

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD., and
SAMSUNG ELECTRONICS, AMERICA, INC.

Petitioners

v.

STATON TECHIYA, LLC,

Patent Owner

Case IPR2024-01004

U.S. Patent No. 11,710,473

**DECLARATION OF CHRIS KYRIAKAKIS, PH.D. IN SUPPORT
OF PETITION FOR INTER PARTES REVIEW
OF U.S. PATENT NO. 11,710,473**

TABLE OF CONTENTS

	<u>Page</u>
I. ASSIGNMENT	1
II. QUALIFICATIONS.....	1
III. SUMMARY OF CONCLUSIONS FORMED	7
IV. LEVEL OF ORDINARY SKILL IN THE ART.....	7
V. LEGAL PRINCIPLES.....	8
VI. MATERIALS CONSIDERED.....	14
VII. OVERVIEW OF THE '473 PATENT	17
A. THE SPECIFICATION	17
B. PROSECUTION HISTORY	23
C. THE CLAIMS	51
VIII. BACKGROUND OF THE PRIOR ART	55
A. Ambient Pass-Through and Mixing with Audio Content Were Well-known Before February 2022	55
B. Earpiece Remote Controls Were Well-Known Before February 2022	64
C. Earpieces With Multiple Microphones, A Processor, And A Memory Were Well-Known Before February 2022	67
IX. INTERPRETATION OF THE '473 PATENT CLAIMS	68
X. SPECIFIC GROUNDS FOR CHALLENGE.....	69
A. THE CHALLENGED CLAIMS ARE NOT ENTITLED TO A PRIORITY DATE EARLIER THAN FEBRUARY 3, 2022	69
1. The '892App. does not support claims 1-7	71
a. No disclosure of a device “sending an audio content gain value and an ambient sound gain value to the earpiece.” (Claims 1-7).....	71
b. No disclosure of a device sending both “gain values” and an “audio content signal” to an earpiece. (Claims 1-7).....	75

c.	No disclosure of a “portable communication device” that is a “a watch, a tablet, earpiece, a laptop computer or a combination thereof.” (Claim 7)	77
2.	The ‘892App. does not support claims 8-20	77
a.	No disclosure of combining microphone signals. (Claims 8-20).....	77
b.	No disclosure of “generating a noise reduction signal” (Claims 10-12).....	79
c.	No disclosure of “mixing the noise reduction signal with the mixed signal to generate a new mixed signal, and sending the new mixed signal to the speaker instead of the mixed signal.”	80
B.	GROUND 1: <i>KIRSCH</i> AND <i>DICENSO</i> RENDER OBVIOUS CLAIMS 1-7	81
1.	Motivation to Combine <i>Kirsch</i> and <i>DiCenso</i>	81
a.	Overview of Kirsch	82
b.	Overview of DiCenso	88
c.	Motivation to Combine Kirsch and DiCenso	94
2.	Claim 1	97
a.	[1.pre]: A device that can control ambient passthrough in an earpiece comprising:	97
b.	[1.1]: a first memory that stores instructions; and [1.2] a processor that executes the instructions to perform operations, the operations comprising	98
c.	[1.3]: communicatively connecting to an earpiece, wherein the earpiece includes a first microphone, a second microphone, a speaker, a second memory and an earpiece processor;	99
d.	[1.4] and [1.5] sending an audio content gain value and an ambient sound gain value to the earpiece, sending an audio content signal to the earpiece	102
e.	[1.6]-[1.8] wherein the earpiece processor applies the audio content gain value to the audio content signal to generate a modified audio content signal,	

	wherein the earpiece processor applies the ambient sound gain value to an ambient sound signal to generate a modified ambient sound signal, and mixes the modified ambient sound signal with the modified audio content signal to generate a mixed signal.....	106
3.	Claim 2 (“The device according to claim 1, wherein the earpiece processor calculates a noise level based upon a first microphone signal from the first microphone, wherein the earpiece processor modifies the mixed signal based upon the noise level.”).....	109
4.	Claim 3 (“The device according to claim 1, wherein the earpiece processor generates the ambient sound signal from a first microphone signal from the first microphone”); Claim 5 (“The device according to claim 1, wherein the earpiece processor applies an mbient gain to a first microphone signal from the first microphone to generate the ambient sound signal.”)	111
5.	Claim 4 (“The device according to claim 1 further including a user interface.”)	112
6.	Claim 6 (“The device according to claim 1, wherein the device is a portable communication device”); Claim 7 (“The device according to claim 6, where the device portable communication device is at least one of a phone, a watch, a tablet, earpiece, a laptop computer or a combination thereof.”)	113
C.	GROUND 2: <i>GOLDSTEIN</i> IN COMBINATION WITH <i>WOODRUFF</i> RENDER OBVIOUS CLAIMS 8-20	113
1.	Motivation to combine <i>Goldstein</i> and <i>Woodruff</i>	113
a.	Overview of Woodruff	114
b.	Motivation to combine.....	119
2.	Claim 8	121
a.	[8.pre]: A device that can control ambient sound passthrough comprising:.....	121
b.	[8.1]-8.5]: a first microphone that measures a first acoustic environment to generate a first microphone	

	signal; a second microphone that is positioned closer to a user's ear canal than the first microphone when the device is worn, where the second microphone generates a second microphone signal; a speaker; and a memory that stores instructions; and a processor that executes the instructions to perform operations, the operations comprising:	122
c.	[8.6] and [8.7]: receiving an audio content signal; modifying the audio content signal to generate a modified audio content signal;	127
d.	[8.8] and [8.9]: modifying the first microphone signal to generate a modified first microphone signal; modifying the second microphone signal to generate a modified second microphone signal;	128
e.	[8.10]: generating an ambient sound signal from at least one of the modified first microphone signal, the modified second microphone signal or a combination thereof;	129
f.	[8.12]: detecting an acute sound by analyzing at least one of the modified first microphone signal, the modified second microphone signal or a combination thereof;	130
g.	[8.10]: modifying the modified audio content signal if an acute sound is detected to generate a new modified audio content signal;	131
h.	[8.13] and [8.14]: generating a mixed signal by mixing the ambient sound signal with the modified audio content signal or the new modified audio content signal; and sending the mixed signal to the speaker	132
3.	Claim 9: The device according to claim 8, wherein the operations further comprise: determining if the acute sound is a user's voice by analyzing the temporal and spectral characteristics of at least one of the modified first microphone signal, the modified second microphone signal or a combination thereof.	133

4. Claim 10 (“The device according to claim 9, wherein the operations further comprise: generating a noise signal from at least one of the modified first microphone signal, the modified second microphone signal, or both; generating a noise reduction signal”); Claim 11 (“mixing the noise reduction signal with the mixed signal to generate a new mixed signal, and sending the new mixed signal to the speaker instead of the mixed signal.”) 134
5. Claim 12: The device according to claim 11, wherein the operations further comprise: sending a modified ambient signal to the speaker instead of the new mixed signal if the user’s voice is detected. 136
6. Claim 13: The device according to claim 9, wherein the operations further comprise: sending a modified ambient signal to the speaker instead of the mixed signal if the user's voice is detected..... 138
7. Claim 14: The device according to claim 9, wherein the operations further comprise: detecting whether the acute sound is at least one of a warning sound, siren, voice, specific noise type, or a combination, by analyzing the spectrum of at least one of th modified first microphone signal, the modified second microphone signal, the modified ambient sound signal, or a combination. 138
8. Claim 15: The device according to claim 14, wherein the operations further comprise: decreasing a volume of the modified audio content signal when a warning or siren is detected..... 139
9. Claim 16: The device according to claim 14, where the operations further comprise: sending a notification signal to the speaker if the acute sound is a warning sound or siren. 140
10. Claim 17: The device according to claim 16, wherein the warning sound is at least one of a bell, an emergency vehicle, the sound of a security system or a combination thereof. 140
11. Claim 18: The device according to claim 14, wherein if an alarm is detected it is at least one of a police siren, an ambulance siren, a car honking or a combination thereof. ... 141

12. Claim 19: The device according to claim 8, wherein the operations further comprise: decreasing a volume of the modified audio content signal when a user's voice is detected.	141
13. Claim 20: The device according to claim 8, wherein the acute sound is a voice.	142
XI. SECONDARY CONSIDERATIONS	143
XII. CONCLUSION	143

I, Chris Kyriakakis declare that:

I. ASSIGNMENT

1. I have been retained on behalf of Samsung Electronics Co., Ltd. to offer technical opinions related to U.S. Patent No. 11,710,473 (“the ’473 patent”) (EX1001). 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 ’473 patent.

2. I have been asked to provide my independent analysis of the ’473 patent based on the prior art publications cited in this declaration.

3. I am not and never have been, an employee of Samsung. I received no compensation for this declaration beyond my normal hourly compensation based on my time actually spent analyzing the ’473 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 ’473 patent.

II. QUALIFICATIONS

4. 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 education, experience, and knowledge regarding electrical engineering, computer science, and audio and acoustic sciences.

5. I am over 18 years of age and, if I am called upon to do so, I would be competent to testify as to the matters set forth herein. A copy of my current curriculum vitae, which details my education and professional and academic experience, as well as a list of all publications I have authored in the past ten years, is included as EX1003 in this proceeding. The following provides an overview of some of my experience that is relevant to the matters set forth in this declaration.

6. I earned my Bachelor of Science degree in Engineering and Applied Science from the California Institute of Technology (Caltech) in 1985. I received my Master of Science degree in Electrical Engineering in 1987 and my Ph.D. in Electrical Engineering in 1993, both from the University of Southern California (“USC”).

7. Since 2002, I am a tenured Associate Professor in the Electrical Engineering Department at USC. My research interests lie at the intersection of acoustics, psychoacoustics (the science that studies human perception of sound), and audio signal processing. My recent research has focused on the study of audio systems in challenging environments including automobiles and mobile devices, as well as algorithms for enhancing the performance of voice recognition engines. I have published nearly 100 technical papers, including several peer reviewed papers. I have published a book entitled *Immersive Audio*

Signal Processing, and hold several patents in acoustic measurement of loudspeakers in rooms and cars, loudspeaker crossover optimization, and loudspeaker response correction using signal processing. My publications examine various aspects of sound measurement, how sound interacts with the acoustical elements of the environment, novel methods for surround sound recording and reproduction, and the perception of sound by human listeners.

8. A focus of my research has been the study of microphone arrays for applications in enhanced far field voice recognition. This includes methods for Direction of Arrival finding and beam forming from linear and circular microphone arrays. I have also investigated methods for noise removal and reverberation reduction from microphone signals. In addition, over the past year, I have worked on methods for echo cancellation for applications in wearable devices. Previous work includes loudspeakers and how they interact with their acoustical environment.

9. In particular, I have researched the role of sound reflections, absorption, and diffusion in the performance of loudspeakers. I have also published several technical papers on acoustical measurement methods in rooms and device enclosures and developed novel signal processing algorithms for optimizing sound system performance. Other topics I have researched include multichannel audio acquisition and rendering, virtual microphones and virtual

speakers, hybrid headphone- loudspeaker rendering methods, and advanced signal processing techniques for optimizing sound quality from small portable devices.

10. I am the founding Director of the USC Immersive Audio Laboratory with facilities for experimental work in room acoustics, multichannel audio, and psychoacoustics. This laboratory also serves as a unique teaching facility for my undergraduate course in Introduction to Digital Audio and my graduate course in Immersive Audio Signal Processing. Both courses have a major acoustics component that examines the interaction of sound with the acoustical environment (e.g., home, movie theater, car). The graduate course was developed through a two- year grant I received from the National Science Foundation entitled “Collaborative Learning in Engineering Using Immersive Environments,” and was the first of its kind to assess the impact of audio immersion in student learning. In addition to the courses I teach, I have also supervised and served on Ph.D. dissertation committees for more than 30 students.

11. In 2019, I joined Syng as the Chief Audio Scientist. Syng creates innovative products for next generation spatial audio and my role there includes research and development of audio algorithms for sound capture using

microphone arrays to measure the acoustics of the room and loudspeaker beamforming for rendering sound in various directions.

12. From 2003 to 2018, I was the co-founder and Chief Technology Officer of Audyssey Laboratories, a USC spin-off company that develops and licenses audio technology to leading automotive, professional and consumer electronic companies around the world. A major project that I led and worked on was focused on the measurement and characterization of in-ear and over ear earbuds and headphones. This work included the development of methods for measuring earbuds and headphones using a mannequin with artificial ears and, in particular, methods for testing for proper seal prior to taking acoustical measurements. It also included the use of ear canal microphones and comparisons of the in-ear microphone response with a reference microphone in the room. A database of over 500 in-ear earbuds and headphones was created using these methods. The acoustical correction filters that were generated for each headphone were implemented as an embedded solution that could run on DSP processors in mobile devices and laptop computers.

13. I also developed audio algorithms and designed speakers. These speakers were novel acoustical designs that used a combination of unique enclosures, and audio signal processing to optimize their performance and overcome limitations that arise from small drivers and enclosures. For example,

we used signal processing technologies combined with novel acoustical design to extend the bass response of small woofers and passive radiators beyond what was previously possible in small speaker enclosures. The innovations in these designs have received awards, including Popular Science's "Best of What's New."

14. In April 2018 I was elected as Senior Member of the Institute of Electrical and Electronic Engineers (IEEE) in recognition of my contributions to the field of engineering. I am also a member of the Audio Engineering Society (AES), an association for professionals in the audio industry.

15. In 2006, I received a World Technology Network Award. This organization presents awards to innovators in several areas in which technology can foster a paradigm change. My award was for innovations in immersive audio that enable new capabilities in media and journalism. Other award recipients at that event included Vice President Al Gore, Google, and Space-X. In addition, my work has been featured in multiple news articles, including pieces by The Atlantic, the BBC World Service, the New York Times, and National Public Radio.

16. In the late 1990s and early 2000s, I was a faculty researcher and later Deputy Director of the National Science Foundation's engineering research center established at USC. I was studying the fundamental and technological

limitations of immersive audio and the role of acoustics on the performance of loudspeakers and audio systems in homes and cars. In 2003, together with one of my graduate students, I received the award for Best Paper at the Institute of Electrical and Electronics Engineers (“IEEE”) Conference on Signals, Systems and Computers.

III. SUMMARY OF CONCLUSIONS FORMED

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

- Ground 1: *Kirsch* and *DiCenso* render obvious claims 1-7
- Ground 2: *Goldstein* and *Woodruff* render obvious claim 8-20

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 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. As detailed below in §X.A, it is my opinion that the Challenged Claims are not entitled to priority before February 3, 2022. I have filed a separate declaration in connection with IPR2024-01003 in which I was asked to presume that the Challenged Claims are entitled to a priority date January 22, 2007.

19. Based on my knowledge and experience in the field and my review of the ’473 patent and file history, I believe that a person having ordinary skill in

the art in this matter would have had at least 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 or speech processing and/or acoustic pattern recognition. A greater amount of education could compensate for fewer years of work experience, and vice versa. This is the appropriate level of skill whether the claims are entitled to priority as of January 22, 2007 or February 3, 2022.

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 a published nonprovisional application is entitled to claim priority to the filing date of its provisional application (as opposed to the filing date of the published non-provisional application) if (1) the provisional application discloses the portions of the published non-provisional application relied upon as prior art, and (2) at least one claim of the published non-provisional claim is supported by the provisional application, i.e., the provisional application must disclose the subject matter of the claim and enable a person of ordinary skill in the art to make and use the claim.

24. 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.

25. 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.

26. 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.

27. 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.

28. 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.

29. I further understand that a hypothetical person of 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.

30. I further understand that, in making a determination as to whether the claimed invention would have been obvious to a person of 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.

31. 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.

32. 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.

33. 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

34. 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 early 2000s, and I taught, participated in organizations, and worked closely with many such persons in the field during that time frame.

35. 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 '473 patent; my own knowledge and experiences gained from my work experience in the field of the '473 patent and

related disciplines; and my experience in working with others involved in this field and related disciplines.

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

- U.S. Patent 11,710,473 (EX1001)
- File History of U.S. Patent 11,710,473 (EX1004)
- U.S. Provisional Application 60/885,917 (EX1005)
- U.S. Application 17/321,892 (EX1006)
- U.S. Patent 11,244,666 (“’666 patent”) (EX1007)
- File History of U.S. Patent 11,244,666 (EX1008)
- File History of U.S. Appl. No. 90/019,169, Samsung Electronics Co., Ltd. and Samsung Electronics, America, Inc., Request for *Ex Parte Reexamination* of U.S. Pat. No. 11,244,666, Date: Feb. 24, 2023 (EX1009)
- U.S. Patent 4,455,677 (“*Fox*”) (EX1023)
- U.S. Patent 4,827,458 (“*d’Arc*”) (EX1024)
- EP0495653A (“*Smiedt*”) (EX1025)
- U.S. Patent 5,647,011 (“*Garvis*”) (EX1026)
- U.S. Patent 6,782,106 (“*Kong*”) (EX1027)

- 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) (EX1028)
- Florian Mueller & Matthew Karau, *Transparent Hearing*, CHI '02 EXTENDED ABSTRACTS ON HUM. FACTORS IN COMPUTING SYS. 730 (2002) (EX1029)
- U.S. Publication 2001/0046304A1 ("*Rast*") (EX1030)
- U.S. Patent 4,947,432 ("*Topholm432*") (EX1031)
- U.S. Patent 5,202,927 ("*Topholm927*") (EX1032)
- Excerpts from ROBERT OSHANA, DSP SOFTWARE DEVELOPMENT TECHNIQUES FOR EMBEDDED AND REAL-TIME SYSTEMS (2006) ("*Oshana*") (EX1036)
- U.S. Patent 7,903,826 ("*Boersma*") (EX1051)
- U.S. Publication 2018/0160211 ("*Kirsch*") (EX1052)
- U.S. Publication 2015/0195641 ("*DiCenso*") (EX1053)
- U.S. Publication 2008/0181419 ("*Goldstein*") (EX1054)
- U.S. Publication 2020/0380945 ("*Woodruff*") (EX1055)
- U.S. Publication 2006/0120545A1 ("*Rasmussen*") (EX1057)

- *Kuo*, et al., “Active Noise Control: A Tutorial Review,” In Proc. IEEE 87(6) (June 1999) (“*Kuo*”) (EX1058)

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

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

VII. OVERVIEW OF THE ’473 PATENT

A. THE SPECIFICATION

38. The ’473 patent is titled “Method and Device for Acute Sound Detection and Reproduction.”

(12) United States Patent Goldstein et al.	(10) Patent No.: US 11,710,473 B2 (45) Date of Patent: Jul. 25, 2023
(54) METHOD AND DEVICE FOR ACUTE SOUND DETECTION AND REPRODUCTION	(58) Field of Classification Search CPC G10K 11/17827; G10K 11/002; H04R 1/1016; H04R 1/1083; H04R 3/002.

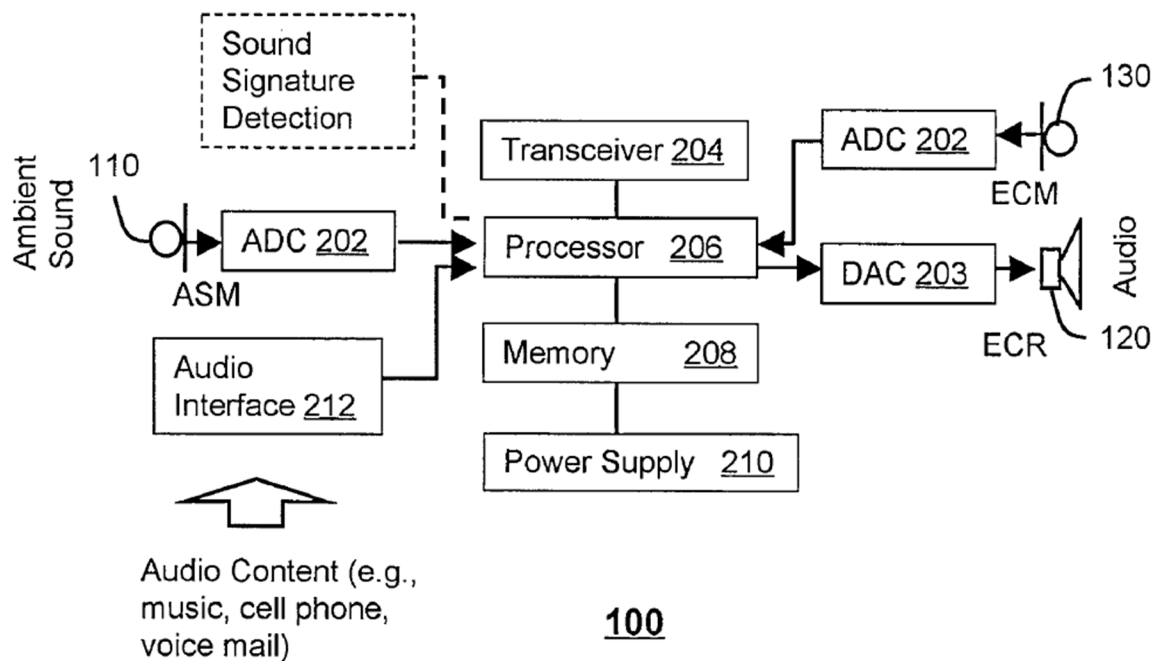
EX1001, Cover (annotated)¹

39. The ’473 patent explains that “[o]n a daily basis, people are exposed to various environmental sounds and noises within their environment, such as the sounds from traffic, construction, and industry.” ’473*Pat.*, 1:55-58. “To combat the undesired cacophony of annoying sounds, people are arming themselves with portable audio playback devices to drown out intrusive noise.” *Id.*, 1:59-61. “With such devices, the person is immersed in the audio experience

¹ All emphases and annotations throughout are added unless otherwise noted.

and generally less likely to hear warning sounds within their environment. In some cases, the user may even turn up the volume to hear their personal audio over environmental noises. It also puts them at high sound exposure risk which can potentially cause long term hearing damage.” *Id.*, 2:3-9. “A need therefore exists for enhancing the user's ability to listen in the environment without harming his or her hearing faculties.” *Id.*, 2:23-25.

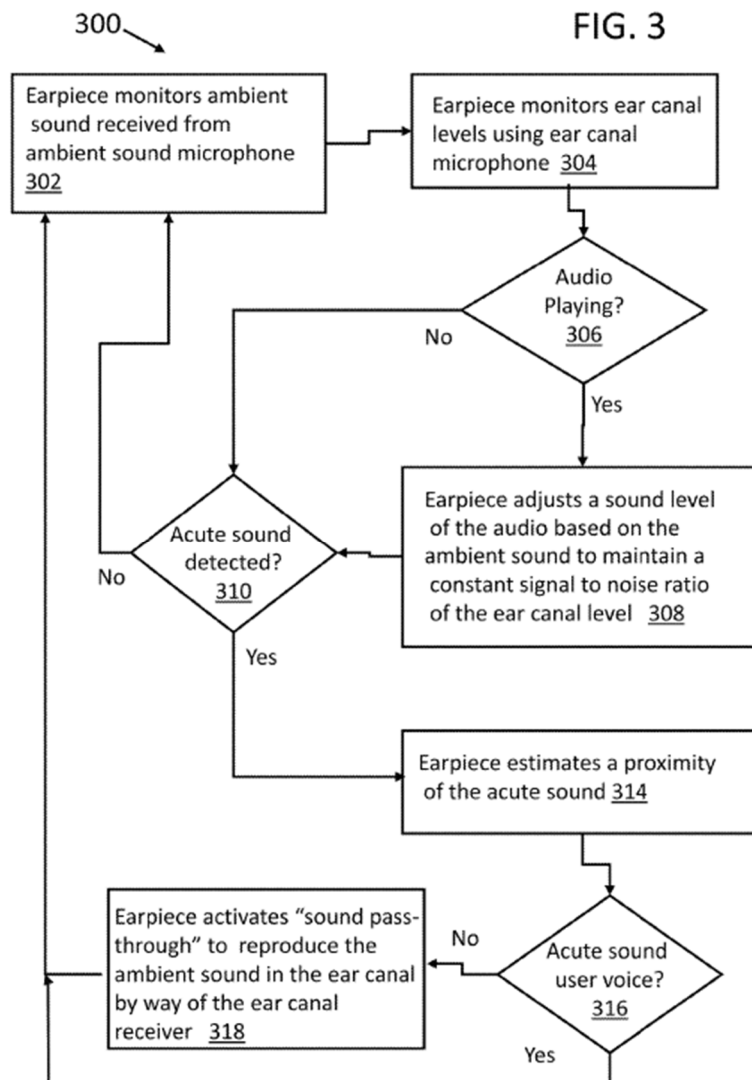
40. The alleged invention of the '473 patent “provide[s] a method and device for acute sound detection and reproduction.” *Id.*, 2:29-31. “At least one exemplary embodiment of the invention is directed to an earpiece for ambient sound monitoring and warning detection.” *Id.*, 4:56-58. With reference to Figure 1, copied below, “[e]arpiece 100 includes an Ambient Sound Microphone (ASM) 111 [sic] to capture ambient sound, an Ear Canal Receiver (ECR) 125 to deliver audio to an ear canal 131, and an Ear Canal Microphone (ECM) 123 to assess a sound exposure level within the ear canal.” *Id.*, 5:3-7.



'473pat., FIG. 2

42. “The earpiece 100 can include an audio interface 212 operatively coupled to the processor 206 to receive audio content, for example from a media player or cell phone, and deliver the audio content to the processor 206. The processor 206 responsive to detecting acute sounds can adjust the audio content and pass the acute sounds directly to the ear canal.” *Id.*, 5:59-65.

43. Figure 3 provides “a flowchart of a method 300 for acute sound detection and reproduction in accordance with an exemplary embodiment.” *Id.*, 6:30-32. “The method 300 can start in a state wherein the earpiece 100 has been inserted and powered on. As shown in step 302, the earpiece 100 can monitor the environment for ambient sounds received at the ASM 111.” *Id.*, 6:40-43.



'473pat., FIG. 3

44. "If at step 306, audio is playing (e.g., music, cell phone, etc.), the earpiece 100 adjusts a sound level of the audio based on the ambient sound to maintain a constant signal to noise ratio with respect to the ear canal level at step 308. For instance, the processor 206 can selectively amplify or attenuate audio content received from the audio interface 212 before it is delivered to the ECR 125. The processor 206 estimates a background noise level from the ambient

sound received at the ASM 111, and adjusts the audio level of delivered audio content (e.g., music, cell phone audio) to maintain a constant signal (e.g., audio content) to noise level (e.g., ambient sound).” *Id.*, 7:10-21.

45. “If at step 310, an acute sound is detected within the ambient sound, the earpiece 100 activates ‘sound pass-through’ to reproduce the ambient sound in the ear canal by way of the ECR 125.” *Id.*, 7:28-31. “The processor 206 permits the ambient sound to pass through the ECR 125 to the ear canal 131 directly for example by replicating the ambient sound external to the ear canal within the ear canal.” *Id.*, 7:31-34.

46. “In one embodiment, the earpiece 100 looks for temporal and spectral characteristics in the ambient sound for detecting acute sounds. For instance, as will be explained ahead, the processor 206 looks for an abrupt change in the Sound Pressure Level (SPL) of an ambient sound across a small time period. The processor 206 can also detect abrupt magnitude changes across frequency sub-bands (e.g. filter-bank, FFT, etc.). Notably, the processor 206 can search for on-sets (e.g., fast rising amplitude wave-front) of an acute sound or other abrupt feature characteristics without initially attempting to initially identify or recognize the sound source. That is, the processor 206 is actively listening for a presence of acute sounds before identifying the type of sound source.” *Id.*, 7:48-61.

47. “At step 316, the earpiece 100 determines whether it is the user's voice that generates the acute sound when the user speaks, or whether it is an external sound such as a vehicle approaching the user. If at step 316, the processor 206 determines that the acute sound is a result of the user speaking, the processor 206 does not activate a pass-through mode, since this is not considered an external warning sound. The pass-through mode permits ambient sound detected at the ASM 111 to be transmitted directly to the ear canal. If however, the acute sound corresponds to an external sound source, such as an on-set of a warning sound, the earpiece at step 318 activates ‘sound pass-through’ to reproduce the ambient sound in the ear canal by way of the ECR 125.” *Id.*, 8:44-57.

48. “The earpiece 100 can also present an audible notification to the user indicating that an external sound source generating the acute sound has been detected. The method 300 can proceed back to step 302 to continually monitor for acute sounds in the environment.” *Id.*, 8:57-61.

B. PROSECUTION HISTORY

49. The ’473 patent issued from U.S. Application No. 17/592,143 (“’143 application”), filed on February 3, 2022. ’473*Pat.*, Cover. The ’473 patent claims priority through a chain of non-provisional applications to a provisional application filed on January 22, 2007. ’473*Pat.*, Cover. The ’473

patent's parent application is U.S. 17/321,892 (the "892 application" or "892App."). *Id.*

(12) United States Patent Goldstein et al.	(10) Patent No.: US 11,710,473 B2 (45) Date of Patent: Jul. 25, 2023
(54) METHOD AND DEVICE FOR ACUTE SOUND DETECTION AND REPRODUCTION	(58) Field of Classification Search CPC G10K 11/17827; G10K 11/002; H04R 1/1016; H04R 1/1083; H04R 3/002; (Continued)
(71) Applicant: Staton Techiya LLC , Delray Beach, FL (US)	(56) References Cited
(72) Inventors: Steven Wayne Goldstein , Delray Beach, FL (US); John Usher , Beer (GB); Marc Andre Boillot , Plantation, FL (US)	U.S. PATENT DOCUMENTS 3,876,843 A 4/1975 Moen 4,054,749 A 10/1977 Suzuki et al. (Continued)
(73) Assignee: Staton Techiya LLC , Delray Beach, FL (US)	FOREIGN PATENT DOCUMENTS EP 1385324 1/2004 EP 1401240 3/2004 (Continued)
(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.	OTHER PUBLICATIONS
(21) Appl. No.: 17/592,143	Olwal, A. and Feiner S. Interaction Techniques Using Prosodic Features of Speech and Audio Localization. Proceedings of IUI 2005 (International Conference on Intelligent User Interfaces), San Diego, CA, Jan. 9-12, 2005, p. 284-286. (Continued)
(22) Filed: Feb. 3, 2022	<i>Primary Examiner</i> — Andrew L. Sniezek (74) <i>Attorney, Agent, or Firm</i> — Akerman LLP; Peter A. Chiabotti
(65) Prior Publication Data US 2022/0230616 A1 Jul. 21, 2022	(57) ABSTRACT Earpieces and methods for acute sound detection and repro- duction are provided. A method can include measuring an external ambient sound level (xASL), monitoring a change in the xASL for detecting an acute sound, estimating a proximity of the acute sound, and upon detecting the acute sound and its proximity, reproducing the acute sound within an ear canal, where the ear canal is at least partially occluded by an earpiece. Other embodiments are disclosed. 20 Claims, 9 Drawing Sheets
Related U.S. Application Data (63) Continuation of application No. 17/321,892, filed on May 17, 2021, which is a continuation of application (Continued)	
(51) Int. Cl. G10K 11/178 (2006.01) H04R 3/00 (2006.01) (Continued)	
(52) U.S. Cl. CPC G10K 11/17827 (2018.01); G10K 11/002 (2013.01); H04R 1/1016 (2013.01); (Continued)	

EX1001, Cover (annotated)

50. The snip below shows the text of claim 1 as originally filed in the '143 application.

1. A wearable device that can control ambient passthrough in an earpiece comprising:
a display;
a first memory that stores instructions; and
a processor configured to execute the instructions to perform operations, the operations comprising:
communicatively connecting to an earpiece, wherein the earpiece includes a first microphone, a second microphone, a speaker, a second memory and an earpiece processor;
sending a mixing value to the earpiece; and
sending an audio content signal to the earpiece, wherein the earpiece processor is configured to mix an ambient sound signal with the audio content signal based upon the mixing value.

EX1004 at 48

51. The snip below shows the text of claim 6 as originally filed in the '143 application. After various amendments, claim 6 issued as independent claim 8.

6. A wearable device that can control ambient sound passthrough comprising:

- a first microphone configured to measure a first acoustic environment to generate a first microphone signal;

- a second microphone configured to be positioned closer to a user's ear canal than the first microphone when the device is worn, where the second microphone is configured to generate a second microphone signal;

- a speaker;

- a memory that stores instructions; and

- a processor configured to execute the instructions to perform operations, the operations comprising:

 - receiving an audio content signal;

 - modifying the audio content signal to generate a modified audio content signal;

 - modifying the first microphone signal to generate a modified first microphone signal;

 - modifying the second microphone signal to generate a modified second microphone signal;

 - generating an ambient sound signal from at least one of the modified first microphone signal, the modified second microphone signal or a combination of both;

 - detecting an acute sound by analyzing at least one of the modified first microphone signal, the modified second microphone signal or both, and if an acute sound is detected, determining whether the acute sound is a user's voice;

 - generating a mixed signal by mixing the ambient sound signal with the modified audio content signal, and if a user's voice is detected modifying the modified audio content signal before forming the mixed signal; and

 - sending the mixed signal to the speaker.

EX1004 at 48-49

52. On December 22, 2022, the Patent Office mailed a non-final rejection of claims 1-17.



UNITED STATES PATENT AND TRADEMARK OFFICE

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

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/592,143	02/03/2022	Steven Wayne Goldstein	CONT-17321892	3471
150139 7590 12/22/2022 Akerman LLP 777 South Flagler Drive Suite 1100 West Tower West Palm Beach, FL 33401			EXAMINER SNIEZEK, ANDREW L.	
			ART UNIT 2688	PAPER NUMBER
			NOTIFICATION DATE 12/22/2022	DELIVERY MODE ELECTRONIC

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

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

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

ip@akerman.com
jp.keady@techiya.co
personics_docketing@cardinal-ip.com

EX1004 at 786 (annotated)

Office Action Summary	Application No. 17/592,143	Applicant(s) Goldstein et al.	
	Examiner ANDREW SNieZEK	Art Unit 2688	AIA (FITF) Status No

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

Period for Reply

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

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).

Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) ☒ Responsive to communication(s) filed on 2/3/22.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a) ☐ This action is **FINAL**.

2b) ☒ This action is non-final.

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

4) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☒ Claim(s) 1-17 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☒ Claim(s) 1-17 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

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

EX1004 at 787 (annotated)

53. The Patent Office rejected claims 1-17 “as failing to comply with the enablement requirement.” With respect to claim 1, the Patent Office stated:

The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. Independent claim 1 sets forth a “mixing value” that is sent to the earpiece, and configured to mix based upon a “mixing value”. The written disclosure as filed does not even mention a “mixing value”, what structure is used to

provide such a value, nor how such a value is used to mix the ambient sound signal and the audio content signal as set forth.

Claims 2-5 inherit this language of claim 1.

EX1004 at 788-789.

54. With respect to claim 6, the Patent Office stated

Independent claim 6 sets forth that a mixed signal is generated by mixing ambient sound signal with a modified audio content signal and “if a user's voice is detected modifying the modified audio content signal before forming the mixed signal”. The written disclosure as filed does not teach such an arrangement as set forth.

The limitations of claims 7-17 inherit the language of claim 6.

EX1004 at 788-789.

55. On March 22, 2023, the applicant mailed a response to the December 22, 2022 office action that included amendments to the claims and arguments.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICATION NO.	:	17/592,143	CONFIRMATION No. 3471
APPLICATION OF	:	Steven Wayne Goldstein	
DATE FILED	:	3 Feb. 2022	
EXAMINER	:	SNIEZEK, ANDREW L	
TC/A.U.	:	2688	
DOCKET	:	CONT-173218892	
TITLE	:	METHOD AND DEVICE FOR ACUTE SOUND DETECTION AND REPRODUCTION	

RESPONSE TO OFFICE ACTION

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

Date: March 22, 2023

Sir:

These remarks are filed in response to the Office Action dated 22 Dec. 2022.

Please amend the above-identified patent application as follows:

- **Amendments to the Claims** begin on page 2 of this paper; and
- **Remarks/Arguments** begin on page 5 of this paper.

EX1004 at 887 (annotated)

56. The snip below shows the amendments that the applicant made to claim 1.

Listing of Claims:

1.(currently amended) A ~~wearable~~ device that can control ambient passthrough in an earpiece comprising:

a display;

a first memory that stores instructions; and

a processor ~~configured to~~ that ~~executes~~ the instructions to perform operations, the operations comprising:

communicatively connecting to an earpiece, wherein the earpiece includes a first microphone, a second microphone, a speaker, a second memory and an earpiece processor;

sending an audio content gain value and an ambient sound gain value ~~a mixing value~~ to the earpiece; and

sending an audio content signal to the earpiece, wherein the earpiece processor is configured to:

apply the audio content gain value to the audio content signal to generate a modified audio content signal;

apply the ambient sound gain value to an ambient sound signal to generate a modified ambient sound signal; and

mix ~~an~~ the modified ambient sound signal with the modified audio content signal to generate a mixed signal ~~based upon the mixing value.~~

EX1004 at 888

57. The snip below shows the amendments that the applicant made to claim 6.

6.(currently amended) A ~~wearable~~ device that can control ambient sound passthrough comprising:

- a first microphone configured to measure a first acoustic environment to generate a first microphone signal;

- a second microphone configured to be positioned closer to a user's ear canal than the first microphone when the device is worn, where the second microphone is configured to generate a second microphone signal;

- a speaker;

- a memory that stores instructions; and

- a processor configured to execute the instructions to perform operations, the operations comprising:

 - receiving an audio content signal;

 - modifying the audio content signal to generate a modified audio content signal;

 - modifying the first microphone signal to generate a modified first microphone signal;

 - modifying the second microphone signal to generate a modified second microphone signal;

 - generating an ambient sound signal from at least one of the modified first microphone signal, the modified second microphone signal or a combination of both;

 - detecting an acute sound by analyzing at least one of the modified first microphone signal, the modified second microphone signal or both, ~~and if an acute sound is detected, determining whether the acute sound is a user's voice;~~

 - modifying the modified audio content signal if an acute sound is detected to generate a new modified audio content signal;

 - generating a mixed signal by mixing the ambient sound signal with the modified audio content signal or the new modified audio content signal; ~~and if a user's voice is detected modifying the modified audio content signal before forming the mixed signal;~~ and

 - sending the mixed signal to the speaker.

EX1004 at 889-890

58. The applicant also added new claims 18-20:

18.(new) The device according to claim 1, wherein the device is a portable communication device.

19.(new) The device according to claim 18, where the device portable communication device is at least one of a phone, a watch, a tablet, earpiece, a laptop computer or a combination thereof.

20.(new) The device according to claim 6, wherein the acute sound is a voice.

EX1004 at 892

59. The applicant stated that the written description support in the '143 application for amendments to claim 1 "can at least be found in the specification [0069] and in Figure 9." EX1004 at 894.

60. Paragraph [0069] of the '143 application and Figure 9 are copied below.

[0069] At step 922 the BNL is estimated using inputs from either or both the ASM signal at step 902, and/or the ECM signal at step 906. The BNL may be adjusted by the earpiece noise reduction rating 924. These signals are selected using the BNL input switch at step 918, which may be controlled automatically or with a specific user-generated manual operation at step 926. The Ear-Canal SNR is calculated at step 920 by differencing the ACL from step 914 and the BNL from step 922 and the resulting SNR 930 is passed to the method step 932 for AGC coefficient calculation. The AGC coefficient calculation 932 calculates gains for the Audio Content signal and ASM signal from the Automatic Gain Control steps 928 and 936 (for the Audio Content and ASM signals, respectively). AGC coefficient calculation 932 may use a default preferred SNR 938 or a user-preferred SNR 934 in its calculation. After the ASM signal and Audio content signal have been processed by the AGCs 928 and 936, the two signals are mixed at step 940.

EX1004 at 45

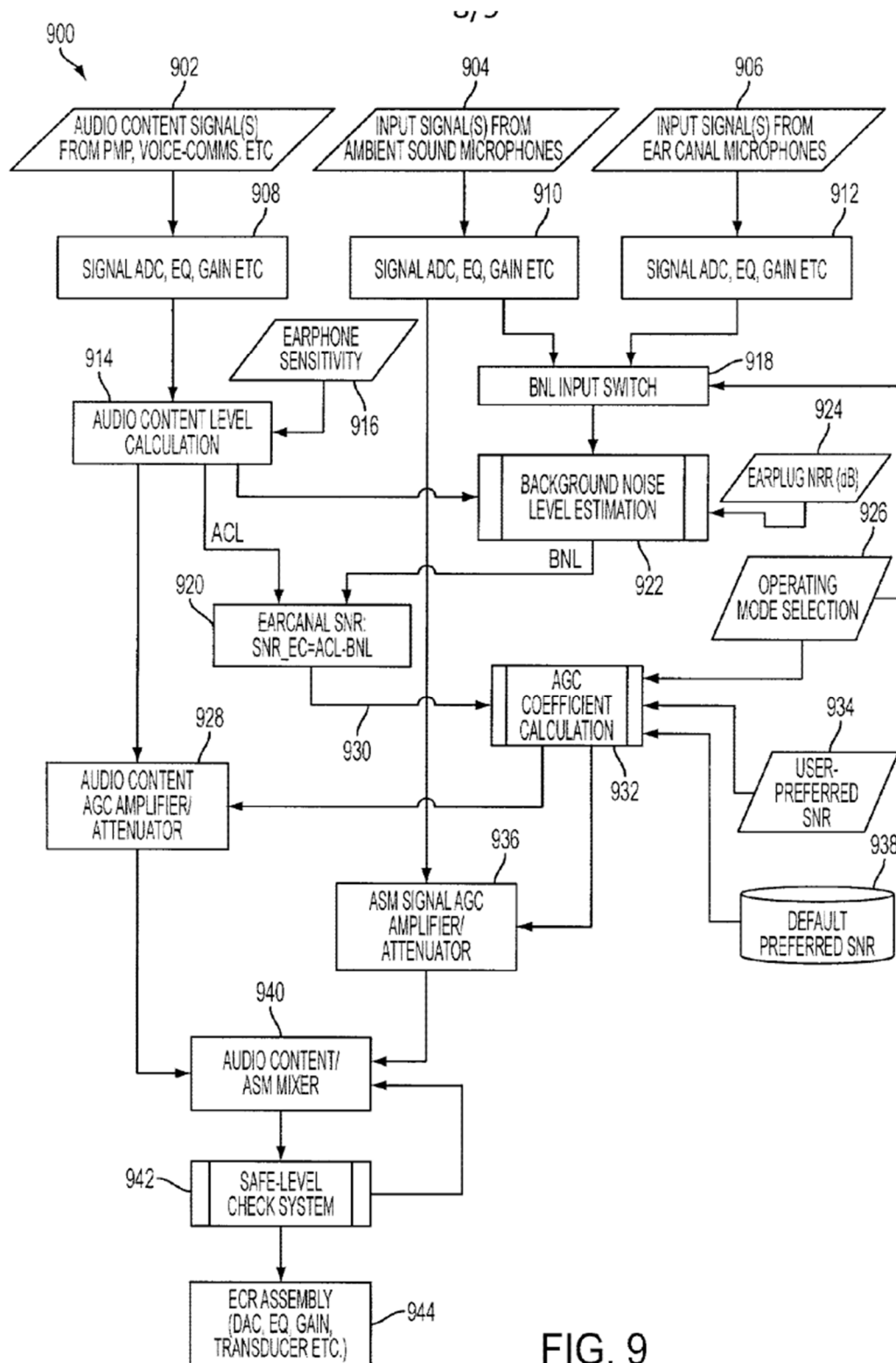


FIG. 9

EX1004 at 97

61. The applicant stated that the written description support in the '143 application for the amendments to claims 6 “can at least be found in the specification [0012], [0036] and in Figure 2.” EX1004 at 895.

62. Paragraphs [0012], [0036], and Figure 2 of the '143 application are copied below.

[0012] In a second embodiment, an earpiece can comprise an Ambient Sound Microphone (ASM) to capture ambient sound, at least one Ear Canal Receiver (ECR) to deliver audio to an ear canal, an audio interface operatively coupled to the processor to receive audio content, and a processor operatively coupled to the ASM and the at least one ECR. The processor can monitor a change in the ambient sound level to detect an acute sound from the change, adjust an audio content level (ACL) of the audio content delivered to the ear canal, and reproduce the acute sound within the ear canal via the ECR responsive to detecting the acute sound and based on the ACL.

EX1004 at 32

[0036] Referring to FIG. 2, a block diagram of the earpiece 100 in accordance with an exemplary embodiment is shown. As illustrated, the earpiece 100 can include a processor 206 operatively coupled to the ASM 111, ECR 125, and ECM 123 via one or more Analog to Digital Converters (ADC) 202 and Digital to Analog Converters (DAC) 203. The processor 206 can monitor the ambient sound captured by the ASM 111 for acute sounds in the environment, such as an abrupt high energy sound corresponding to the on-set of a warning sound (e.g., bell, emergency vehicle, security system, etc.), siren (e.g., police car, ambulance, etc.), voice (e.g., "help", "stop", "police", etc.), or specific noise type (e.g., breaking glass, gunshot, etc.). The processor 206 can utilize computing technologies such as a microprocessor, Application Specific Integrated Chip (ASIC), and/or digital signal processor (DSP) with associated storage memory 208 such as Flash, ROM, RAM, SRAM, DRAM or other like technologies for controlling operations of the earpiece device 100. The memory 208 can store program instructions for execution on the processor 206 as well as captured audio processing data.

EX1004 at 36

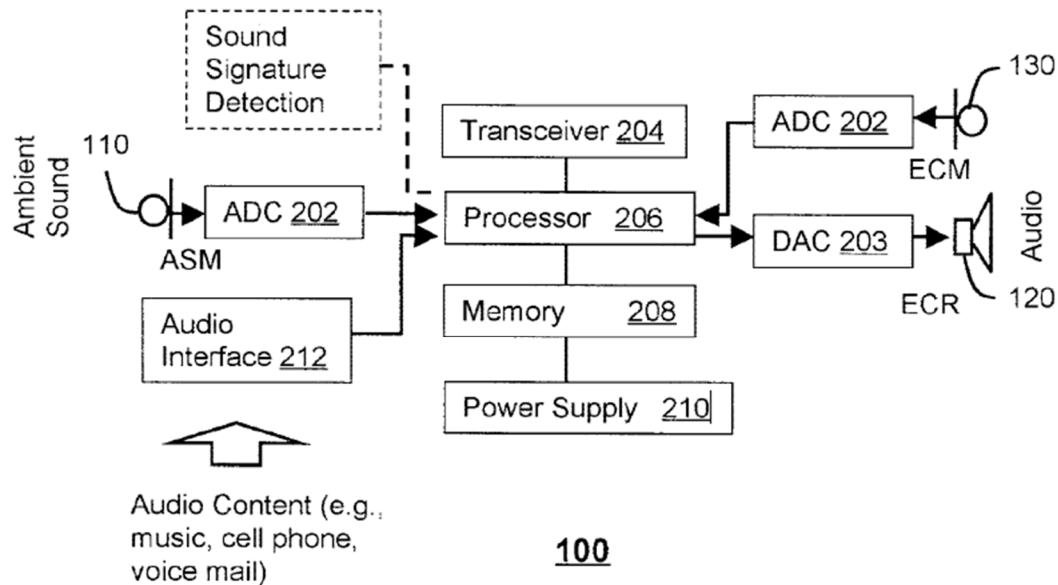


FIG. 2

EX1004 at 90

63. The applicant stated that support for new claims 18-20 “can be found [0013].”

REMARKS

The foregoing amendments and the following remarks are made in response to the Office Action dated 22 Dec. 2022. At the time of the Office Action, the Examiner noted that claims 1-17 were pending. The Examiner rejected claims 1-17 under 35 U.S.C. § 112(a), as discussed in further detail below. Claims 1-17 have been amended, and claims 18-20 are new (support can be found [0013]). In view of the arguments set forth below, claims 1-20 are allowable, and the Examiner is respectfully requested to withdraw the rejection and issue a Notice of Allowance.

EX1004 at 893(annotated)

64. Paragraph 13 of the '143 application is copied below.

[0013] The audio interface can receive the audio content from at least one among a portable music player, a cell phone, and a portable communication device. During operation, the processor can maintain an approximately constant ratio between an audio content level (ACL) and an internal ambient sound level (iASL) measured within the ear canal. In one arrangement, the processor can mute the audio content and pass the acute sound to the ECR for reproducing the acute sound within the ear canal. In another arrangement, the processor can amplify the acute sound with respect to the audio content level (ACL).

EX1004 at 32

65. On April 20, 2023, the Patent Office mailed an “Ex parte Quayle” office action allowing claims 1-20.



UNITED STATES PATENT AND TRADEMARK OFFICE

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

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/592,143	02/03/2022	Steven Wayne Goldstein	11472-27-5_CONT-17321892	3471
150139 7590 04/20/2023 Akerman LLP 777 South Flagler Drive Suite 1100 West Tower West Palm Beach, FL 33401			EXAMINER SNIEZEK, ANDREW L.	
			ART UNIT	PAPER NUMBER
			2688	
			NOTIFICATION DATE	DELIVERY MODE
			04/20/2023	ELECTRONIC

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

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

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

ip@akerman.com
jp.keady@techiya.co
personics_docketing@cardinal-ip.com

EX1004 at 897 (annotated)

the earpiece (by closing switch (70a) to directly sent audio on line (80) to the earpiece; applying an audio content gain value (by use of (84)) to the audio content signal generating a modified audio content signal; applying the ambient sound gain value (by use of (90)) to an ambient sound signal to generate a modified ambient sound signal. This reference however functions differently that the claimed invention and does not teach additionally in combination a display, a processor executing stored instructions on a memory, an earpiece including each of a first microphone, a second microphone, a speaker, a second memory and an ear processor along with as set forth in claim 1 to “mix the modified ambient sound signal with the modified audio content signal to generate a mixed signal”. In Boersma, modifying the audio content signal (using (84) occurs after the audio content signal and a modified ambient sound signal have been mixed by element (82). Also, in Boersma, it is not an earpiece processor the receives an audio content gain value and a ambient sound gain value, to form the modified signals and mix the modified signals. This combination of features as set forth are not an obvious variation of the teaching Boersma. The limitations of claims 2-5, 18-19 depend upon those features of claim 1.

EX1004 at 899-900

67. With respect to claim 6, the Patent Office stated:

Also, in addition to that discussed with respect to claim 1, Boersma teaches that the arrangement is used to detect an acute sound (such as sounds produced by police and sirens) as provided in applicants

claim 6. However, Boersma does not alone or obvious combination teach a device controlling ambient sound passthrough that includes the use of in combination first and second microphones, the signals produced by each being modified; generating an ambient sound signal from these modified signal(s), modifying a modified audio content signal if an acute sound is detected to generate a new modified audio content signal; generating a mixed signal from the ambient sound signal and the modified or new modified audio content signal which is then sent to the speaker as set forth in claim 6. The limitations o [sic] claims 7-17 and 20 depend upon those features of claim 6.

EX1004 at 900.

68. The Patent Office also included an objection with respect to the term “display” in claim 1:

Specification

The disclosure is objected to because of the following informalities: the specification is objected to as failing to provide proper antecedent basis for the claimed subject matter. See 37 CFR 1.75(d)(1) and MPEP § 608.01(o). Correction of the following is required: The written disclosure must make reference to a “display” as originally set forth in claim 1.

Appropriate correction is required.

EX1004 at 901.

69. On the same day the Patent Office mailed the office action (April 20, 2023), the applicant mailed a “312 Amendment in Response to Exparte

Quayle Action” including various amendments, including an amendment to claim 1.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICATION NO.	:	17/592,143	CONFIRMATION NO. 3471
APPLICATION OF	:	Steven Wayne Goldstein	
DATE FILED	:	3 Feb. 2022	
EXAMINER	:	SNIEZEK, ANDREW L	
TC/A.U.	:	2688	
DOCKET	:	CONT-17321892	
TITLE	:	METHOD AND DEVICE FOR ACUTE SOUND DETECTION AND REPRODUCTION	

312 Amendment in Response to Ex parte Quayle Action

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

Date: April 20, 2023

Sir:

These remarks are filed in response to the Ex parte Quayle Office Action dated 20 Apr. 2023. Please amend the above-identified patent application as follows:

- **Amendments to the Claims** begin on page 2 of this paper; and
- **Remarks/Arguments** begin on page 5 of this paper.

EX1004 at 926 (annotated)

70. The amendments to claim 1 and 6 are shown below.

Listing of Claims:

1.(currently amended) A device that can control ambient passthrough in an earpiece comprising:

- a ~~display~~;

- a first memory that stores instructions; and

- a processor that executes the instructions to perform operations, the operations comprising:

- communicatively connecting to an earpiece, wherein the earpiece includes a first microphone, a second microphone, a speaker, a second memory and an earpiece processor;

- sending an audio content gain value and an ambient sound gain value to the earpiece; and

- sending an audio content signal to the earpiece, wherein the earpiece processor is configured to:

- apply the audio content gain value to the audio content signal to generate a modified audio content signal;

- apply the ambient sound gain value to an ambient sound signal to generate a modified ambient sound signal; and

- mixing the modified ambient sound signal with the modified audio content signal to generate a mixed signal.

EX1004 at 927

6.(currently amended) A device that can control ambient sound passthrough comprising:

- a first microphone configured to measure a first acoustic environment to generate a first microphone signal;

- a second microphone configured to be positioned closer to a user's ear canal than the first microphone when the device is worn, where the second microphone is configured to generate a second microphone signal;

- a speaker;

- a memory that stores instructions; and

- a processor ~~configured to that~~ executes the instructions to perform operations, the operations comprising:

 - receiving an audio content signal;

 - modifying the audio content signal to generate a modified audio content signal;

 - modifying the first microphone signal to generate a modified first microphone signal;

 - modifying the second microphone signal to generate a modified second microphone signal;

 - generating an ambient sound signal from at least one of the modified first microphone signal, the modified second microphone signal or a combination ~~thereof of both~~;

 - detecting an acute sound by analyzing at least one of the modified first microphone signal, the modified second microphone signal or a combination thereof ~~both~~;

 - modifying the modified audio content signal if an acute sound is detected to generate a new modified audio content signal;

 - generating a mixed signal by mixing the ambient sound signal with the modified audio content signal or the new modified audio content signal; and

 - sending the mixed signal to the speaker.

EX1004 at 928-929

71. The applicant explained that the “The Examiner allowed claims 1-20 but objected to the term “display” in claim 1. Claim 1 has been amended. In

view of the arguments set forth below, claims 1-20 are allowable, and the Examiner is respectfully requested to withdraw the objection and issue a Notice of Allowance on the currently amended claims.” EX1004 at 932. The applicant further stated:

The Examiner has objected to the specification and drawings as not implicitly showing a “display.” The Applicant in the interest of expedited prosecution has amended claim 1 to remove “display” since the display is not referred to directly in any dependent claim. However, Applicant points out that the device can be a phone, tablet, watch or any other communication device, which inherently can include a display, as would be acknowledged by one of ordinary skill in the art. Hence the removal of the term “display” is not an admission that such a term is not inherently discussed within the specification. For at least these reasons, withdrawal of the specification and drawing objection is respectfully requested.

EX1004 at 932.

72. On May 23, 2023, the Patent Office mailed a Notice of Allowance.

NOTICE OF ALLOWANCE AND FEE(S) DUE

150139 7590 05/23/2023
Akerman LLP
777 South Flagler Drive
Suite 1100 West Tower
West Palm Beach, FL 33401

EXAMINER

SNIEZEK, ANDREW L.

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

2688

DATE MAILED 05/23/2023

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/592,143	02/03/2022	Steven Wayne Goldstein	11472-27-5_CONT-17321892	3471

TITLE OF INVENTION: METHOD AND DEVICE FOR ACUTE SOUND DETECTION AND REPRODUCTION

APPL.N. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	\$480	\$0.00	\$0.00	\$480	08/23/2023

EX1004 at 934 (annotated)

73. In the Notice of Allowance the Patent Office noted that “Claims 1-5, 6-13, 14, 15-17, 18-19 and 20 have been renumbered as claims 1-5, 8-15, 19, 16-18, 6-7 and 20 respectively.” EX1004 at 939.

74. On May 25, 2023, the applicant mailed another 312 amendment including various additional amendments. The applicant stated that the amendments “are clarifying amendments and are not intended to add any new matter.” EX1004 at 973.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICATION NO.	:	17/592,143	CONFIRMATION No. 3471
APPLICATION OF	:	Steven Wayne Goldstein	
DATE FILED	:	3 Feb. 2022	
EXAMINER	:	SNIEZEK, ANDREW L	
TC/A.U.	:	2688	
DOCKET	:	CONT-17321892	
TITLE	:	METHOD AND DEVICE FOR ACUTE SOUND DETECTION AND REPRODUCTION	

312 Amendment

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

Date: May 25, 2023

Sir:

The claim amendments herein are clarifying amendments and are not intended to add any new matter. Please amend the above-identified patent application as follows:

- **Amendments to the Claims** begin on page 2 of this paper.

Should the Examiner believe that anything further is necessary, the Examiner is respectfully requested to contact the undersigned representative at the telephone number listed below.

EX1004 at 973 (annotated)

75. The amendments that the applicant made to claim 1 and claim 6 are shown below.

Listing of Claims:

1.(currently amended) A device that can control ambient passthrough in an earpiece comprising:

a first memory that stores instructions; and

a processor that executes the instructions to perform operations, the operations comprising:

communicatively connecting to an earpiece, wherein the earpiece includes a first microphone, a second microphone, a speaker, a second memory and an earpiece processor;

sending an audio content gain value and an ambient sound gain value to the earpiece; and

sending an audio content signal to the earpiece, wherein the earpiece processor is ~~configured to:~~

appl[[y]]ies the audio content gain value to the audio content signal to generate a modified audio content signal[[:]], wherein the earpiece processor

appl[[y]]ies the ambient sound gain value to an ambient sound signal to generate a modified ambient sound signal[[:]], and wherein the earpiece processor

~~mixes~~ the modified ambient sound signal with the modified audio content signal to generate a mixed signal.

EX1004 at 974

6.(currently amended) A device that can control ambient sound passthrough comprising:

- a first microphone ~~configured to~~ that measures a first acoustic environment to generate a first microphone signal;

- a second microphone ~~configured to be that~~ is positioned closer to a user's ear canal than the first microphone when the device is worn, where the second microphone ~~is configured to~~ generates a second microphone signal;

- a speaker;

- a memory that stores instructions; and

- a processor that executes the instructions to perform operations, the operations comprising:

 - receiving an audio content signal;

 - modifying the audio content signal to generate a modified audio content signal;

 - modifying the first microphone signal to generate a modified first microphone signal;

 - modifying the second microphone signal to generate a modified second microphone signal;

 - generating an ambient sound signal from at least one of the modified first microphone signal, the modified second microphone signal or a combination thereof;

 - detecting an acute sound by analyzing at least one of the modified first microphone signal, the modified second microphone signal or a combination thereof;

 - modifying the modified audio content signal if an acute sound is detected to generate a new modified audio content signal;

 - generating a mixed signal by mixing the ambient sound signal with the modified audio content signal or the new modified audio content signal; and

 - sending the mixed signal to the speaker.

EX1004 at 975-976

76. On June 5, 2023, the Patent Office mailed a response to the applicant's Rule 312 Communication. The Patent Office entered the applicant's amendment.



UNITED STATES PATENT AND TRADEMARK OFFICE

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

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/592,143	02/03/2022	Steven Wayne Goldstein	11472-27-5_CONT-17321892	3471
150139	7590	06/05/2023	EXAMINER	
Akerman LLP 777 South Flagler Drive Suite 1100 West Tower West Palm Beach, FL 33401			SNEZEK, ANDREW L.	
			ART UNIT	PAPER NUMBER
			2688	
			NOTIFICATION DATE	DELIVERY MODE
			06/05/2023	ELECTRONIC

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

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

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

ip@akerman.com
jp.keady@techiya.co
personics_docketing@cardinal-ip.com

EX1004 at 986 (annotated)

Response to Rule 312 Communication	Application No.	Applicant(s)	
	17/592,143	Goldstein et al.	
	Examiner	Art Unit	AIA (FITF) Status
	ANDREW SNIEZEK	2688	No

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

1. ☒ The amendment filed on 25 May 2023 under 37 CFR 1.312 has been considered, and has been:

a) ☐ entered.

b) ☒ entered as directed to matters of form not affecting the scope of the invention.

c) ☐ disapproved because the amendment was filed after the payment of the issue fee.
Any amendment filed after the date the issue fee is paid must be accompanied by a petition under 37 CFR 1.313(c)(1) and the required fee to withdraw the application from issue.

d) ☐ disapproved. See explanation below.

e) ☐ entered in part. See explanation below.

f) ☐ not entered because the supplemental or corrected Application Data sheet (ADS)

☐ was not accompanied by a petition to accept an unintentionally delayed claim under 37 CFR 1.55 or 27 CFR 1.78;

☐ did not identify the information being changed in accordance with 37 CFR 1.76(c)(2);

☐ was not properly signed in accordance with 37 CFR 1.76(e) (or 37 CFR 1.33(b) for applications filed prior to September 16, 2012).

EX1004 at 987 (annotated)

77. The patent Office mailed an issue notification on July 25, 2023.



UNITED STATES PATENT AND TRADEMARK OFFICE

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

APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/592,143	07/25/2023	11710473	11472-27-5_CONT-17321892	3471

150139 7590 07/05/2023

Akerman LLP
777 South Flagler Drive
Suite 1100 West Tower
West Palm Beach, FL 33401

ISSUE NOTIFICATION

The projected patent number and issue date are specified above. The patent will issue electronically. The electronically issued patent is the official patent grant pursuant to 35 U.S.C. § 153. The patent may be accessed on or after the issue date through Patent Center at <https://patentcenter.uspto.gov/>. The patent will be available in both the public and the private sides of Patent Center. Further assistance in electronically accessing the patent, or about Patent Center, is available by calling the Patent Electronic Business Center at 1-888-217-9197.

The USPTO is implementing electronic patent issuance with a transition period, during which period the USPTO will mail a ceremonial paper copy of the electronic patent grant to the correspondence address of record. Additional copies of the patent (i.e., certified and presentation copies) may be ordered for a fee from the USPTO's Certified Copy Center at <https://certifiedcopycenter.uspto.gov/index.html>. The Certified Copy Center may be reached at (800)972-6382.

EX1004 at 998 (annotated)

C. THE CLAIMS

78. The table below includes identifiers for the '473 patent claims and limitations, which are referenced throughout.

Claim 1	
1.pre	A device that can control ambient passthrough in an earpiece comprising:
1.1	a first memory that stores instructions; and
1.2	a processor that executes the instructions to perform operations, the operations comprising:
1.3	communicatively connecting to an earpiece, wherein the earpiece includes a first microphone, a second microphone, a speaker, a second memory and an earpiece processor;

1.4	sending an audio content gain value and an ambient sound gain value to the earpiece; and
1.5	sending an audio content signal to the earpiece,
1.6	wherein the earpiece processor applies the audio content gain value to the audio content signal to generate a modified audio content signal,
1.7	wherein the earpiece processor applies the ambient sound gain value to an ambient sound signal to generate a modified ambient sound signal, and
1.8	wherein the earpiece processor mixes the modified ambient sound signal with the modified audio content signal to generate a mixed signal.
Claim 2	
2	The device according to claim 1, wherein the earpiece processor calculates a noise level based upon a first microphone signal from the first microphone, wherein the earpiece processor modifies the mixed signal based upon the noise level.
Claim 3	
3	The device according to claim 1, wherein the earpiece processor generates the ambient sound signal from a first microphone signal from the first microphone.
Claim 4	
4	The device according to claim 1 further including a user interface.
Claim 5	
5	The device according to claim 1, wherein the earpiece processor applies an ambient gain to a first microphone signal from the first microphone to generate the ambient sound signal.
Claim 6	
6	The device according to claim 1, wherein the device is a portable communication device.
Claim 7	

7	The device according to claim 6, where the device portable communication device is at least one of a phone, a watch, a tablet, earpiece, a laptop computer or a combination thereof.
Claim 8	
8.pre	A device that can control ambient sound passthrough comprising:
8.1	a first microphone that measures a first acoustic environment to generate a first microphone signal;
8.2	a second microphone that is positioned closer to a user's ear canal than the first microphone when the device is worn, where the second microphone generates a second microphone signal;
8.3	a speaker;
8.4	a memory that stores instructions; and
8.5	a processor that executes the instructions to perform operations, the operations comprising:
8.6	receiving an audio content signal;
8.7	modifying the audio content signal to generate a modified audio content signal;
8.8	modifying the first microphone signal to generate a modified first microphone signal;
8.9	modifying the second microphone signal to generate a modified second microphone signal;
8.10	generating an ambient sound signal from at least one of the modified first microphone signal, the modified second microphone signal or a combination thereof;
8.11	detecting an acute sound by analyzing at least one of the modified first microphone signal, the modified second microphone signal or a combination thereof;
8.12	modifying the modified audio content signal if an acute sound is detected to generate a new modified audio content signal;
8.13	generating a mixed signal by mixing the ambient sound signal with the modified audio content signal or the new modified audio content signal; and

8.14	sending the mixed signal to the speaker.
Claim 9	
9	The device according to claim 8, wherein the operations further comprise: determining if the acute sound is a user's voice by analyzing the temporal and spectral characteristics of at least one of the modified first microphone signal, the modified second microphone signal or a combination thereof.
Claim 10	
10	The device according to claim 9, wherein the operations further comprise: generating a noise signal from at least one of the modified first microphone signal, the modified second microphone signal, or both; generating a noise reduction signal.
Claim 11	
11	The device according to claim 10, wherein the operations further comprise: mixing the noise reduction signal with the mixed signal to generate a new mixed signal, and sending the new mixed signal to the speaker instead of the mixed signal.
Claim 12	
12	The device according to claim 11, wherein the operations further comprise: sending a modified ambient signal to the speaker instead of the new mixed signal if the user's voice is detected.
Claim 13	
13	The device according to claim 9, wherein the operations further comprise: sending a modified ambient signal to the speaker instead of the mixed signal if the user's voice is detected.
Claim 14	
14	The device according to claim 9, wherein the operations further comprise: detecting whether the acute sound is at least one of a warning sound, siren, voice, specific noise type, or a combination, by analyzing the spectrum of at least one of the modified first microphone signal, the modified second microphone signal, the modified ambient sound signal, or a combination.
Claim 15	

15	The device according to claim 14, wherein the operations further comprise: decreasing a volume of the modified audio content signal when a warning or siren is detected.
Claim 16	
16	The device according to claim 14, where the operations further comprise: sending a notification signal to the speaker if the acute sound is a warning sound or siren.
Claim 17	
17	The device according to claim 16, wherein the warning sound is at least one of a bell, an emergency vehicle, the sound of a security system or a combination thereof.
Claim 18	
18	The device according to claim 14, wherein if an alarm is detected it is at least one of a police siren, an ambulance siren, a car honking or a combination thereof.
Claim 19	
19	The device according to claim 8, wherein the operations further comprise: decreasing a volume of the modified audio content signal when a user's voice is detected.
Claim 20	
20	The device according to claim 8, wherein the acute sound is a voice.

VIII. BACKGROUND OF THE PRIOR ART

A. Ambient Pass-Through and Mixing with Audio Content Were Well-known Before February 2022

79. The problem identified by the specification of the '473 patent related to users wearing earbuds listening to music and unable to hear their surroundings (EX1001, 1:66-2:5) was identified well before February 2022. So was the solution of providing "ambient pass-through" for headphones, e.g.,

equipping a pair of headphones with a microphone and “passing through” the ambient sound picked up by the microphone into the headphone speaker so that the user could hear the ambient sound without having to take off the headphones.

80. For example, U.S. Patent No. 4,455,677 (“*Fox*”), filed in May 1982, explains that “[o]ne of the problems encountered in the use of headphones used as a stereophonic system is that while the listener has the headphones on, he cannot hear extraneous noises such as doorbells, telephones, or other communications. Device for picking up such sounds are not known in the prior art, and yet it is desirable that such an apparatus be available and the reason for the desirability of such a device stems from the need to hear such extraneous raises in order to be aware whenever the telephone rings or the doorbell is sounded.” EX1023, 1:16-25. Thus, *Fox* discloses a headphone system that is “structured so that when an ambient sound of sufficient magnitude is detected, an automatically actuated switch allows such sound signal to be first compressed through the voice compressor, then amplified and directed through to the headphones to be heard by the listener. The listener need not actuate any switches, and can determine his course of action once such a signal is heard.” *Id.*, 2:12-19.

81. As another example, U.S. Patent No. 4,827,458 (“*d’Arc*”) (EX1024), filed in March 1988, explains that “miniature portable appliances, such as cassette players, compact disc players ... have enjoyed great success for several years but they have the major disadvantage of acoustically isolating the user from the surrounding environment.” EX1024, 1:18-26. “[S]uch isolation could subject the user to a wide range of accidents or risks.” *Id.*, 1:28-30. “[T]he majority of users of portable appliances are, by virtue of their helmets or headphones, completely insensitive to calls, warning signals, and, above all, to any sudden, unexpected change in their surroundings.” *Id.*, 1:33-37. “Furthermore, it is unpleasant, when calling someone nearby who is wearing a helmet or headphones, to have to shout in order to warn the person of some danger or simply to attract the person's attention.” *Id.*, 1:42-45. Accordingly, *d’Arc* discloses “providing an apparatus by which the headphone user is alerted in a reliable manner upon the occurrence of a surge in sound representing an abnormal event or a warning of which the user should be made aware while minimizing false alerts in response to high sound levels that do not represent dangerous situations.” 1:58-65.

82. As another example, EP0495653A (“*Smiedt*”), filed in January 1992, discloses that “[p]ortable compact disc players and portable tape cassette players usually include headphones. Additionally, many people prefer to listen

to music from a Hi-Fi set through headphones rather than by way of speakers in the room. Modern headphones are so efficient at shutting out ambient sounds that the wearer of the headphones is in effect isolated from the world around him. Consequently the user does not hear someone speak to him, or a telephone ringing or a knock on the door.” EX1025, 1:4-13. Thus, *Smiedt* discloses “audio equipment which comprises a sound operated switch which is activated by an ambient sound which is above the response level of the switch, the switch being connected so that the output signal it produces on responding to said sound, alerts the person wearing the headphones that the switch has responded.” *Id.*, 1:20-27.

83. As another example, U.S. Patent No. 5,647,011 (“*Garvis*”), filed in March 1995, discloses that “[o]ne of the problems encountered in the wide usage of such headphone stereo systems is that while the listener has the headphones on, he cannot hear extraneous noises, such as sirens or emergency warning devices. When a person has earphones in place over the ears with the sound system playing loud music or the like, extraneous sound signals are completely obliterated. The signals thus become a hazard to the user of the headphones in the case of emergency or warning signals and are inconvenient when anyone desires to communicate with a person using the headphone stereo system. The headphone wearer, in effect, is tuned out to loud from all extraneous noises and

communications.” EX1026, 1:16-27. *Garvis* notes that “[i]t has been suggested in the past to pick up extraneous sounds, especially in automobiles and vehicles, and recreate the sounds within the vehicle cab, either over the radio or to interrupt the radio and produce the sounds. This becomes important within vehicles since persons driving with the windows up and a radio playing are unable to hear sirens or emergency vehicles, which may be result in endangering people's lives.” *Id.*, 1:29-35. “The problem is aggravated by portable stereo systems worn by people driving cars or in vehicles since, even if the radio is turned down and a warning is made within the vehicle, the wearer of the headphones would not hear the extraneous sounds.” *Id.*, 1:36-40.

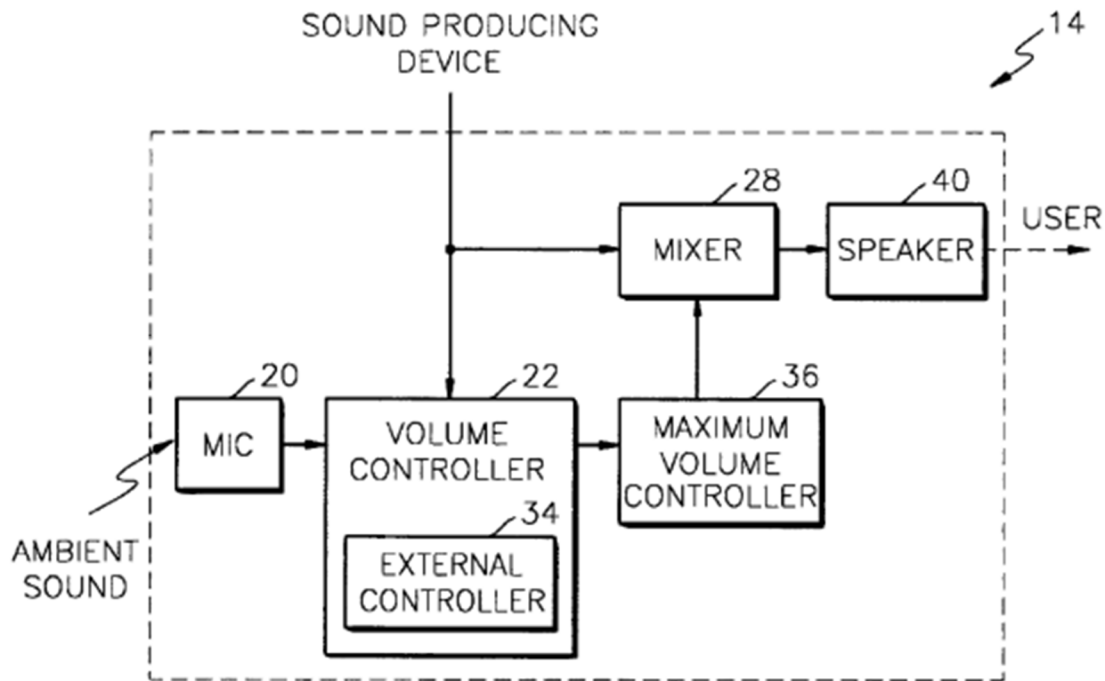
84. In view of those issues, *Garvis* discloses “a self-contained unit for attaching to the belt of an individual or to his clothing or body and which allows for the headphones to be plugged thereinto with the CD player or cassette player plugged thereinto so that the sound from the sound source to the headphones can be interrupted subject to predetermined sound levels being picked up by a microphone in the housing to switch off the connection between the sound source and the earphone, which connection is manually reset at the option of the user. Extraneous sounds can also be processed as desired.” *Id.*, 2:48-58.

85. As another example, U.S. Patent No. 6,782,106 (“*Kong*”), filed in May 2000, explains that “people frequently listen to sound of small and portable

sound producing devices using sound receivers or earphones.” EX1027, 1:29-35.

“When using these sound receivers and earphones, it frequently happens that users do not hear ambient sound, for example, an alarm whistle which may be a danger signal, a warning voice or a calling sound. In this case, the user him/her self may be in danger or may be placing those around him/her self in danger.”

Id., 1:43-48 . To solve that problem *Kong* discloses “an apparatus and method for transmitting the sound of a sound producing device to a user together with adjusted external sound.” *Id.*, 2:3-6. “The apparatus includes an external sound receiver for receiving external sounds and converting them into an external sound signal, a volume controller for outputting only, the reproduced sound signal and the external sound signal having a volume exceeding a predetermined reference level, and a mixer for mixing the reproduced sound signal with the reproduced and external sound signals output from the volume controller and outputting the result.” *Id.*, 2:7-17.



Kong, FIG. 3

86. As another example, *Basu* (EX1028), published in May 2001, is titled “Smart Headphones: Enhancing Auditory Awareness Through Robust Speech Detection And Source Localization” and discloses “a method for enhancing auditory awareness by selectively passing speech sounds in the environment to the user.” *Basu* at 1. With the “smart headphones,” “a user can be listening to music over headphones and hear speech from specified directions mixed in.” *Id.*, Abstract; *see also* Preliminary Results (“All four reported that the system significantly improved their awareness of the speech around them without distracting them with all of the non-speech sounds, and found they could carry on a conversation with music playing.”)

87. As another example, *Mueller* (EX1029), published in April 2002, is titled “Transparent Hearing.” The “Transparent Headphones” “is a system in which sound is picked up just before it enters the ears, altered, and then played back in real-time, creating transparent augmented hearing.” *Mueller* at 1. “The microphones pick up ambient sound, which is then amplified and sent to a computer, where it can be altered. The modified audio is then played back through the headphones. This allows switching between two modes: one sounds as if you have headphones on (opaque mode), dulling the external, environmental noise, while the other pipes through the audio from the microphones, sounding as if you are not wearing headphones at all (transparent mode).” *Id.* “Positions between these two extremes form a gradient from opacity to transparency and are called semi-transparent modes: each passes a different level of external audio to the ear.” *Id.*

88. *Rast*, filed in April 2001, is titled “System And Method For Selective Control Of Acoustic Isolation In Headsets.” *Rast* explains that “[a] wide variety of traditional headsets exist for noise abatement or for listening to an audio source, or communication. ... Audio headsets are ubiquitous today for the reproduction of audio sources, in particular, music. ... Headsets are often further equipped with noise cancelation circuitry which introduces a negative environmental noise feedback signal (opposing phase) into the audio source

being received, so that the ambient noise is further attenuated and thus acoustic isolation of the wearer from the environment increases.” EX1030 ¶[0007].

89. *Rast* notes, however, “that being isolated from every sound within the external acoustical environment can often be inconvenient, or even dangerous.” *Id.* ¶[0009]. “Therefore, a need exists for the development of methods for controlling acoustic isolation, so that important events are not missed and non-important noises can be properly identified and ignored.” *Id.*

90. Thus, *Rast* discloses “environmentally responsive headsets” that are “capable of changing isolation mode in response to a manual trigger, or automatically in response to matching a sound from the external environment with a stored element of sound characterization information which is programmed within the apparatus.” *Id.* ¶[0014]. “The mode of the headset may be changed by any of a number of mechanisms, for example, by temporarily routing external sound to earpieces (a ‘hearthrough mode’), replaying the detected sound (temporally displaced sound—an ‘echo back’), generating an alert signal (‘user alert tone’), attenuating the sound by augmenting active noise cancelation with selective sound acoustical isolation (‘block matched sound’), amplifying the ambient sounds after extracting spurious noises, accentuating spoken sounds (drop noise floor while amplifying speech highlights and formants), combinations of the preceding modes, and so forth. Furthermore, if

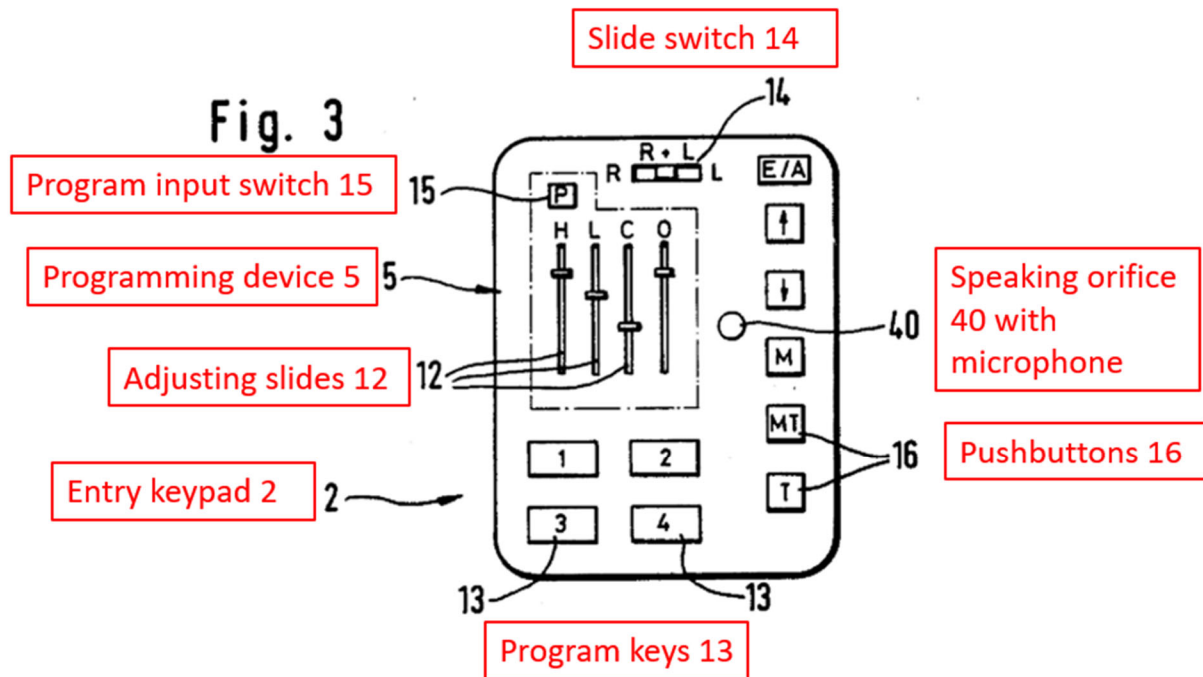
the headset is configured for listening to a programmed sound, such as that being received over a wired connection, or wireless receiver, then the audio amplitude of the programmed audio source may be temporarily attenuated, or disconnected, such that the external sound may be more easily discerned by the wearer.” *Id.*

91. Accordingly, *DiCenso*, *Kirsch*, *Goldstein*, and *Woodruff* are just exemplary prior art references of many that pre-date February 2022 that are essentially directed to solving the same problem with very similar signal processing solutions, i.e., using a headset augmented with a microphone to pick up sound in the ambient environment, and under certain conditions, pass-through the ambient sound mixed with the user’s audio content so that the user is made more aware of their surroundings while wearing the headset. A POSITA would have considered each of these references to be analogous to the ’473 patent because they are within the same field of endeavor of the ’473 patent and reasonably pertinent to one or more problems addressed by the ’473 patent.

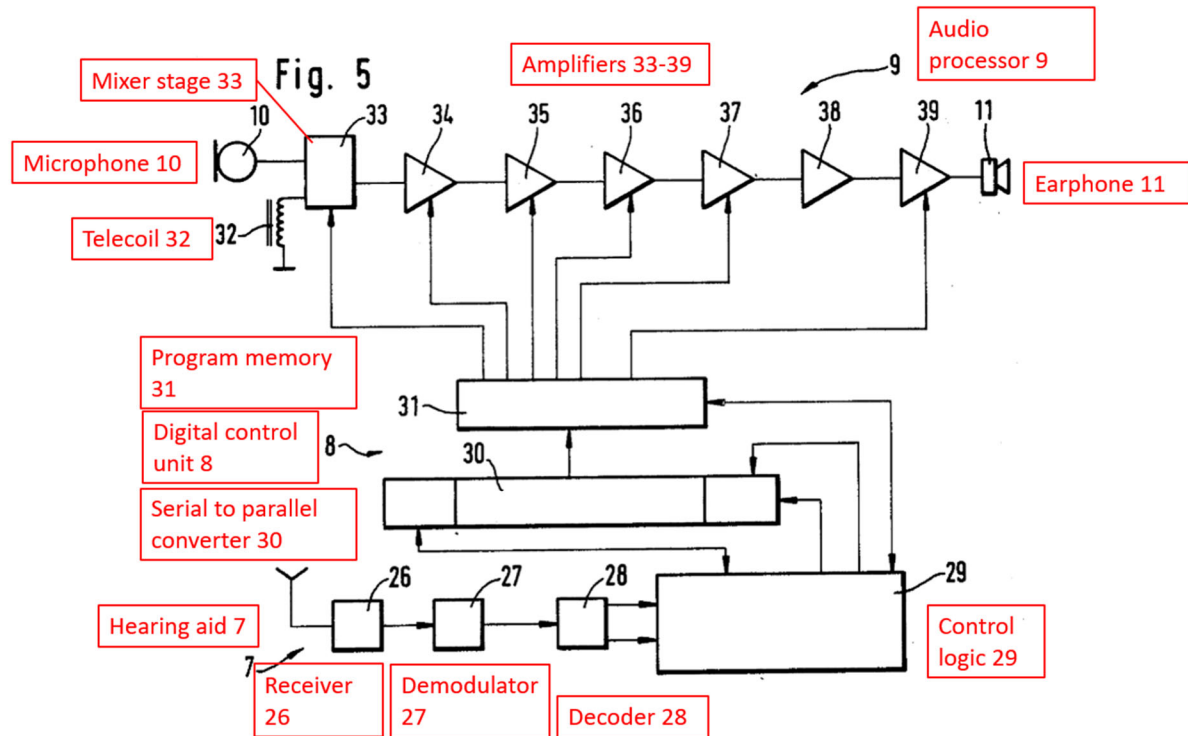
B. Earpiece Remote Controls Were Well-Known Before February 2022

92. Claims 1-7 of the ’473 patent generally recite a device that sends an audio content signal, an audio content gain value, and an ambient sound gain value to an earpiece that applies the gain values to an ambient signal and audio signal and then mixes the signals together. It was well-known before February

2022 to use a remote device to control the audio processing parameters of earpieces, particularly in the field of hearing aids. For example, U.S. Patent No. 4,947,432 (“*Topholm* ’432”), filed January 22, 1987, discloses “a programmable hearing aid with an amplifier section and a transmission section whose transmission characteristics can be controlled.” EX1031, 1:6-8. The programmable hearing aid is assigned “an external control unit with a modulatable transmitter for transmission of specific data, determining the transmission characteristics, by means of wireless transmission to the hearing aid.” *Id.*, 2:34-42.

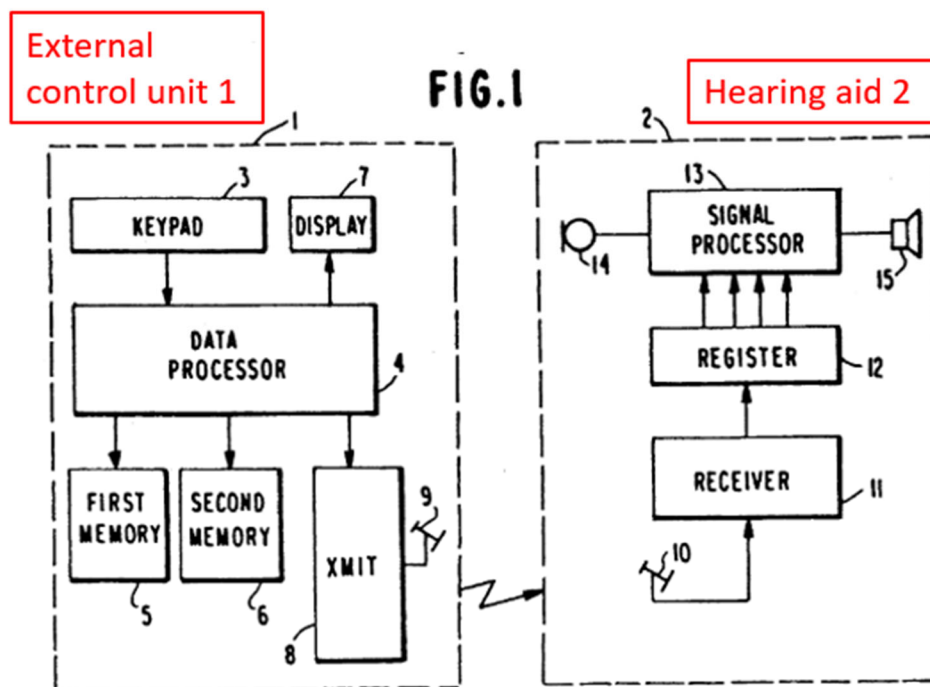


Topholm ’432, FIG. 3 (annotated)



Topholm '432, FIG. 5 (annotated)

93. Similarly, U.S. Patent No. 5,202,927 (“*Topholm '927*”), issued April 13, 1993, discloses “a remote-controllable, programmable hearing aid system which consists of an external control unit 1 and an actual hearing aid 2.” EX1032, 1:50-54. “The control unit 1 contains a keypad 3 ... connected to a data processor 4, i.e. microprocessor, to which a first memory 5 for audiometry data and a second memory 6 for data describing various environmental situations are connected in turn.” *Id.*, 1:64-2:4. “[A] transmitter 8 is also connected to the data processor 4, whereby the former is intended for wireless transmission of data/parameters to the actual hearing aid.” *Id.*, 2:7-11.



Topholm '927, FIG. 1 (annotated)

94. Thus, while *Patel* and *Topholm*, discussed below, generally disclose controlling the audio processing parameters of an earpiece with a remote device, similar technology and techniques had been known at least since the late 1980s and early 1990s.

C. Earpieces With Multiple Microphones, A Processor, And A Memory Were Well-Known Before February 2022

95. The '473 patent claims recite earpieces or devices that include two microphones, a processor, and a memory storing instructions executed by the processor. Earpieces with such components were well-known long before February 2022. For example, *Kvaløy*, filed March 1, 2002 and titled “Voice

Detection And Discrimination Apparatus And Method” discloses such an earpiece, as shown in Figures 1 and 2, below.

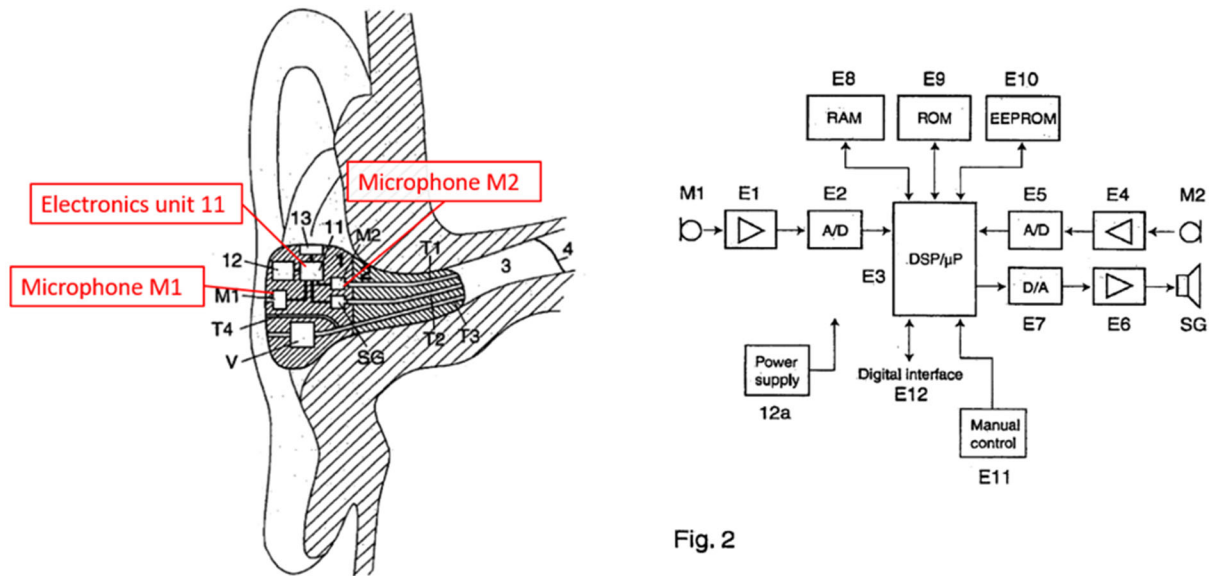


Fig. 2

Kvaløy, FIGs. 1, 2 (annotated)

IX. INTERPRETATION OF THE '473 PATENT CLAIMS

96. I have given all the claim terms their plan 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.

X. SPECIFIC GROUNDS FOR CHALLENGE

A. THE CHALLENGED CLAIMS ARE NOT ENTITLED TO A PRIORITY DATE EARLIER THAN FEBRUARY 3, 2022

97. As noted in §VII.B, the '473 patent was filed on February 3, 2022. The '473 patent claims priority to a parent application (the '892App.) that was filed on May 17, 2021. As discussed in §V, 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. Here, that means that the for the claims of the '473 patent to be entitled to priority as of the filing date of the '892App., the specification of the '892App. must provide an adequate written description of the '473 patent claims.

98. 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.

99. 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.

100. As explained further below, it is my opinion that the '892App. does not provide adequate written description of the '473 patent claims. Therefore, I understand that the claims of the '473 patent are not entitled to priority before February 3, 2022.

1. The '892App. does not support claims 1-7

- a. *No disclosure of a device “sending an audio content gain value and an ambient sound gain value to the earpiece.” (Claims 1-7)***

101. Claim 1 recites “a device” that includes a memory and processor that executes instructions to perform operations including “communicatively connecting to an earpiece” and “sending an audio content gain value and an ambient sound gain value to the earpiece” and wherein the earpiece processor “applies the audio content gain value to the audio content signal” and “applies the ambient sound gain value to an ambient sound signal.” *'473pat.*, 13:58-66. This is part of the limitation that the examiner considered an important distinction over the closest prior art of record. EX1004 at 899-900. As noted above in §VII.B, the Patent Office stated with respect to claim 1:

The following is an examiner's statement of reasons for allowance: Page 2 Boersma, considered to be the closest art of record teaches a device a processor (34) that is communicatively coupled to an earpiece (38) with the earpiece including a microphone (50) and a speaker (56); *sending an audio content gain value and an ambient sound gain value to the ear piece (on line (88) after gain adjustments made by (84, 90),...*; applying an audio content gain value (by use of (84)) to the audio content signal generating a modified audio content signal; applying the ambient sound gain value (by use of (90)) to an ambient sound signal to generate a modified ambient sound signal. This reference however functions

differently that the claimed invention and does not teach additionally in combination a display, a processor executing stored instructions on a memory, an earpiece including each of a first microphone, a second microphone, a speaker, a second memory and an ear processor along with as set forth in claim 1 to “mix the modified ambient sound signal with the modified audio content signal to generate a mixed signal”. In Boersma, modifying the audio content signal (using (84) occurs after the audio content signal and a modified ambient sound signal have been mixed by element (82). *Also, in Boersma, it is not an earpiece processor the receives an audio content gain value and a ambient sound gain value, to form the modified signals and mix the modified signals.* This combination of features as set forth are not an obvious variation of the teaching Boersma. The limitations of claims 2-5, 18-19 depend upon those features of claim 1.

EX1004 at 899-900

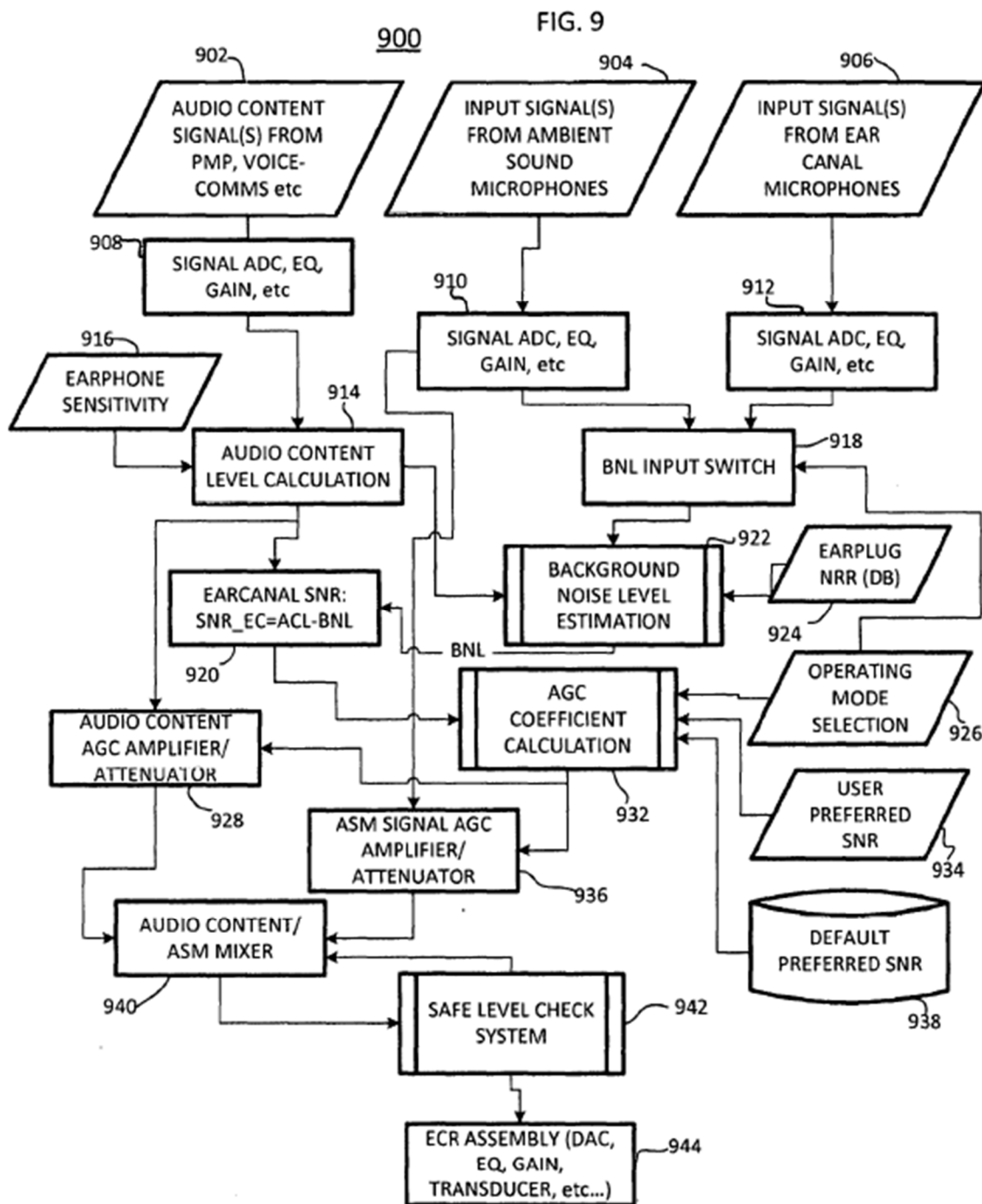
102. In my opinion, this feature is not disclosed in the '892App.

103. During prosecution, the applicant stated that the support for that limitation could be found in paragraph [0069] and Figure 9 of the '143App.

EX1004 at 894. The corresponding paragraphs and Figure of the '892App. (also paragraph [0069] and Figure 9) do not disclose such a device. Paragraph [0069] and Figure 9 of the '892App. are copied below for reference.

[0069] At step 922 the BNL is estimated using inputs from either or both the ASM signal at step 902, and/or the ECM signal at step 906. The BNL may be adjusted by the earpiece noise reduction rating 924. These signals are selected using the BNL input switch at step 918, which may be controlled automatically or with a specific user-generated manual operation at step 926. The Ear-Canal SNR is calculated at step 920 by differencing the ACL from step 914 and the BNL from step 922 and the resulting SNR 930 is passed to the method step 932 for AGC coefficient calculation. The AGC coefficient calculation 932 calculates gains for the Audio Content signal and ASM signal from the Automatic Gain Control steps 928 and 936 (for the Audio Content and ASM signals, respectively). AGC coefficient calculation 932 may use a default preferred SNR 938 or a user-preferred SNR 934 in its calculation. After the ASM signal and Audio content signal have been processed by the AGCs 928 and 936, the two signals are mixed at step 940.

EX1006 at 51



EX1006 at 13

104. To be sure, '892App. paragraph [0069] describes a step of the method shown in Figure 9 for calculating "AGC coefficients" but the '892App.

only discloses that the method can be performed “in a single earpiece, a pair of earpieces, headphones, or other suitable headset audio delivery devices” (‘892App. ¶[0066]), and there is no hint that the “AGC coefficients” can be calculated by a processor separate from an earpiece processor and then sent to the earpiece.

105. Patent Owner may argue that the ‘892App. discloses in paragraph [0040] that “[t]he earpiece 100 can further represent a single operational device or a family of devices configured in a master-slave arrangement, for example, a mobile device and an earpiece. In the latter embodiment, the components of the earpiece 100 can be reused in different form factors for the master and slave devices.” This disclosure is insufficient. Paragraph [0040] is silent as to any details of any potential “master-slave arrangement,” and there is no hint of an arrangement in which “gain values” are sent from a processor to an earpiece.

**b. No disclosure of a device sending both “gain values” and an “audio content signal” to an earpiece.
(Claims 1-7)**

106. The ‘892App. does not disclose a device that sends **both** an audio content signal **and** the claimed gain values to an earpiece. The ‘892App. discloses that the earpiece includes an “audio interface” which can “receive the audio content from at least one among a portable music player, a cell phone, and a portable communication device.” ‘892App. ¶[0044]. There is no disclosure

that the same device that transmits audio content can also send the claimed “gain values.”

[0044] Sound within the ear canal 131 can also be provided via the audio interface 212. The audio interface 212 can receive the audio content from at least one among a portable music player, a cell phone, and a portable communication device. The audio interface 212 responsive to user input can direct sound to the ECR 125. For instance, a user can elect to play music through the earpiece 100 which can be audibly presented to the ear canal 131 for listening. The user can also elect to receive voice communications (e.g., cell phone, voice mail, messaging) via the earpiece 100. For instance, the user can receive audio content for voice mail or a phone call directed to the ear canal via the ECR 125. As shown in step 304, the earpiece 100 can monitor ear canal levels due to ambient sound and user selected sound via the ECM 123.

'892App. ¶[0044]

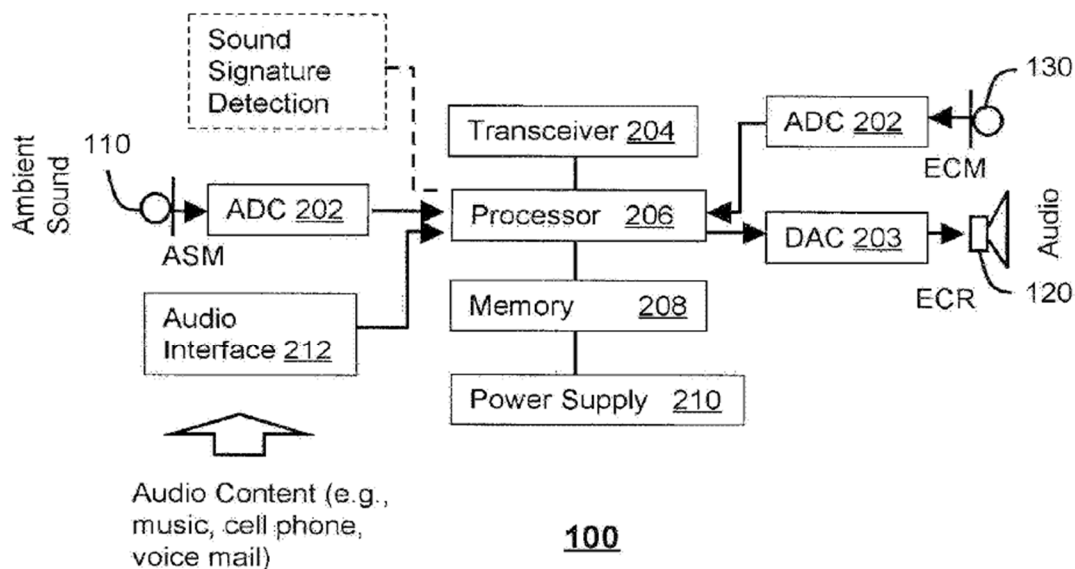


FIG. 2

'892App. FIG. 2

- c. ***No disclosure of a “portable communication device” that is a “a watch, a tablet, earpiece, a laptop computer or a combination thereof.” (Claim 7)***

107. The ‘892App. discloses certain examples of a “portable communication device” including a “portable music player” and a “cell phone.” ‘892App. ¶[0044]. There is no disclosure of using a watch, an earpiece, or a laptop as a “portable communication device” with the other limitations of the claimed invention (e.g., the memory and processor that executes instructions to perform the claimed operations).

2. The ‘892App. does not support claims 8-20

- a. ***No disclosure of combining microphone signals. (Claims 8-20)***

108. Claim 8 requires a processor that executes instructions to perform operations including generating an ambient sound signal “from at least one of the modified first microphone signal, the modified second microphone signal ***or a combination thereof***” and “detecting an acute sound by analyzing “at least one of the modified first microphone signal, the modified second microphone signal ***or a combination thereof***.”

109. A POSITA would have understood that the plain language of this limitation encompasses (1) combining the signals from two ambient sound microphones together or (2) combining a signal from an ASM and an ECM. The ‘892App. does not disclose combining any microphone signals together, let

alone combining an ASM and an ECM signal together, or performing the claimed “generating” and “detecting” steps in connection with combined microphone signals. Claims 9 and 14 include similar limitations and are not supported by the ‘892App. for the same reason.

110. This feature was considered important by the examiner in distinguishing over the closest prior art. EX1004 at 900. As explained in §VII.B, the examiner stated with respect to claim 6:

Also, in addition to that discussed with respect to claim 1, Boersma teaches that the arrangement is used to detect an acute sound (such as sounds produced by police and sirens) as provided in applicants claim 6. However, Boersma does not alone or obvious combination teach a device controlling ambient sound passthrough that includes *the use of in combination first and second microphones, the signals produced by each being modified; generating an ambient sound signal from these modified signal(s)*, modifying a modified audio content signal if an acute sound is detected to generate a new modified audio content signal; generating a mixed signal from the ambient sound signal and the modified or new modified audio content signal which is then sent to the speaker as set forth in claim 6. The limitations o [sic] claims 7-17 and 20 depend upon those features of claim 6.

EX1004 at 900.

111. A POSITA would have understood that a step for combining microphone signals would have been meaningfully more complex and would have at least required an additional processing step that is not disclosed in the '892App. A POSITA would have understood that combining the ambient microphone signals to encompass what is known in the art as beamforming. This is corroborated by, for example, *Woodruff*, which describes a sound pickup channel from “combining multiple microphone signals, e.g., by a beamforming process.” *Woodruff* ¶[0024]. Beamforming would have had benefits that the named inventors did not envision or describe, such as reducing noise in the ambient signal passed through to the user and providing the user with an ambient signal focused on the ambient sound of interest rather than all ambient sound.

b. *No disclosure of “generating a noise reduction signal” (Claims 10-12)*

112. Claims 10 (and claims 11 and 12, by virtue of their dependency from claim 10) require “generating a noise reduction signal.” '473pat., 14:62-15:9. A POSITA would have understood a “noise reduction signal” to be a signal that, when mixed with a noisy signal, has the effect of reducing noise. There is no disclosure in the '892App. of generating a “noise reduction signal.” At best, the '892App. includes certain references to “noise reduction” in the context of describing the “noise reduction rating” of the earpiece “due to

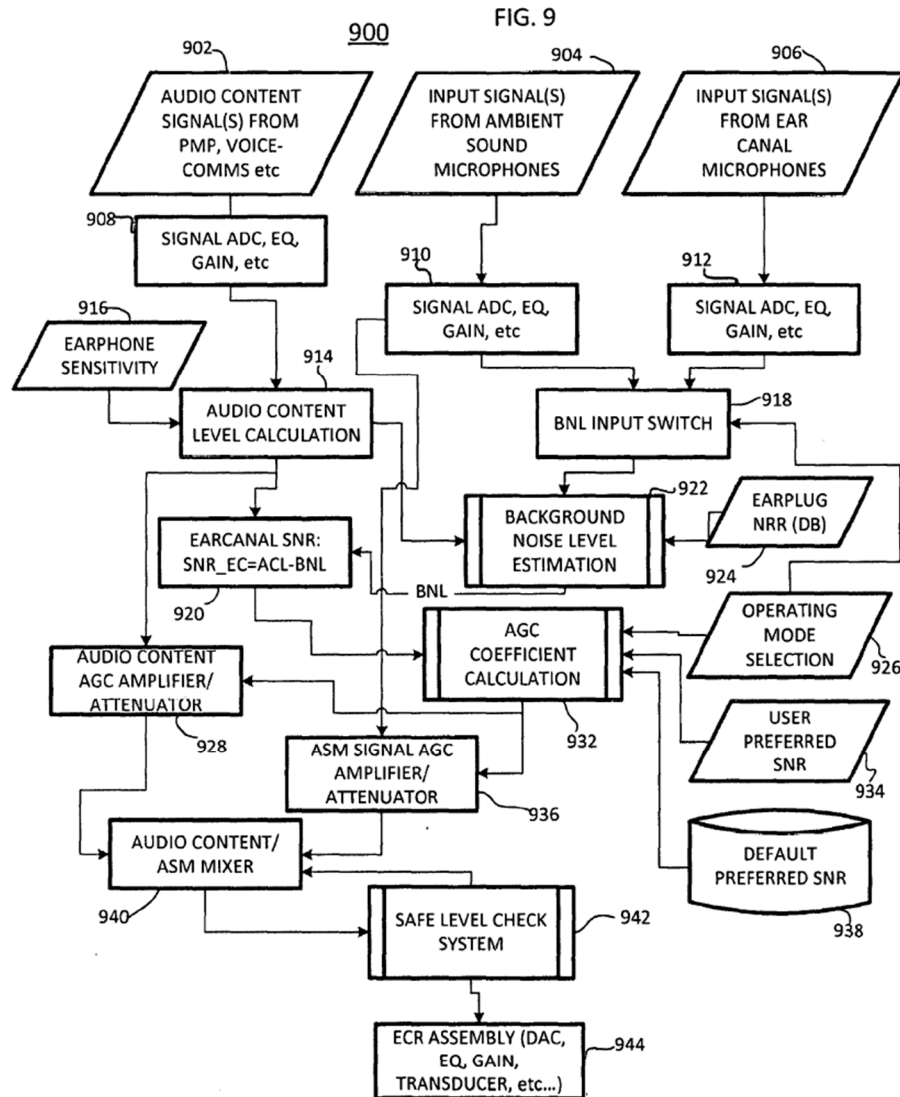
physical and sealing properties of the earpiece.” ‘892App. ¶[0043]. A POSITA would have understood that these references do not relate to a processor generating a “noise reduction signal.”

[0043] Although the earpiece 100 when inserted in the ear can partially occlude the ear canal, the earpiece 100 may not completely attenuate the ambient sound. During the monitoring of ambient sounds in the environment, the earpiece 100 also monitors ear canal levels via the ECM 123 as shown in step 304. The passive aspect of the physical earpiece 100, due to the mechanical and sealing properties, can provide upwards of a 22-26 dB noise reduction. However, portions of ambient sounds higher than 26 dB can still pass through the earpiece 100 into the ear canal. For instance, high energy low frequency sounds are not completely attenuated. Accordingly, residual sound may be resident in the ear canal and heard by the user.

EX1006 at 44

- c. ***No disclosure of “mixing the noise reduction signal with the mixed signal to generate a new mixed signal, and sending the new mixed signal to the speaker instead of the mixed signal.”***

113. Claim 11 requires “mixing the noise reduction signal with the mixed signal to generate a new mixed signal, and sending the new mixed signal to the speaker instead of the mixed signal.” Because there is no disclosure of “generating a noise reduction signal,” there is no disclosure of mixing that noise reduction signal with another “mixed signal.” At best, the method of Figure 9 discloses a step related mixing audio content and an ASM signal. ‘892App. ¶[0069], FIG. 9 (step 940). There is no additional, separate step for further mixing a “noise reduction signal.”



EX1006 at 13

B. GROUND 1: *KIRSCH* AND *DICENSO* RENDER OBVIOUS CLAIMS 1-7

1. Motivation to Combine *Kirsch* and *DiCenso*

114. *Kirsch* and *DiCenso* are analogous to the '473 patent because they are within the same field of endeavor of the '473 patent and reasonably pertinent to one or more problems addressed by the '473 patent. As detailed below, *Kirsch*

and *DiCenso* have similar, complementary disclosures, and a POSITA would have been motivated to combine their teachings in a manner than renders claims 1-7 obvious and would have had a reasonable expectation of success in doing so. As detailed below, *Kirsch* discloses a functional system diagram for an audio system that mixes processed audio signals obtained from ambient microphones and obtained from an audio playback device (e.g., music) in a selective manner. *Kirsch* discloses that its audio system is for a personal listening device (e.g., earbuds), that it may be implemented with a digital signal processor, and that the parameters of the system may be controlled by a remote smartphone application. *DiCenso* discloses a wearable device (e.g., earbuds) that communicate with a remote mobile device (e.g., smartphone) to receive both music and preferences related to the relative mix of ambient sounds and music. A POSITA would have recognized that *DiCenso*'s system was a suitable environment in which to implement *Kirsch*'s audio system.

a. Overview of *Kirsch*

115. *Kirsch* discloses “an audio processing system for a personal listening device” such as earbuds. *Kirsch*, Abstract, ¶[0002] (“Headphones, earphones, ***earbuds, and other personal listening devices...***”). As background, *Kirsch* explains that earbuds provide an “acoustic seal” which improves the quality of the user’s acoustic experience, but that causes a problem because the

user may not hear important environmental sounds. *Id.* ¶¶[0002]-[0003]. *Kirsch* acknowledges that a known solution for that problem is to “electronically mix audio from the environment with the audio signal received from the playback device.” *Id.* ¶[0004]. But there is a drawback with that solution: “the listener typically hears all audio from the environment rather than just the specific environmental sounds that the listener desires to hear.” *Id.* ¶[0004]. Thus, *Kirsch* explains that “a more effective technique for providing both playback audio and environmental sound to a personal listening device would be useful.” *Id.* ¶[0005].

116. *Kirsch* discloses “an audio processing system for a personal listening device” that may be implemented with a “central processing unit (CPU), digital signal processor (DSP), a microcontroller, an application-specific integrated circuit (ASIC), or any device or structure configured to process data and execute software applications.” *Id.* ¶¶[0006], [0016] (“In various embodiments, audio processing system 100 may be implemented as a state machine, a central processing unit (CPU), digital signal processor (DSP), a microcontroller, an application-specific integrated circuit (ASIC), or any device or structure configured to process data and execute software applications. In some embodiments, one or more of the blocks illustrated in FIG. 1 may be implemented with discrete analog or digital circuitry. In one example, and

without limitation, the left amplifier 140(0) and right amplifier 140(1) could be implemented with operational amplifiers.”). The system includes a “set of microphones ... integrated into the personal listening device and configured to receive a first set of audio signals from an environment.” *Id.* More particularly, the system includes a left microphone array 105(0) and a right microphone array 105(1) that receive audio from the physical environment in the vicinity of the user’s left ear and right ear, respectively. *Id.* ¶[00117], FIG. 1. Each array includes at least two microphones. *Id.*

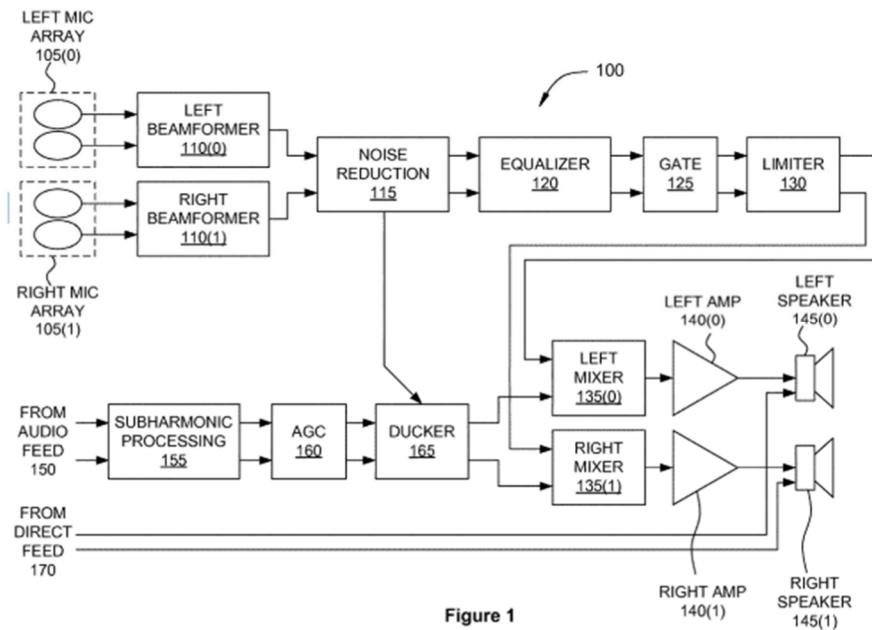


Figure 1

Kirsch FIG. 1

117. Audio signals from the microphones and audio signals from a playback device and audio feed (such as music) are mixed and output to the user.

Kirsch, Abstract, ¶[0031] (“Subharmonic processing 155 **receives audio signals**

from a playback device (not explicitly shown) from an audio feed 150.”).

Particularly relevant for present purposes, the audio signals from the microphone arrays are received and processed by several modules that, in sum, reduce steady-state noise and only pass signals of interest from the environment to the left mixer 135(0) and a right mixer 135(1).

118. “**Beamformers 110(0) and 110(1)** receive audio signals from microphone arrays 105(0) and 105(1)” and “process the received audio signals according to one of a number of modes” *Id.* ¶[0018]. “In some embodiments, the signal received from one of the microphones in microphone arrays 105(0) and 105(1) is digitally delayed and then subtracted from the signal from another one of the microphones in the microphone arrays 105(0) and 105(1).” *Id.* ¶[0019]. The beamformers may “amplify signals originating from certain directions while attenuating signals originating from other directions.” *Id.* ¶[0020].

119. **The noise reduction module 115** “analyzes the received audio signal, suppresses signals determined to be of less interest, such as steady-state or noise signals, and passes signals determined to be signals of interest, such as transient signals.” *Id.* ¶[0021]. “In general, steady-state signals may correspond to background noise, including, without limitation, traffic din, hum, hiss, rain, and wind.” *Id.* ¶[0021]. “On the other hand, transient signals may correspond to signals of interest, including, without limitation, human speech, honking

automobile horns, and sirens.” *Id.* ¶[0022]. “These types of important sounds emanating from the environment are typically characterized as an audio signal that has a high audio level relative to the average background audio level and is intermittent, acting as an interruption.” *Id.* ¶[0024]. “Noise reduction 115 may pass such transient signals to equalizer 120 and optionally may amplify the transient signals.” *Id.* ¶[0022]. If the noise reduction module detects a signal of interest, “noise reduction 115 transmits a corresponding signal to ducker 165” and then “ducker 165 temporarily reduces the volume level of the received audio signal.” *Id.* ¶¶[0024], [0033].

120. “**Equalizer 120** receives audio signals from noise reduction 115.” *Id.* ¶[0027]. “Equalizer 120 performs frequency-based amplitude adjustments on the received audio signals in order to improve audio quality for audio signals received from the environment of the listener.” *Id.* “[E]qualizer 120 may amplify audio signals in certain frequency bands in order to make such audio signals more noticeable to the user.” *Id.* ¶[0028]. “In this way, equalizer 120 may amplify certain audio signals, such as speech or alarms, so that the listener may readily hear these certain audio signals.” *Id.* “Equalizer 120 transmits the equalized audio signal to gate 125.” *Id.*

121. “**Gate 125** receives audio signals from equalizer 120 and suppresses audio signals that fall below a threshold volume, or amplitude, level.

Audio signals above the threshold volume, or amplitude, level pass through gate 125 to limiter 130.” *Id.* ¶[0029].

122. “**Limiter 130** rapidly detects loud sounds before such loud signals reach the listener’s ears and limits such loud signals so as not to exceed a maximum allowable audio level. In this way, limiter 130 attenuates loud signals to protect the listener.” *Id.* ¶[0030].

123. “**Mixers 135(0) and 135(1)** receive processed environmental audio signals from limiter 130 and processed music or other audio from ducker 165. Mixer 135(0) mixes, or combines, received audio signals for the left audio channel, and, correspondingly, mixer 135(1) mixes received audio signals for the right audio channel.” *Id.* ¶[0034]. “[M]ixers 135(0) and 135(1) may weight each of the incoming audio signals based on the user volume settings.” *Id.* ¶[0034]. “After performing the mix function, left mixer 135(0) and right mixer 135(1) transmit the resulting signals to left amplifier 140(0) and right amplifier 140(1).” *Id.*

124. *Kirsch* discloses that “the listener may control certain functions or set certain parameters of audio processing system 100” including volume settings, “via an application that executes on a computing device, including, without limitation, a smartphone, a tablet computer, or a laptop computer” that

communicates with the audio processing system via, for example, Bluetooth.

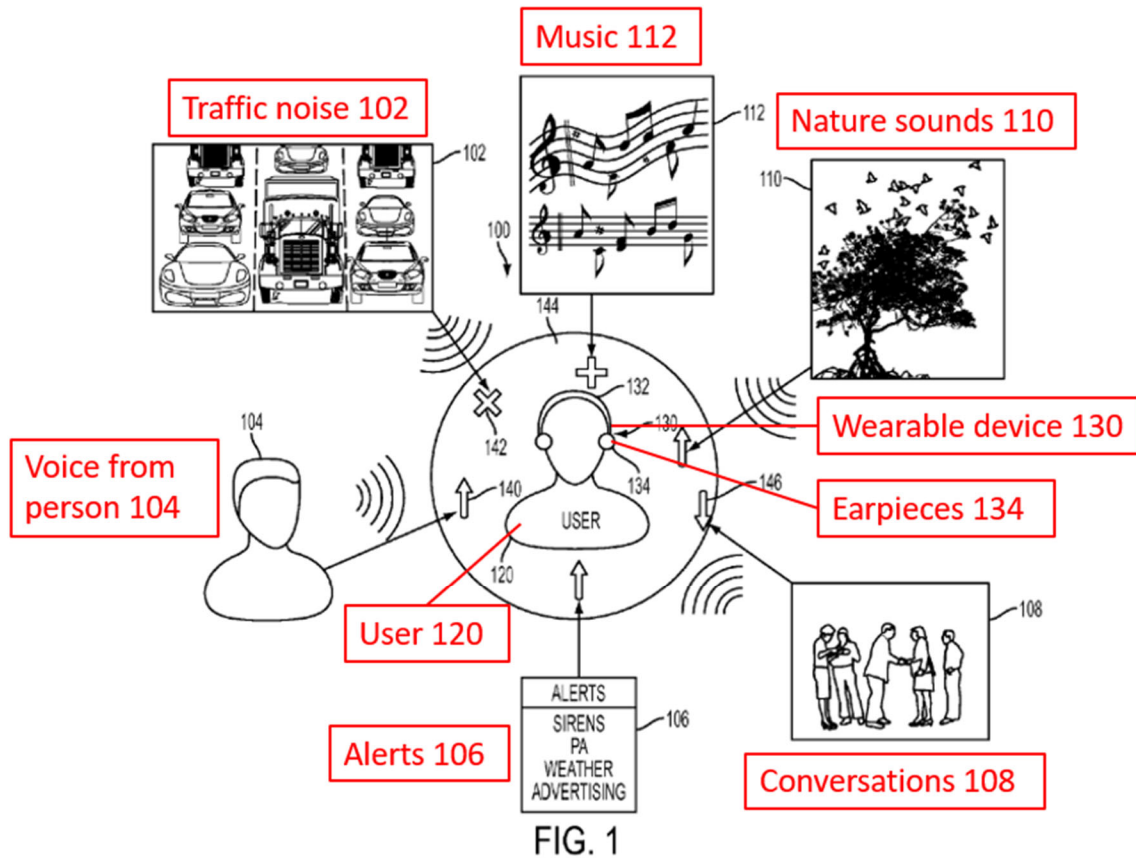
Kirsch ¶[0035].

b. Overview of *DiCenso*

125. *DiCenso* “relates to systems and methods for a user controllable auditory environment using wearable devices such as ... in-ear devices, for example, to selectively cancel, add, enhance, and/or attenuate auditory events for the user.” *DiCenso* ¶[0001]. As background, *DiCenso* explains that “[v]arious types of noise cancelling headphones and hearing aid devices allow users some control or influence over their auditory environment.” *Id.* ¶[0003]. But these systems “usually cancel or enhance the overall sound field” and “the cancellation or enhancement is not selective and cannot be finely tuned by the user.” *Id.* ¶[0003].

126. With reference to Figure 1, *DiCenso* discloses a system 100 that “includes a user 120 surrounded by an ambient auditory environment including a plurality of types or groups of sounds.” *Id.* ¶[0019]. “[R]epresentative sound sources ... are represented by traffic noise 102, a voice from a person 104 talking to user 120, various types of alerts 106, voices from a crowd or conversations 108 either not directed to user 120 or in a different spatial location than voice from person 104, nature sounds 110, and music 112.” *Id.* “Various sounds, such as those represented in FIG. 1, may be stored in a database and

accessed to be added or inserted into the auditory environment of the user in response to user preferences as described in greater detail below.” *Id.* ¶[0020].



DiCenso, FIG. 1 (annotated)

127. “[S]ystem 100 includes a wearable device 130.” *Id.* ¶[0022]. The wearable device “may be implemented by ... ear buds 134,” which each contain a speaker and “one or more microphones” such as “an ambient microphone to detect ambient sounds” and an “internal microphone used in a closed loop feedback control system for cancellation of user selected sounds.” *DiCenso* ¶[0022], FIG. 1. *DiCenso* also refers to the earbuds 134 as “earpieces 134”

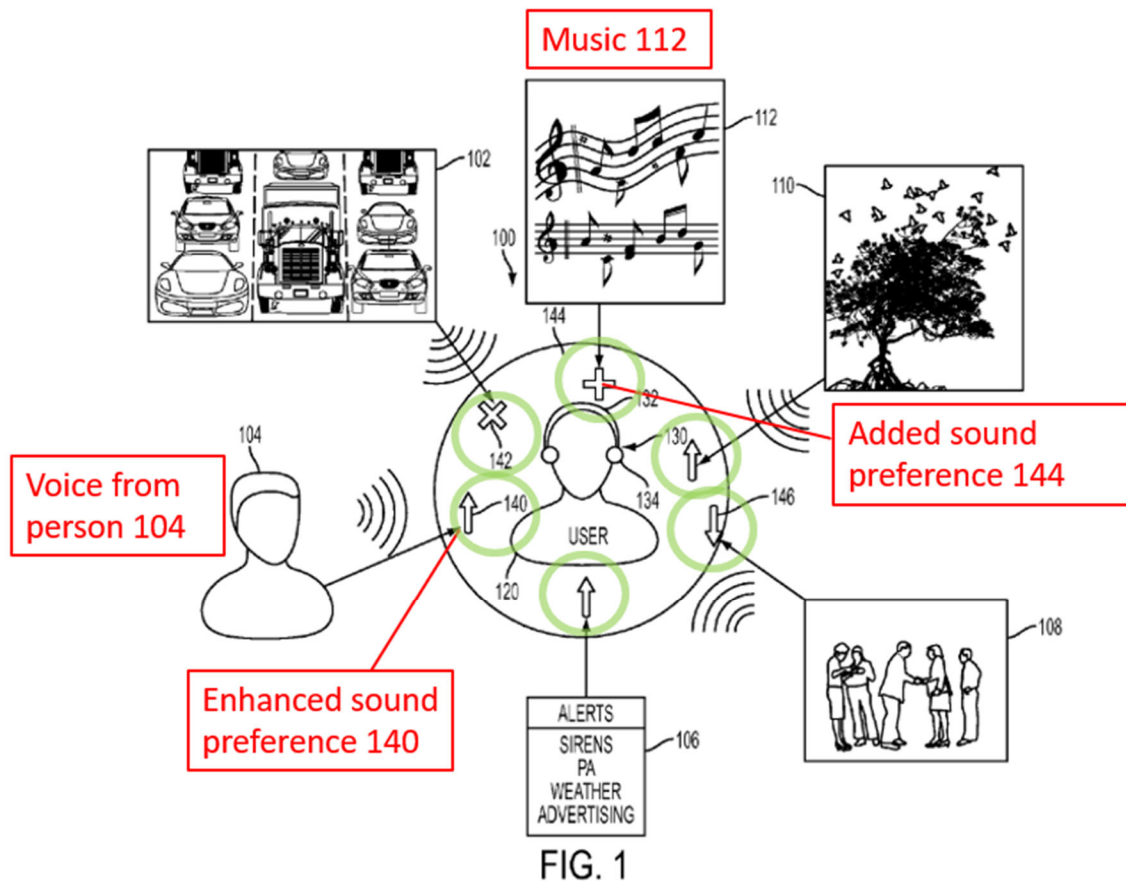
which may be “configured for positioning around a respective ear of user 120.”

Id. “In one embodiment, earpieces 134 are in-the-ear devices.” *Id.* More particularly, the earpieces 134 “may be implemented by highly miniaturized devices that fit completely in the ear canal.” *Id.* ¶[0024]. “[E]arpieces 134 may isolate the user from the ambient auditory environment ..., while, at the same time, reproducing only the desired sound sources either with or without enhancement or augmentation.” *Id.* ¶[0025]; *see also id.* ¶[0023].

128. *DiCenso* further explains that “wearable device 130 ... includes ... a microprocessor-based digital signal processor (DSP).” *Id.* ¶[0022]. A POSITA would have understood *DiCenso* to disclose or suggest that at least one of the two earpieces includes the processor. This is because *DiCenso* discloses that the wearable device 130 “may be implemented within earpieces 134” (*id.* ¶[0025]), and that the earpieces 134 may be implemented to “fit completely in the ear canal” (*id.* ¶[0024]). In other words, because the wearable device may be implemented within the earpieces, and the earpieces may be implemented completely within the ear canal, a POSITA would have understood that at least one of the two earpieces contains a processor. This is underscored by *DiCenso*’s method in Figure 2, which explains that the user’s preferences “get communicated to the in-ear devices” (*DiCenso*, FIG. 2 (block 230)) and that “the in-ear devices apply the user’s preferences” (*DiCenso*, FIG. 2 (block 240))

which suggests to a POSITA that at least one of the in-ear earpieces includes its own processor and circuitry for receiving and applying the user's preferences to audio signals.

129. As also generally shown in Figure 1, the system 100 includes a user interface that “allows user 120 to create a personalized or customized auditory experience by setting his/her preferences indicated by **symbols 140, 142, 144, 146**, for associated sound types to indicate which sounds to amplify, cancel, add or insert, or attenuate, respectively.” *Id.* ¶[0028].



DiCenso FIG. 1 (annotated)

130. “The changes made by user 120 using the user interface are communicated to the wearable device 130 to control corresponding processing of input signals to create auditory output signals that implement the user preferences.” *Id.* ¶[0028]. “Sounds within the ambient auditory environment can be enhanced as generally indicated by user preference 140.” *Id.* ¶[0130]. “Wearable device 130 may actively add or insert sounds to the user’s auditory field using one or more inward facing loudspeaker(s) based on a user preference as indicated at 144. This function may be implemented in a similar manner as used for headphones by playing back music or other audio streams (phone calls, recordings, spoken language digital assistant, etc.).” *Id.* ¶[0030].

131. *DiCenso* explains that the user sets auditory preferences via a user interface implemented “by a second microprocessor-based device such as a smartphone.” *Id.* ¶[0033]. “User preferences captured by the user interface are communicated to the wearable device.” *Id.* ¶[0034]. The processor in the wearable device “receives user preferences ... corresponding to each of the plurality of types of sounds and modifies the signal for each type of sound in the ambient auditory environment based on the corresponding user preference.” *Id.* ¶[0042].

132. Figure 5 illustrates a simplified user interface having controls for specifying user preferences. *Id.* ¶[0046]. “Through this interface, the user can raise or lower the volume of specific sound sources as well as completely cancel or enhance other auditory events.” *Id.* ¶[0048]. “[T]he user interface may capture user preferences in terms of sound level values that may be expressed as sound pressure levels (dBA SPL) and/or attenuation/gain values (e.g., specified in decibels).” *Id.* ¶[0051]. For example, “the user may move a selector, such as slider 548 toward a gain value of +20 dB (e.g., corresponding to the “Loud” value 560 in FIG. 5) when the user would like to enhance a particular sound by increasing the loudness of the sound.” *Id.* ¶[0051].

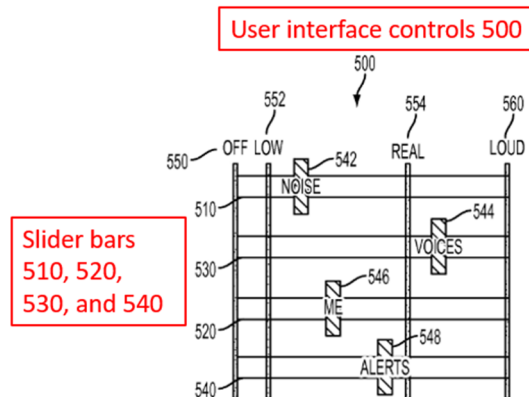


FIG. 5

DiCenso FIG. 5 (annotated)

133. *DiCenso* further discloses various use cases for its system. In one example, “[a] user is about to go for a run” and “[s]he sets the wearable device preferences using a user interface on her smartphone.” *Id.* ¶[0062]. “She decides

to keep hearing the traffic noise to avoid being hit by a vehicle, however she chooses to dim it down.” *Id.* She selects a playlist to be streamed in her ears at a certain volume from her smartphone or another external device and she chooses to enhance the sound of birds and nature to make this run even more enjoyable.” *Id.* Thus, *DiCenso* discloses an embodiment in which a user may set the preferences for her auditory environment from the same smartphone that streams a playlist to her ears. *Id.*

c. Motivation to Combine *Kirsch* and *DiCenso*

134. A POSITA would have been motivated to combine *Kirsch* and *DiCenso* in a manner that renders claims 1-7 obvious and would have had a reasonable expectation of success. *Kirsch* and *DiCenso* are similar and complement each other in multiple ways. For example, both *Kirsch* and *DiCenso* are generally directed to controlling the ambient sounds that the user hears through a set of earbuds or earpieces. *DiCenso*’s teachings advance *Kirsch*’s objectives by providing more fine-tuned control over the ambient sounds that are output to the user than what *Kirsch* provides. In particular, while *Kirsch* generally discloses passing transient sounds of interest to the user, *DiCenso* provides a system for selectively amplifying or attenuating certain sounds of interest specifically, such as only sirens but not car horns. *Id.*

135. In addition, *Kirsch* discloses receiving an audio playback signal such as music from a playback device, and that various parameters of its audio processing system may be controlled by a smartphone application. *DiCenso*, in turn, expressly discloses the details of such a smartphone that can stream music to an earpiece with an application that can capture and transmit user preferences related to audio processing parameters for both the music and sounds in the environment. Finally, *DiCenso* also discloses additional details related to the structure of the earbuds that would advantageously be used to implement *Kirsch*'s audio processing system to mix audio signals in a user-controlled manner.

136. A POSITA also would have considered implementing *Kirsch*'s audio system in *DiCenso*'s wearable device (i.e., the earbuds with a processor and one or more microphones) to amount to applying a known technique (*DiCenso*'s wearable device) to a known device (*Kirsch*'s audio processing system) ready for improvement (*Kirsch*'s system is for a personal playback device such as earbuds and may be implemented by a processor) to yield predictable results (*Kirsch*'s audio processing system implemented in *DiCenso*'s earpieces). A POSITA would have considered using *DiCenso*'s smartphone application to control the parameters of *Kirsch*'s audio processing system (implemented by the processor in *DiCenso*'s wearable device) to amount to

following *Kirsch*'s express suggestion to control such parameters using a smartphone application.

137. Finally, a POSITA would have considered implementing *DiCenso*'s teaching of using the same smartphone to transmit both audio and preferences to amount to applying a known technique (*DiCenso*'s technique of transmitting audio and preferences with the same device) to a known device (*Kirsch*'s audio processing system) ready for improvement (*Kirsch*'s audio processing system is capable of receiving an audio signal and control parameters from a remote device) to yield predictable results (*Kirsch*'s audio processing system implemented in *DiCenso*'s wearable device receiving user's preferences for controlling the audio processing system).

138. In sum, the *Kirsch-DiCenso* combination discloses or suggests *Kirsch*'s audio processing system implemented by *DiCenso*'s earpieces, including *DiCenso*'s earpiece microphones, processor, and memory. *DiCenso*'s smartphone streams an audio playback signal and transmits user preferences to *DiCenso*'s earpiece processor, which uses the preferences to modify the parameters of *Kirsch*'s audio processing system, including the weights applied by *Kirsch*'s mixers to the audio signals representing the sound of interest and playback audio.

2. Claim 1

a. *[1.pre]: A device that can control ambient passthrough in an earpiece comprising:*

139. To the extent the preamble is limiting, *Kirsch* in combination with *DiCenso* discloses or suggests it.

140. As detailed in §X.B.1.b, *DiCenso* discloses a smartphone with a user interface that allows the user to set auditory preferences communicated to a wearable device implemented by earpieces. The preferences are used to “to amplify, attenuate, cancel, add, replace, or enhance particular sounds from the ambient auditory environment and/or external sources to create a personalized, user controlled auditory environment for the user.” *DiCenso* ¶[0046]. Moreover, the combination renders obvious *DiCenso*’s earpiece processor applying the preferences to amplify or attenuate specific sounds of interest from the environment and adjust the weight given to the sound of interest by *Kirsch*’s mixer. This is consistent with how a POSITA would have understood how a smartphone (“a device”) would “control ambient passthrough in an earpiece.”

141. Accordingly, a POSITA would have understood the *Kirsch-Dicenso* combination to disclose or suggest an earpiece that reproduces sounds of interest from the environment in accordance with user preferences selected on a user interface implemented on a smartphone (“[a] device that can control ambient passthrough in an earpiece”).

- b. *[1.1]: a first memory that stores instructions; and [1.2] a processor that executes the instructions to perform operations, the operations comprising*

142. *Kirsch* in combination with *DiCenso* discloses or suggests this feature.

143. *DiCenso* discloses that the smartphone with the user interface has a microprocessor with an associated memory. *DiCenso* ¶¶[0005](“ Embodiments may include receiving user preferences wirelessly from a user interface *generated by a second microprocessor, which may be embedded in a mobile device*, such as a cell phone, for example.”), [0006](“ Embodiments may include various types of user interfaces generated by the microprocessor or *by a second microprocessor associated with a mobile device*, such as a cell phone, laptop computer, or tablet computer, wrist watch, or other wearable accessory or clothing, for example.”), [0033] (“The user sets auditory preferences as represented by block 220 via a user interface that may be implemented by the wearable device *or by a second microprocessor-based device such as a smartphone*, tablet computer, smartwatch, etc.”), [0039](“ DSP 310 receives user preferences 322 captured by an associated user interface 324. In the representative embodiment illustrated in FIG. 3, *user interface 324 is implemented by a second microprocessor 326 having associated memory 328 embedded in a mobile device 320, such as a smartphone*, tablet computer, wrist

watch, or arm band, for example.”). *DiCenso* discloses that the functions ascribed to the user interface on the smartphone such as setting auditory preferences, and communicating the preferences to the earpieces, “may be performed by hardware and/or software executed by a programmed microprocessor” and that the software may be stored in a computer-readable storage medium (i.e., a memory) that stores “executable instructions.” *Id.* ¶[0031]; FIG. 2.

144. Accordingly, a POSITA would have understood the *Kirsch-DiCenso* combination to disclose or suggest that the smartphone includes a microprocessor and memory for implementing the functions related to setting user preferences with the user interface and communicating them to the earpiece (“a first memory that stores instructions; and a processor that executes the instructions to perform operations”).

- c. ***[1.3]: communicatively connecting to an earpiece, wherein the earpiece includes a first microphone, a second microphone, a speaker, a second memory and an earpiece processor;***

145. *Kirsch* in combination with *DiCenso* discloses or suggests this feature.

146. *DiCenso* discloses that the “[w]earable device 130, which may be implemented within earpieces 134, may ... be equipped with wireless communication ... to connect with various external sound sources [and] an

external user interface.” *DiCenso* ¶[0025]. As detailed in §X.B.1.b, *DiCenso* discloses implementing a user interface with a smartphone (the “device”) for inputting user preferences, and *DiCenso* further explains that the “[u]ser preferences are then communicated to the DSP associated with earpieces 134 through wired or wireless technology.” *Id.* ¶[0023]; *see also id.* ¶[0034], FIG. 2 (step 230). In view of these disclosures, a POSITA would have understood *DiCenso* to disclose or suggest that the processor of the smartphone executes instructions to “communicatively connect” to at least one of *DiCenso*’s earpieces.

147. As detailed in §X.B.1.b, *DiCenso* discloses that each earpiece 134 includes one or more microphones including an ambient microphone and internal microphone and a speaker. Thus, a POSITA would have understood *DiCenso* to disclose that each earpiece of its wearable device includes “a first microphone,” such as an ambient microphone, “a second microphone,” such as the internal microphone, and “a speaker.” In the *Kirsch-DiCenso* combination, *DiCenso*’s one or more earpiece microphones implement the function of *Kirsch*’s left and right microphone arrays.

148. Moreover, as also detailed in §X.B.1.b, a POSITA would have understood that at least one of the two earpieces contains a processor. A POSITA would have understood that processors, and digital signal processors in

particular, commonly include a memory for storing programs and/or data. A POSITA would have understood that a programmable digital signal processor (DSP) includes a memory. For example, *Oshana* mentions this basic fact in the Introduction section: “A DSP is really just a special form of a microprocessor. It has all of the same basic characteristics and components; a CPU, memory, instruction set, buses, etc.” EX1036 (*Oshana* p. xi).² *Oshana* further discloses, in the DSP Architectures chapter, “This simultaneous use of two data buses is a fundamental characteristic of a DSP system. If the coefficients were constants, the user might want to store them in ROM. This is a common place to hold the program, and it allows the user to perform the MAC [multiply and accumulate] operations using coefficients stored in program memory and accessed via the program bus.” EX1036 (*Oshana* p. 124).

149. Accordingly, a POSITA would have understood the *Kirsch-DiCenso* combination to disclose or suggest a smartphone with a processor executing instructions to connect to an earpiece (“communicatively connecting to an earpiece,”), wherein the earpiece has an ambient microphone (“first microphone”), an internal microphone (“second microphone”), a speaker, and a

² To be clear, I am relying on *Oshana* as evidence of the knowledge of a person having ordinary skill in the art and it is not part of the unpatentability ground 1.

processor (“wherein the earpiece includes a first microphone, a second microphone, a speaker, a second memory and an earpiece processor”).

- d. ***[1.4] and [1.5] sending an audio content gain value and an ambient sound gain value to the earpiece, sending an audio content signal to the earpiece***

150. *Kirsch* in combination with *DiCenso* discloses or suggests these features.

151. As detailed in §X.B.1.c, the *Kirsch-DiCenso* combination discloses or suggests *Kirsch*’s audio processing system implemented by the processor in *DiCenso*’s wearable device such that the user’s preferences captured by *DiCenso*’s smartphone user interface are communicated to *DiCenso*’s earpiece processor and used by the processor to modify the parameters of *Kirsch*’s audio processing system.

152. *DiCenso* discloses that “the user interface may capture user preferences in terms of sound level values that may be expressed as sound pressure levels (dBA SPL) and/or attenuation/***gain values*** (e.g., specified in decibels).” *DiCenso* ¶[0051]. “For example, a user may move a selector, such as slider 548 to an attenuation value of –20 decibels (dB) (e.g., corresponding to a ‘Low’ value) when the user would like to attenuate a particular sound.” *Id.*

153. *DiCenso* explains that the user preferences may be applied to “sounds from the ambient auditory environment ***and/or*** external sources.” *Id.*

¶[0046]. A POSITA would have understood that “sounds from the ambient auditory environment” are “ambient sounds” and that, in the *Kirsch-DiCenso* combination, correspond to *Kirsch*’s signals of interest from the environment. That is, a POSITA would have understood the combination to disclose or suggest using *DiCenso*’s user interface to capture user preferences including a gain value for *Kirsch*’s signals of interest from the environment.

154. A POSITA would have understood *DiCenso*’s “sounds from ... external sources” refers to a sound signal from an external device such as streaming music. *DiCenso* ¶[0005] (“Various embodiments may include receiving ***a sound signal from an external device*** in communication with the microprocessor, and combining the sound signal from the external device with the modified types of sound.”), [0041] (“As previously described, context-sensitive sounds or ***data streams representing sounds may be provided from an associated audio source 340, such as a music player, an alert broadcaster, a stadium announcer, a store or theater, etc.***”), [0042](“ DSP 310 may receive a sound signal from an external device or source 340 in communication with DSP 310 via wired or wireless network 342.”), [0049](“When the slider is in the ‘off’ position 550, the DSP may be attenuating the associated sound so that it cannot be heard (in the case of ***a direct, external sound*** or advertisement), or apply active cancellation to significantly attenuate or cancel the designated sound from

the ambient auditory environment.”), [0062](“The user is about to go for a run. She sets the wearable device preferences using a user interface on her smartphone. She decides to keep hearing the traffic noise to avoid being hit by a vehicle, however she chooses to dim it down. *She selects a playlist to be streamed in her ears at a certain volume from her smartphone or another external device* and she chooses to enhance the sound of birds and nature to make this run even more enjoyable.”), [0074](“The user receives a call on his phone. The communication is streamed directly to his in-ear devices in a way that still allows him to hear the environment and the sounds around him, but at the same time can hear the person on the phone loud and clear. The same could be done when the user is watching TV or listening to music. He can have those audio sources streaming directly to his in-ear pieces.”), [0076] (“The user listens to music on his in-ear devices, streamed directly from his mobile device. The system plays back the music in a very spatial way that allows him to hear the sounds of his surroundings. The effect is similar to listening to music playing from a loud speaker placed next to the user. It's not obstructing other sounds, but at the same time hearable only by the user.”). In other words, *DiCenso* discloses using the user interface to capture the user's preferences (e.g., a gain value) regarding the volume of sounds provided by external sources such as steaming music. The *Kirsch-DiCenso* combination discloses or suggests using *DiCenso's*

user interface to capture the user's preferences including a gain value regarding *Kirsch's* playback audio signal.

155. *Kirsch's* signals of interest from the environment constitute “ambient sounds” within the meaning of the '473 patent, and *Kirsch's* playback audio signals constitute “audio content” within the meaning of the '473 patent. '473pat., 3:8-10 (“The earpiece 100 can include an audio interface 212 operatively coupled to the processor 206 to receive audio content, for example from a media player or cell phone, and deliver the audio content to the processor 206.”).

156. Thus, a POSITA would have understood the *Kirsch-DiCenso* combination to disclose or suggest capturing user preferences including the gain values to be applied to ambient sounds and audio content and communicating those preferences to the wearable device.

157. Therefore, the *Kirsch-DiCenso* combination discloses or suggests communicating a gain value to be applied to ambient sounds (“ambient sound gain value”) and a gain value to be applied to audio content (“audio content gain value”) to the earpiece processor.

158. *DiCenso* discloses an embodiment in which the user's smartphone captures and sends the user's preferences as well as an “audio content signal.” *Id.* ¶[0062]. In particular, *DiCenso* describes a use case in which a user “sets the

wearable device preferences using a user interface on her smartphone.” *Id.* The user dims down traffic noise, and “selects a playlist to be streamed in her ears at a certain volume from her smartphone.” *Id.* The playlist streamed in her ears at a certain volume from her smartphone discloses or suggests transmitting an “audio content signal” to the earpiece.

159. Accordingly, a POSITA would have understood the *Kirsch-DiCenso* combination to disclose or suggest a smartphone with a processor executing instructions to send user preferences expressed as gain values for sounds of interest from the ambient auditory environment and an audio playback signal to the earpiece (“sending an audio content gain value and an ambient sound gain value to the earpiece”) and also streaming a playlist in the user’s ears from the smartphone (“sending an audio content signal to the earpiece”).

- e. ***[1.6]/[1.8] wherein the earpiece processor applies the audio content gain value to the audio content signal to generate a modified audio content signal, wherein the earpiece processor applies the ambient sound gain value to an ambient sound signal to generate a modified ambient sound signal, and mixes the modified ambient sound signal with the modified audio content signal to generate a mixed signal.***

160. *Kirsch* in combination with *DiCenso* discloses or suggests this feature.

161. As detailed in §X.B.1.c, the *Kirsch-DiCenso* combination renders obvious *DiCenso*’s earpiece processor receiving the user’s preferences from the

smartphone and applying the user's preferences to control the weights applied by *Kirsch*'s mixers to the audio signals representing the sound of interest and playback audio.

162. A POSITA would have understood that the signal representing the sound of interest to be an "ambient sound signal" within the context of the '473 patent because it represents sounds in the ambient environment. '473pat., 6:40-49 ("As shown in step 302, the earpiece 100 can monitor the environment for ambient sounds received at the ASM 111. Ambient sounds correspond to sounds within the environment such as the sound of traffic noise, street noise, conversation babble, or any other acoustic sound. Ambient sounds can also correspond to industrial sounds present in an industrial setting, such as factory noise, lifting vehicles, automobiles, and robots to name a few."). A POSITA would have understood that *Kirsch*'s audio playback signal is an "audio content signal" within the context of the '473 patent because it represents sounds from an audio playback device. '473pat., 12:29-32 ("The method 900 also receives as input an Audio Content signal 902, e.g. a music audio signal from a portable Media Player or mobile-phone").

163. A POSITA would have understood that applying the weight to *Kirsch*'s playback signal constitutes "appl[ying] the audio content gain value to the audio content signal to generate a modified audio content signal" because the

weight is based on the audio content gain value received from *DiCenso*'s smartphone user interface and it modifies the music signal. Similarly, a POSITA would have understood that applying the weight to the signal of interest from the environment constitutes "appl[ying] the ambient sound gain value to an ambient sound signal to generate a modified ambient sound signal." A POSITA would have understood that after *Kirsch*'s mixers apply the applicable weights to the signal of interest, the mixers output the mixed signal.

164. Accordingly, a POSITA would have understood the *Kirsch-DiCenso* combination to disclose or suggest the processor in *DiCenso*'s earpiece implementing mixers that apply a weight corresponding to the user's preferences, i.e., the gain values selected by *DiCenso*'s user interface ("wherein the earpiece processor applies the audio content gain value to the audio content signal to generate a modified audio content signal, wherein the earpiece processor applies the ambient sound gain value to an ambient sound signal to generate a modified ambient sound signal,") and then mixes the sounds of interest from the ambient environment and the playback signal together ("mixes the modified ambient sound signal with the modified audio content signal to generate a mixed signal.").

3. Claim 2 (“The device according to claim 1, wherein the earpiece processor calculates a noise level based upon a first microphone signal from the first microphone, wherein the earpiece processor modifies the mixed signal based upon the noise level.”)

165. *Kirsch* in combination with *DiCenso* discloses or suggests this claim.

166. As detailed in §X.B.1.a, *Kirsch* discloses an audio processing system that includes a left microphone array with at least two microphones that receive audio signals from the environment in the vicinity of the user. The microphone signals are sent to beamformers. The beamformers may subtract one microphone signal from another microphone signal and pass the resulting signal to the noise reduction module. Therefore, a POSITA would have understood *Kirsch* to disclose an embodiment in which one of the signals from one of the microphones in the array (a “first microphone signal from a first microphone”) is sent to the noise reduction module.

167. As also detailed in §X.B.1.a, the noise reduction module identifies signals of interest, which are “typically characterized as an audio signal that has a high audio level relative to the average background audio level and is intermittent, acting as an interruption.” *Kirsch* ¶[0024]. Noise reduction 115 “suppresses signals determined to be of less interest ... and passes signals determined to be signals of interest.” *Id.* ¶[0021]. If noise reduction 115 detects a

signal of interest, then “noise reduction 115 transmits a corresponding signal to ducker 165” (*id.* ¶[0024]) and the ducker “reduces, or ducks, the audio from the playback device when a signal of interest is received from the environment” and “the listener more readily hears signals of interest from the environment” (*id.* ¶[0033]).

168. In view of the above disclosures, a POSITA would have understood *Kirsch* to disclose or suggest that its audio processing system calculates an “average background noise level” based upon a signal from an external microphone and suppresses signals that are not of interest, passes signals of interest, and, together with the ducker, reduces the audio from the playback device when it detects a transient sound above the background noise level. In this way, *Kirsch* discloses modifying the mixed signal based upon the average background noise level.

169. Accordingly, a POSITA would have understood the *Kirsch-DiCenso* combination to disclose or suggest *DiCenso*’s earpiece processor (“the earpiece processor”) calculating an average background noise level (“calculates a noise level based upon a first microphone signal from the first microphone”) and passing a signal of interest and transmitting a ducking signal to the ducker when a signal of interest is identified (“wherein the earpiece processor modifies the mixed signal based upon the noise level.”)

4. **Claim 3 (“The device according to claim 1, wherein the earpiece processor generates the ambient sound signal from a first microphone signal from the first microphone”); Claim 5 (“The device according to claim 1, wherein the earpiece processor applies an ambient gain to a first microphone signal from the first microphone to generate the ambient sound signal.”)**

170. *Kirsch* in combination with *DiCenso* discloses or suggests these claims.

171. Claims 3 and 5 add a requirement that the “ambient sound signal” is “generat[ed]” from “a first microphone signal.” Claim 5 in particular requires “appl[ying] an ambient gain” to the “first microphone signal.”

172. As detailed in §§X.B.1.a and X.B.2.e, a POSITA would have understood the *Kirsch-DiCenso* combination to disclose or suggest *Kirsch*’s mixers mixing a signal representing a sound of interest (“ambient sound signal”) with a playback audio signal (“audio content signal”).

173. A POSITA would have understood that the signal representing a sound of interest was generated through multiple processing steps. More particularly, as explained in §§X.B.1.a and X.B.3, a POSITA would have understood *Kirsch* to disclose an embodiment in which one of the signals from one of the microphones in the array (a “first microphone signal from a first microphone”) is sent to the noise reduction module. *Kirsch* discloses that the noise reduction module may “amplify” a signal of interest before passing it to

the equalizer. *Kirsch* ¶[0022] (“Noise reduction 115 may pass such transient signals to equalizer 120 and optionally may amplify the transient signals.”). A POSITA would have understood that amplifying a signal includes applying a gain to the signal. A POSITA would have understood that the gain applied by the noise reduction module is an “ambient gain” because it is applied to a signal representing a sound from the environment (“ambient sound”).

174. Accordingly, a POSITA would have understood the *Kirsch-DiCenso* combination to disclose or suggest *DiCenso*’s earpiece processor receiving a signal from a first microphone of the microphone array (“first microphone signal”), subtracting one of the microphone signals from it, identifying a transient signal in the first microphone signal, and then amplifying it (“generates the ambient sound signal from a first microphone signal from the first microphone” and “applies an ambient gain to a first microphone signal from the first microphone to generate the ambient sound signal.”).

5. Claim 4 (“The device according to claim 1 further including a user interface.”)

175. *DiCenso* in combination with *Kirsch* discloses or suggests this claim because *DiCenso* discloses that the smartphone includes a user interface to capture user preferences, as discussed in §X.B.2.d.

6. **Claim 6 (“The device according to claim 1, wherein the device is a portable communication device”); Claim 7 (“The device according to claim 6, where the device portable communication device is at least one of a phone, a watch, a tablet, earpiece, a laptop computer or a combination thereof.”)**

176. *Kirsch* in combination with *DiCenso* discloses or suggests these claims because *DiCenso* discloses that the device may be a smartphone, as discussed in §X.B.2.a.

C. GROUND 2: GOLDSTEIN IN COMBINATION WITH WOODRUFF RENDER OBVIOUS CLAIMS 8-20

1. Motivation to combine *Goldstein* and *Woodruff*

177. *Goldstein* shares a specification with the ’473 patent and therefore discloses the same earpiece and methods summarized above in §VII.A.

Goldstein also shares a specification with the ’892App. Thus, as detailed in §X.A.2, although *Goldstein* discloses some limitations of claims 8-20, *Goldstein* does not disclose others.

178. A POSITA would have been motivated to combine *Goldstein* with *Woodruff* in a manner that renders claims 8-20 obvious and would have had a reasonable expectation of success in doing so. *Woodruff* discloses several features of the challenged claims that are not disclosed by *Goldstein*. Namely, aspects related to combining microphone signals and noise reduction signals.

a. Overview of *Woodruff*

179. *Woodruff* “relates to digital audio signal processing techniques for automatically controlling how ambient sound is reproduced by an against-the-ear hearing device, such as a headphone or a mobile phone handset, in accordance with a context of the user of the device.” *Woodruff* ¶[0002]. As background, *Woodruff* states that headphones “are used in a variety of different ambient sound environments” and “[t]he listening experience of users of these devices may be affected by changing ambient sound environments.” *Id.* ¶[0003].

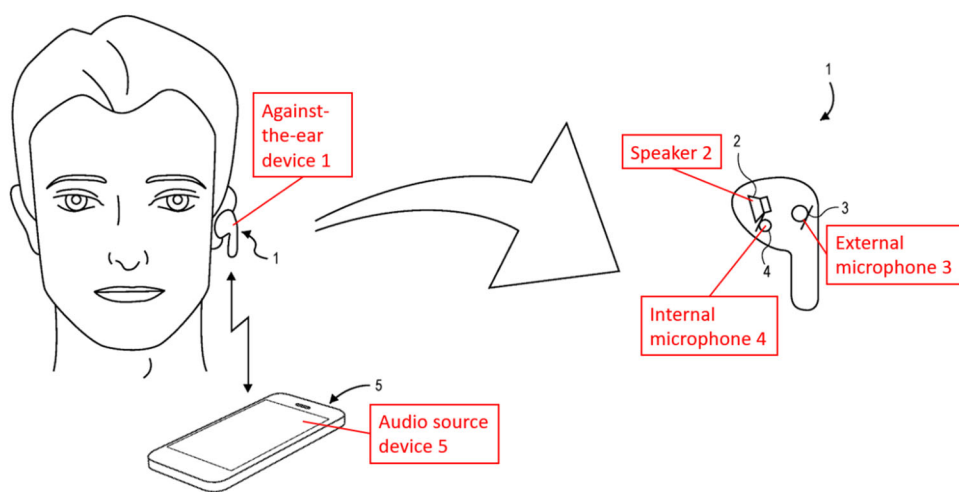


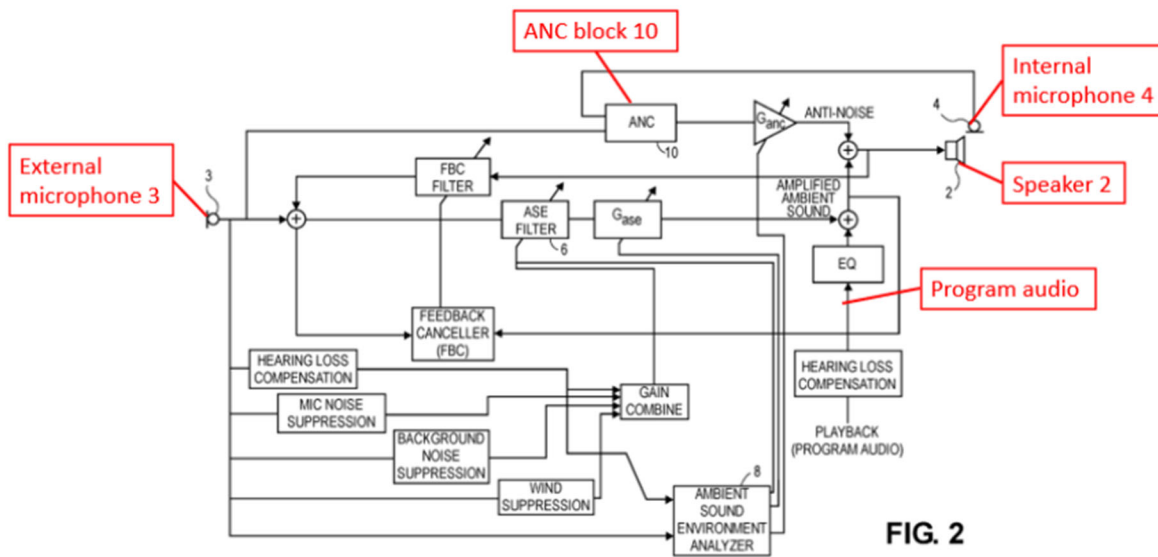
FIG. 1

Woodruff FIG. 1 (annotated)

180. “The against-the-ear device 1 has [a] speaker 2..., an external microphone 3 ..., and an internal microphone 4.” *Id.* ¶[0020]. “These may all be integrated in a housing of the against-the-ear device, along with the transducers and the electronics that process and produce the transducer signals (output

microphone signals and an input audio signal to drive the speaker 2.)” *Id.* This is similar to the earpiece disclosed by *Goldstein*.

181. *Woodruff* Figure 2 shows a “block diagram of an audio system that combines personalized ambient sound enhancement and acoustic noise cancellation for a user of the against the ear device 1.” *Id.* ¶[0022]. “The elements of the audio system shown in FIG. 2 ... may all be implemented as one or more programmed digital processors (generically referred to here as a ‘a processor’ that is to execute instructions stored in memory.)” *Id.*



Woodruff FIG. 2 (annotated)

182. In operation, “[a]mbient sound in an acoustic environment ... is picked up by the external microphone 3” and “[i]ts output, digitized microphone (audio) signal is then filtered by an [ambient sound enhancement (ASE)] filter 6.” *Id.* ¶[0022]. A “gain combine process combines information from various

detectors, to determine the transfer function of the ASE filter 6.” *Id.* “These detectors may provide information about ... the hearing profile of the user (hearing loss compensation block.)” *Id.* “Such information is then used by the gain combine process, to determine how to configure the ASE filter 6” which may be “tuned for compensating the user’s hearing loss.” *Id.*

183. After the ASE filter 6, the ambient sound “is filtered in a frequency-dependent transparency gain block G_{ase} , which is controlled by an ambient sound environment analyzer 8 according to the hearing profile of the user (based on input from the hearing loss compensation block.)” *Id.* ¶[0025], FIG. 2.

184. “When the ambient sound enhancement function is active ..., [an] ambient sound environment analyzer 8 may detect that the ambient sound environment changes from quiet to loud.” *Id.* ¶[0026]. In response, “the analyzer 8 signals the G_{ase} gain block to reduce its gain, and it may do so in accordance with a hearing profile of the user.” *Id.* ¶[0026]. After the transparency gain block G_{ase} , “[t]he ambient sound content is then combined with a playback signal which contains program audio” and “[t]his combined audio signal then drives the speaker 2, thereby reproducing the ambient sound.” *Id.* ¶[0025]. Other examples of user context that may be detected by the sound environment analyzer 8 include “the type of ambient sounds that are being picked up, e.g.,

fire alarm, mechanical machine noise, city street sound, highway noise, construction site noise, train subway noise, babble, nature sounds, television, etc.” *Id.* ¶¶[0033], [0037].

185. *Woodruff* discloses that the audio system “may also have an acoustic noise cancellation, ANC, block 10 that enables the against-the-ear audio device to produce anti-noise for acoustic noise cancellation.” *Id.* ¶[0029]. “The ANC block 10 produces an anti-noise signal” and “the anti-noise signal is combined with the ambient sound signal before they together drive the speaker 2.” *Id.* “The anti-noise delivered into the user's ear may mitigate some of the occlusion effect (caused by the against-the-ear device blocking the ear.)” *Id.*

186. *Woodruff* also discloses that when the ambient sound enhancement function is active, the audio signal may be a combination of ambient sound and program audio. *Id.* ¶[0004] (“When the ambient sound enhancement function is active, the input audio signal contains ambient or environmental sound pick up from one or more microphones in the device; in a ‘playback’ situation, the input audio signal is a combination signal that also contains program audio, such as music, the voice of a far end user during a phone call, or the voice of a virtual assistant program.”); *see also id.* ¶[0025], FIG. 2. Thus, a POSITA would have understood *Woodruff* to disclose that the anti-noise signal is combined with a mix of ambient sound and audio content.

pickup channel may be the result of combining multiple microphone signals, e.g., by a beamforming process performed on a multi-channel output from a microphone array.” *Id.* ¶[0024].

b. Motivation to combine

189. A POSITA would have been motivated to implement *Woodruff*’s teachings related to its ambient sound enhancement function into *Goldstein* and would have had a reasonable expectation of success in doing so. *Goldstein* and *Woodruff* are similar insofar as they both disclose processing techniques for adjusting the audio output based on the user’s context, including sounds in the user’s environment.

190. *Goldstein* discloses that its earpiece is “suitable for use with users having healthy or abnormal auditory functioning” (*Goldstein* ¶[0033]), and a POSITA would have understood that implementing *Woodruff*’s ambient sound enhancement function, which beamforms and compensates for a user’s hearing loss, would have improved the functionality of *Goldstein*’s earpiece for users with abnormal auditory functioning.

191. *Goldstein* discloses that its earpiece may fully occlude the ear canal. *Goldstein* ¶[0033]. A POSITA would have understood that such earpieces cause an “occlusion effect” which is uncomfortable to users, and that it would have been advantageous to reduce the occlusion effect. This is corroborated by, for

example, *Rasmussen*, which explains that “[o]ne of the most common complaints of hearing aid users is that their own voice sounds unnatural: boomy, hollow or echoing. Poor sound quality of own voice is also one of the top ten reasons why some hearing aids end up in the drawer. This problem with own voice is very often due to the so-called occlusion effect, which occurs because the body-conducted contribution to a person’s perception of own voice is trapped in the cavity between the occluding earmold of the hearing instrument and the tympanic membrane.” *Rasmussen* ¶[0002].³ *Woodruff* discloses that its anti-noise signal mitigates the occlusion effect. *Woodruff* ¶[0029] (“The anti-noise delivered into the user's ear may mitigate some of the occlusion effect (caused by the against-the-ear device blocking the ear.).”).

192. Accordingly, a POSITA would have considered combining *Woodruff*’s teachings with *Goldstein* to amount to the use of known technique (*Woodruff*’s ambient sound enhancement function and noise cancellation) to improve similar devices (*Goldstein*’s earpiece and acute sound detection and reproduction system) in the same way (to compensate for a user’s hearing loss in implementing an ambient sound passthrough and reduce the occlusion effect).

³ To be clear, I am relying on *Rasmussen* as evidence of the knowledge of a person having ordinary skill in the art and it is not part of the unpatentability ground 2.

193. In the combination, *Goldstein*'s ambient sound passthrough is modified to implement additional processing steps according to *Woodruff*'s teachings related to ambient sound enhancement, i.e., combining microphone signals for beamforming and filtering to compensate for the user's hearing loss, and generating an anti-noise signal based on a hybrid feedforward and feedback algorithm for mixing). The *Goldstein-Woodruff* combination therefore discloses or suggests *Goldstein*'s earpiece processor processing ambient sound microphone signals to combine them and compensate for the user's hearing loss, and generating an anti-noise signal and mixing it into the signal output to the speaker.

2. Claim 8

a. [8.pre]: A device that can control ambient sound passthrough comprising:

194. To the extent the preamble is limiting, *Goldstein* discloses or suggests this feature. For example, *Goldstein* discloses "a single earpiece, a pair of earpieces, headphones, or other suitable headset audio delivery device" that implement "a method 300 for acute sound detection and reproduction." *Goldstein* ¶[0041]. *Goldstein* further explains that "[i]f at step 310, an acute sound is detected within the ambient sound, the earpiece 100 activates 'sound pass-through' to reproduce the ambient sound in the ear canal by way of the ECR 125." *Id.* ¶[0046].

195. Accordingly, a POSITA would have understood *Goldstein* to disclose or suggest an earpiece, pair of earpieces, or headphones (“a device”) that can detect an acute sound and activate sound pass-through to reproduce the ambient sound in the ear canal (“that can control ambient sound passthrough”).

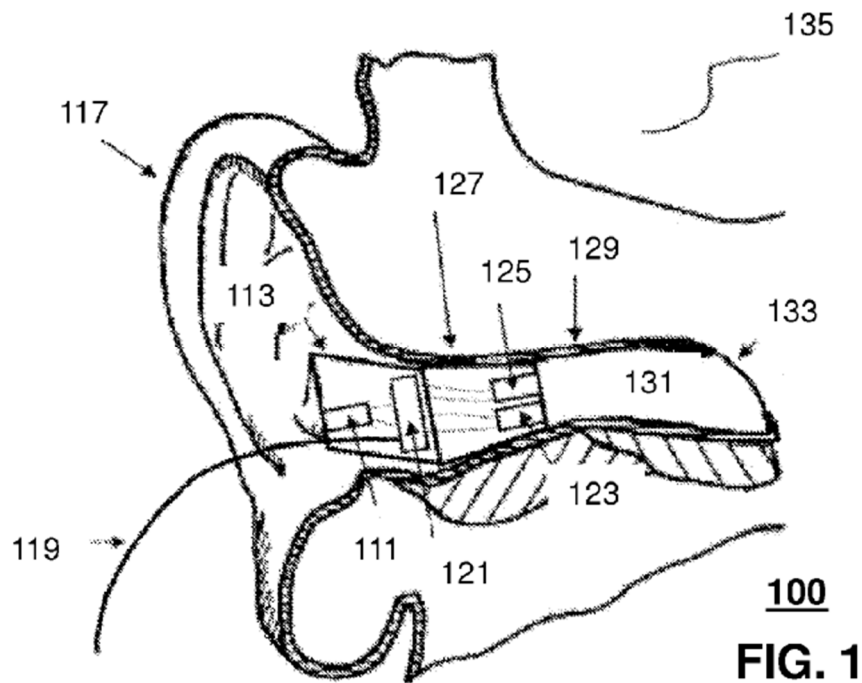
- b. ***[8.1]-8.5]: a first microphone that measures a first acoustic environment to generate a first microphone signal; a second microphone that is positioned closer to a user’s ear canal than the first microphone when the device is worn, where the second microphone generates a second microphone signal; a speaker; and a memory that stores instructions; and a processor that executes the instructions to perform operations, the operations comprising:***

196. *Goldstein* discloses or suggests these features.

197. For example, *Goldstein* discloses an earpiece 100 that includes Ambient Sound Microphone (ASM) 111, Ear Canal Receiver (ECR) 125 or speaker, and Ear Canal Microphone (ECM) 123. *Goldstein* ¶[0034].

198. The earpiece also includes a processor operatively coupled to the ASM 111, ECR 125, and ECM 123. *Id.* ¶[0036]. “All transducers ... can receive or transmit audio signals to a processor 121.” *Id.* ¶[0035]. A POSITA would have understood *Goldstein*’s reference to “[a]ll transducers” to include the ASM and ECM because microphones are transducers.

199. The earpiece also includes a memory that “can store program instructions for execution on the processor.” *Id.* ¶[0036], FIG. 2.



Goldstein, FIG. 1

200. *Goldstein* discloses an embodiment in which “a pair of earpieces” carry out the disclosed methods. *See, e.g., Goldstein* ¶[0053]. In such an embodiment, a POSITA would have understood that the ASM in one earpiece may be the claimed “first microphone” and that the ASM in the other earpiece in the user’s other ear meets the claimed “second microphone.” This is consistent with the ’473 patent’s description that the alleged invention “can be implemented in a single earpiece, *a pair of earpieces, headphones*, or other suitable headset audio delivery devices.” ’473*pat.*, 6:37-39 (emphasis added); *see also id.*, 9:3-5, 10:7-10, 10:50-52, 11:21-23, 11:48-51, 12:21-24, 13:16-19.

201. This interpretation is also consistent with how the Patent Office interpreted similar claim language during prosecution of U.S. Patent 11,244,666 (the “’666 patent”)—a parent to the ’473 patent that shares a specification with the ’473 patent. During prosecution of the ’666 patent, the pending claims recited:

An earphone comprising:

a first microphone configured to measure an ambient acoustic environment,

a second microphone configured to measure an acoustic environment closer the [sic] ear canal of a wearer than that measured by the first microphone

...

EX1008 at 157.

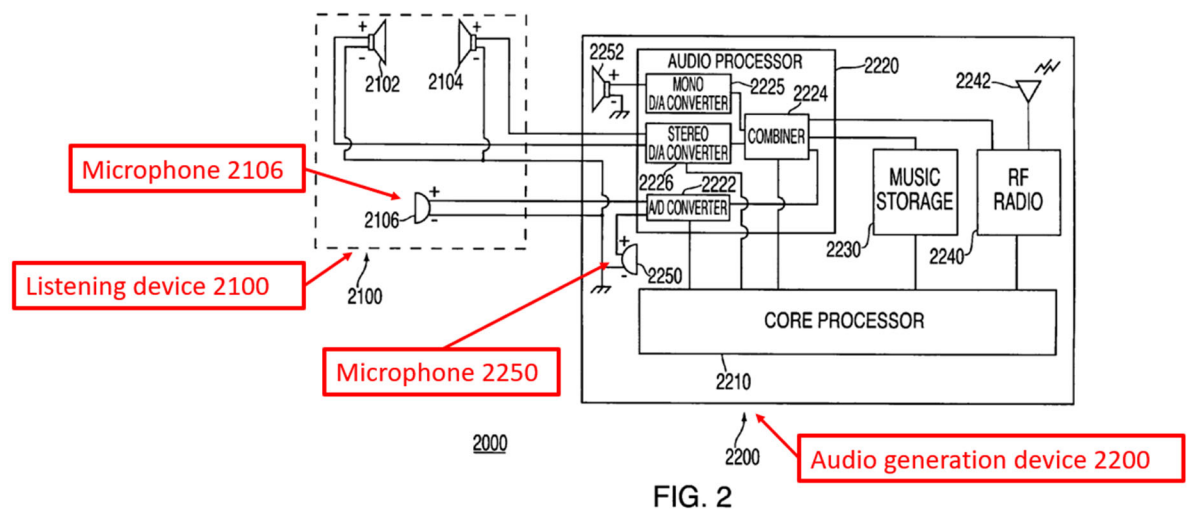
202. The examiner rejected the claims and mapped this claim language to the *Terlizzi* reference as follows:

Terlizzi et al. teaches an earphone arrangement (the specific circuit arrangement of which can be seen in figure 2 for blending signals, which as discussed with respect to figure 9 can be included in the earpiece) comprising: a first microphone configured to measure an ambient acoustic environment (2250, capable of picking up ambient sounds); a second microphone (2106) configured to measure an acoustic environment closer the ear canal of a wearer than that measured by the first microphone (note locations of

microphones 2106 and 2250 are used at different locations relative to a user's ear and therefor ear canal)

EX1008 at 118-119.

203. I have annotated *Terlizzi's* Figure 2, below, which confirms that the Patent Office mapped the claimed “first microphone” to microphone 2250 on the audio generation device 2200 and the claimed “a second microphone configured to measure an acoustic environment closer the [sic] ear canal of a wearer” to microphone 2106 on the listening device 2100 (i.e., headphones).



EX1044, FIG. 2 (annotated)

204. In response to the examiner's rejection, the applicant amended the claims as show below:

Amended claim 1 currently states:

1.(currently amended) An earphone comprising:

a first microphone configured to measure an ambient acoustic environment, wherein the first microphone has a first microphone port that is configured to face away from a user when the earphone is inserted;

a second microphone configured to measure an acoustic environment closer the ear canal of a wearer than that measured by the first microphone, wherein the second microphone has a second microphone port that is configured to face toward the user when the earphone is inserted;

EX1008 at 108. The applicant explained that the amendment was meant to clarify that the “second microphone” was “an ear canal microphone (ECM).” *Id.* at 112.

205. The Patent Office’s interpretation and the applicant’s subsequent amendment support my interpretation of the “first” and “second” microphone of the ’473 patent is accurate because the claim amendments that were added to the claims of the ’666 patent to limit the “second microphone” to an ear canal microphone are not present in the claims of the ’473 patent. Thus, the “second microphone” need not be an “ear canal microphone.”

206. Accordingly, a POSITA would have understood *Goldstein* to disclose or suggest an earpiece including an ambient sound microphone that outputs an audio signal (“a first microphone that measures a first acoustic environment to generate a first microphone signal”), a second earpiece with a second ambient sound microphone that outputs an audio signal (“a second microphone that is positioned closer to a user’s ear canal than the first

microphone when the device is worn, where the second microphone generates a second microphone signal”), an ear canal receiver (“speaker”), a memory that stores program instructions to be executed by a processor (“a memory that stores instructions; and a processor that executes the instructions to perform operations”).

c. [8.6] and [8.7]: receiving an audio content signal; modifying the audio content signal to generate a modified audio content signal;

207. *Goldstein* discloses or suggests these features.

208. *Goldstein* discloses that “[t]he earpiece 100 can include an audio interface 212 operatively coupled to the processor 206 to receive audio content, for example from a media player or cell phone, and deliver the audio content to the processor 206.” *Goldstein* ¶[0037]. *Goldstein* further discloses a method “for maintaining constant audio content level (ACL) to internal ambient sound level (iASL)” in which one step is to “receive[] as input an Audio Content signal 902, e.g. a music audio signal from a portable Media Player or mobile-phone, which is processed with analog and digital signal processing system as shown in step 908.” *Goldstein* ¶[0067]. Figure 9 block 908 states “SIGNAL, ADC, EQ, GAIN etc.” *Id.*, FIG.9. A POSITA would have understood that EQ refers to a step for equalizing the signal, and that equalizing a signal modifies the signal because

equalization adjusts the amplitude of one or more frequency components of the signal.

209. Accordingly, a POSITA would have understood *Goldstein* to disclose or suggest the earpiece processor executing instructions to receive an audio content signal (“receiving an audio content signal”) and, for example, equalizing it (“modifying the audio content signal to generate a modified audio content signal”).

- d. [8.8] and [8.9]: modifying the first microphone signal to generate a modified first microphone signal; modifying the second microphone signal to generate a modified second microphone signal;**

210. *Goldstein* discloses or suggests these features.

211. As explained in §X.C.2.b, the plain language of the claim is broad enough to encompass *Goldstein*’s embodiment in which the “first microphone signal” and “second microphone signal” may correspond to the signals output by an ASM in the left earpiece and an ASM in a second earpiece, respectively.

212. *Goldstein* discloses that ASM signal(s) are captured and processed “to condition and compensate the ambient sound signal for the ASM 111 transducer.” *Goldstein* ¶[0054]; FIG. 4 (block 404). A POSITA would have understood that conditioning and compensating the signal for the ASM modifies the signal.

213. Accordingly, a POSITA would have understood *Goldstein* to disclose or suggest equalizing the signal output from one earpiece ASM to generate an equalized ASM signal (“modifying the first microphone signal to generate a modified first microphone signal”) and equalizing the signal output from a second earpiece ASM signal to generate equalized ASM signal (“modifying the second microphone signal to generate a modified second microphone signal”).

- e. ***[8.10]: generating an ambient sound signal from at least one of the modified first microphone signal, the modified second microphone signal or a combination thereof;***

214. *Goldstein* in combination with *Woodruff* discloses or suggests this feature.

215. As detailed in §X.C.1, a POSITA would have considered the *Goldstein-Woodruff* combination to disclose or suggest *Goldstein*’s earpiece processor processing ambient sound microphone signals to combine them and compensate for the user’s hearing loss. As also detailed in §X.C.1, *Woodruff* discloses beamforming microphone signals from a microphone array and processing the signal through ambient sound enhancement filter 6 which, among other things, compensates for the user’s hearing loss. The beamformed and filtered microphone signal representing ambient sounds is consistent with how a POSITA would have understood an “ambient sound signal” generated from “at

least one of the modified first microphone signal, the modified second microphone signal or a combination thereof.”

216. Accordingly, a POSITA would have understood the *Goldstein-Woodruff* combination to disclose or suggest combining (i.e., beamforming) and filtering the equalized ASM input signals from each earpiece (“generating an ambient sound signal from at least one of the modified first microphone signal, the modified second microphone signal or a combination thereof”).

- f. ***[8.12]: detecting an acute sound by analyzing at least one of the modified first microphone signal, the modified second microphone signal or a combination thereof;***

217. *Goldstein* in combination with *Woodruff* discloses or suggests this feature.

218. *Goldstein* discloses in Figure 4 a method for acute sound detection. *Goldstein* ¶¶[0021], [0022]. The first step of the method is to “condition and compensate the ambient sound signal for the ASM 111 transducer.” *Id.* ¶[0054]. As discussed in §X.C.2.d, this constitutes modifying the first and second microphone signals to generate modified first and second microphone signals. *Goldstein* discloses detecting an acute sound in the modified microphone signals in blocks 408-428 of the method of Figure 4. *Goldstein* ¶¶[0054]-[0056].

219. Accordingly, a POSITA would have understood the *Goldstein-Woodruff* combination to disclose or suggest a method for detecting an acute

sound by analyzing at least one of the two modified ASM signals (“detecting an acute sound by analyzing at least one of the modified first microphone signal, the modified second microphone signal”).

- g. [8.10]: modifying the modified audio content signal if an acute sound is detected to generate a new modified audio content signal;**

220. *Goldstein* in combination with *Woodruff* discloses or suggests this feature.

221. As discussed in §X.C.2.c, *Goldstein* discloses receiving and processing (e.g., equalizing) the audio content signal (“modifying the audio content signal”). *Goldstein* also discloses that the earpiece processor can “lower a volume of the audio content responsive to detecting an acute sound.” *Goldstein* ¶[0037]. A POSITA would have understood that lowering a volume of the audio content signal modifies the signal.

222. Accordingly, the *Goldstein-Woodruff* combination discloses or suggests adjusting the gain of the equalized audio content signal (“modifying the modified audio content signal”) to maintain a constant ratio between an audio content level and an internal ambient sound level if an acute sound is detected (“if an acute sound is detected”) which generates a modified version of the equalized audio content signal (“new modified audio content signal”).

- h. [8.13] and [8.14]: generating a mixed signal by mixing the ambient sound signal with the modified audio content signal or the new modified audio content signal; and sending the mixed signal to the speaker**

223. *Goldstein* in combination with *Woodruff* discloses or suggests this feature.

224. *Goldstein* discloses in Figure 9 a method for “maintaining constant audio content level (ACL) to internal ambient sound level (iASL)” and that, after the gain processing steps 928 and 936, the ASM and audio content signals are mixed. *Goldstein* ¶[0069]. A POSITA would have understood that in the *Goldstein-Woodruff* combination, the mixing step 940 would have mixed the audio content signal with the beamformed, hearing loss compensated ambient sound signal (“ambient sound signal”).

225. *Goldstein* further discloses that after the audio content signal and ambient sound signal are mixed, the mixed signal is reproduced with the ear canal receiver (the “speaker”) in block 944. *Goldstein* ¶[0070].

226. Accordingly, a POSITA would have understood the *Goldstein-Woodruff* combination to disclose or suggest mixing the audio content signal with the beamformed, hearing-loss compensated signal (“generating a mixed signal by mixing the ambient sound signal with the modified audio content

signal or the new modified audio content signal”) and reproducing the mixed signal to the ear canal receiver (“and sending the mixed signal to the speaker”).

3. **Claim 9: The device according to claim 8, wherein the operations further comprise: determining if the acute sound is a user’s voice by analyzing the temporal and spectral characteristics of at least one of the modified first microphone signal, the modified second microphone signal or a combination thereof.**

227. *Goldstein* in combination with *Woodruff* discloses or suggests this claim.

228. *Goldstein* discloses that “the earpiece 100 looks for temporal and spectral characteristics in the ambient sound for detecting acute sounds” and that “the processor 206 is actively listening for presence of acute sounds before identifying the type of sound source.” *Goldstein* ¶[0047]. *Goldstein* further discloses estimating the proximity of an acute sound to “determine[] whether it is the user’s voice that generates the acute sound when the user speaks, or whether it is an external sound such as a vehicle approaching the user.” *Id.* ¶[0052].

229. Accordingly, a POSITA would have understood *Goldstein* to disclose detecting an acute sound by analyzing temporal and spectral characteristics of the equalized or conditioned microphone signal and then estimating a proximity of the acute sound to determine if it was the user’s voice (“determining if the acute sound is a user’s voice by analyzing the temporal and

spectral characteristics of the modified first microphone signal” or “modified second microphone signal”).

4. **Claim 10 (“The device according to claim 9, wherein the operations further comprise: generating a noise signal from at least one of the modified first microphone signal, the modified second microphone signal, or both; generating a noise reduction signal”); Claim 11 (“mixing the noise reduction signal with the mixed signal to generate a new mixed signal, and sending the new mixed signal to the speaker instead of the mixed signal.”)**

230. *Goldstein* in combination with *Woodruff* discloses or suggests these claims.

231. As detailed in §X.C.1.b, the *Goldstein-Woodruff* combination discloses or suggests *Goldstein*’s earpiece processor generating an anti-noise signal based on a hybrid feedforward and feedback algorithm and mixing it into the signal output to the speaker.

232. A POSITA would have understood that for *Woodruff*’s hybrid ANC block 10 to generate an anti-noise signal, it first generates a noise signal. In particular, a POSITA would have understood that a hybrid ANC algorithm will take as input a signal from a reference microphone (i.e., the signal from *Woodruff*’s microphone 3) and filter it to generate an estimation of the noise. This is corroborated, for example, by *Kuo*, which describes how hybrid ANC

works. With reference to Figure 18, the signal $x'(n)$ is an estimate of the noise.⁴

A POSITA would have understood that an “anti-noise signal” is a “noise reduction signal” because when the anti-noise signal is mixed with a noisy signal, it has the effect of reducing noise.

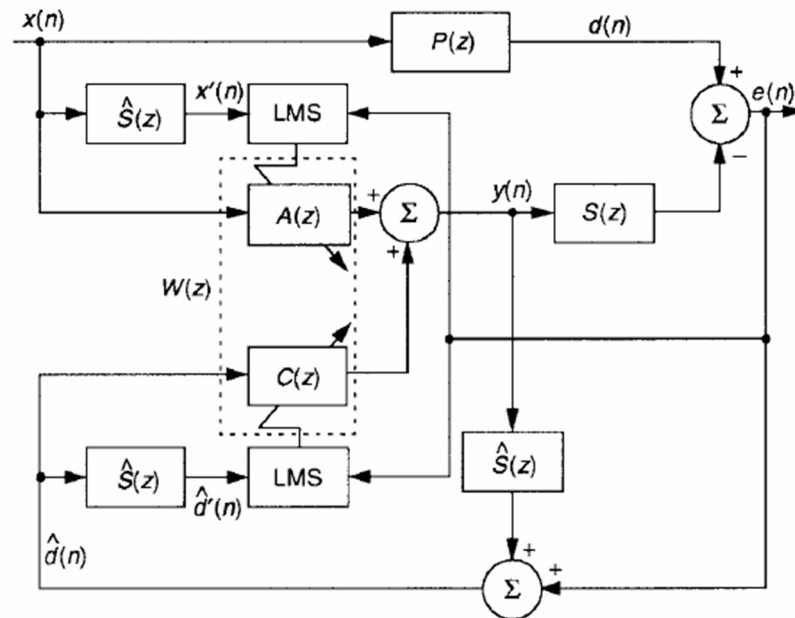


Fig. 18. Hybrid ANC system using the FIR feedforward ANC with the FXLMS algorithm.

Kuo FIG. 18

233. A POSITA would have understood that the *Goldstein-Woodruff* combination renders obvious generating the anti-noise signal “from at least one of the modified first microphone signal, the modified second microphone signal, or both” because *Woodruff* discloses that the ANC block 10 takes as its input a

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

signal from the environmental microphone 3 and the internal microphone 4, which in the *Goldstein-Woodruff* combination are the equalized microphone signals from the ASM (i.e., the “first” and “second” modified microphone signal”) and ECM, respectively.

234. Accordingly, a POSITA would have understood the *Goldstein-Woodruff* combination to disclose or suggest generating an anti-noise signal based on a based on a hybrid feedforward and feedback algorithm (“generating a noise signal from at least one of the modified first microphone signal, the modified second microphone signal, or both; generating a noise reduction signal”) and mixing the anti-noise signal with the combined audio content and ambient sound signal and outputting the mixed signal to the speaker (“mixing the noise reduction signal with the mixed signal to generate a new mixed signal, and sending the new mixed signal to the speaker instead of the mixed signal.”).

5. Claim 12: The device according to claim 11, wherein the operations further comprise: sending a modified ambient signal to the speaker instead of the new mixed signal if the user’s voice is detected.

235. *Goldstein* in combination with *Woodruff* discloses or suggests this claim.

236. As explained in §X.C.4, the *Goldstein-Woodruff* combination discloses or suggests generating a mixed signal including an anti-noise signal, an ambient sound signal, and an audio content signal.

237. *Goldstein* discloses detecting an acute sound and then making a determination as to whether the acute sound originated with the user. *See Goldstein* ¶¶[0052], [0056], FIG. 3 (blocks 314, 316), FIG. 4 (block 436).

238. *Goldstein* further discloses that if the acute sound originated with the user, a hysteresis is invoked and the processor decides of the processor recently invoked pass-through; if so, then the processor invokes the passthrough system. *Id.* ¶[0056], FIG. 4 (blocks 432, 440). Thus, *Goldstein* discloses a method in which, if a user's voice is detected, and if pass-through was recently activated, then the passthrough system is invoked.

239. *Goldstein* explains that the passthrough system may amplify the acute sound. *Goldstein* ¶[0013]. A POSITA would have understood that amplifying the acute sound includes amplifying the ambient sound signal representing the acute sound and passing the amplified ambient sound signal the ECR or speaker. A POSITA would have understood that amplifying the ambient sound signal modifies it.

240. Accordingly, a POSITA would have understood the *Goldstein-Woodruff* combination to disclose or suggest sending an amplified ambient sound signal to the speaker instead of the prior mixed signal of anti-noise, audio content, and ambient sound (“sending a modified ambient signal to the speaker instead of the new mixed signal if the user's voice is detected”).

6. **Claim 13: The device according to claim 9, wherein the operations further comprise: sending a modified ambient signal to the speaker instead of the mixed signal if the user's voice is detected.**

241. *Goldstein* in combination with *Woodruff* discloses or suggests this claim for the same reasons discussed in §X.C.5.

7. **Claim 14: The device according to claim 9, wherein the operations further comprise: detecting whether the acute sound is at least one of a warning sound, siren, voice, specific noise type, or a combination, by analyzing the spectrum of at least one of the modified first microphone signal, the modified second microphone signal, the modified ambient sound signal, or a combination.**

242. *Goldstein* in combination with *Woodruff* discloses or suggests this claim.

243. As explained in §X.C.2.f, *Goldstein* discloses analyzing the modified first or second microphone signals for the acute sound. *Goldstein* further discloses “the earpiece 100 looks for temporal and spectral characteristics in the ambient sound for detecting acute sounds” and that the acute sounds may correspond to “the on-set of a warning sound (e.g., bell, emergency vehicle, security system, etc.), siren (e.g., police car, ambulance,

etc.), voice (e.g., “help”, “stop”, “police”, etc.), or specific noise type (e.g., breaking glass, gunshot, etc.).” *Goldstein* ¶[0036], [0047].

244. Accordingly, a POSITA would have understood the *Goldstein-Woodruff* combination to disclose or suggest analyzing the spectral characteristics of the modified first or second microphone signal (“analyzing the spectrum of at least one of the modified first microphone signal, the modified second microphone signal”) to detect an acute sound that corresponds to a warning sound (e.g., a siren) (“detecting whether the acute sound is at least one of a warning sound, siren, voice, specific noise type, or a combination”).

8. Claim 15: The device according to claim 14, wherein the operations further comprise: decreasing a volume of the modified audio content signal when a warning or siren is detected.

245. *Goldstein* in combination with *Woodruff* discloses or suggests this claim. *Goldstein* discloses that “the processor can lower a volume of the audio content responsive to detecting an acute sound.” *Id.* ¶[0037]. As explained in §X.C.2.d, *Goldstein* discloses equalizing the audio content signal upon receiving it to generate a “modified audio content signal.” And as explained in §X.C.7, the acute sound may correspond to a warning sound such as a siren.

246. Accordingly, a POSITA would have understood the *Goldstein-Woodruff* combination to disclose or suggest lowering a volume of an equalized

audio content signal (“decreasing a volume of the modified audio content signal”) if an acute sound is detected (“when a warning or siren is detected.”).

9. Claim 16: The device according to claim 14, where the operations further comprise: sending a notification signal to the speaker if the acute sound is a warning sound or siren.

247. *Goldstein* in combination with *Woodruff* discloses or suggests this claim. *Goldstein* discloses that “[t]he earpiece 100 can also present an audible notification to the user indicating that an external sound source generating the acute sound has been detected.” *Goldstein* ¶[0052]. A POSITA would have understood that presenting an audible notification to the user sends a notification signal to the speaker. And as explained in §X.C.7, the acute sound may correspond to a warning sound such as a siren.

248. Accordingly, a POSITA would have understood *Goldstein* to disclose or suggest presenting an audible notification to the user when an acute sound is detected (“sending a notification signal to the speaker if the acute sound is a warning sound or siren”).

10. Claim 17: The device according to claim 16, wherein the warning sound is at least one of a bell, an emergency vehicle, the sound of a security system or a combination thereof.

249. *Goldstein* in combination with *Woodruff* discloses or suggests this claim. *Goldstein* discloses that the warning sound may for example, be “bell, emergency vehicle, security system, etc.”). *Goldstein* ¶[0036]. Accordingly, a POSITA would have understood that the *Goldstein-Woodruff* combination discloses or suggests that the warning sound may be a bell, emergency vehicle, or a security system (“wherein the warning sound is at least one of a bell, an emergency vehicle, the sound of a security system”).

11. Claim 18: The device according to claim 14, wherein if an alarm is detected it is at least one of a police siren, an ambulance siren, a car honking or a combination thereof.

250. *Goldstein* in combination with *Woodruff* discloses or suggests this claim. *Goldstein* discloses that the acute sound may correspond to a “siren (e.g., police car, ambulance, etc.).” *Goldstein* ¶[0036]. A POSITA would have understood that a siren is a type of alarm. Accordingly, a POSITA would have understood the *Goldstein-Woodruff* combination to disclose or suggest detecting an acute sound that corresponds to a siren that may be a police siren (“wherein if an alarm is detected it is at least one of a police siren”).

12. Claim 19: The device according to claim 8, wherein the operations further comprise: decreasing a volume of the modified audio content signal when a user’s voice is detected.

251. *Goldstein* in combination with *Woodruff* discloses or suggests this claim.

252. As explained in §X.C.2.c, *Goldstein* discloses receiving an audio content signal and equalizing it (“modifying the audio content signal”). *Goldstein* further discloses that sound-passthrough mode may involve decreasing the volume of the audio content signal in response to detecting an acute sound. *Id.* ¶[0037]. *Goldstein* discloses that the acute sound may originate with the user. *Goldstein* ¶[0052]. Moreover, as discussed in §X.C.5, *Goldstein* discloses an embodiment in which, if it is determined that the acute sound originated with the user, and if sound-passthrough was recently activated, then sound-passthrough is invoked. *See Goldstein* ¶[0056]; FIG. 4 (blocks 432, 440, 438). Thus, *Goldstein* discloses a scenario in which if the user’s voice is detected, and if sound-passthrough was recently invoked, then the earpiece processor decreases a volume of the audio content signal.

253. Accordingly, a POSITA would have understood *Goldstein* to disclose invoking sound-passthrough when it is determined that the acute sound originated with the user (“decreasing a volume of the modified audio content signal when a user’s voice is detected.”)

13. Claim 20: The device according to claim 8, wherein the acute sound is a voice.

254. *Goldstein* in combination with *Woodruff* discloses or suggests this claim. *Goldstein* discloses that the acute sound may correspond to a voice.

Goldstein ¶[0036]. Accordingly, a POSITA would have understood *Goldstein* to

disclose or suggest that the acute sound may correspond to a voice (“wherein the acute sound is a voice”).

XI. SECONDARY CONSIDERATIONS

255. I am not aware of any evidence in the '473 patent's prosecution history or elsewhere supporting any secondary considerations arguments, or evidence of nexus of such alleged evidence to the challenged claims. 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

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

257. 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.

258. 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.

259. 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: 06/12/2024


Chris Kyriakakis