031)
- Excerpt from COMPUTER DICTIONARY (2d ed. 1994) (“*Computer Dictionary*”) (EX1032)
- U.S. Publication 2007/0223717A1 (“*Boersma*”) (EX1033)
- U.S. Patent 5,636,351 (“*Lee*”) (EX1034)

and any other materials I refer to in this declaration in support of my opinions.

36. My analysis and conclusions set forth in this declaration are based on the perspective of a person having ordinary skill in the art.

VII. INTERPRETATION OF THE '315 PATENT CLAIMS

37. Claim 1 of the '315 patent recites “[a]n earpiece comprising.” I understand that this is considered the preamble of the claim. I understand that whether the preamble is considered a claim limitation if it recites essential structure or steps, or if it is necessary to give life, meaning, and vitality to the claim. I understand that even if a preamble recites additional structure for a claim, it may be non-limiting. I understand that if the preamble is relied upon as the antecedent basis for a claim term in the body of the claim, it may be limiting. I also understand that if the preamble was relied upon to distinguish the prior art during prosecution, it may be limiting. In my opinion, the preambles to claim 1 and the preambles to the remaining Challenged Claims that all depend from claim 1 should not be treated as limitations. The preamble is not used for antecedent basis and it was not relied upon during prosecution to distinguish the prior art.

38. In any event, even if the preamble is considered to be a limitation, the '315 patent specification uses the term “earpiece” to encompass more than a *single* earpiece. For example, the specification states that “earbuds” and “headphones” are examples of “an earpiece.” '315 patent, 3:25-28 (“At least one exemplary embodiment is directed to a system for Personalized Services delivered to a Personal Audio Assistant incorporated within *an earpiece (e.g.,*

earbuds, headphones)”); *see also id.*, 3:39-41 (“At least one exemplary embodiment is directed to a Personal Audio Assistant system that is included as part of an *earpiece (e.g., Headphone system)*.”).² The ’315 patent, in turn, defines “headphones” as “a pair of transducers.” *Id.*, 7:30-43 (“Headphones: ‘Headphones’ (also known as earphones, earbuds, stereophones, headsets, Canalphones, or the slang term ‘cans’) are a pair of transducers that receive an electrical signal from a media player, communication receivers and transceivers, and use speakers placed in close proximity to the ears (hence the name earphone) to convert the signal into audible sound waves.”). Thus, if treated as a limitation, a POSITA would have understood the claimed “earpiece” to encompass a left and/or right device.

39. With the exception of the preamble, I have given all the claim terms their plain and ordinary meaning, as would have been understood by a person having ordinary skill in the art, at the time of the alleged invention, having taken into consideration the language of the claims, the specification, and the prosecution history of record.

² I have added all emphases/color/annotations unless I note otherwise.

VIII. OVERVIEW OF THE '315 PATENT

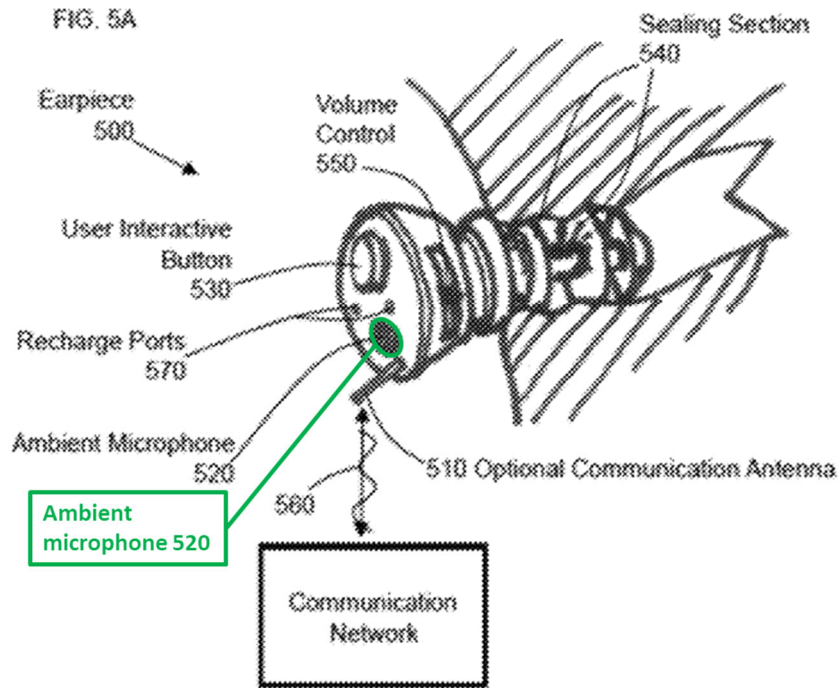
A. THE SPECIFICATION

40. The '315 patent specification can be considered in two parts copied side-by-side. The title, abstract, “Field of the Invention,” column 18, line 28 to column 22, line 67, and Figures 7-22 generally relate to “methods and mechanisms for inflation” and “inflation of a balloon in a device that operates cooperatively with an accessory device.” '315 patent, Abstract, 1:21-25, 18:28-22:67, FIGs. 7-22.

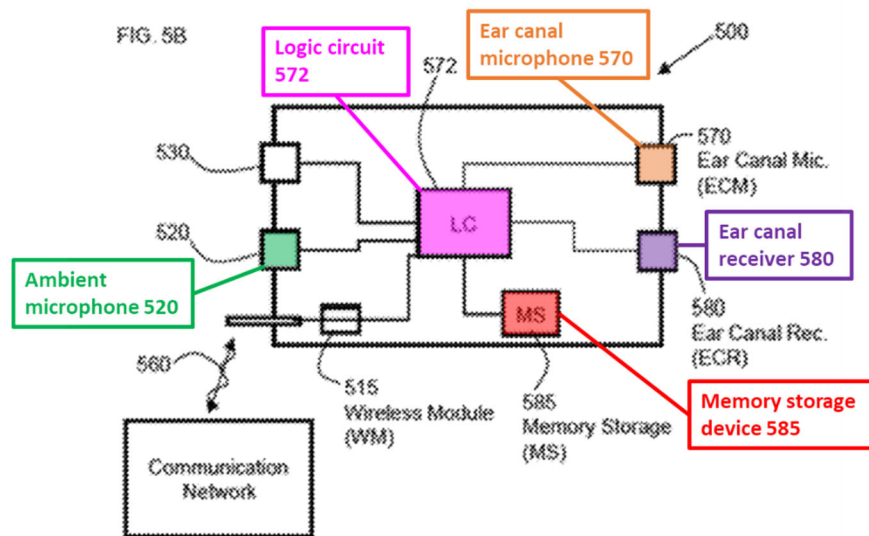
41. A second part of the specification, including the “Background of the Invention” and column 3, line 25 to column 18, line 27, and Figures 1-6, relates to “a system for Personalized Services delivered to a Personal Audio Assistant incorporated within an earpiece (e.g., earbuds, headphones).” In this part, the specification describes a “Personal Audio Assistant” that “mitigat[es] the need to carry a personal music player” and provides a subscription-based service for audio content. *Id.*, 3:39-48. Petitioners refer to this portion of the specification as the “Personal Audio Disclosure.”

42. In Figures 5A and 5B, the specification describes “an earpiece that can store and download audio content in accordance with at least one exemplary embodiment.” '315 patent, 1:63-65. The earpiece includes a **logic circuit 572** operatively coupled to an **ambient microphone (AM) 520**, an **ear canal**

microphone (ECM) 590, an ear canal receiver (ECR) 580, and a memory storage device 585. *Id.*, 10:15-18, 10:31-40.



'315 patent, Figure 5A (annotated)



'315 patent, Figure 5B (annotated)

43. From column 11, line 19 through column 18, line 27, the specification describes more than two dozen “exemplary embodiments.” In one paragraph, the '315 patent mentions an embodiment including mixing environmental audio input signals with audio playback. '315 patent, 14:32-35. The '315 patent also notes that one embodiment can include “active noise reduction.” *Id.*, 14:43-49.

B. PROSECUTION HISTORY

44. The '315 patent issued from U.S. Application No. 17,211,814 ('814 application), filed on March 24, 2021. '315 patent, Cover. The '315 patent purports to claim priority through a series of applications to U.S. Provisional Application No. 61/737,932, filed December 12, 2012. The originally-filed application included 13 claims, which were substantively identical to issued claims 1-13 of the '315 patent. *Compare* EX1004, 28-29 *with* '315 patent, claims 1-13.

45. The Office did not reject any claims during prosecution. On September 23, 2022, the Office issued a notice of allowance. *Id.*, 114. The Examiner stated in the reasons for allowance that the prior art of record failed to teach each limitation of claim 1 “as substantially described and connected with the other functional recited language.” *Id.*, 119.

46. On November 25, 2022, applicants filed a request for continued examination, which “corrected grammatical issues with claims 1, 3[,] and 5.” *Id.*, 165.

47. On January 11, 2023, the Office again issued a notice of allowance. *Id.*, 198. The Examiner stated the same reasons for allowance as in the previous notice. *Id.*, 201. In April 2023, the Office issued a corrected notice of allowance and signed additional information disclosure statements. *Id.*, 214-217, 227-229.

48. The ’315 patent issued on May 23, 2023. *Id.*, 230, 232.

C. THE CLAIMS

49. The table below includes identifiers for the ’315 patent claims and limitations, which are referenced throughout.

Claim 1	
1.pre	An earpiece comprising:
1.1	a first ambient microphone configured to generate a first microphone signal;
1.2	a second ambient microphone configured to generate a second microphone signal;
1.3	an ear canal microphone configured to generate a third microphone signal;
1.4	a speaker;
1.5	a memory that stores instructions;
1.6	a logic circuit, where the logic circuit is configured to execute the instructions to perform operations comprising:

1.6.1	generating a noise reduction signal using at least one of the first microphone signal or the second microphone signal or the third microphone signal or a combination of microphone signals;
1.6.2	receiving an audio signal;
1.6.3	generating a mixed audio signal by mixing the noise reduction signal with the audio signal; and
1.6.4	sending a modified audio signal to the speaker, where the modified audio signal includes the mixed audio signal.
Claim 2	
2	The earpiece according to claim 1, wherein the operations further comprise: generating an ambient sound signal using at least one of the first microphone signal or the second microphone signal or a combination of both.
Claim 3	
3	The earpiece according to claim 2, wherein the operations further comprise: generating the modified audio signal by mixing the ambient sound signal with the mixed audio signal.
Claim 4	
4	The earpiece according to claim 1, wherein the operations further comprise: receiving an indication of an event.
Claim 5	
5	The earpiece according to claim 4, wherein the event is at least one of a scheduled meeting, an incoming phone call, an email, a voice message, or a text message.
Claim 6	
6	The earpiece according to claim 5, wherein the operations further comprise: retrieving an Earcon from the memory, where the Earcon matches the event.
Claim 7	
7	The earpiece according to claim 5, wherein the operations further comprise: sending the Earcon to the speaker.
Claim 8	

8	The earpiece according to claim 1, further comprising: a sealing section.
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IX. THE CLAIMS OF THE '315 PATENT ARE NOT ENTITLED TO A PRIORITY DATE EARLIER THAN MARCH 24, 2021

50. The '315 patent issued from U.S. 17/211,814 (“’814App”) filed on March 24, 2021. The ’814App is a continuation of U.S. 16/266,829 (“’829App”), filed on February 4, 2019. In my opinion, the ’829App does not describe certain limitations of at least claim 1 and claim 3, and the claims at best reflect a combination of elements that the specification never links together or explains with adequate disclosure. Therefore, independent claim 1 and each of the remaining Challenged Claims—which depend from claim 1 directly or indirectly—are entitled to a priority date no earlier than the date the ’814App was filed on March 24, 2021.

A. The ’829App Does Not Disclose “generating a noise reduction signal” Using Any Specific Microphone Signal or Combination of Microphone Signals

51. Limitation [1.6.1] requires “generating a noise reduction signal using at least one of the first microphone signal or the second microphone signal or the third microphone signal or a combination of microphone signals.” A POSITA would have understood that a noise reduction signal is a signal that, when mixed with a noisy signal, reduces noise. The claim requires generating a noise reduction signal using specific microphone signals.

52. At best, in the context of the Personal Audio Disclosure, the '829App includes passing references to noise-cancelling or active noise reduction:

At least one exemplary embodiment can include **active noise reduction**, echo cancellation and signal conditioning that can be environmentally customized through the registration process to better meet the user's specific needs (i.e., occupation-related noise cancellation); A typical application would be a special set of noise cancellation parameters tuned to the drilling equipment used by a dentist.

'829App ¶[0113];

At least one exemplary embodiment includes a Walkie-Talkie mode, which broadcasts input to the system's built-in microphone, whereby the user's speech can be detected by the input acoustic transducer and remotely broadcast where at least one of the following occurs: the Walkie-Talkie mode receives input via AM/FM broadcasts (as well as digital communications protocols) from a nearby user; the Walkie-Talkie mode allows nearby users to engage in conversation with increased perceptual clarity in noisy environments (e.g., aircraft cockpits), **using for example a noise-cancellation system**; selectively engage and disengage the Walkie-Talkie mode using the control system; detect other users of the system within a given range; and alert the user of the system when other detected systems contain certain Public Data and contain a predefined Public Message Key (e.g., "If the detected

system belongs to a single male between the ages of 25 and 30 and whose favorite sport is tennis, then broadcast the message, ‘I like tennis also; would you like to have coffee?’” or “If the detected system belongs to a user who attended Princeton University, then broadcast the message, ‘Go Tigers!’”).

Id. ¶[0128]

53. Beyond this cursory identification, the ’829App does not explain any of the details related to implementing active noise reduction or noise reduction, including “generating a noise reduction signal using at least one of the first microphone signal or the second microphone signal or the third microphone signal or a combination of microphone signals.”

54. Accordingly, in my opinion, a POSITA would not have understood the ’829App to disclose, expressly or inherently, generating a noise reduction signal using at least one of the first microphone signal or the second microphone signal or the third microphone signal or a combination of microphone signals.

B. The ’829App Does Not Disclose “generating a mixed audio signal by mixing the noise reduction signal with the audio signal.”

55. As previously discussed, the ’829App does not disclose generating a noise reduction signal as claimed. *See* §IX.A. Thus, the ’829App also does not disclose mixing a noise reduction signal with an audio signal and provides no support for this limitation. At best, the ’829App discloses mixing environmental

audio with an audio signal—***not mixing a noise reduction signal with an audio signal*** as claimed. *See, e.g.:*

[0047] At least one exemplary embodiment includes input Acoustic Transducers (microphones) for capturing user's speech as well as Environmental Audio. In further embodiments, stereo input Acoustic Transducers ***capture Environmental Audio, and, mixing it with the audio signal path, present the ambient sound field to the user***, mitigating the need to remove the Headphone apparatus for normal conversation.

'829App ¶[0047];

[00111] In at least one exemplary embodiment, the ***stereo input Acoustic Transducers are ultimately connected to the audio signal path at the DSP, allowing the user to audition Environmental Audio (e.g., speech or music)*** and mitigating the need for the user to remove the Headphone apparatus to audition Environmental Audio....

Id. ¶[0111];

[00112] At least one exemplary embodiment includes a system for ***first attenuating Audio Playback and then mixing the Environmental Audio input signals***, at a louder listening level, with the audio signal path using the DSP, where the system is activated by any combination of the following methods: a manual switch to activate/ deactivate the system;

Id. ¶[0112].

56. Accordingly, in my opinion, a POSITA would not have understood the '829App to disclose, expressly or inherently, generating a mixed audio signal by mixing a noise reduction signal with an audio signal.

C. The '829App Does Not Disclose “sending a modified audio signal to the speaker, where the modified audio signal includes the mixed audio signal.”

57. Claim 1 requires “sending a modified audio signal to the speaker, where the modified audio signal includes the mixed audio signal.” The plain language of this claim requires a “modified audio signal” that may be different from the “mixed audio signal.” As discussed above, the '829App does not disclose generating the claimed “mixed audio signal” as claimed. *See* §IX.B. Nor does the '829App disclose any down-stream modifications or processing of the “mixed signal” so as to generate a “modified audio signal” that “includes the mixed audio signal.”

58. Accordingly, in my opinion, a POSITA would not have understood the '829App to disclose, expressly or inherently, sending a modified audio signal to the speaker, where the modified audio signal includes the mixed audio signal.

D. The '829App Does Not Disclose “generating the modified audio signal by mixing the ambient sound signal with the mixed audio signal”

59. Dependent claim 3 requires “generating the modified audio signal by mixing the ambient sound signal with the mixed audio signal.” Claim 3 depends from claim 2, which requires “generating an ambient sound signal.” The plain language of claim 3 requires mixing that “ambient sound signal” with the “mixed audio signal,” and a POSITA would have understood this limitation to require a downstream modification of the mixed audio signal; that is, to generate the mixed audio signal in a first stage (or step) and then in a subsequent, second stage, mix the “ambient sound signal” with “the mixed audio signal.” This flows from the requirement that the ambient sound signal is mixed with a “mixed audio signal,” i.e., a signal that has already been mixed. This is to be contrasted with a system in which the audio signal, noise reduction signal, and ambient sound signal are mixed in a single stage.

60. As discussed in §§IX.A and IX.B, the '829App does not disclose either of the predicate steps of generating the claimed noise reduction signal or generating the claimed mixed signal. And as discussed in §IX.D, the '829App does not disclose any modification to the mixed audio signal, let alone the specific addition of an ambient sound signal with the mixed audio signal as

required by claim 3. Thus, a POSITA would not have understood the '829App to disclose the two-stage mixing required by claim 3.

X. SPECIFIC GROUNDS FOR CHALLENGE

A. GROUND 1A: *DOCLO* IN COMBINATION WITH *BEASLEY* RENDERS OBVIOUS CLAIMS 1-3

1. Overview of the *Doclo-Beasley* combination

a. Overview of *Doclo*

61. *Doclo* is titled “Active noise reduction method using perceptual masking.” *Doclo*, [Cover]. *Doclo* notes that active noise reduction (ANR) is a known method of producing a noise cancellation signal with a loudspeaker such that undesired ambient noise is reduced. *Doclo* ¶[0003]. *Doclo* explains that it was also known that headsets could reduce the amount of noise perceived by a user by increasing the intensity of an incoming audio (e.g., music) signal, which would “mask” the noise—a “masking effect.” *Doclo* ¶[0005]. *Doclo* discloses a system in which the masking effect is leveraged to provide a more efficient noise-cancellation system.

62. The noise cancellation signal is generated based on both an incoming audio signal and ambient noise signal and takes into account the fact that the audio signal will at least partially mask the noise signal without any noise cancellation, so that “noise reduction (or noise cancellation) may be

focused in frequency regions where the noise is not masked by the audio signal,” and “[i]n this way, noise reduction efficiency may be improved.” *Id.* ¶[0010].

63. *Doclo* discloses various embodiments of its active noise reduction system (“ANR system”). *Doclo* does not repeat the description of each component common to each embodiment. *Doclo* explains that “in different figures, similar or identical elements are provided with the same reference signs or with reference signs, which are different from the corresponding reference signs only within the first digit.” *Doclo* ¶[0055]; *see also id.* ¶[0060] (“It should be noted that in FIG. 2 similar or identical elements are denoted with the same reference signs as in FIG. 1 and the description thereof is not repeated here.”) My opinions are focused on the ANR system of Figure 2, but I cite to descriptions of those same components disclosed in connection with other embodiments because a POSITA would have understood those descriptions to apply, or at least be obvious to apply, to the embodiment of Figure 2.

64. *Doclo* discloses a block diagram of a combined feedforward-feedback ANR system. *Doclo* ¶¶[0056], [0060]. With reference to Figure 1, *Doclo* discloses that the ANR system includes an audio source 134, a loudspeaker 102, and a noise cancellation signal generator (which comprises the remaining elements in the figure). *Doclo* ¶[0059]. *Doclo* discloses that the remaining elements include at least one external reference microphone 104,

66. Indeed, it was known by the earliest alleged priority date to implement active noise-cancelling in hearing aids. This is corroborated, for example, by *Olsen* which discloses a hearing aid with noise cancellation. *Olsen* ¶[0013] (“From FIG. 1 a schematic representation of **a hearing aid appears featuring the noise cancellation according to the invention**. The hearing aid comprises a signal path with one or more external input transducers 1-N1, a signal processor performing compensation for hearing loss as well as the Noise cancellation part (ANC) and one or more output transducers 1-N3. In addition to this the signal path comprises one or more further input transducers 1-N2 placed internally, i.e. facing the interior of the ear canal or being integrated into the receiver, when the hearing aid is mounted. The internal input transducer(s) or error microphone(s) provides the signal present in the ear canal and feeds this to the signal processor, which generates a error signal capable of adjusting the attenuation signal and hence at least partly attenuate the undesired signal present in the ear canal.”).³

³ To be clear, I am relying on *Olsen* as evidence of the knowledge of a person having ordinary skill in the art and they are not part of the unpatentability ground 1A.

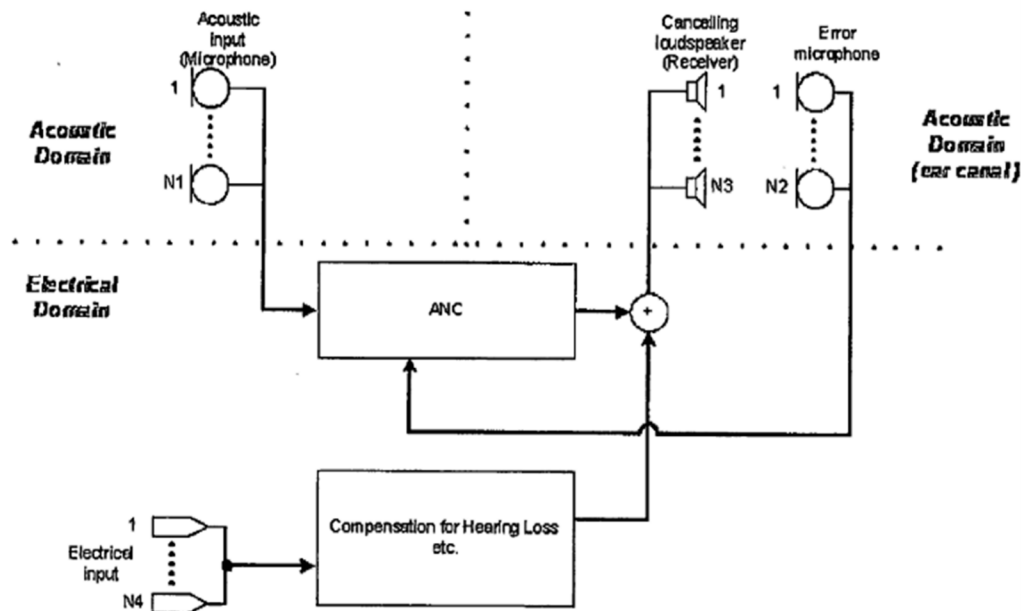


FIG. 1

Olsen FIG. 1

67. A POSITA would have understood that a hearing aid that applies active noise-cancelling as taught by *Doclo* would require a technique for providing ambient sound to the user because that is part of the main function of a hearing aid. That is, a hearing aid user is using the hearing aid so that he/she can better hear their surroundings, and so a POSITA would have understood that noise cancellation applied to a hearing aid would have required a technique for providing ambient sound to the user.

68. A POSITA also would have been aware that, although active-noise cancelling has certain benefits, it also has drawbacks in certain environments by

making it harder for the user to be aware of dangerous events in the environment. This is corroborated, for example, by *Melanson*, which explained that “[r]ecently, the technique of noise cancellation has been applied to consumer headphones. ... thus improving the user’s listening experience and making it less likely that a user will increase the volume of the program material to overcome ambient sounds. However, such a device does not solve the ... problems of providing for conversations, and if an environmental noise indicative of a hazard is not sufficiently loud to as to defeat the noise-canceling mechanism, then the noise cancellation will also not produce a desirable result.” *Melanson*, 1:58-2:2.⁴

69. Thus, a POSITA would have been motivated to consider ways to implement *Doclo*’s ANR system in a hearing aid that did not frustrate the main function of the hearing aid and balanced the benefits of active noise-cancelling with its drawbacks. As discussed further below, *Beasley* discloses one example of a technique for providing a user with ambient sound and noise cancellation.

⁴ To be clear, I am relying on *Melanson* as evidence of the knowledge of a person having ordinary skill in the art and it is not part of the unpatentability ground 1A.

b. Overview of *Beasley*

70. *Beasley* discloses improving active noise-reducing headsets by providing an ambient sound passthrough feature. *Beasley* ¶[0006]-[0014] (“[M]any contemporary headsets offer active or passive noise rejection or noise cancellation ... Unfortunately, the advantages offered by many headsets also result in a disadvantage as well. That is, when listening to audio program content via a headset the user often experiences difficulty participating in a conversation with others around him or her or otherwise hearing certain background audible content that may be of interest.”). More particularly, *Beasley* discloses an “audio bypass module 306 ... implemented to allow background sounds originating outside the headset to more readily be heard by the user of an audio headset.” *Id.* ¶[0033]. *Beasley* discloses implementing its solution in “headset applications where it may be useful or desirable for a user to allow outside audio information such as, for example, a conversation to pass through the headset so this information can be heard by the user.” *Id.* ¶[0027]. And it may be “implemented utilizing hardware, firmware, software, or a combination thereof, as may be desirable based on the given application.” *Id.* ¶[0033].

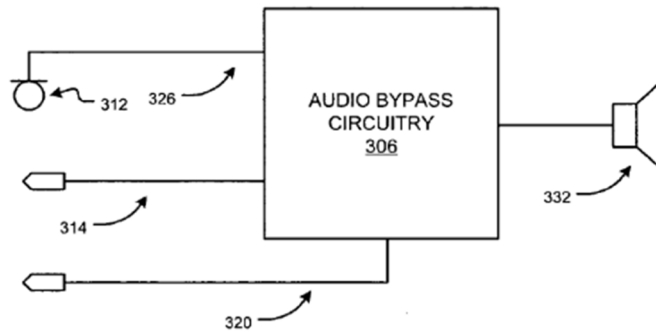


Fig. 3

Beasley, FIG. 3

71. With reference to Figure 9, *Beasley* discloses a **bypass module 306** with **amplifiers** that variably adjust the gain of a **noise-cancellation signal 728**, a **background audio signal 726**, and an **audio signal 314**. The signals are then mixed in **summer 730** and amplified by **driver/amplifier 732** to generate a **signal** that is provided to the **speaker 332**. *Id.* ¶[0053]. The output of **summer 730** is variably amplified by **driver/amplifier 732** prior to output from the **speaker 332**. *Id.* ¶[0051].

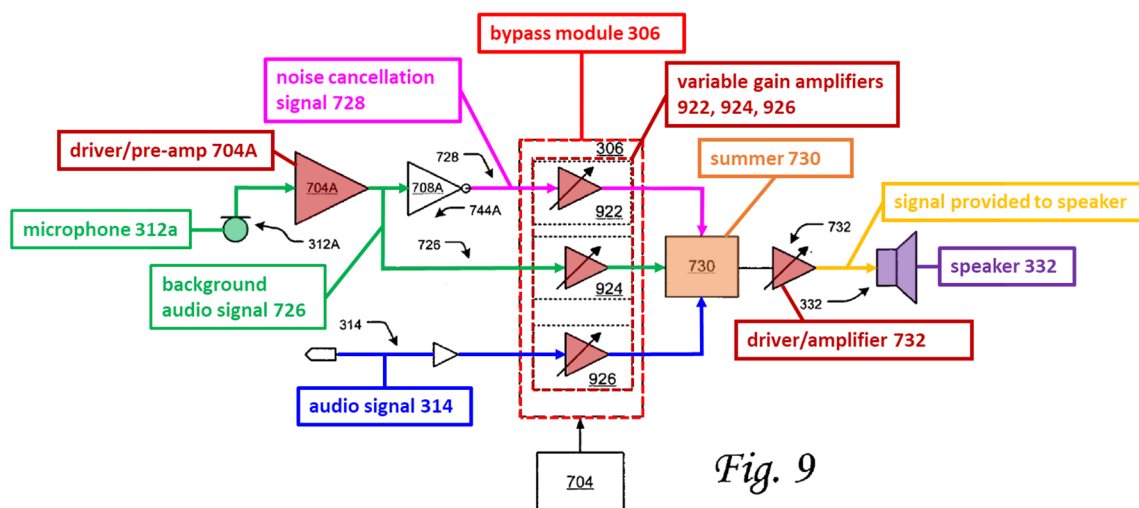


Fig. 9

Beasley, Fig. 9 (annotated)

72. “[W]hen the audio bypass mode is initiated, the gain of variable gain amplifiers 922 and 926 is attenuated such that noise cancellation signal 728 and audio signal 314 are attenuated and the gain of variable gain amplifier 924 is increased such that the background audio signal 726 is amplified and readily heard by the user through speaker 332.” *Id.* ¶[0053]. “Conversely, when the bypass mode is terminated, the gain of variable gain amplifier 924 is turned down such that the background audio signal 726 is no longer amplified (or is attenuated to some extent). Additionally, the gain of variable gain amplifier 926 is increased such that audio signal 314 is amplified and can be readily heard by the user via speaker 332.” *Id.* ¶[0053].

c. Motivation to combine *Doclo* and *Beasley*

73. A POSITA would have been motivated to apply *Beasley*’s teachings related to its audio bypass module and ambient sound passthrough to *Doclo*’s ANR system applied to a hearing aid and would have had a reasonable expectation of success in doing so. *Doclo* and *Beasley* are analogous to the ’315 patent because they are within the same field of endeavor of the ’315 patent and/or reasonably pertinent to one or more problems addressed by the ’315 patent.

74. As noted in §X.A.1.a, a POSITA would have been motivated to consider ways to implement *Doclo*’s ANR system in a hearing aid that did not

frustrate the main function of the hearing aid and balanced the benefits of active noise-cancelling with its drawbacks. *Beasley* provides a system that attenuates unwanted ambient sound through noise cancellation, but allows desired sounds—such as speech—to passthrough, allowing a user to hear desired sounds while attenuating unwanted sound. *Beasley*, ¶[0039]. A POSITA would have considered modifying *Doclo*’s hearing aid ANR system to implement *Beasley*’s teachings related to providing a bypass background audio signal and variable amplification to amount to the use of a known technique (*Beasley*’s audio bypass and variable amplification) to improve similar devices (*Doclo*’s ANR hearing aids) in the same way (to provide the user with the ability to hear the ambient environment with a noise-cancelling headset).

75. A POSITA also would have been motivated to implement *Beasley*’s teaching related to providing variable amplification of the output of *Beasley*’s summer. A POSITA would have understood that *Beasley*’s driver/amplifier 732 allows control of the output volume of the summed (i.e., mixed) signal. A POSITA would have recognized that providing variable amplification of the output signal is a common feature of audio systems because it provides users control over the volume of audio output. This is corroborated, for example, by *Arndt*, which explains that “Audio amplification devices, such as hearing aids are typically manufactured with volume controls to provide users with the ability

to adjust the sound level (i.e. loudness) of output from the devices. Many users of hearing aids appreciate the flexibility provided by a volume control. For example, the volume control allows users to turn down the hearing aid volume when exposed to loud sounds, or to turn up the hearing aid volume when they want to hear very quiet sounds. Users may also use the volume control to compensate for auditory fatigue, which may occur in the course of a day.” *Arndt*, 1:13-23; *see also Boersma* ¶[0063] (“The volume switch 72, also preferably a rheostat in this embodiment, functions to adjust the gain of the amplifier 84. Accordingly, the user may control the gain of the amplifier 84 which amplifies the combined audio and ambient sound signals. As a result, the user may control the overall volume of the sound reproduced by the headset.”).⁵

76. Thus, a POSITA would have considered further modifying the *Doclo-Beasley* combination to include variable amplification of the mixed signal to amount to applying a known technique (variable amplification a signal prior to output) to a known device (the *Doclo-Beasley* combination) ready for

⁵ To be clear, I am relying on *Arndt* and *Boersma* as evidence of the knowledge of a person having ordinary skill in the art and they are not part of the unpatentability ground 1A.

improvement to yield predictable results (the *Doclo-Beasley* combination with variable amplification of the mixed signal prior to output).

2. Claim 1

a. [1.pre]: An earpiece comprising:

77. I understand that “an earpiece comprising” is the preamble to claim 1 of the ’315 patent. For purposes of Ground 1A, I have been asked to assume that the preamble is a claim limitation. As discussed in §VII, in my opinion, a POSITA would have understood the claimed “earpiece” to encompass a left and/or right device.

78. *Doclo* discloses a block diagram of a combined feedforward-feedback ANR system. *Doclo* ¶¶[0056], [0060]. With reference to Figure 1, *Doclo* discloses that the ANR system includes an audio source 134, a loudspeaker 102, and a noise cancellation signal generator, which comprises the remaining elements in the figure. *Doclo* ¶[0059]. *Doclo* discloses that the remaining elements include “**external reference microphone 104**, and an **internal error microphone 106**, although it should be noted that the proposed method can be easily generalized for multiple loudspeakers, and multiple reference and error microphones.” *Id.* Similar elements are shown in *Doclo*’s Figure 2. *Id.* ¶[0060] (“A modification for the feedback loop of the ANR system in FIG. 1 is depicted in FIG. 2. ... It should be noted that in FIG. 2 similar or

identical elements are denoted with the same reference signs as in FIG. 1 and the description thereof is not repeated here.”).

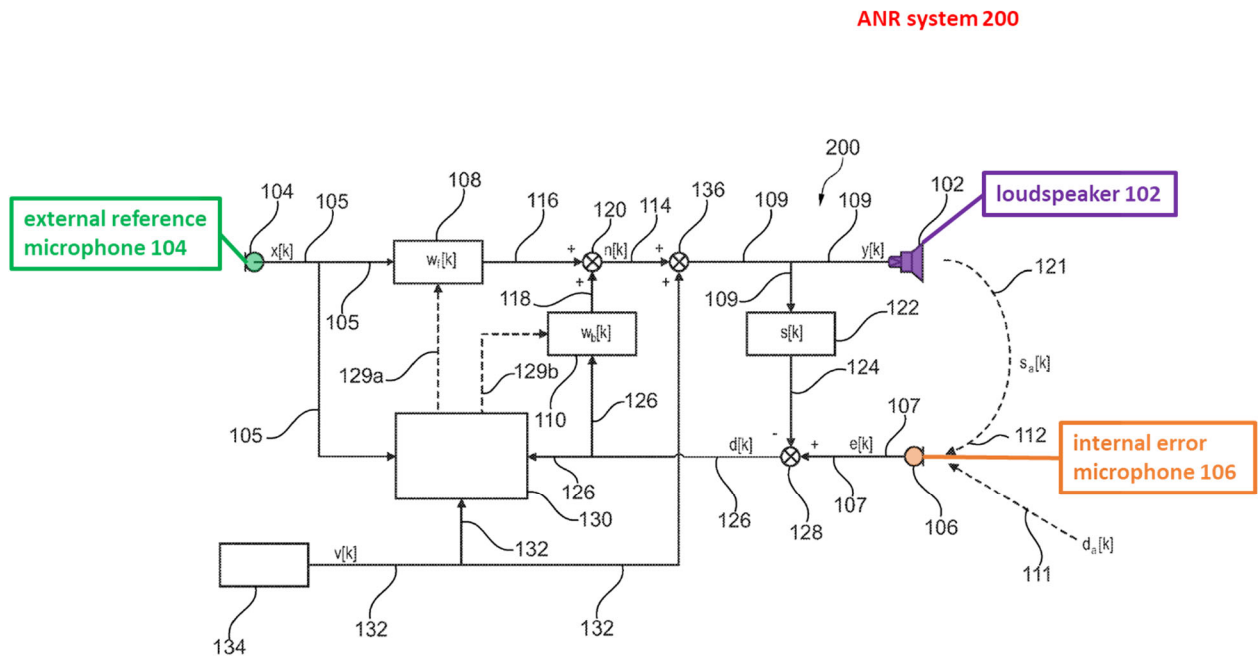


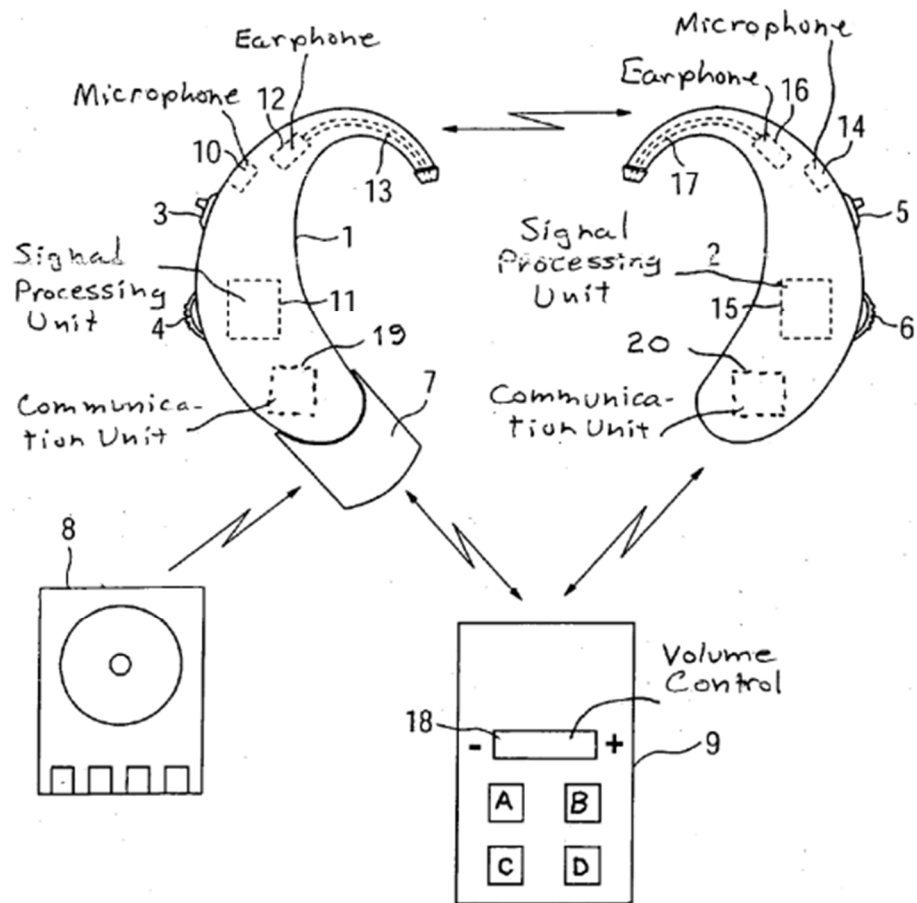
Fig. 2

Doclo, Figure 2 (annotated)

79. *Doclo* discloses that its ANR system may be applied in, for example, hearing aids. *Id.* ¶[0099] (“ANR can be beneficial for several applications, such as **headsets**, mobile phone handsets, cars and **hearing instruments**.”); *id.* ¶[0124] (“Finally it should be noted that the herein disclosed subject matter can be **used e.g. in any ANR application** (e.g. **headsets**, mobile phone handsets, cars, **hearing aids**) where the loudspeaker is playing an audio signal simultaneously with the noise cancellation signal.”).

80. A POSITA would have understood that hearing aids typically include a left and/or right earpiece in various form factors and include a processor and microphones. This is corroborated, for example, by *Fischer*, filed in October 2007, and *Niederdrank*, filed in July 2005. *Fischer* explains that “[h]earing aids have very recently been introduced that employ digital signal processing. They contain one or more microphones, A/D converters, digital signal processors, and loudspeakers.” *Fischer* ¶[0004]. *Niederdrank* explains that hearing aid systems “having two hearing aids that can be worn on the head for binaural supply to the user the hearing aids each having an input transducer for acquisition of an input signal and conversion into an electrical signal, a signal-processing unit for processing and frequency dependent amplification of the electrical signal, and an output transducer for conversion of the processed signal into a signal perceivable as an acoustic signal by the hearing aid user” were known. *Niederdrank* ¶¶[0002], [0005].⁶

⁶ To be clear, I am relying on *Fischer* and *Niederdrank* as evidence of the knowledge of a person having ordinary skill in the art and they are not part of the unpatentability ground 1A.



Niederdrank, FIGURE

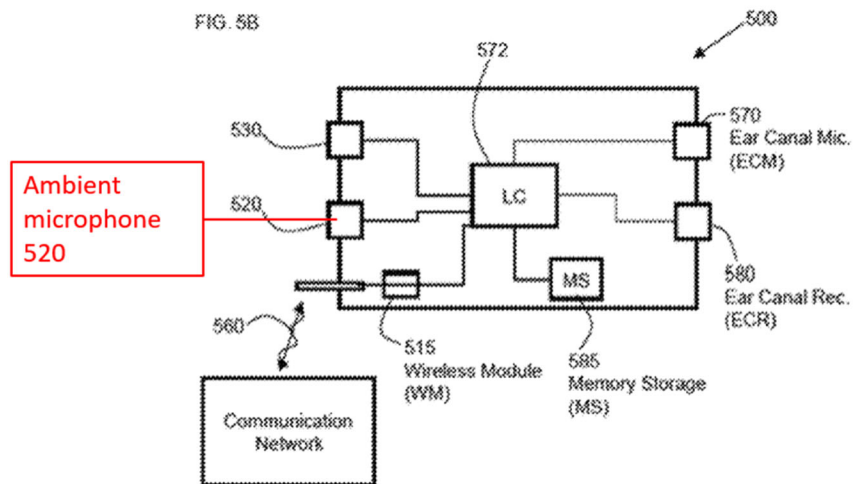
81. Thus, *Doclo*'s disclosure of applying its teachings in a "hearing aids" application discloses or suggests applying *Doclo*'s ANR system within an "earpiece."

82. Accordingly, in my opinion, if the Board finds that the preamble is limiting, a POSITA would have understood *Doclo* to disclose or suggest hearing aids ("An earpiece").

b. [1.1]: a first ambient microphone configured to generate a first microphone signal;

83. In my opinion, *Doclo* discloses or suggests “a first ambient microphone configured to generate a first microphone signal.”

84. *Doclo* discloses in Figure 2 an **external reference microphone 104**, which produces a **noise signal/reference signal 105 denoted by $x[k]$** indicative of ambient noise 111. *See, Doclo* ¶¶[0056] (“The ANR system 100 consists of ... *an external reference microphone 104* ...”), [0056] (“The reference microphone signal 105 is denoted by $x[k]$...”), [0059] (“Hence, in accordance with an embodiment, the cancellation signal generator 101 has a first input 103 a for receiving the audio signal 132 to be played and a second input 103 b for receiving from the at least one *microphone 104*, 106 *at least one noise signal 105*, 107 indicative of the ambient noise 111.”); [0102]-[0103] (“Embodiments of an ANR system using a combined feedforward-feedback configuration (i.e. as shown in FIGS. 1 and 2), may comprise one or more of the following features: *at least one reference microphone, recording the reference microphone signal $x[k]$* ”); [0129] (“*104 reference microphone*”); [0130] (“*105 reference microphone signal*”).



'315 patent, FIG. 5B (annotated)

87. Accordingly, in my opinion, a POSITA would have understood *Doclo* to disclose or suggest external reference microphone 104 (“first ambient microphone”), which is configured to generate noise/reference microphone signal 105 denoted by $x[k]$ that is indicative of ambient noise 111 (“configured to generate a first microphone signal”).

c. [1.2]: a second ambient microphone configured to generate a second microphone signal;

88. In my opinion, *Doclo* discloses or suggests “a second ambient microphone configured to generate a second microphone signal.”

89. *Doclo* discloses “at least one reference microphone” and that the reference microphones produce “reference microphone signal(s).” *Doclo* ¶[0100]; *see also id.* ¶¶[0102], [0103] (“Embodiments of an ANR system using a combined feedforward-feedback configuration (i.e. as shown in FIGS. 1 and

2), may comprise one or more of the following features: ... *at least one reference microphone*, recording the reference microphone signal $x[k]$ ”); [0056] (“The ANR system 100 consists of a loudspeaker 102, an external reference microphone 104, and an internal error microphone 106, although it should be noted that the *proposed method can be easily generalized for ... multiple reference ... microphones.*”).

90. As noted in §X.A.1.a, *Doclo* explains that Figure 2 includes “similar or identical elements” to Figure 1, including reference microphone 104, and that the description of common elements is not repeated for Figure 2, so a POSITA would have understood that *Doclo*’s disclosure of “multiple reference microphones” applies to the embodiment of Figure 2.

91. A POSITA would have understood *Doclo*’s “multiple microphones” disclosure to disclose or suggest a second reference microphone that generates a second signal that is indicative of ambient noise. Moreover, a POSITA would have understood this disclosure applies equally to *Doclo*’s hearing aid application. *Doclo* ¶[0099] (“ANR can be beneficial for several applications, such as headsets, mobile phone handsets, cars and hearing instruments.”), [0124] (“Finally it should be noted that the herein disclosed subject matter can be used e.g. in any ANR application (e.g. headsets, mobile phone handsets, cars, hearing aids).”).

92. As noted in §X.A.2.b, *Doclo*'s description of the "external reference microphone" is consistent with how the '315 patent describes an "ambient microphone."

93. Accordingly, in my opinion, a POSITA would have understood *Doclo* to disclose or suggest a second reference microphone ("second ambient microphone") that is configured to generate a second reference microphone signal that is indicative of ambient noise ("configured to generate a second microphone signal").

d. [1.3]: an ear canal microphone configured to generate a third microphone signal;

94. In my opinion, *Doclo* discloses or suggests "an ear canal microphone configured to generate a third microphone signal."

95. *Doclo* discloses **internal error microphone 106** in Figure 2 that generates an **error microphone signal 107 denoted by $e[k]$** .

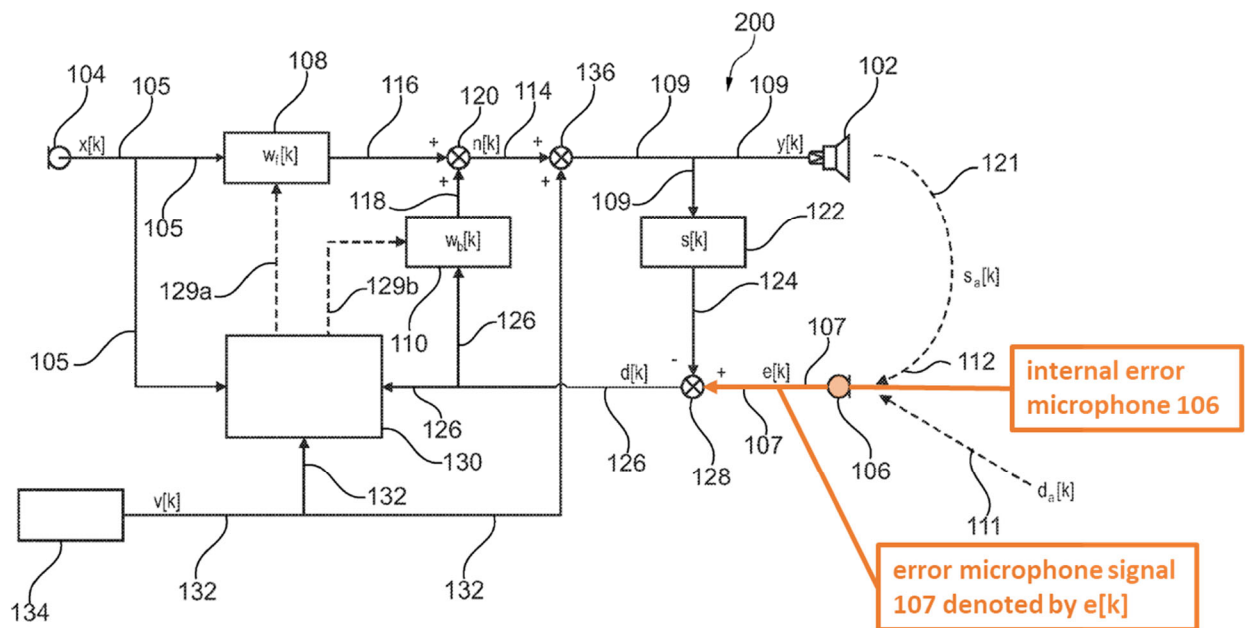


Fig. 2

Doclo, Figure 2

96. *Doclo* discloses that its system may be implemented in hearing aids. *Doclo* ¶¶[0099], [0124]. Further, *Doclo* discloses that the **internal error microphone 106** may be placed internal to the device in which the ANR system is implemented (e.g., a hearing aid), receives a sound identical or close to the sound received by the user's ear (i.e., ambient noise and the audio signal played by the loudspeaker), and generates an **error microphone signal 107 denoted by e[k]**. *Doclo* ¶¶[0023] (“[T]he **error microphone** may be placed such that the sound which is received by the error microphone is *identical or close to the sound which is received by a user's ear*. Hence, the error microphone receives

the ambient noise as well as the sound corresponding to the audio signal.”), [0056], [0059], [0102]-[0104], [0131]-[0132].

97. A POSITA would have understood hearing aids include a speaker for emitting sound into the user’s ear canal. This is corroborated, for example, by *Armstrong*, which discloses a hearing aid including a loudspeaker 18 “for transmitting audio signals into the ear canal.” *Armstrong* ¶[0011].⁷

98. As noted above, *Doclo*’s “**error microphone** may be placed such that the sound which is received by the **error microphone** is *identical or close to the sound which is received by a user’s ear.*” *Doclo* ¶[0023]. A POSITA would have therefore understood that to implement *Doclo*’s internal **error microphone 106** in a hearing aid, the microphone would be in the ear canal to pick up the output of the speaker and any residual noise. At a minimum, a POSITA would have considered it obvious to place the error microphone in the ear canal in a hearing aid application because placing it there would allow the error microphone to effectively perform *Doclo*’s desired function.

⁷ To be clear, I am relying on *Armstrong* as evidence of the knowledge of a person having ordinary skill in the art and it is not part of the unpatentability ground 1A.

99. Indeed, it was known to implement hearing aids with an ear canal microphone. This is corroborated, for example, by *Olsen* and *Armstrong*, each of which disclose hearing aids including an ear canal microphone. *Olsen* ¶[0013] (“In addition to this the signal path comprises one or more further input transducers 1-N2 placed internally, i.e. facing the interior of the ear canal or being integrated into the receiver, when the hearing aid is mounted.”).

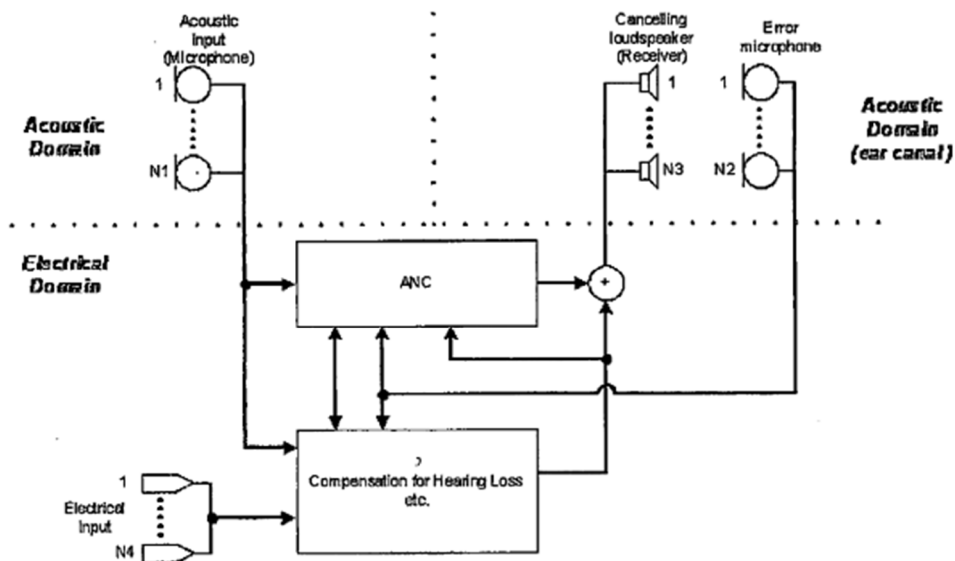


FIG. 2

Armstrong ¶[0011] (“With reference now to the drawing figures, FIG. 1 is a block diagram illustrating an example hearing instrument 10 having a serial data (SDA) port 20 and an ear canal microphone 16. The hearing instrument 10 includes a digital signal processor (DSP) 12 for controlling the operation of the hearing instrument 10, an outer microphone 14 for receiving audio signals from

outside of the ear canal; the ear canal microphone 16 for receiving audio signal from inside of the ear canal; and a loudspeaker 18 (also referred to as a receiver) for transmitting audio signals into the ear canal.”⁸

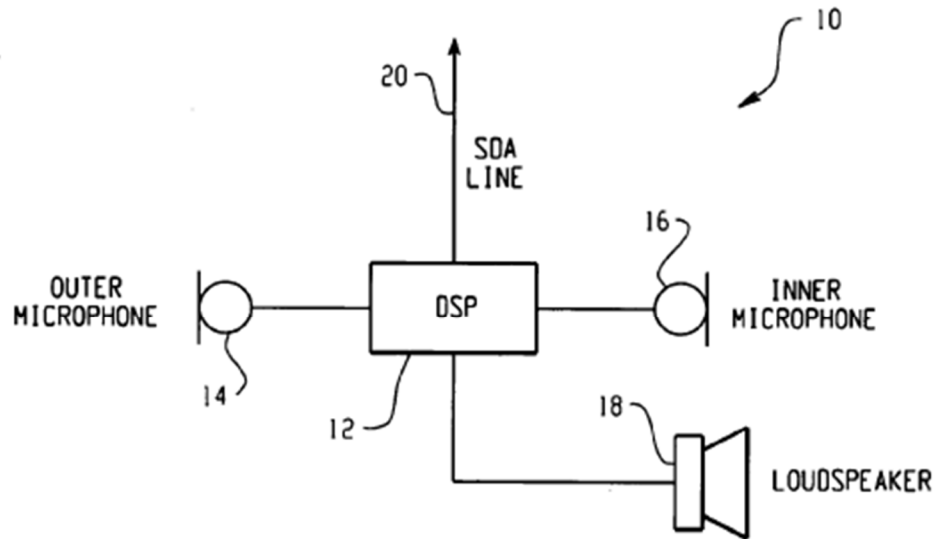


Fig. 1

100. This is consistent with how the '315 patent describes an “ear canal microphone.” ’315 patent, 10:31-38 (“FIG. 5B illustrates a block diagram of the earpiece of FIG. 5A, illustrating ... an ear canal microphone (ECM) 590 that can pick up audio in the ear canal region”); *id.*, 20:6-11 (“The ear canal microphone 23 can be configured to pick up audio in the proximity of an ear canal.”)

⁸ To be clear, I am relying on *Olsen* and *Armstrong* as evidence of the knowledge of a person having ordinary skill in the art and they are not part of the unpatentability ground 1A.

be used e.g. in any ANR application (e.g. *headsets*, mobile phone handsets, cars, *hearing aids*) where the *loudspeaker* is playing an audio signal simultaneously with the noise cancellation signal.”); *see also id.* ¶¶[0029], [0056] (“The ANR system 100 consists of a *loudspeaker 102*...”); [0057] (“a noise cancellation signal 114 is generated with the *loudspeaker*.”); [0059] (“It should be noted that the ANR system of FIG. 1 may be considered as comprising ... the *loudspeaker 102* ...”); [0060] (“FIG. 2 shows a ANR system 200 where an estimate 124 of the *loudspeaker* contribution at the error microphone 106 is first subtracted from the error microphone signal 107 before filtering with the feedback filter 110.”); [0100]-[0102], [0105] (“Embodiments of an ANR system using a combined feedforward-feedback configuration (i.e. as shown in FIGS. 1 and 2), may comprise one or more of the following features: ...at least one *loudspeaker*, playing back the loudspeaker signal $y[k]$ ”); [0127] (“*102 loudspeaker*”).

105. Accordingly, in my opinion, a POSITA would have understood *Doclo* to disclose or suggest a loudspeaker (“a speaker”).

- f. **[1.5]: a memory that stores instructions; [1.6]: a logic circuit, where the logic circuit is configured to execute the instructions to perform operations comprising:**

106. In my opinion, *Doclo* discloses or suggests “a memory that stores instructions” and “a logic circuit, where the logic circuit is configured to execute the instructions to perform operations comprising.”

107. *Doclo* discloses a “computer program” which *Doclo* explains is equivalent to “a computer readable medium containing instructions for controlling a computer system to coordinate the performance of the ... method/functionality of components/units” of *Doclo*’s disclosure. *Doclo* ¶[0037]. *Doclo* discloses that the computer program is stored in the computer readable medium and further discloses implementing the computer readable medium as a memory. *Id.* ¶[0038] (“The computer program ... may be stored on a computer-readable medium (removable disk, *volatile or non-volatile memory*, embedded *memory*/processor, etc.)”).

108. *Doclo* further discloses that the computer program is executed by a processor for performing the method and functionality of the noise cancellation signal generator its components. *Id.* ¶¶[0035] (“the computer program, when being executed by a data processor, is adapted for controlling the method”), [0036] (“the computer program, when executed by a data processor, is adapted for providing the functionality of the cancellation signal generator” and “the functionality of one or more of the units of the cancellation signal generator”); *see also id.* ¶¶[0096] (“[A]ny component of the active noise reduction (ANR) system, e.g. the above mentioned units and filters are provided in the form of respective *computer program products which enable a processor to provide the functionality of the respective entities as disclosed herein.*”), [0039]. As noted

above in §X.A.1.a, *Doclo* discloses that its ANR system includes three general parts, “the audio source 134, the loudspeaker 102 and a cancellation signal generator 101,” and the cancellation signal generator includes “the remaining elements” of the system shown in Figure 1. *Doclo* ¶[0059]. As noted in §X.A.1.a, a POSITA would have understood this description to apply to the system in Figure 2, as well.

109. A POSITA would have understood a processor is consistent with how the '315 patent describes a “logic circuit.” '315 patent, 9:47-67 (“The earpiece can include all or some of the elements illustrated in FIG. 5B. For example the logic circuit 572 or the operatively connected memory storage device 585, can include spatial enhancement software 329, a DSP codec 330, a speech synthesis and recognition system 311, and a digital timer system 312. Additional elements can be connected to the logic circuit 572 as needed, for example a power supply 320, a software communication interface 307 (e.g., wireless module 515) (which may be connected to communication network 308), data port interface 306, audio input buffers 300 connected to digital audio input 302 and/or analog audio input 303 converted to digital via an ADC 301, environmental audio input acoustic transducer(s) 321 converted to digital via an ADC 316, user control 324, digital audio output 328, output acoustic transducers 319 (which receive signals converted to analog via a DAC 310 and amplified via

amplifier 309), display system 318, communication buffers 325, program memory 305, data and personal memory 315, as well as other electronic devices as known by one of ordinary skill in the relevant arts.”).

110. Because *Doclo* discloses a computer program executed by a processor to coordinate the performance of its disclosed method and the functionality of the noise-cancellation signal generator, a POSITA would have understood *Doclo* to disclose or suggest the processor executing instructions to perform the claimed operations discussed below.

111. Accordingly, in my opinion, a POSITA would have understood *Doclo* to disclose or suggest a computer program stored as instructions in a computer readable medium such as a memory (“a memory that stores instructions”) and a processor (“logic circuit”) that executes the instructions of the computer program to perform the claimed operations discussed below (“where the logic circuit is configured to execute the instructions to perform operations comprising:”).

- g. [1.6.1]: generating a noise reduction signal using at least one of the first microphone signal or the second microphone signal or the third microphone signal or a combination of microphone signals;**

112. In my opinion, *Doclo* discloses or suggests “generating a noise reduction signal using at least one of the first microphone signal or the second

microphone signal or the third microphone signal or a combination of microphone signals.”

113. As described with respect to [1.1] (*see* §X.A.2.b), *Doclo* discloses a noise/reference microphone signal 105 denoted by $x[k]$ indicative of ambient noise 111 that is a “first microphone signal.” As described with respect to [1.3] (*see* §X.A.2.d), *Doclo* discloses an error microphone signal 107 denoted by $e[k]$ indicative of the sound received in the ear canal that is a “third microphone signal.” As detailed below, with reference to Figure 2, *Doclo* discloses generating noise cancellation signal 114 denoted by $n[k]$ using $x[k]$ (“first microphone signal”) and $e[k]$ (“third microphone signal”).

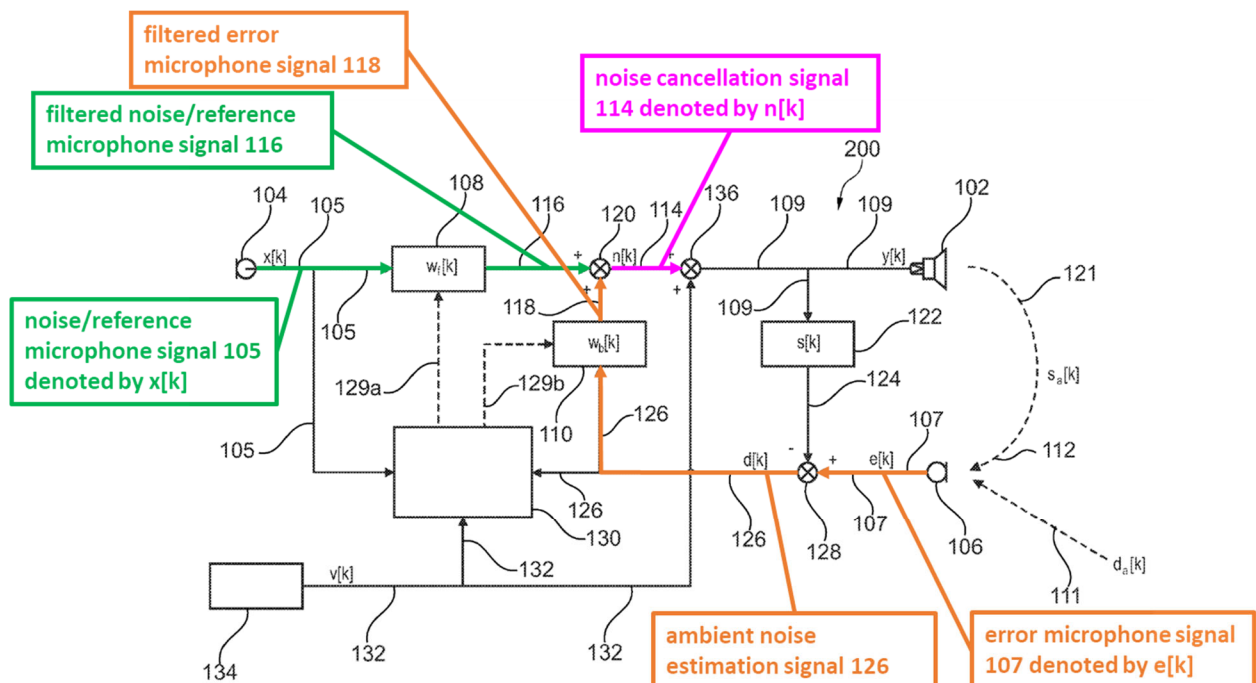


Fig. 2

Doclo, Figure 2 (annotated)

114. As to the “first microphone signal,” *Doclo* discloses that a feedforward filter 108 generates a filtered reference microphone signal 116 from the first microphone signal, and the filtered reference microphone signal 116 is input to summing unit 120. As to the “third microphone signal,” *Doclo* discloses that feedback filter 110 generates a filtered error microphone signal 118 from $e[k]$ 107 (“the third microphone signal”), and the filtered error microphone signal 118 is another input to summing unit 120. The output of summing unit 120 is noise cancellation signal 114 denoted by $n[k]$. *Doclo* ¶[0057] (“According to an embodiment, the noise cancellation signal 114, denoted by $n[k]$, is the sum of a filtered reference microphone signal 116 and a filtered error microphone signal 118 Summing of the microphone signals 116, 118 is performed by a summing unit 120.”). Because the noise cancellation signal 114 is derived from filtered versions of the noise/reference microphone signal 105 and the error microphone signal 107, the noise cancellation signal 114 is generated “using” the microphone signals 105 and 107..

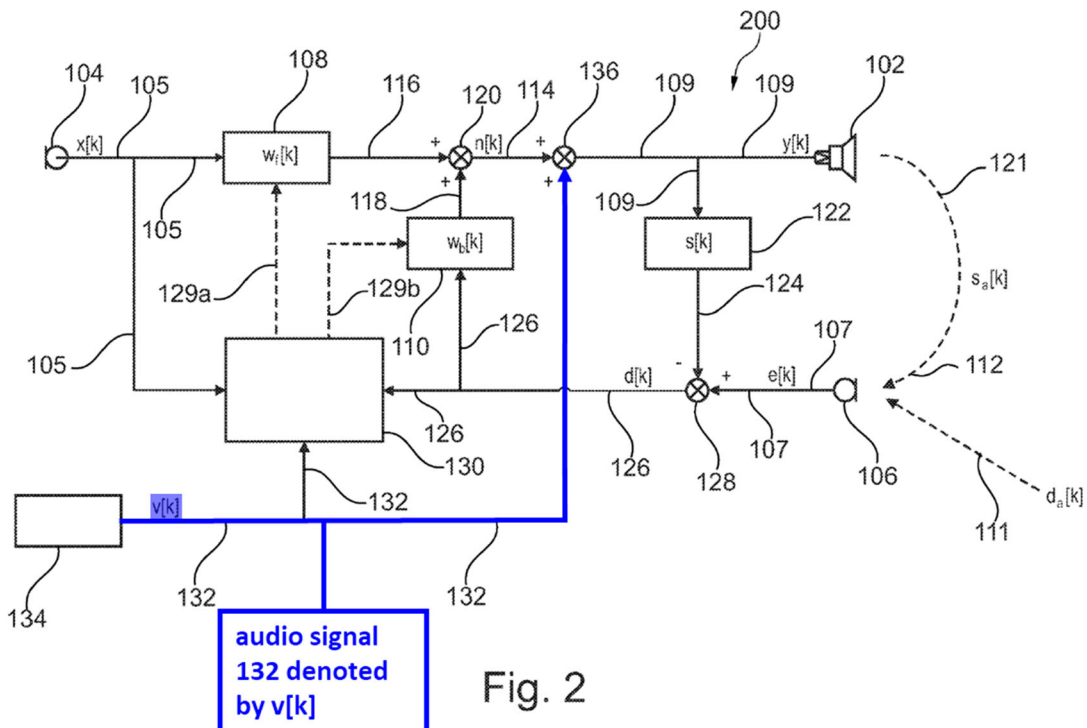
115. Accordingly, in my opinion, a POSITA would have understood *Doclo* to disclose or suggest a processor (“logic circuit”) that executes computer program instructions to perform operations including generating a noise cancellation signal (“generating a noise reduction signal”) using a noise/reference microphone signal (“using at least one of the first microphone

signal”) and the error microphone signal (“using at least one of ... the third microphone signal”).

h. [1.6.2]: receiving an audio signal;

116. In my opinion, *Doclo* discloses or suggests “receiving an audio signal.”

117. *Doclo* discloses that its ANR system receives audio signal 132 denoted by $v[k]$ from audio source 134. *Doclo* ¶¶[0059] (“[T]he cancellation signal generator 101 has a first input 103 *a* for receiving the audio signal 132 to be played ...”), [0102], [0106], [0149]. *Doclo* further discloses that the audio signal may comprise music or voice communication. *Id.* ¶[0062].



Doclo, Figure 2 (annotated)

118. Accordingly, in my opinion, a POSITA would have understood *Doclo* to disclose or suggest a processor (“logic circuit”) that executes computer program instructions to perform operations including receiving an audio signal (“receiving an audio signal”).

i. [1.6.3]: generating a mixed audio signal by mixing the noise reduction signal with the audio signal; and

119. *Doclo* discloses or suggests “generating a mixed audio signal by mixing the noise reduction signal with the audio signal.”

120. *Doclo* discloses generating loudspeaker signal 109 denoted by $y[k]$ by summing the noise cancellation signal 114 denoted by $n[k]$ with the audio signal denoted by $v[k]$. *Doclo* ¶[0058] (“Summing the outputs of these filters, which correspond to filtered noise[-]related signals 116 and 118 determine the noise cancellation signal 114 which is added to the audio signal 132 at a summing unit 136, thereby yielding the loudspeaker signal 109.”). A POSITA would have understood that *Doclo*’s “summing” is a mixing operation, at least because *Doclo* uses “summing” and “combining” interchangeably (*Doclo* ¶[0013]), and because a POSITA would have understood that summing or combining signals is how signals are “mixed” together.

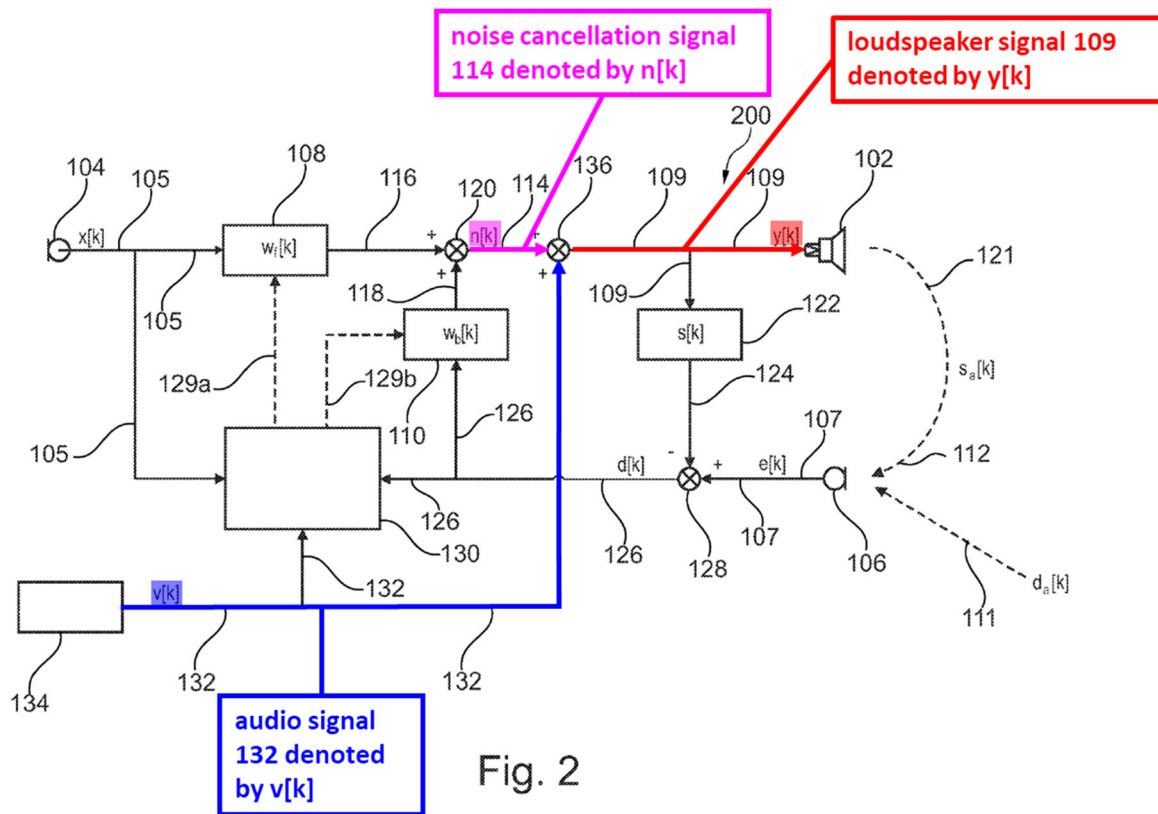


Fig. 2

Doclo, Figure 2

121. Accordingly, in my opinion, a POSITA would have understood *Doclo* to disclose or suggest a processor (“logic circuit”) that executes computer program instructions to perform operations including generating a loudspeaker signal (“generating a mixed audio signal”) by summing a noise cancellation signal with an audio signal (“by mixing the noise reduction signal with the audio signal”).

j. [1.6.4]: sending a modified audio signal to the speaker, where the modified audio signal includes the mixed audio signal.

122. In my opinion, *Doclo* in view of *Beasley* discloses or suggests “sending a modified audio signal to the speaker, where the modified audio signal includes the mixed audio signal.”

123. As detailed in §X.A.1.c, a POSITA would have found it obvious to modify *Doclo*’s hearing aid ANR system to incorporate *Beasley*’s teaching related to providing variable amplification of the mixed signal output.

124. As discussed in §X.A.2.i, *Doclo* discloses or suggests generating a loudspeaker signal (“generating a mixed audio signal”) by summing a noise cancellation signal with an audio signal (“by mixing the noise reduction signal with the audio signal”). The *Doclo-Beasley* combination, therefore, discloses or suggests that the loudspeaker signal is variably amplified before being output from the speaker. A POSITA would have recognized that variably amplifying the loudspeaker signal modifies the signal.

125. Accordingly, in my opinion, a POSITA would have understood the *Doclo-Beasley* combination to disclose or suggest a processor (“logic circuit”) that executes computer program instructions to perform operations including sending a variably amplified loudspeaker signal to a loudspeaker (“sending a modified audio signal to the speaker”), wherein the loudspeaker signal

comprises an audio signal (“where the modified audio signal includes the mixed audio signal”).

3. **Claim 2: The earpiece according to claim 1, wherein the operations further comprise: generating an ambient sound signal using at least one of the first microphone signal or the second microphone signal or a combination of both.**

126. In my opinion, the *Doclo-Beasley* combination discloses or suggests this claim.

127. As explained in §X.A.1.c, a POSITA would have found it obvious to modify *Doclo*’s hearing aid ANR system to incorporate *Beasley*’s teachings related to providing a bypass background audio signal.

128. As discussed in §X.A.2.b, *Doclo* discloses or suggests an external reference microphone (“first ambient microphone”) configured to generate a noise/reference microphone signal that is indicative of ambient noise (“configured to generate a first microphone signal”).

129. A POSITA would have understood that in the *Doclo-Beasley* combination, the *Beasley* bypass background audio signal is implemented by variably amplifying a signal from one of *Doclo*’s reference microphone signals before being mixed at summing unit 136. A POSITA would have understood that the variably amplified bypass background audio signal constitutes an “ambient sound signal” within the context of the ’315 patent. To note, neither

the claims nor the specification limit or otherwise specify a particular method for “generating” an ambient sound signal; all that is required is “using” one of the claimed microphone signals.

130. Accordingly, in my opinion, a POSITA would have understood the *Doclo-Beasley* combination to disclose or suggest a processor (“logic circuit”) that executes computer program instructions to perform operations including generating a variably amplified version of a bypass reference microphone signal (“generating an ambient sound signal using at least one of ... the first microphone signal”).

4. Claim 3: The earpiece according to claim 2, wherein the operations further comprise: generating the modified audio signal by mixing the ambient sound signal with the mixed audio signal.

131. In my opinion, the *Doclo-Beasley* combination discloses or suggests this claim.

132. As detailed in §X.A.1.c, a POSITA would have found it obvious to modify *Doclo*’s hearing aid ANR system to incorporate *Beasley*’s teachings related to providing a bypass background audio signal.

133. The combination discloses or suggests mixing the variably amplified bypass background audio signal (“ambient sound signal”) at *Doclo*’s summing unit 136. When audio bypass mode is off, *Doclo*’s audio signal and *Doclo*’s noise-cancellation signal are mixed and then the mixed signal is

variably amplified prior to being output from the speaker. When audio bypass mode is initiated, the respective gains of *Doclo*'s audio signal and noise-cancellation signal are attenuated, and the gain of *Doclo*'s bypass reference microphone signal is amplified; then all three signals are mixed and amplified prior to being output. As explained in §X.A.2.j, the variably amplified loudspeaker signal is a “modified audio signal,” as claimed.

134. As discussed in §IX.D, a POSITA would have understood this claim to require mixing the “ambient sound signal” with the “mixed audio signal” in a downstream modification of the mixed audio signal; that is, to generate the “mixed audio signal” in a first stage (or step) and then in a subsequent, second stage, mix the “ambient sound signal” with “the mixed audio signal.” The *Doclo-Beasley* combination renders obvious this two-step mixing process in view of the knowledge of a POSITA.

135. *Beasley* does not disclose how its summer 730 performs the summation of three signals, instead illustrating a black box. A POSITA would have understood that first generating a “mixed audio signal” by mixing a noise cancellation signal and an audio signal as disclosed in *Doclo* and then mixing the resulting “mixed audio signal” with an “ambient sound signal” would have amounted to choosing from a finite number of predictable solutions, with a reasonable expectation of success.

136. In particular, a POSITA would have recognized that when processors mix signals, they mix two signals at a time. This is because processors have an arithmetic logic unit (ALU)—the component of a processor that performs arithmetic operations such as addition—which performs operations on two operands at a time. This is corroborated, for example, by *Lee* and *Muthusamy*. *Lee* explains that “[i]n general, single processor systems sequentially perform operations on two operands. ... Thus an integer “add” instruction, in a 64-bit computer, adds two 64-bit integer operands to produce a 64-bit integer result.” *Lee*, 1:12-20; *see also Muthusamy*, 1:59-2:26 (“Many mathematical operations performed by the ALU proceed from the least significant bits of the operands to the most bits. For example, a typical ADD operation executed by a ripple-carry adder will add the least significant bit of a first operand to the least significant bit of a second operand to produce a least significant bit of result and a first carry bit.”)).⁹

137. Thus, a POSITA would have recognized that there are three potential implementations of the summing unit in the *Doclo-Beasley*

⁹ To be clear, I am relying on *Lee* and *Muthusamy* as evidence of the knowledge of a person having ordinary skill in the art and they are not part of the unpatentability ground 1A.

combination: (1) mixing the noise cancellation and audio signals followed by mixing the bypass background audio signal, (2) mixing the bypass background audio signal and audio signal first, followed by mixing the noise cancellation signal, and (3) mixing the noise cancellation and bypass background audio signals first, followed by mixing the audio signal.

138. A POSITA reviewing the disclosures of *Doclo* and *Beasley* would have recognized that each of these approaches is a design choice that would have the same predictable result—i.e., a “modified audio signal” that includes a mix of the noise cancellation signal, background audio, and the audio signal and desirably provides ambient sound passthrough. Indeed, *Beasley* expressly contemplates that “alternative configurations” may be used. *Beasley* ¶[0064]. Further, a POSITA would have had a reasonable expectation of success in mixing the noise reduction signal with the audio signal and then mixing the resulting signal with an ambient sound signal because this would involve performing conventional operations (amplifying and mixing signals) that were well known to a POSITA. At the very least, a POSITA would have recognized that *Beasley* does not specify how to add the three signals, and adding the noise reduction signal and audio signal first and then adding the ambient sound signal to the result was a known technique applicable to the summation in *Beasley*, with predictable results.

139. Thus, the *Doclo-Beasley* combination discloses or suggests applying *Beasley*'s teachings related to its bypass background audio signal to *Doclo*'s ANR system by mixing a variably amplified version of the bypass reference microphone signal ("ambient sound signal") the summed noise-cancellation and audio signal ("mixed audio signal") and then variably amplifying the resulting mixed signal prior to being output from the speaker (a "modified audio signal").

140. Accordingly, in my opinion, a POSITA would have understood the *Doclo-Beasley* combination to disclose or suggest a processor ("logic circuit") that executes computer program instructions to perform operations including generating a "modified audio signal" ("generating the modified audio signal") by mixing ("by mixing") a variably amplified version of a bypass background audio signal from a reference microphone ("the ambient sound signal") with a previously-generated loudspeaker signal ("with the mixed audio signal").

141. Alternatively, to the extent PO argues that claim 3 allows single step mixing, the *Doclo-Beasley* combination renders this limitation obvious because it discloses or suggests entering audio bypass mode and mixing all three signals at summing unit 136. More particularly, the combination discloses or suggests that when audio bypass mode is off, the loudspeaker signal is a mix of the noise-cancellation signal and the audio signal; and when audio bypass mode

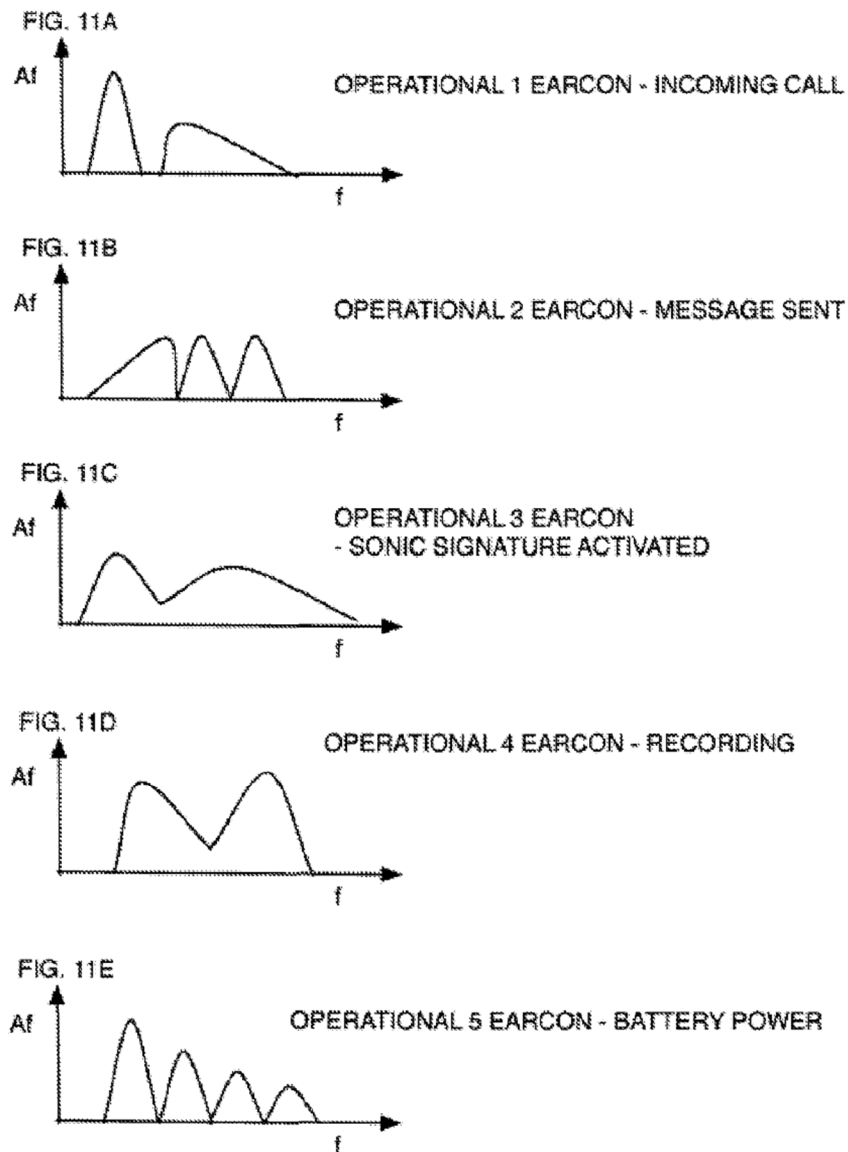
is initiated, the variably amplified bypass background audio signal from a reference microphone (“ambient sound signal”) is mixed with the noise-cancellation signal and audio signal.

B. Ground 1B: *Doclo, Beasley, and Goldstein* Render Obvious Claims 4-8

1. Claim 4: The earpiece according to claim 1, wherein the operations further comprise: receiving an indication of an event.

142. In my opinion, the *Doclo-Beasley-Goldstein* combination discloses or suggests this claim.

143. *Goldstein* is analogous to the '315 patent, as it is within the same field of endeavor and and/or reasonably pertinent to one or more problems addressed by the '315 patent. *Goldstein* discloses several examples of “operational earcons” that correspond to events such as an incoming phone call or incoming email. *Goldstein*, [0054] (“Briefly, FIGS 11A-11E, indicate examples of operational earcons that can be emitted to indicate to a user operational environment and status (e.g., battery life, *incoming call*, *incoming call name*, *incoming e-mail* ...”).



Goldstein, Figures 11A-E

144. In my opinion, a POSITA would have understood *Goldstein* to disclose or suggest that these earcons are emitted in response to receiving an indication that the event (e.g., an incoming call or incoming email) has occurred. In particular, *Goldstein* discloses a method including the steps of “detecting an operational status of a device [and] matching the detected operational status with

a related operational audio content; reproducing the related operational audio content with ... an Ear Canal Loudspeaker.” *Goldstein* ¶[0033]. In view of the exemplary “operational earcons” including, e.g., “incoming call,” a POSITA would have understood *Goldstein* to disclose or suggest a method including the step of detecting, for example, an incoming phone call or email (i.e., detecting an operational status). A POSITA would have understood that detecting an incoming phone call or email constitutes “receiving an indication of an event.”

145. A POSITA would have been motivated to combine the teachings of *Doclo*, *Beasley*, and *Goldstein* and would have had a reasonable expectation of success in doing so. *Doclo*, *Beasley*, and *Goldstein* are in the same field of art and are analogous art to the ’315 patent—i.e., they are all in the field related to a noise cancelling headset/earpiece. *See also Goldstein*, [0035] (“At least one exemplary embodiment of the invention is directed to an earpiece for background noise mitigation.”).

146. A POSITA would have been familiar with earcons as a common user interface tool and would have been familiar with how they are implemented to provide notifications from other applications. This is corroborated, for

example, by *Blattner* and *Loring*.¹⁰ *Blattner*, which bears a 1989 copyright date, discusses “earcons, which are audio messages used in the user-computer interface to provide information and feedback to the user about computer entities.” *Blattner* and Abstract. *Loring*, filed in 1996, explains that “[n]umerous advances have been made recently to simplify the manner in which users interact with computer systems,” including “in manner in which computers interact with the user’s auditory sense.” *Loring* at 1:13-2:18. “More recently, advances in the sampling and storage of audio wave forms has allowed many real-world sounds to be stored and played back by the computer system in coordination with certain system events, typically under control of the operating system. Such sonic events or ‘earcons’ are more interesting than the earlier rudimentary sounds generated by personal computers.” *Id.* *Loring* thus discloses “a user configurable earcon engine for use in a computer system having an audio processor contains apparatus, responsive to a message from a task executing on the computer system, for selecting one of plural earcon files and apparatus,

¹⁰ To be clear, I am relying on *Blattner* and *Loring* as evidence of the knowledge of a person having ordinary skill in the art and they are not part of the unpatentability ground 1B.

responsive to the selected earcon file, for translating the selected earcon file into information useable by the audio processor.” *Id.*

147. *Goldstein* further states its disclosures are applicable to hearing aids. *Goldstein* ¶[0028]. Moreover, a POSITA would have recognized that receiving an indication of an event in a hearing aid (such as an incoming call)—and subsequently, alerting the user of the event with an earcon—would be advantageous because it would allow the user to determine what action to take in response to the event. Indeed, *Doclo* expressly discloses that its ANR system is used for “voice communication” and further that “ANR can be beneficial for several applications,” including “mobile phone handsets.” *Doclo* ¶¶[0099] (“*ANR can be beneficial for several applications*, such as headsets, *mobile phone handsets*....”), [0124], [0062] (“When the ANR system ... is used for listening to music or for *voice communication* ...”), [0101] (“When the ANR headset is used for listening to music or for *voice communication*...”), [0003]-[0004].

148. A POSITA would have recognized that it would be advantageous to alert the ANR system—such as a hearing aid—user of an event such as an incoming call when the system is used in conjunction with a “mobile phone handset” for “voice communication.” This is corroborated, for example, by *Chambers*, which discloses a hearing prosthesis device (e.g., hearing aid) and

explains that “certain types of sounds may be of particular interest to the recipient, e.g. a telephone ringing, a baby crying or a fire alarm.” *Chambers* ¶[0095].¹¹

149. Further, applying *Goldstein*’s teachings related to earcons to the *Doclo-Beasley* combination would have amounted to applying a known technique (receiving a notification of an event and using earcons to provide alerts) to a known device (a noise cancelling hearing aid) ready for improvement to yield predictable results (a noise cancelling hearing aid that receives indications of events and alerts a user of, e.g., an incoming call). A POSITA would have also had a reasonable expectation of success in making the combination because receiving indications of events and providing earcon notifications would be a routine task that was well within the skill of a POSITA.

150. Accordingly, in my opinion, a POSITA would have understood the *Doclo-Beasley* combination to disclose or suggest a processor (“logic circuit”) that executes computer program instructions to perform operations including

¹¹ To be clear, I am relying on *Chambers* as evidence of the knowledge of a person having ordinary skill in the art and it is not part of the unpatentability ground 1B.

receiving an indication of an event such as an incoming phone call or incoming email (“receiving an indication of an event”).

2. Claim 5: The earpiece according to claim 4, wherein the event is at least one of a scheduled meeting, an incoming phone call, an email, a voice message, or a text message.

151. In my opinion, the *Doclo-Beasley-Goldstein* combination discloses or suggests this claim.

152. *Goldstein* discloses that the event may be an incoming call or an incoming email. *Goldstein*, [0054] (“Briefly, FIGS 11A-11E, indicate examples of operational earcons that can be emitted to indicate to a user operational environment and status (e.g., battery life, *incoming call*, *incoming call name*, *incoming e-mail*, feature on, feature off, wireless connection complete, volume, and any other operational status and environmental indicators one of ordinary skill can think of that can be associated with an earpiece.”).

153. In my opinion, a POSITA would have been motivated to combine the teachings of *Doclo*, *Beasley*, and *Goldstein* for the reasons discussed in §X.B.1.

154. Accordingly, in my opinion, a POSITA would have understood the *Doclo-Beasley* combination to disclose or suggest a processor (“logic circuit”) that executes computer program instructions to perform operations including receiving an indication of an event such as an incoming phone call or an

incoming email (“wherein the event is at least one of a scheduled meeting, *an incoming phone call, an email*, a voice message, or a text message”).

3. Claim 6: The earpiece according to claim 5, wherein the operations further comprise: retrieving an Earcon from the memory, where the Earcon matches the event.

155. In my opinion, the *Doclo-Beasley-Goldstein* combination discloses or suggests this claim.

156. *Goldstein* discloses that an earcon can be fetched from memory upon insertion. *Goldstein* ¶[0055] (“When the earphone is detected as being inserted, *an earcon can be fetched at step 404 from a memory storage 405.*”).

A POSITA would have understood this disclosure in *Goldstein* to disclose or suggest that earcons that match other events—such as an incoming call—are likewise retrieved from memory.

157. A POSITA would have been motivated to combine the teachings of *Doclo, Beasley*, and *Goldstein* for the reasons discussed in §X.B.1, and that, in this combination, the earcon would be retrieved from memory.

158. Accordingly, in my opinion, a POSITA would have understood the *Doclo-Beasley* combination to disclose or suggest a processor (“logic circuit”) that executes computer program instructions to perform operations including retrieving earcons that match incoming call or incoming email events from

memory (“retrieving an Earcon from the memory, where the Earcon matches the event”).

4. Claim 7: The earpiece according to claim 5, wherein the operations further comprise: sending the Earcon to the speaker.

159. In my opinion, the *Doclo-Beasley-Goldstein* combination discloses or suggests this claim.

160. *Goldstein* discloses that an earcon can be reproduced by a loudspeaker such as an ear canal receiver (ECR) (i.e., a speaker). *Goldstein* ¶[0056] (“At step 408, the *earcon can be reproduced with the loudspeakers such as the ECR 125* as shown at filtering step 409 and sound reproduction step 410.”). A POSITA would have understood this disclosure in *Goldstein* to disclose or suggest that earcons corresponding to events such as an incoming call or an incoming email are likewise sent to a speaker for reproduction.

161. A POSITA would have been motivated to combine the teachings of *Doclo, Beasley*, and *Goldstein* for the reasons discussed in §X.B.1, and that, in this combination, the earcon would be sent to the speaker.

162. Accordingly, a POSITA would have understood the *Doclo-Beasley* combination to disclose or suggest a processor (“logic circuit”) that executes computer program instructions to perform operations including sending earcons

corresponding to incoming call or incoming email events to a speaker (“sending the Earcon to the speaker”).

5. Claim 8: The earpiece according to claim 1, further comprising: a sealing section.

163. In my opinion, the *Doclo-Beasley-Goldstein* combination discloses or suggests this claim.

164. *Goldstein* discloses that “[t]he earpiece 100 can partially or fully occlude the ear canal 131 to provide various degrees of acoustic isolation.” *Goldstein* ¶[0036]. In particular, “[t]he assembly is designed to be inserted into the user[']s ear canal 131, and to form an **acoustic seal with the walls of the ear canal at a location 127** between the entrance to the ear canal and the tympanic membrane (or ear drum) 133. Such a seal is typically achieved by means of a soft and compliant housing of assembly 113.” *Id.*; *see also id.* ¶[0043].

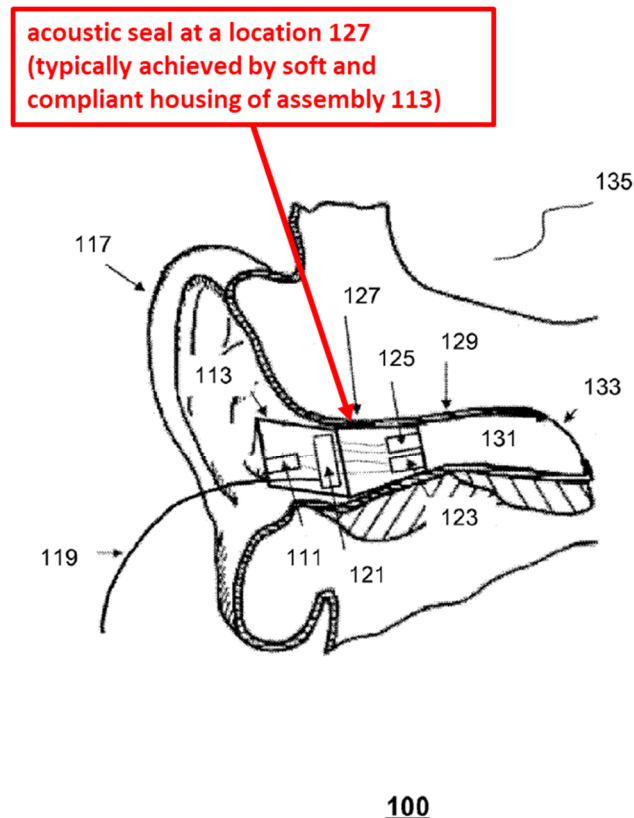


FIG. 1

Goldstein, Figure 1 (annotated)

165. A POSITA would have been motivated to combine the teachings of *Doclo*, *Beasley*, and *Goldstein* for the reasons discussed in §X.B.1. Additionally, a POSITA reviewing *Goldstein* would have recognized that, when applying ANR techniques in *Doclo*'s hearing aids, a sealing section would advantageously allow for "a full range bass response when reproducing sounds for the user" and "significantly reduce the sound pressure level at the user's eardrum." *Goldstein* ¶[0036]. And *Goldstein* discloses its disclosures are applicable to hearing aids. *Id.* ¶[0028]. A POSITA would have also found

including a sealing section in an in-ear earpiece with active noise reduction to amount to applying a known technique (including a sealing section) to a known device (in-ear earpiece with ANR) ready for improvement to yield predictable results.

166. Accordingly, in my opinion, a POSITA would have understood the *Doclo-Beasley-Goldstein* combination to disclose or suggest including an ear sealing section in an earpiece (“a sealing section”).

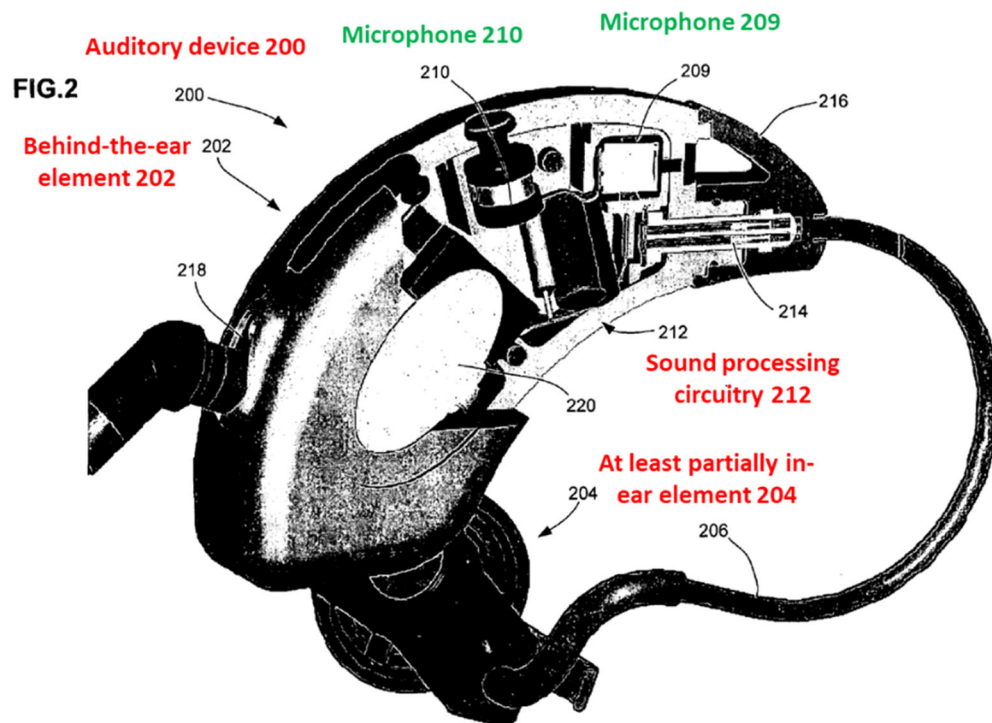
C. Ground 1C: *Doclo*, *Beasley*, and *Darbut* render obvious claims 1-3

167. If the Board finds that the preamble to claim 1—“[a]n earpiece comprising”—limits the claim to a single earpiece that includes the claimed components, it is my opinion that claims 1-3 nevertheless would have been obvious in view of the combination of *Doclo*, *Beasley*, and *Darbut*.

168. As discussed in §§X.A.2.a-X.A.2.f, a POSITA would have understood *Doclo*’s disclosure of applying its ANR system to hearing aids to encompass a hearing aid earpiece including at least one external microphone, an ear canal microphone, a speaker, a memory, and a processor for implementing *Doclo*’s ANR system as required by limitations [1.1], and [1.3]-[1.6.4].

169. By the earliest alleged priority date, it was also known to include a second external microphone in a hearing aid earpiece, which enabled directional processing (also known as beamforming). *Darbut* is exemplary, and it is

analogous to the '315 patent, as it is within the same field of endeavor and and/or reasonably pertinent to one or more problems addressed by the '315 patent. *Darbut* discloses an “auditory device” such as a “hearing aid” that “includes a behind-the-ear element and an at least partially in-ear element.” *Darbut*, Abstract, ¶[0002], [0011]. In Figure 2, *Darbut* illustrates auditory device 200 includes behind-the-ear element 202 with two external microphones 209, 210. *Darbut*, [0053]. “Sound from both microphones 209, 210 is ported to a digital signal processor ... to produce a directional effect, allowing the user of the auditory device 200 to improve the signal to noise ratio which provides better detection of signal in front of the user and attenuates sounds coming from behind.” *Id.*



Darbut, Figure 2 (annotated)

170. In view of the known benefits of including two external microphones in an earpiece as exemplified by *Darbut* (i.e., improved signal-to-noise ratio), a POSITA would have found it obvious to incorporate *Darbut*'s teaching related to a second external microphone into *Doclo*'s ANR hearing aid earpiece because it would have amounted to the use of known technique (*Darbut*'s second external microphone) to improve similar devices (*Doclo*'s ANR hearing aid) in the same way (to provide the user of *Doclo*'s hearing aid with an improved signal to noise ratio).

171. The analysis of how the *Doclo-Beasley-Darbut* combination renders claims 1-3 obvious is the same as discussed in §§X.A.2-X.A.4 with two exceptions. First, as to element [1.2], the *Doclo-Beasley-Darbut* combination discloses or suggests two ambient microphones in a single hearing aid earpiece.

172. Second, with respect to the “ambient sound signal” required by claims 2 and 3, the *Doclo-Beasley-Darbut* combination discloses or suggests that the signals from the two external reference microphones are combined (to implement beamforming) prior to being variably amplified, thus generating a beamformed, bypass reference audio signal. This beamformed bypass reference audio signal is still an “ambient sound signal” within the meaning of the '315 patent.

D. Ground 1D: *Doclo, Beasley, Darbut, and Goldstein* render obvious claims 4-8

173. *Doclo, Beasley, Darbut, and Goldstein* render claims 4-8 obvious for the same reasons discussed in §§X.B and X.C.

E. Ground 2A: *Asada* Renders Obvious Claims 1-5 and 8

174. *Asada* is analogous to the '315 patent, as it is within the same field of endeavor and and/or reasonably pertinent to one or more problems addressed by the '315 patent. *Asada* explains that earphones with noise-cancelling have become widespread. *Asada* ¶[0002]. At the same time, smartphones have also become widespread and uses for earphones and other head-mounted devices are no longer limited to listening to audio content, and the user's ability to listen to ambient sounds should be considered. *Id.* ¶¶[0004], [0005]. *Asada* therefore discloses a signal processing device for a head mounted acoustic device "capable of enabling a listener to listen to ambient sounds." *Id.* ¶[0006].

175. *Asada* explains that "there are cases in which it is desirable for the user to be able to hear so-called ambient sounds coming from an external environment in addition to acoustic information (for example, audio content) output from the information processing device while constantly wearing the head mounted acoustic device 51." *Id.* ¶[0039]. This is called the "hear-through state" or "hear-through effect," and it allows a user to "check a sound output indicating notification of content of e-mails or news while checking a

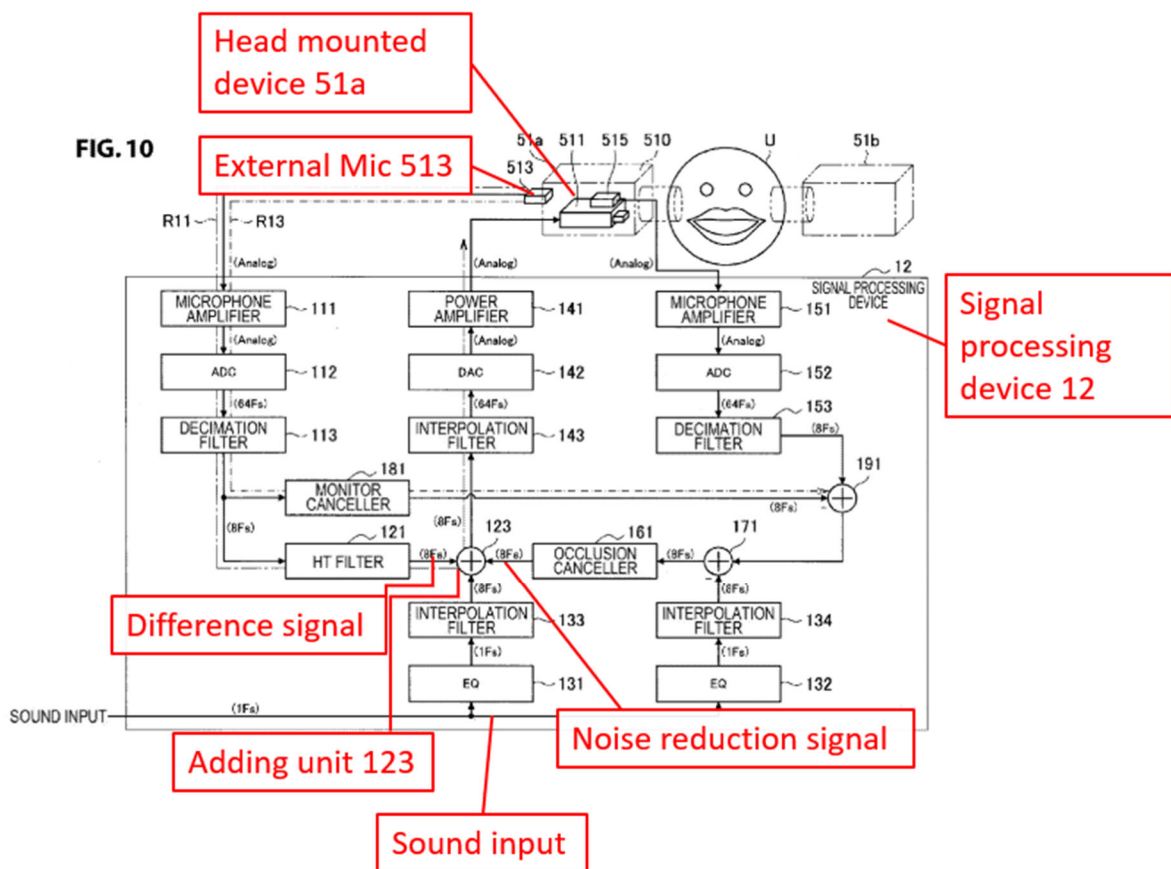
surrounding situation” or “to perform a phone call with another user by means of a so-called phone call function while checking a surrounding situation in motion.” *Id.* ¶[0040]. *Asada* explains that this is important for a head mounted devices with “high hermeticity ... such as a so-called canal type earphone.” *Id.* ¶[0042]. Thus, *Asada* discloses a technique for implementing the hear-through state in an “ear canal type earphone.” *Id.* ¶[0044].

176. *Asada* discloses several embodiments. My analysis focuses on the embodiment of Figure 10, but *Asada*’s embodiments build on each other, and *Asada* does not repeat the entire description of each component that is common to prior embodiments. *Asada* first describes a “basic functional configuration of the signal processing device for implementing the hear-through effect” in Figure 5. *Asada* ¶[0061]. Then, in Figure 7, *Asada* discloses a first embodiment of a “signal processing device 11” which differs from Figure 5 in certain specific respects, for example by addition of the subtracting unit 171, occlusion canceller 161, and EQ 132. *Id.* ¶[0084]. Figure 8 shows an example configuration of the signal processing device 11, and explains that it can be installed in the mounting unit 510 of the head mounted acoustic device. *Asada* ¶[0099]. Figures 9 and 10 further build on Figure 7 and disclose a “signal processing device 12.” *Id.* ¶¶[0105]-[0106], [0128]-[0129]. Thus, for example, my analysis cites some

description of the embodiments in Figures 7-9 for the purpose of explaining *Asada*'s disclosure regarding those components in the embodiment of Figure 10.

177. In Figure 10, *Asada* discloses a head mounted device that includes an external microphone 513, and internal microphone 515, and a signal processing device 12. *Asada* ¶¶[0105]-[0119]. The signal processing device 12 may be implemented within the head mounted device. *Id.* ¶¶[0099], [0105]-[0106], FIG. 8. To note, although *Asada* paragraph [0099] describes “signal processing device 11” being implemented in the head-mounted device, it is clear from the context that *Asada* discloses implementing signal processing devices 11-14 within the head-mounted device. *Asada* generally describes the differences between the different signal processing devices 11-14 (*Asada* ¶¶[0084], [106], [161]), and *Asada* never mentions any differences between the devices with respect to whether they can be implemented within the head-mounted device or not. Thus, a POSITA would have understood that each of *Asada*'s signal processing devices 11-14 may be implemented within the head-mounted acoustic device.

178. The adding unit 123 of the signal processing device adds three signals together: a “difference signal output from the HT filter 121,” a “sound input,” and a “noise reduction signal output from the occlusion canceller 161.” *Id.* ¶[0096].



Asada FIG. 10 (annotated)

179. **“Difference signal.”** The signal from the external microphone 513 is amplified by microphone amplifier 111 and processed through decimation filter 113 and an HT filter 121, which generates the “difference signal.” *Asada* ¶¶[0069]-[0071], [0132]-[0133]. *Asada* explains that the “difference signal” is a signal that when output in the user’s ear, simulates the “hear-through effect,” i.e., “the ambient sound in a case in which the user directly hears it is simulated.” *Id.* ¶[0071].

180. **“Sound input” signal.** Sound input is “audio content or a received signal in a voice call” that is processed through EQ 131 which performs an equalizing process and the interpolation filter 133 that performs up-sampling. *Asada ¶¶[0071], [0136].*

181. **“Noise reduction signal.”** The signal from the internal microphone 515 is first amplified by microphone amplifier 151. *Asada ¶[0088]. Asada* explains that the signal from the internal microphone 515 includes three component sounds: (1) the output from the speaker, (2) a component of the ambient sound that propagates into the ear canal; and (3) a component of the user’s voice propagating into the ear canal. *Asada ¶[0087].* The subtraction unit 191, together with the monitor canceller 181, are “configured to suppress a component corresponding to the difference signal among components” of the signal from the internal microphone. *Id. ¶[0107].*

182. The “subtracting unit 171 subtracts the sound input” from the output of the subtracting unit 191. *Id. ¶¶[0090], [0116]-[0117].* Then the output of the subtracting unit 191 is input into the occlusion canceller 161 which is “an acoustic signal in which the component corresponding to a difference signal and the component corresponding to the sound input ... are suppressed.” *Id. ¶[0117].* Then the occlusion canceller 161 “generates the noise reduction signal.” *Id. ¶[0118].*

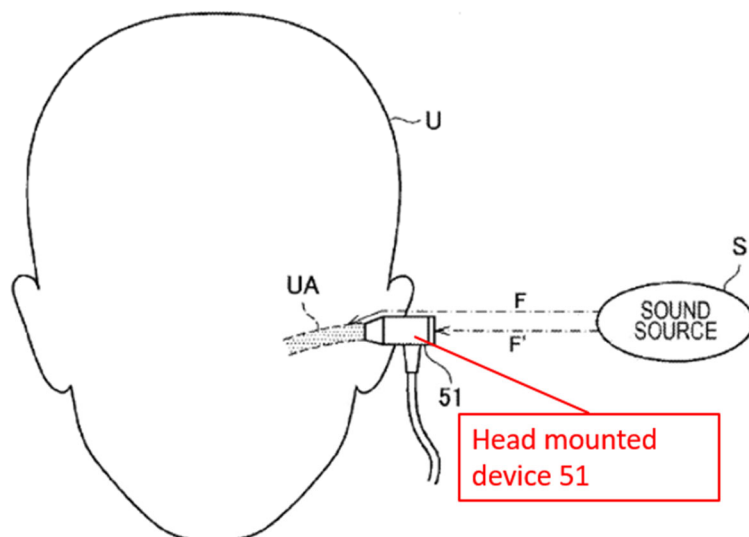
1. Claim 1

a. [1.pre]: An earpiece comprising:

183. I understand that “an earpiece comprising” is the preamble to claim 1 of the ’315 patent. For purposes of Ground 2A, I have been asked to assume that the preamble is a claim limitation. As discussed in §VII, in my opinion, a POSITA would have understood the claimed “earpiece” to encompass a left and/or right device.

184. *Asada* discloses or suggests “an earpiece.” For example, *Asada* discloses a “head-mounted device” implemented as an “ear canal-type earphone.” *Asada* ¶[0047], FIG. 3. This is consistent with how the ’315 patent describes an “earpiece.” *See, e.g.*, ’315 patent, 10:15-18, FIG. 5A.

FIG. 3



Asada FIG. 3 (annotated)

185. *Asada* discloses implementing a head mounted device in both the left ear and the right ear. *Asada* ¶[0062]. The head-mounted device 51b (for the left ear) is not shown in detail, because *Asada* states that it has a “similar configuration” to head mounted device 51a (for the right ear). *Id.* A POSITA would have understood *Asada* to disclose or suggest that the head-mounted devices 51a and 51b are the same with respect to the elements described below.

Asada FIG. 10 (annotated)

186. Accordingly, in my opinion, if the Board finds that the preamble is limiting, a POSITA would have understood *Asada* to disclose or suggest a head-

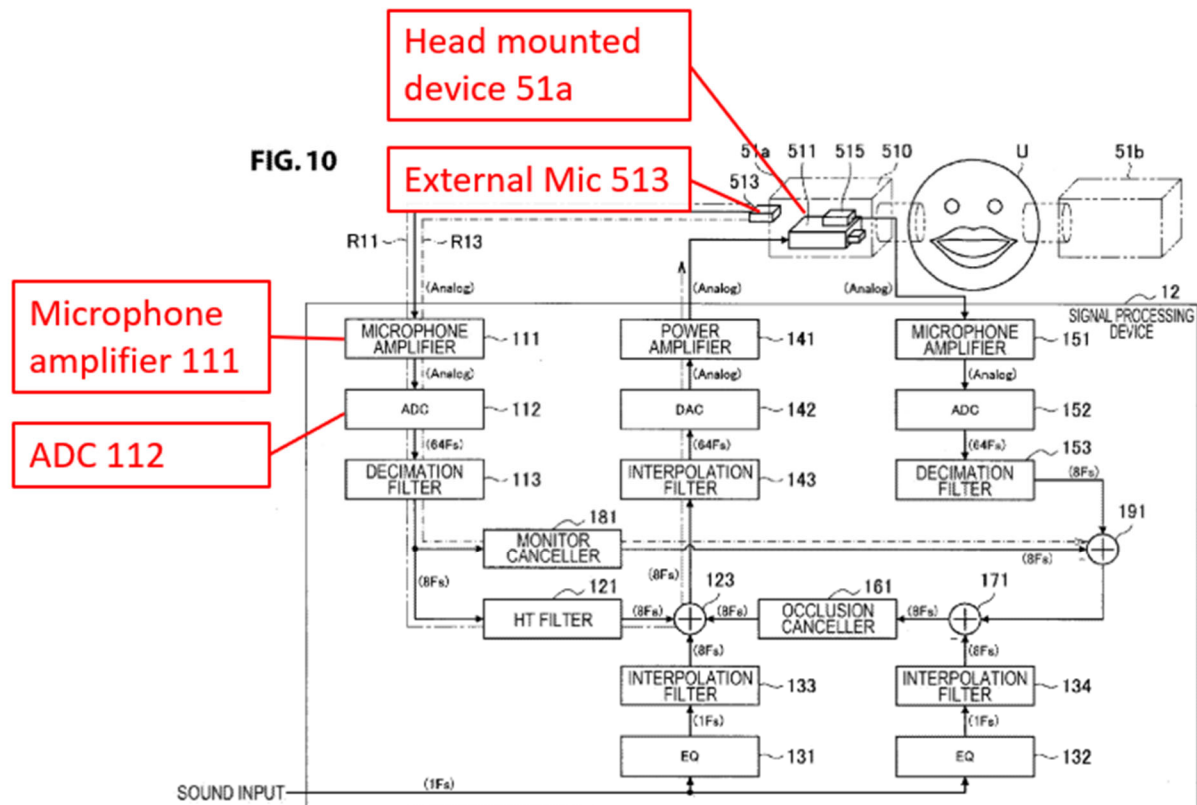
mounted device implemented as an ear canal-type earphone for the left and right ears (“An earpiece”).

- b. **[1.1] and [1.2]: a first ambient microphone configured to generate a first microphone signal; a second ambient microphone configured to generate a second microphone signal;**

187. In my opinion, *Asada* discloses or suggests “a first ambient microphone configured to generate a first microphone signal; a second ambient microphone configured to generate a second microphone signal.”

188. *Asada* discloses that the head-mounted device 51a includes an “external microphone 513” that “directly collects a sound (a so-called ambient sound).” *Asada* ¶¶[0063], [0068]. These disclosures are consistent with how the ’315 patent describes an “ambient microphone.” ’315 patent, 10:31-34.

189. *Asada* further discloses that “[t]he analog acoustic signal output on the basis of the sound collection result of the external microphone 513 undergoes gain adjustment performed by the microphone amplifier 111 and then converted into a digital signal through the ADC 112.” *Asada* ¶[0132], FIG. 10.



Asada FIG. 10 (annotated)

190. As explained in §X.E.1.a, *Asada* discloses or suggests that head-mounted device 51b has the same configuration as head-mounted device 51a. Thus, a POSITA would have understood *Asada* to disclose that head-mounted device 51b also includes an external microphone 513 that outputs a signal.

191. Accordingly, in my opinion, a POSITA would have understood *Asada* to disclose or suggest a first head-mounted device with an external microphone that collects ambient sound (“first ambient microphone”) and outputs a signal (“configured to generate a first microphone signal”), and a

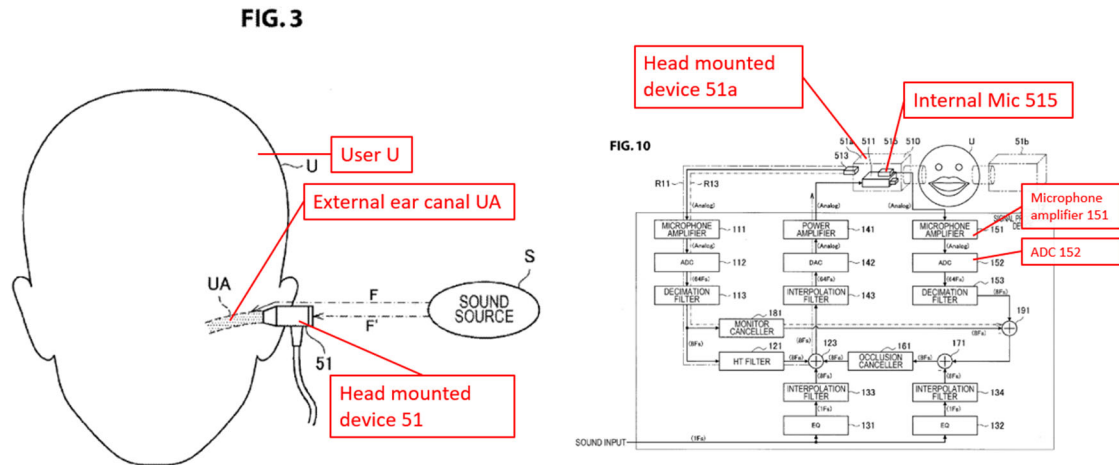
second head-mounted device with an external microphone that collects ambient sound (“second ambient microphone”) and outputs a signal (“configured to generate a second microphone signal”).

c. [1.3]: an ear canal microphone configured to generate a third microphone signal;

192. In my opinion, *Asada* discloses or suggests “an ear canal microphone configured to generate a third microphone signal.”

193. *Asada* discloses that the head mounted device 51a includes an “internal microphone 515” that is “installed in the mounting unit 510 to face the direction of the external ear canal UA” so it is “capable of collecting the sound propagating to the internal space.” *Asada* ¶¶[0085]-[0086]. This is consistent with how the ’315 patent describes an “ear canal microphone.” ’315 patent, 10:34-35.

194. *Asada* further discloses that “the analog acoustic signal output on the basis of the sound collection result of the internal microphone 515 undergoes gain adjustment performed by the microphone amplifier 151 and converted into a digital signal through the ADC 152.” *Id.* ¶[0134].



Asada FIGs. 3, 10 (annotated)

195. Accordingly, in my opinion, a POSITA would have understood *Asada* to disclose or suggest a head-mounted device including an internal microphone facing the ear canal and capable of collecting the sound propagating to the internal space (“ear canal microphone”) that outputs a signal (“configured to generate a third microphone signal”).

d. [1.4]: a speaker;

196. In my opinion, *Asada* discloses or suggests “a speaker.” *Asada* discloses that the head mounted device 51a includes a speaker. *Asada* ¶[0067].

197. Accordingly, in my opinion, a POSITA would have understood *Asada* to disclose or suggest a head-mounted device including a speaker (“a speaker”).

- e. **[1.5] and [1.6]: a memory that stores instructions; a logic circuit, where the logic circuit is configured to execute the instructions to perform operations comprising:**

198. In my opinion, *Asada* discloses or suggests “a memory that stores instructions; a logic circuit, where the logic circuit is configured to execute the instructions to perform operations”

199. *Asada* discloses that the head mounted device 51a includes a signal processing device housed within the head mounted device. *Asada* ¶[0099], FIG. 8.

200. *Asada* further discloses that the signal processing device includes a processor and memory and implements the components of the signal processing device. *Asada* ¶¶[0196]-[0197] (“The processor 901 may be constituted by, for example, an electronic circuit that executes various kinds of calculation processes. The components of the signal processing devices 11 to 14 (particularly, the HT filter 121, the occlusion canceller 161, the monitor canceller 181, or the like) may be implemented by the processor 901.”). This is consistent with how a POSITA would have understood the claimed “logic circuit.” ’315 patent, 10:36-38.

201. For example, *Asada* states that “[t]he components of the signal processing devices 11 to 14 (particularly, the HT filter 121, the occlusion canceller 161, the monitor canceller 181, *or the like*) may be implemented by the

processor 901.” *Asada* ¶[0197]. A POSITA would have understood that “or the like” includes the other components of the signal processing device, such as the adding units and the decimation/interpolation filters, which are also implemented after the ADC step in the digital domain. Thus, *Asada*’s broad assertion that the “[t]he components of the signal processing devices 11 to 14 ... may be implemented by the processor” discloses, and at a minimum suggests, to a POSITA such an implementation. *Asada* ¶[0008] (explaining “processor” “add[s] the difference signal and the noise reduction signal to the input acoustic signal”). This is consistent with the fact that the signals are converted to digital signals by the analog-to-digital converters (ADC) 112 and 152 from microphones 513 and 515 and are converted from digital signal by the digital-to-analog converter (DAC) 142 for transmission to the speaker 511. *Asada*, [0130], Fig. 10. A POSITA would have understood from these teachings that the components operating in the digital domain are implemented in processor 901.

202. *Asada* discloses the memory “stores programs and data executed by the processor 901.” *Asada* ¶[0198]. *Asada* further discloses “creat[ing] a program causing hardware such as a processor, a memory, and a storage which are installed in a computer to perform functions similar to those of the components of the signal processing device.” *Id.* ¶[0207]. A POSITA would have understood that programs comprise software instructions to be executed by

a processor. *See Computer Dictionary* (defining “program” as “[a] sequence of instructions that can be executed by a computer”).

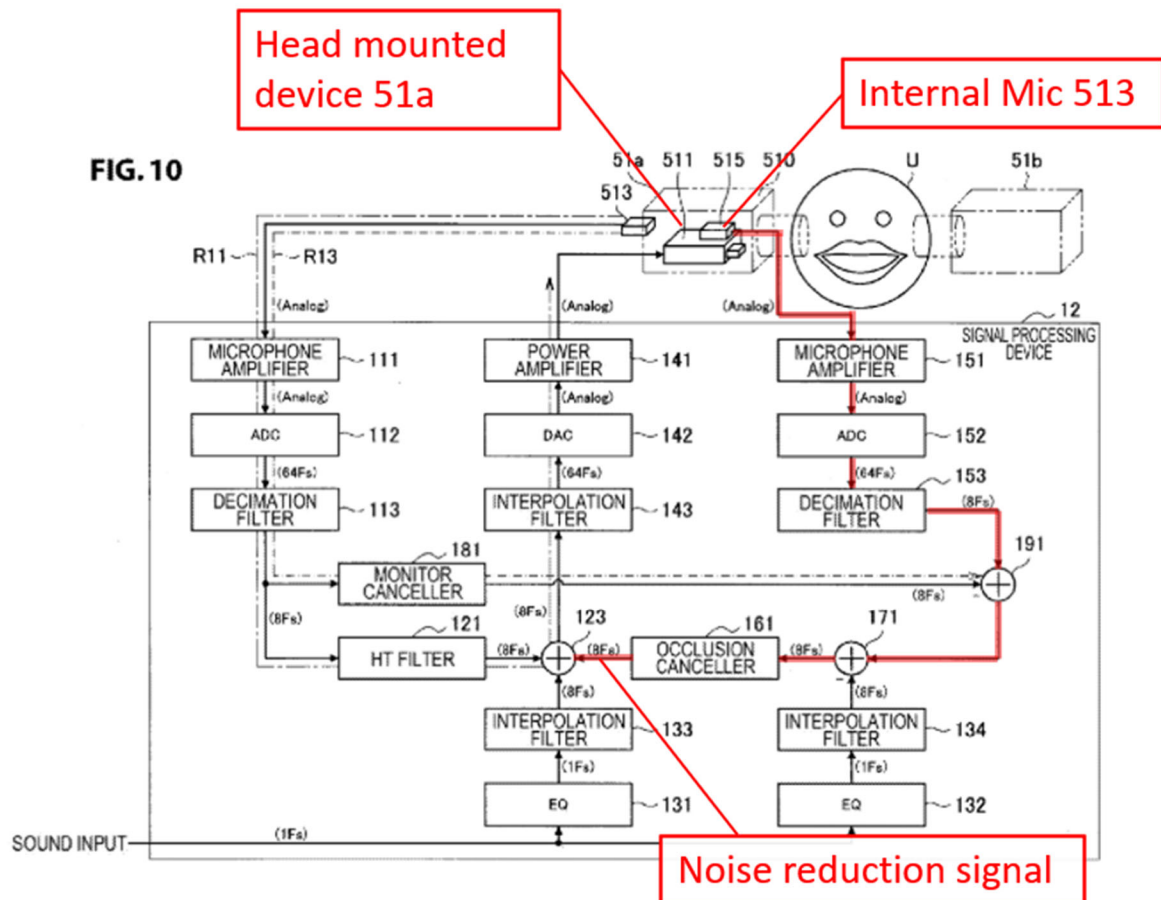
203. Accordingly, in my opinion, a POSITA would have understood *Asada* to disclose or suggest a head-mounted device including a signal processing circuit with a processor (“logic circuit”) and memory that stores programs (“a memory that stores instructions”) to be executed by the processor to perform functions of the signal processing device (“where the logic circuit is configured to execute the instructions to perform operations”).

- f. **[1.6.1]: generating a noise reduction signal using at least one of the first microphone signal or the second microphone signal or the third microphone signal or a combination of microphone signals;**

204. In my opinion, *Asada* discloses or suggests “generating a noise reduction signal using at least one of the first microphone signal or the second microphone signal or the third microphone signal or a combination of microphone signals.”

205. *Asada* discloses that the signal processing circuit includes an “occlusion canceller 161” that “generates [a] noise reduction signal on the basis of the acoustic signal output from the subtracting unit 171.” *Asada* ¶[0093]. The output from the subtracting unit 171 that is input to the occlusion canceller 161 is “an acoustic signal in which the component corresponding to a difference signal and the component corresponding to the sound input among the

components of the acoustic signal collected by the internal microphone 515 are suppressed.” *Id.* ¶[0117]. In other words, *Asada* discloses that the occlusion canceller generates a “noise reduction signal” based on an acoustic signal in which certain components of the signal collected by the internal microphone (“third microphone signal”) are suppressed.



Asada FIG. 10 (annotated)

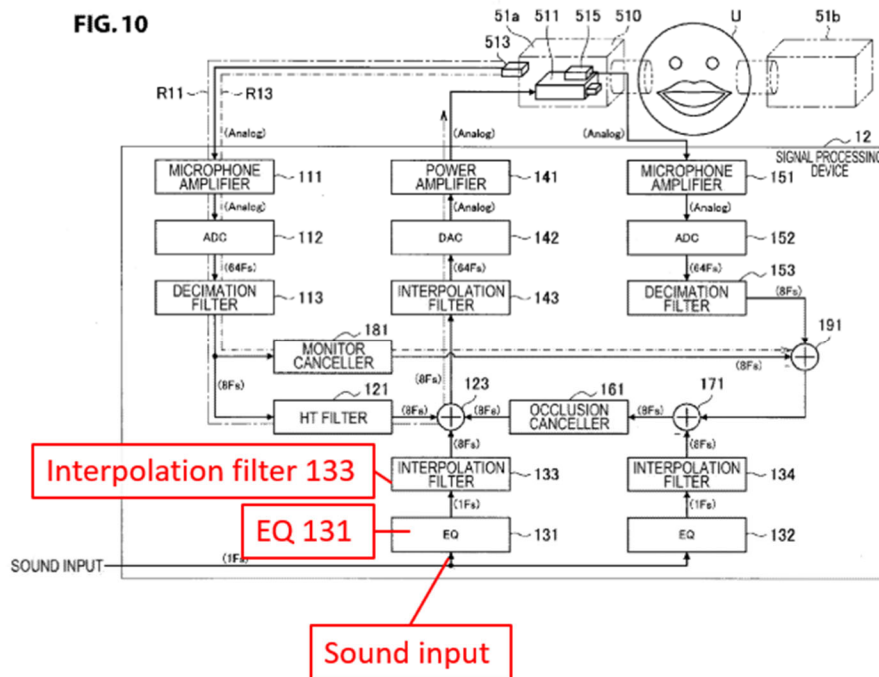
206. Accordingly, in my opinion, *Asada* discloses or suggests a signal processing device including a processor (“logic circuit”) executing instructions to implement the functions of the signal processing device, including generating

a noise reduction signal (“generating a noise reduction signal”) based on a signal collected by the internal microphone (“using at least one of the ... third microphone signal”).

g. [1.6.2]: receiving an audio signal;

207. In my opinion, *Asada* discloses or suggests “receiving an audio signal.”

208. *Asada* discloses that the signal processing device includes “EQ 131” that “performs a so-called equalizing process on the acoustic signal input to the signal processing device 80 (hereinafter also referred to as a ‘sound input’) such as audio content or a received signal in a voice call.” *Asada* ¶[0073]. “The sound input corresponds to an example of an ‘input acoustic signal.’” *Id.* “[T]he sound input ... which has undergone the equalizing process performed by the EQ 131 is up-sampled ... by the interpolation filter 133.” *Id.* ¶[0136].



Asada, FIG. 10 (annotated)

209. The “sound input” or “input acoustic signal” are consistent with how a POSITA would have understood an “audio signal” in the context of the ’315 patent. *See* ’315 patent, 6:30-33 (“Audio Playback: ‘Audio Playback’ shall be defined as the auditory stimuli generated when Playback Hardware reproduces audio content (music, speech, etc) for a listener or a group of listeners listening to Headphones.”), 12:30-33 (“In at least one exemplary embodiment the Personal Audio Assistant system can exchange audio signals with a mobile phone via the Communications Port, allowing the Personal Audio Assistant to function as a mobile phone accessory.”), 16:30-39 (“In at least one exemplary embodiment, as part of the Personalized Services, the user receives medication reminders in the form of speech signals, audio signals, text, or

graphics on the user's Personal Audio Assistant; Medication reminders are generated by the Server system based on the user's registration information. ... In at least one exemplary embodiment, as part of the Personalized Services, the user receives stock market information in the form of speech signals, audio signals, text, or graphics on the user's Personal Audio Assistant”).

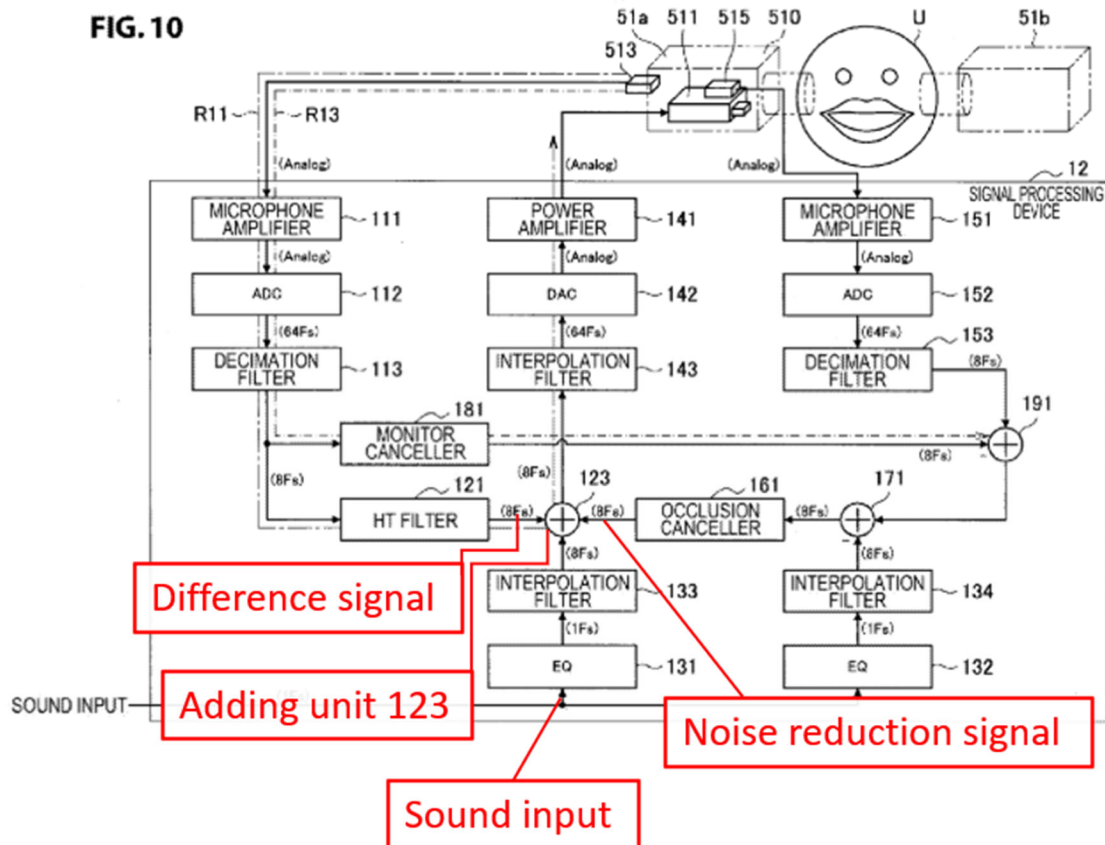
210. Accordingly, in my opinion, a POSITA would have understood *Asada* to disclose or suggest a signal processing device including a processor (“logic circuit”) executing instructions to perform the functions of the signal processing device including an EQ 131 that receives a sound input or input acoustic signal (“receiving an audio signal”).

h. [1.6.3]: generating a mixed audio signal by mixing the noise reduction signal with the audio signal; and

211. In my opinion, *Asada* discloses or suggests “generating a mixed audio signal by mixing the noise reduction signal with the audio signal.”

212. *Asada* discloses that the signal processing device includes an “addition unit 123” that “***adds*** ... the ***sound input*** output from the interpolation filter 133[] and the noise reduction signal output from the occlusion canceller 161.” *Asada* ¶[0137]. A POSITA would have understood that *Asada*’s adding unit 123 mixes the noise reduction signal output from the occlusion canceller and the sound input signal because mixing audio signals is accomplished by adding. This is corroborated, for example, by *Boersma*, which describes an

“adder” that “functions to combine the ambient sound signal with the audio signal” and that “[b]y way of adjusting the *mix switch 74*, the user can control the relative amplitude or ratio of the ambient sound signal to the audio signal as represented by the output of the adder 82.” *Boersma* ¶[0062].¹²



Asada, FIG. 10 (annotated)

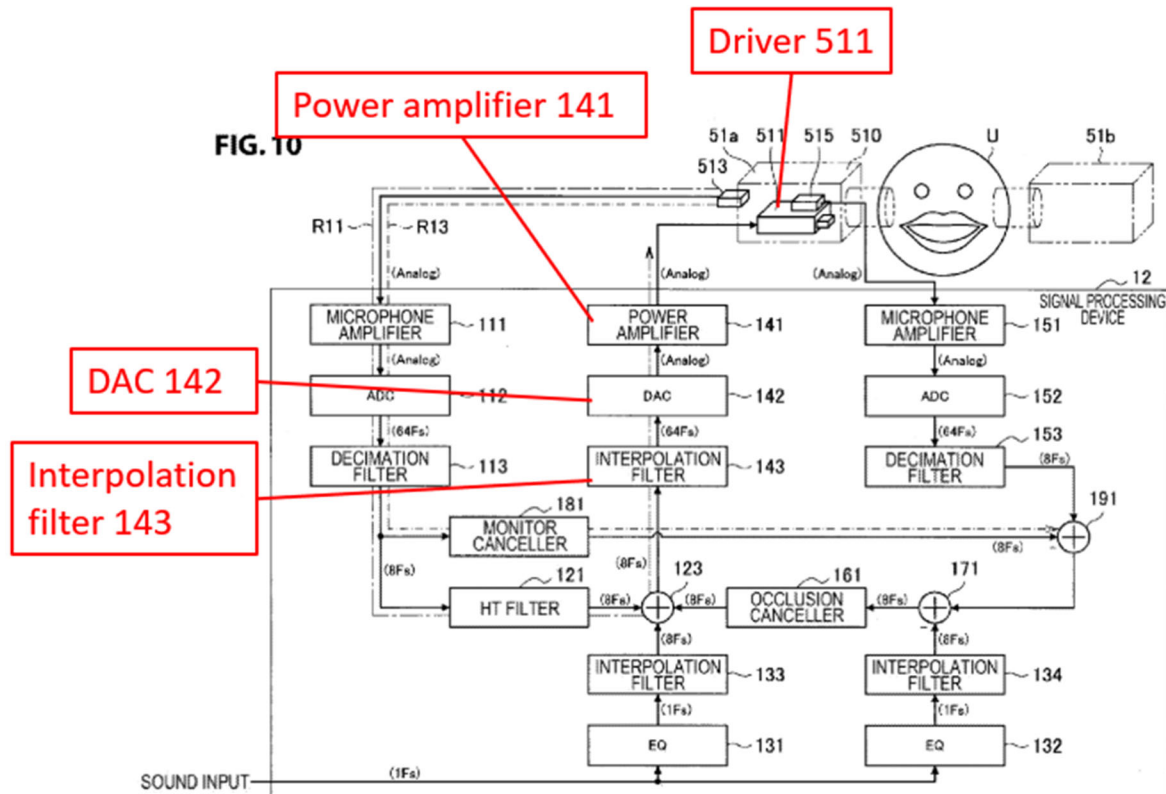
¹² To be clear, I am relying on *Boersma* as evidence of the knowledge of a person having ordinary skill in the art and they are not part of the unpatentability ground 2A.

213. Accordingly, in my opinion, a POSITA would have understood *Asada* to disclose or suggest a signal processing device including a processor (“logic circuit”) executing instructions to perform the functions of the signal processing device including an adding unit (“generating a mixed audio signal”) that adds a noise reduction signal to the sound input (“by mixing the noise reduction signal with the audio signal”).

i. [1.6.4]: sending a modified audio signal to the speaker, where the modified audio signal includes the mixed audio signal.

214. In my opinion, *Asada* discloses or suggests “sending a modified audio signal to the speaker, where the modified audio signal includes the mixed audio signal.”

215. *Asada* discloses that “the addition result of the adding unit 123 is up-sampled to a digital signal of 64 Fs by the interpolation filter 143, converted into an analog acoustic signal by the DAC 142, and input to the power amplifier 141,” and then “the analog acoustic signal undergoes gain adjustment performed by the power amplifier 141 and then input to the driver 511.” *Asada* ¶[0138]. And then the “driver 511 drives the speaker on the basis of the inputted analog acoustic signal.” *Id.* Thus, a POSITA would have understood that the interpolation filter outputs a signal that is sent to the speaker.



Asada FIG. 10 (annotated)

216. As explained in §X.E.1.h, the acoustic signal output from the adding unit 123 includes the “mixed signal.” Thus, a POSITA would have understood *Asada* to disclose that the mixed signal is up-sampled by the interpolation filter 143 included in the signal processing device before it is output to the speaker. A POSITA would have understood that up-sampling the signal modifies it because up-sampling increases the bit-rate of the signal. In this regard, *Asada* teaches that the bit rate of the signal output from the adding unit 123 and input to the interpolation unit 143 is $8 F_s$, and the bit rate of the signal output by the interpolation unit 143 is $64 F_s$, where F_s is equal to 48 kHz. *Asada*

¶¶[0129] (“In the example illustrated in FIG. 10, the sampling rate of the sound input to the signal processing device 12 is assumed to be 1 Fs (1 Fs=48 kHz).”), [0137]-[0138] (“At this time, all of the difference signal, the sound input, and the noise reduction signal added by the adding unit 123 are digital signals of 8 Fs. ... Then, the digital signal of 8 Fs output as the addition result of the adding unit 123 is up-sampled to a digital signal of 64 Fs by the interpolation filter 143.”).

217. Accordingly, in my opinion, a POSITA would have understood *Asada* to disclose or suggest a signal processing device including a processor (“logic circuit”) executing instructions to perform the functions of the signal processing device including an interpolation filter that outputs an up-sampled signal to the speaker (“sending a modified audio signal to the speaker”) wherein the interpolation filter up-samples the signal output from the adding unit (“where the modified audio signal includes the mixed audio signal”).

2. Claim 2: The earpiece according to claim 1, wherein the operations further comprise: generating an ambient sound signal using at least one of the first microphone signal or the second microphone signal or a combination of both.

218. In my opinion, *Asada* discloses or suggests this claim.

219. *Asada* discloses that the signal output from the external microphone 513 undergoes gain adjustment performed by the microphone amplifier 111, is

converted into a digital signal through the ADC 112, and then “[t]he decimation filter 113 down-samples the sampling rate of the digital signal output from the ADC 112 from 64 Fs to 8 Fs.” *Asada* ¶¶[0132]-[0133]. The HT filter operates on the down-sampled signal to generate a “difference signal,” which, when output to the user, simulates the ambient sound as if the user were not wearing the head-mounted device, i.e., the “hear-through effect.” *Id.* ¶¶[0071]-[0072], [0133]; *see also id.*, ¶¶[0078], [0108]-[0109]. A POSITA would have understood *Asada*’s “difference signal” to be an “ambient sound signal” in the context of the ’315 patent because it represents the ambient sound.

220. Accordingly, in my opinion, a POSITA would have understood *Asada* to disclose or suggest a signal processing device including a processor (“logic circuit”) executing instructions to perform the functions of the signal processing device including processing the signal from the external microphone to output a “difference signal” (“generating an ambient sound signal using at least one of the first microphone signal or the second microphone signal or a combination of both.”).

3. Claim 3: The earpiece according to claim 2, wherein the operations further comprise: generating the modified audio signal by mixing the ambient sound signal with the mixed audio signal.

221. In my opinion, *Asada* discloses or suggests this claim.

222. As explained in §X.E.1.h, *Asada* discloses that the signal processing device includes an adding unit 123 that adds the noise reduction signal output from the occlusion canceller 161 to the sound input (“generating a mixed audio signal”).

223. As explained in §X.E.2, *Asada* discloses that the HT filter outputs a “difference signal” (“ambient sound signal.”). *Asada* explains that the adding unit 123 also adds the difference signal to the noise reduction signal and sound input. *Asada* ¶[0137]; see also *id.* ¶¶[0075], [0096]-[0097].

224. As discussed in §IX.D, a POSITA would have understood this claim to require mixing the “ambient sound signal” with the “mixed signal” in a downstream modification of the mixed signal; that is, to generate the “mixed signal” in a first stage (or step) and then in a subsequent, second stage, mix the “ambient sound signal” with “the mixed signal.”

225. As discussed in §X.A.4 with respect to the *Doclo-Beasley* combination, there are three potential implementations for mixing three signals together. For the same reasons discussed there, it would have been obvious to mix the noise reduction signal with the sound input (to generate the “mixed audio signal”) and then mix the resulting signal with the difference signal (“ambient sound signal”) to generate the “modified audio signal.” At the very

least, a POSITA would have recognized this approach to be a known technique applicable to the summation in *Asada*, with predictable results.

226. Accordingly, in my opinion, a POSITA would have understood *Asada* to disclose or suggest a signal processing device including a processor (“logic circuit”) executing instructions to perform the functions of the signal processing device including “generating the modified audio signal” by mixing a difference signal (“mixing the ambient sound signal”) with *Asada*’s noise reduction signal and sound input (“with the mixed audio signal”).

227. Alternatively, to the extent PO argues that claim 3 does not require two-step mixing as discussed in §IX.D and X.A.4, *Asada* renders this limitation obvious because it discloses or suggests mixing all three signals together—the difference signal (“ambient sound signal”), the noise reduction signal (“noise reduction signal”), and the sound input (“audio signal”).

4. **Claim 4: The earpiece according to claim 1, wherein the operations further comprise: receiving an indication of an event; Claim 5: The earpiece according to claim 4, wherein the event is at least one of a scheduled meeting, an incoming phone call, an email, a voice message, or a text message.**

228. In my opinion, *Asada* discloses or suggests these claims.

229. *Asada* discloses that “in recent years, user interfaces (UIs) that enable users to recognize notification information without checking a screen or the like when an information processing device reads out the information by

voice through a speech synthesis technology have become widespread.” *Asada* ¶[0037]. *Asada* further discloses that if the hear-through state is implemented, “the user is able to check a sound output indicating notification of content of e-mails or news while checking a surrounding situation and wearing the head mounted acoustic device even in a public place.” *Id.* ¶[0041]. “As another example, the user is also able to perform a phone call with another user by means of a so-called phone call function while checking a surrounding situation in motion.” *Id.*; *see also id.* ¶¶[0190]-[0192] (describing a feature to hear the content of an email or voice call through a signal input to the head-mounted device). A POSITA would have understood that the head-mounted device receiving a sound output of, e.g., an email to constitute “receiving an indication of an event ... wherein the event is ... an incoming phone call [or] an email.”

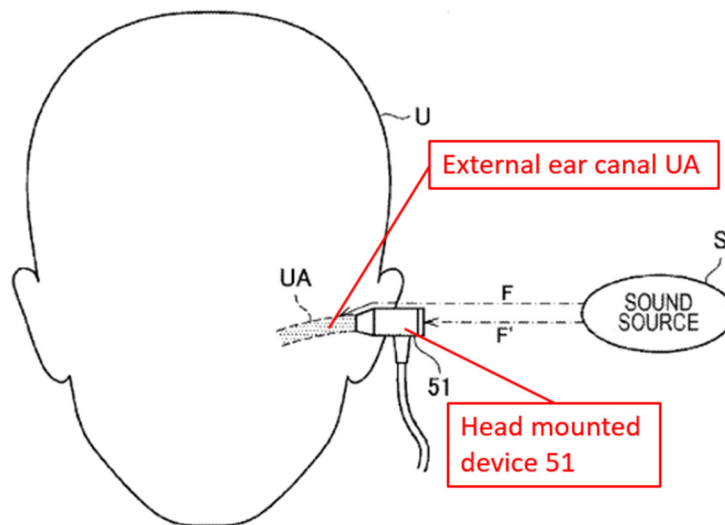
230. Accordingly, a POSITA would have understood *Asada* to disclose or suggest a signal processing device including a processor (“logic circuit”) executing instructions to perform the functions of the signal processing device including receiving a notification (“receiving an indication of an event”) wherein the notification corresponds to the content of e-mail (“wherein the event is at least one of ... an email.”).

5. Claim 8: The earpiece according to claim 1, further comprising: a sealing section.

231. In my opinion, *Asada* discloses or suggests this claim.

232. *Asada* illustrates the head mounted device implemented as an ear canal earphone in Figure 3, which shows “an ear hole insertion portion having a shape insertable into the ear hole of the user.” *Asada* ¶[0065]. *Asada* further discloses that the earphone has a “high hermeticity (in other words, a high shielding property against the external environment).” *Asada* ¶[0042]; *see also id.* ¶¶[0043]-[0044], [0080]-[0081].

FIG. 3



Asada FIG. 3 (annotated)

233. A POSITA would have understood that for the earphone to have high hermeticity and shielding from the external environment, the ear hole insertion portion seals the ear canal. This is consistent with how a POSITA would have understood the “sealing section 540” in Figure 5A of the ’315 patent.

234. Accordingly, a POSITA would have understood *Asada* to disclose or suggest a head mounted device implemented as an earphone with an ear hole insertion portion that has high hermeticity (“a sealing section”)

F. Ground 2B: *Asada* and *Goldstein* render obvious claims 4-7

- 1. Claim 4: The earpiece according to claim 1, wherein the operations further comprise: receiving an indication of an event; Claim 5: The earpiece according to claim 4, wherein the event is at least one of a scheduled meeting, an incoming phone call, an email, a voice message, or a text message.**

235. In my opinion, the *Asada-Goldstein* combination discloses or suggests these claims.

236. As explained in §X.E.4, it is my opinion that *Asada* alone renders these claims obvious. Separately and alternatively, these claims would have been obvious in view of the combination of *Asada* and *Goldstein*. As discussed in §X.B.1, *Goldstein* discloses several examples of “operational earcons” including, e.g., an “incoming e-mail” and a method for detecting the events corresponding to these operational earcons.

237. A POSITA would have found it obvious to incorporate *Goldstein*’s teachings into *Asada* and would have had a reasonable expectation of success in doing so. As discussed in §X.B.4, a POSITA would have been familiar with earcons as a common user interface tool and would have been aware of the advantages of using them. It was known, for example, to use earcons in the

context of phone and messaging applications. This is corroborated by, for example, *Roberts*, *Isaacs*, and *Goldstein-122*.¹³

238. *Roberts* relates to “a system and method for providing a call waiting priority alert service to telephone line subscribers” and describes providing a priority alert, which “may be a tone or an earcon (musical sound).” *Roberts* ¶[0010]. *Isaacs* discloses a system for “facilitating communications among a number of distributed users who can send and receive short sound earcons or sound message which are associated with specific conversational messages.” *Isaacs*, 1:56-2:47. And *Goldstein-122*, which shares a specification with the ’315 patent, discloses “associating a specific Earcon with the importance of the incoming email.” *Goldstein-122* ¶[0107].

239. Thus, applying *Goldstein*’s teachings related to earcons to *Asada* would have amounted to applying a known technique (receiving a notification of an event and using earcons to provide alerts) to a known device (*Asada*’s head-mounted device) ready for improvement to yield predictable results (*Asada*’s

¹³ To be clear, I am relying on *Roberts*, *Isaacs*, and *Goldstein-122* as evidence of the knowledge of a person having ordinary skill in the art and they are not part of the unpatentability ground 1B.

head-mounted device that receives indications of events, and alerts a user with an earcon for, e.g., an incoming call or email).

240. Accordingly, in my opinion, a POSITA would have understood the *Asada-Goldstein* combination to disclose or suggest a signal processing device including a processor (“logic circuit”) executing instructions to implement the functions of the signal processing device, including receiving an indication of an event such as an incoming email (“receiving an indication of an event”) wherein the notification corresponds to the incoming e-mail (“wherein the event is at least one of ... an email.”).

2. Claim 6: The earpiece according to claim 5, wherein the operations further comprise: retrieving an Earcon from the memory, where the Earcon matches the event.

241. In my opinion, the *Asada-Goldstein* combination discloses or suggests this claim.

242. As discussed in §X.B.3, a POSITA would have understood *Goldstein* to disclose or suggest that the earcons are retrieved from memory. A POSITA would have been motivated to combine the teachings of *Asada* and *Goldstein* for the reasons discussed in §X.F.1 and, in this combination, the earcon would be pulled from memory.

243. Accordingly, in my opinion, a POSITA would have understood the *Asada-Goldstein* combination to disclose or suggest a signal processing device

including a processor (“logic circuit”) executing instructions to implement the functions of the signal processing device, including to retrieve earcons that match incoming events (e.g., incoming phone call or email) from memory (“retrieving an Earcon from the memory, where the Earcon matches the event”).

3. Claim 7: The earpiece according to claim 5, wherein the operations further comprise: sending the Earcon to the speaker.

244. In my opinion, the *Asada-Goldstein* combination discloses or suggests this claim.

245. As discussed in §X.B.4, a POSITA would have understood *Goldstein* to disclose or suggest that earcons corresponding to events such as an incoming call or an incoming email are sent to a speaker for reproduction. A POSITA would have been motivated to combine the teachings of *Asada* and *Goldstein* for the reasons discussed in §X.F.1, and that, in this combination, the earcon would be sent to the speaker.

246. Accordingly, in my opinion, a POSITA would have understood the *Asada-Goldstein* combination to disclose or suggest a signal processing device including a processor (“logic circuit”) executing instructions to implement the functions of the signal processing device, including sending earcons corresponding to incoming email events to a speaker (“sending the Earcon to the speaker”).

G. Ground 2C: *Asada* and *Usher* Render Obvious Claims 1-5 and 8

247. If the Board finds that the preamble to claim 1—“[a]n earpiece comprising”—limits the claim to a single earpiece that includes the claimed components, it is my opinion that claims 1-5 and 8 nevertheless would have been obvious in view of the combination of *Asada* and *Usher*.

248. As discussed in §X.E, *Asada* notes that one of the problems with known earphones with high hermeticity was that they made the user less aware of their surroundings. It was also known that such earphones made it difficult to engage in conversations with others. This is corroborated, for example, by *Melanson* and *DiCenso*.¹⁴

249. *Melanson* explains that “it has become increasingly difficult to get the attention of a personal audio device user in order to converse with them, and conversation between persons using personal audio devices tends to be mutually exclusive of such use. For instance, a person generally must turn off or extremely attenuate their program material in order to conduct a conversation, or

¹⁴ To be clear, I am relying on *Melanson* and *DiCenso* as evidence of the knowledge of a person having ordinary skill in the art and they are not part of the unpatentability ground 2C.

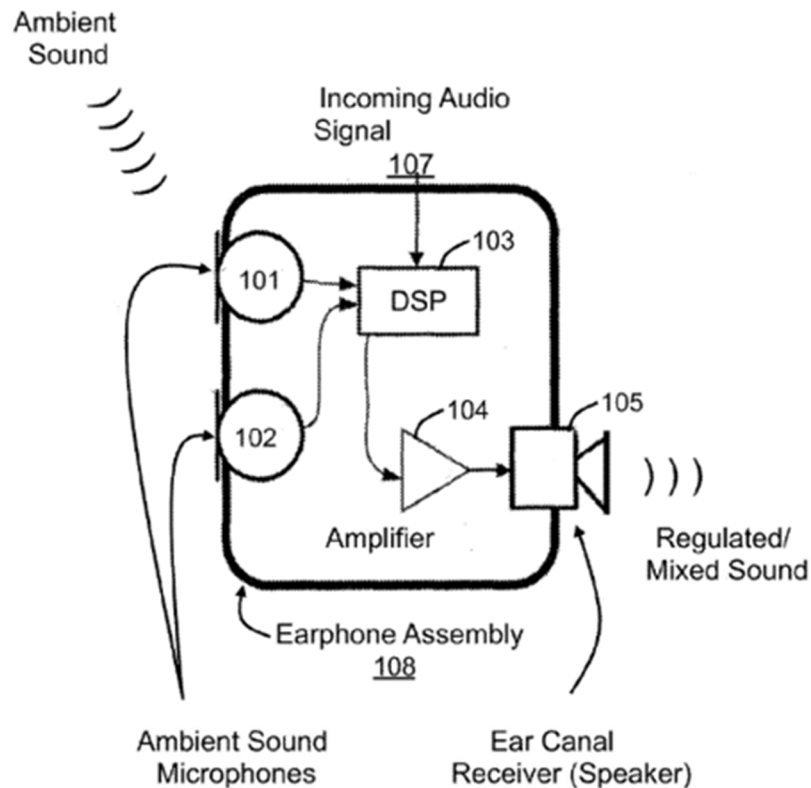
must remove one or both headphone elements from their ears.” *Melanson*, 1:28-35.

250. *DiCenso* similarly explains that “using headphones may reduce a user’s ability to hear and communicate with those around the user, isolating the user from the surrounding environment. Moreover, many headphones provide noise-isolation and/or noise-cancellation functions designed to reduce the degree to which a user can hear ambient sounds. As such, a user may not be able to hear when someone is trying to get his or her attention. Additionally, in many cases, in order to communicate with others, the user must pause the media player and/or remove the headphones in order to converse with others.” *Id.* ¶[0005].

251. *Usher* is analogous to the ’315 patent, as it is within the same field of endeavor and and/or reasonably pertinent to one or more problems addressed by the ’315 patent. *Usher* discloses an earphone similar to *Asada* and discloses techniques “for automatically detecting when an earphone user and a second nearby user are engaged in a voice conversation, and activating a sound pass-through system such that the nearby voice source is automatically heard by the user of the sound isolating earphone.” *Usher* ¶[0019].

252. Like *Asada*, *Usher* discloses an earphone that fully occludes the ear canal and includes a processor and various microphones for implementing an ambient sound pass-through feature. *Usher* ¶¶[0019]-[0020] (“FIG. 1A

illustrates an earphone 100 that can provide sound isolation and is configured by way of electronic components to detect close voice sources and enhance situation awareness in accordance with an exemplary embodiment... In some embodiments, the earphone assembly 108 can occlude a user's ear canal.”). Particularly relevant here, *Usher* discloses implementing two ambient microphones in the earphone *Id.* ¶¶[0020]-[0022], FIG. 1A.



Earphone 100

100

FIG. 1A

Usher FIG. 1A (annotated)

253. *Usher* further discloses using the ambient microphones in the earphone to implement beamforming to, for example, permit manual capture of a sound source. *Id.* ¶[0028]. In particular, *Usher* explains with reference to Figure 2A that “the microphones or any portion thereof in any of the devices **100**, **100 a**, **100 b**, 150, and 160 can work cooperatively to enhance situational awareness as contemplated by the various embodiments herein.” *Id.* As one example, *Usher* teaches that microphones can be used “in an array, for example, beamforming for localization of a user’s voice or for permitting manual capture of a sound source.” *Id.*; *see also* Claim 8.

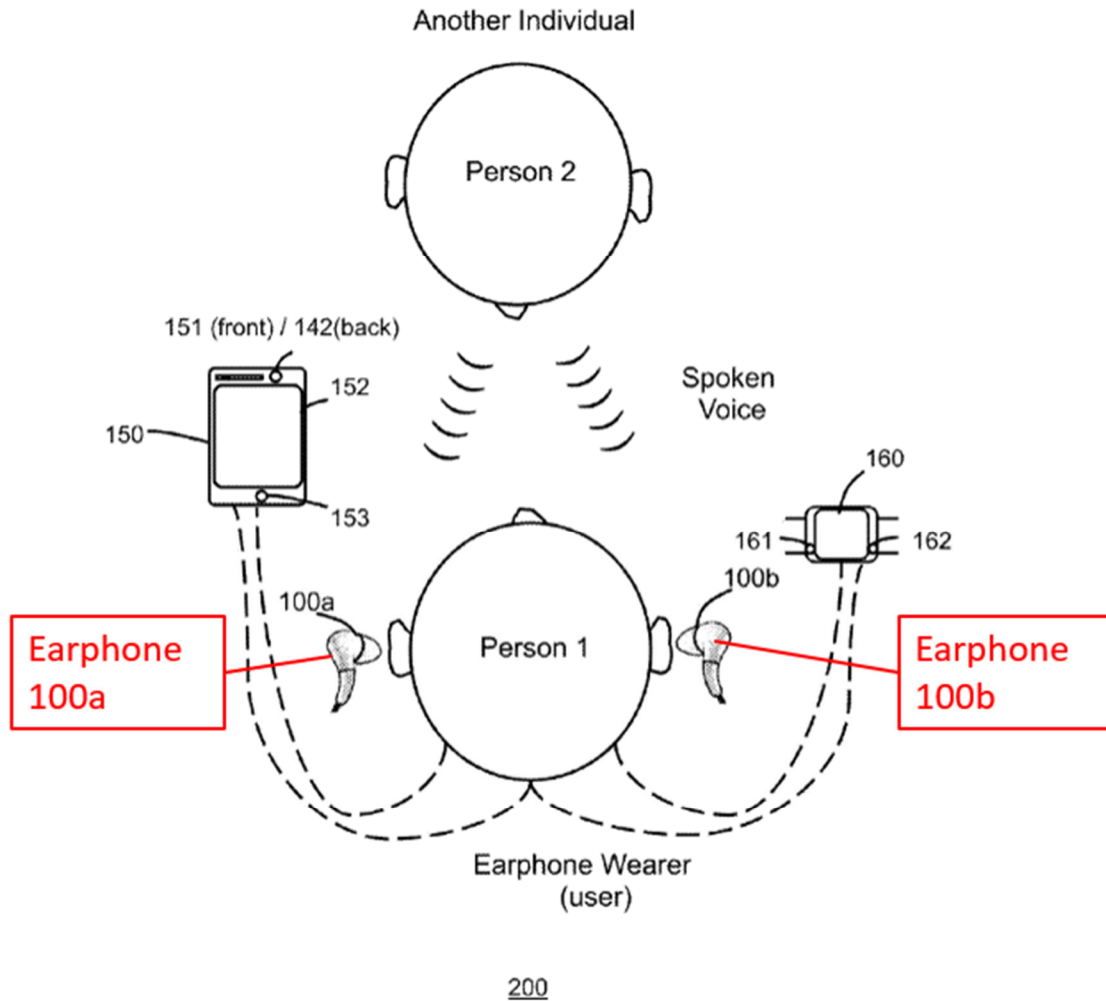


FIG. 2A

Usher, FIG. 2A (annotated)

254. *Usher* further teaches that the “second ambient microphone 102 captures ambient sounds, allowing the processor to localize the direction and the proximity of an incoming acoustic sound of the second individual speaking to the user” and “[i]t thereafter determines the proximity of the individual with respect to the user wearing the earphone 100; and adjusts the gain of the ambient sound pass-through of the ambient sound microphone (one or both 101/102)

reproduced by the internal speaker 105 as a function of the direction and proximity.” *Id.* ¶[0040].

255. Beamforming was a known technique in devices like *Asada* and *Usher* that enables a spatially selective pass-through of ambient sound. This is corroborated, for example, by *Basu*, published in May 2001 and describing “Smart Headphones” for “enhancing auditory awareness by selectively passing speech sounds in the environment to the user.” *Basu* at Abstract, Introduction, Section 2.2. *DiCenso* similarly discloses reproducing ambient sound “in a spatially correct manner” when “using more than one microphone 140.” *DiCenso* ¶[0032]. And *Kirsch* discloses using beamformers to pass-through sounds of interest and suppress other sounds. *Kirsch* ¶¶[0017]-[0020] (“Because microphone arrays 105(0) and 105(1) include multiple microphones, beamformers 110(0) and 110(1) are able to spatially filter environmental audio in a directional manner”).¹⁵

256. Thus, with beamforming, the user could advantageously be provided an ambient sound signal that allowed the user to hear a sound of

¹⁵ To be clear, I am relying on *Basu*, *DiCenso*, and *Kirsch* as evidence of the knowledge of a person having ordinary skill in the art and they are not part of the unpatentability ground 2C.

interest (such as another person speaking) while suppressing other background noise that was not of interest. A POSITA would have understood that *Usher's* teachings would improve *Asada's* device because it would allow a user of *Asada's* device to receive spatially selective ambient sound pass-through.

257. Therefore, a POSITA would have found it obvious to implement *Usher's* teaching related to having multiple ambient microphones in an earpiece for beamforming into *Asada's* device because it would have amounted to the use of a known technique (*Usher's* teachings of multiple ambient microphones and beamforming) to improve similar devices (*Asada* and *Usher* are similarly directed to ambient sound passthrough for occluding earphones) in the same way (to provide *Asada's* earphone with additional microphones to implement beamforming).

258. The analysis of how the *Asada-Usher* combination renders claims 1-5 and 8 obvious is the same as discussed in §§X.E.1-X.E.5 with two exceptions. First, as to element [1.2], the *Asada-Usher* combination discloses or suggests a second external microphone 513 that operates in the same manner as the first external microphone included in the head-mounted device 51a.

259. Second, with respect to the “ambient sound signal” required by claims 2 and 3, the *Asada-Usher* combination discloses or suggests that the signals from the two external microphones 513 are combined (to implement

beamforming) prior to being input to the HT filter 121, thus generating a beamformed “difference signal.” This beamformed difference signal is still an “ambient sound signal” within the meaning of the ’315 patent.

H. Ground 2D: *Asada, Usher, and Goldstein* Render Obvious Claims 4-7

260. *Asada, Usher, and Goldstein* render claims 4-7 obvious for the same reasons discussed in §X.F.

XI. SECONDARY CONSIDERATIONS

261. I am not aware of any evidence in the ’315 patent’s prosecution history or elsewhere supporting any secondary considerations arguments, or evidence of nexus of such alleged evidence to the challenged claims. *See generally* EX1004, §VIII.B. To the extent Patent Owner asserts the existence of any secondary considerations in its responses, I reserve the right to address any such evidence.

XII. CONCLUSION

262. The findings and opinions set forth in this declaration are based on my work and examinations to date.

263. I may continue my examinations. I may also receive additional documentation and other factual evidence over the course of this IPR that will allow me to supplement and/or refine my opinions. I reserve the right to add to, alter, or delete my opinions and my declaration upon discovery of any additional

information. I reserve the right to make such changes as may be deemed necessary.

264. In signing this declaration, I recognize that the declaration will be filed as evidence in an IPR before the PTAB. I also recognize that I may be subject to cross-examination in the case and that cross-examination will take place within the United States. If cross-examination is required of me, I will appear for cross-examination within the United States during the time allotted for cross-examination.

265. I hereby 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 are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Date: June 25, 2024



Nathaniel Polish