

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

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

Petitioners

v.

ZOPHONOS INC.,

Patent Owner

Case IPR2025-00085

U.S. Patent No. 11,900,016

**DECLARATION OF CHRIS KYRIAKAKIS, PH.D.
IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 11,900,016**

Samsung v. Zophonos IPR2026-00085 Exhibit 1002
--

TABLE OF CONTENTS

I.	ASSIGNMENT.....	1
II.	BACKGROUND AND QUALIFICATIONS.....	1
	A. Relevant Academic Experience	2
	B. Relevant Professional Experience.....	4
III.	MATERIALS REVIEWED	7
IV.	LEVEL OF ORDINARY SKILL IN THE ART.....	9
V.	RELEVANT LEGAL STANDARDS.....	10
VI.	SUMMARY OF OPINIONS.....	16
VII.	OVERVIEW OF THE '016 PATENT	16
	A. The Specification.....	16
	B. Prosecution History	20
	1. The '016 Patent	20
	C. The Claims	21
VIII.	OVERVIEW OF THE PRIOR ART	26
	A. <i>Goldstein</i> 873 (Ex. 1005)	30
	B. <i>Newham</i> (Ex. 1006).....	32
IX.	CLAIM CONSTRUCTION	35
X.	SPECIFIC GROUNDS FOR CHALLENGE.....	35
	A. Ground 1A: <i>Goldstein</i> 873 and <i>Newham</i> Render Obvious Claims 39-43.....	36
	1. Claim 39.....	36

a.	“A system comprising:”	36
b.	“at least one cluster of at least one computing device,”	38
c.	“the at least one computing device including:.....	41
	(i) “a sound sensing mechanism, configured to detect a sensed energy, wherein the sensed energy comprises one or more sounds; monitor one or more parameters selected from the group of (i) an amplitude of the one or more sounds and (ii) a frequency of the one or more sounds;”	41
	(ii) “a wireless transceiver; and”	45
d.	“at least one output device, including:”	45
	(i) “a power source for operating the output device;” ..	53
	(ii) “a speaker for outputting sound; and”	54
	(iii) “a communication mechanism”	56
e.	“wherein the at least one computing device further comprises: a memory, containing computer-executable instructions for connecting to the at least one cluster and varying an output of the at least one output device;”	56
f.	“a processor, for executing the computer-executable instructions, wherein the computer-executable instructions include:”	60
	(i) “determining if at least one of the monitored one or more parameters falls outside of a predetermined threshold;”	61
	(ii) “if at least one of the monitored one or more parameters falls outside of the predetermined threshold, altering one or more of the one or more sounds so that at	

	least one of the monitored one or more parameters does not fall outside of the predetermined threshold; and”	64
	(iii) “outputting the one or more sounds on the at least one output device.”	66
2.	Claim 40	68
a.	“The system of claim 39, wherein the sensed energy originates from an environment or from an in-ear device paired with the system”	68
3.	Claim 41	69
a.	“The system of claim 39, wherein an alert comprises an audio alert.”	69
4.	Claim 42	70
a.	“The system of claim 41, wherein the alert comprises at least one of an audio alert and a visual alert.”	70
5.	Claim 43	70
a.	“The system of claim 39, wherein at least one output device comprises a smart speaker.”	70
B.	Ground 1B: <i>Goldstein</i> 873, <i>Newham</i> , and <i>Brulle</i> Render Obvious Claim 44	74
1.	Claim 44	74
a.	“The system of claim 39, wherein the at least one output device comprises an infotainment system of a vehicle.”	74
C.	Ground 2A: <i>Goldstein</i> 873, <i>Newham</i> , and <i>Chaudhri</i> Render Obvious Claims 32, 33, and 36-38	82
1.	Claim 32	82
a.	“A system comprising:”	82

- b. “at least one cluster of at least one computing device,” 82
- c. “the at least one computing device including:” 82
 - (i) “a sound sensing mechanism, configured detect a sensed energy, wherein the sensed energy comprises one or more sounds; and monitor one or more parameters selected from the group of (i) an amplitude of the one or more sounds and (ii) a frequency of the one or more sounds, wherein at least one of the monitored one or more parameters is aggregated over time; and” 82
 - (ii) “a wireless transceiver; and” 83
- d. “at least one output device, including: 83
 - (i) a power source for operating the output device; 84
 - (ii) a speaker for outputting sound; and 84
 - (iii) a communication mechanism;” 84
- e. “wherein the at least one computing device further comprises: a memory, containing computer-executable instructions for connecting to the at least one cluster and varying an output of the at least one output device;” 84
- f. “a processor, for executing the computer-executable instructions and being capable of receiving an input from a user for manually adjusting a volume, wherein the computer-executable instructions include:” 84
 - (i) “determining if at least one of the monitored one or more parameters falls outside of a predetermined threshold;” 89
 - (ii) “if at least one of the monitored one or more parameters falls outside of the predetermined threshold, transmitting, to the at least one output device, an alert” 89

	(iii) “altering one or more of the one or more sounds so that at least one of the monitored one or more parameters does not fall outside of the predetermined threshold; and” 91	
	(iv) “outputting the one or more sounds on the at least one output device.” 91	
2.	Claim 33 92	
	a. The system of claim 32, further comprising: an interfacing mechanism, the interfacing mechanism including: 92	
	b. “a network adapter, configured to transmit and receive electronic information through both wired and wireless communication; and” 93	
	c. at least one input mechanism, configured to manipulate the interfacing mechanism; and 95	
	d. vary the output of the at least one output device. 97	
3.	Claim 36 97	
	a. “The system of claim 32, wherein the predetermined threshold equates to a frequency or an amplitude determined to pose a risk of harm to a user's hearing capabilities.” 97	
4.	Claim 37 98	
	a. “The system of claim 32, wherein the computer-executable instructions further include steps selected from the group consisting of: panning the sensed energy; and equalizing the sensed energy.” 98	
5.	Claim 38 99	

a.	“The system of claim 32, further comprising: an in-ear device, wherein an audio output of the in-ear device auto-adjusts based on signal energy sensed within a cluster or surrounding clusters.”	99
D.	Ground 2B: <i>Goldstein</i> ⁸⁷³ , <i>Newham</i> , <i>Chaudhri</i> , and <i>Smith</i> Render Obvious Claims 34 and 35	101
1.	Claim 34	101
a.	“The system of claim 32, wherein the sound sensing mechanism is selected from the group consisting of: an omnidirectional transducer, an ultrasonic transducer, an infrasonic transducer, and a microwave transducer.”	101
2.	Claim 35	108
a.	“The system of claim 32, wherein the sensed energy includes infrasonic or ultrasonic soundwaves.”	108
XI.	SECONDARY CONSIDERATIONS	108
XII.	CONCLUSION	108

I, Chris Kyriakakis, declare that:

I. ASSIGNMENT

1. I have been retained by Samsung Electronics Co., Ltd. and Samsung Electronics America, Inc. (together “Samsung”) (collectively “Petitioners”) as an independent expert consultant in this proceeding before the United States Patent and Trademark Office (“USPTO”).

2. I am being compensated at a rate of \$525/hour for my services in this proceeding, which is my regular and customary rate.

3. My compensation is in no way contingent on the nature of my findings, the presentation of my findings in testimony, or the outcome of this or any other proceeding. I have no other interest in this proceeding.

4. I have been asked to consider whether certain references disclose or suggest the features recited in the claims of U.S. Patent No. 11,900,016 (“the ’016 patent”) (Ex. 1001).¹ My opinions are set forth below.

II. BACKGROUND AND QUALIFICATIONS

5. I am an independent consultant. All of my opinions stated in this declaration are based on my own personal knowledge and professional judgment. In

¹ Where appropriate, I refer to exhibits I understand will be attached to the petition for *inter partes* review of the ’016 patent (the “Petition”).

forming my opinions, I have relied on my education, experience, and knowledge regarding electrical engineering, computer science, and audio and acoustic sciences.

6. 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 publications I have authored in the past ten years, is included as Ex. 1003 in this proceeding. The following provides an overview of some of my experience that is relevant to the matters set forth in this declaration.

A. Relevant Academic Experience

7. 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).

8. Since 2002, I have been 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.

Another focus of my research has been on the perception of loudness by human listeners. Specifically, I developed algorithms to automatically adjust the frequency response (EQ) and dynamic range of audio content to match the needs of human hearing. 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.

9. 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, 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. 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.

B. Relevant Professional Experience

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 Acoustics of Real and Virtual Spaces and my graduate course in Spatial Audio: Acoustics and Psychoacoustics. Both courses have a major acoustics component that examines the interaction of sound with the acoustical environment (e.g., home, movie theater, headphones, 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 IEEE Conference on Signals, Systems and Computers.

III. MATERIALS REVIEWED

17. The opinions contained in this declaration are based on the documents I reviewed, my professional judgment, as well as my education, experience, and knowledge regarding electrical engineering, computer science, and audio and acoustic sciences.

18. In forming my opinions expressed in this declaration, I reviewed the following materials:

- the '016 patent (Ex. 1001);
- the file history of the '016 patent (Ex. 1004);
- U.S. Patent Application Publication 2008/0137873 ("*Goldstein873*") (Ex. 1005);
- U.S. Patent Application Publication 2013/0316642 ("*Newham*") (Ex. 1006);
- U.S. Patent Application Publication 2007/0127734 ("*Brulle*") (Ex. 1007);

- U.S. Patent Application Publication 2009/0061837 (“*Chaudhri*”) (Ex. 1008);
- U.S. Patent Application Publication 2014/0254842 (“*Smith*”) (Ex. 1009);
- U.S. Patent 8,194,864 (“*Goldstein864*”) (Ex. 1010);
- U.S. Patent Application Publication 2014/0126748 (“*Usher*”) (Ex. 1011);
- U.S. Patent Application Publication 2015/0012826 (“*Tengstrand*”) (Ex. 1012);
- U.S. Patent Application Publication 2013/0064385 (“*Jeong*”) (Ex. 1013);
- Excerpts from Microsoft Computer Dictionary (5th ed. 2002) (“*Computer Dictionary*”) (Ex. 1016);
- Excerpts from Robert Oshana, “DSP Software Development Techniques Embedded and Real-Time Systems” (2006) (“*Oshana*”) (Ex. 1017);
- Excerpts from Thomas D. Rossing, Richard F. Moore, and Paul A. Wheeler, “The Science of Sound” (3rd ed. 2002) (“*Rossing*”) (Ex. 1018); and

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

19. All of the opinions contained in this declaration are based on the documents I reviewed and my knowledge and professional judgment. My opinions have also been guided by my appreciation of how a person of ordinary skill in the art would have understood the claims and the specification of the '016 patent at the time of the alleged invention, which I have been asked to consider as no earlier than September 23, 2014 (the filing date of U.S. Provisional Patent Application 62/054,286). My opinions reflect how one of ordinary skill in the art would have understood the '016 patent, the prior art to the patent, and the state of the art at the time of the alleged invention.

20. Based on my experience and expertise, it is my opinion that certain references disclose and/or suggest all the features recited in claims 32-44 ("challenged claims") of the '016 patent, as I discuss in detail below.

IV. LEVEL OF ORDINARY SKILL IN THE ART

21. I have been informed and understand that, in the context of an invalidity analysis, a person having ordinary skill in the art is a hypothetical person who looks to prior art at the time of the invention. I further understand that the factors that may be considered in determining the level of ordinary skill include: (1) the problems encountered in the art; (2) the prior art solutions to the problems encountered in the art; (3) the rapidity of innovation; (4) the sophistication of the technology; and (5) the education level of active workers in the field. I understand that these factors need

not all be considered for the analysis and that one or more of these factors may control.

22. I was asked to provide my opinion on the level of one of ordinary skill in the art with respect to the alleged invention of the '016 patent as of September 23, 2014. Based on my consideration of the factors above, I believe a person having ordinary skill in the art would have had a Bachelor of Science (or equivalent) in electrical engineering, computer science, audio engineering, or a similar field and at least two years of experience in the design of digital audio systems and associated signal processing in hearing instruments such as earphones, hearing aids, and/or hearing protectors. Persons of ordinary skill in the art could have also obtained similar knowledge and experience through other means.

23. As of September 23, 2014, I met, and in fact exceeded, the qualifications of a person of 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. RELEVANT LEGAL STANDARDS

24. 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.

25. 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.

26. 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.

27. 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.

28. 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.

29. 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.

30. 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.

31. 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.

32. 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.

33. 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.

34. 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.

35. 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.

36. 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. SUMMARY OF OPINIONS

37. For the reasons I discuss below, it is my opinion that claims 32-44 of the '016 patent are rendered obvious by the prior art.

VII. OVERVIEW OF THE '016 PATENT

A. The Specification

38. The '016 patent is directed to a system with devices “to wirelessly communicate with an audio control source” such that “the output of such an in-ear monitor can be autonomously adjusted after sensing audio output.” Ex. 1001 ('016 patent), 8:48-53. The '016 patent describes “a software-defined and/or cognitive-defined based in-ear transceivers,” and that “an in-ear monitor system for use with

the present invention will preferably comprise hardware such as, earphones.” *Id.*, 8:56-60.

39. The ’016 patent describes a problem with exposure to loud sounds, that “[l]oud noises can often lead to stress and hearing loss,” and that “loud music and other forms of loud sounds have put approximately 1.1 billion young people at risk of suffering from hearing loss.” *Id.*, 9:7-11. One of the aims of the ’016 patent is to “provide[] for a mobile cluster-based apparatus that analyzes, reports, and controls outputs based on a range of inputs over a swath of frequency bands, with distinct applications including sound output control, ... detection and reporting.” *Id.*, 10:4-10.

40. Figure 1 (reproduced below) illustrates a cluster 101 including computing device 102 with sound sensing mechanism 150 and wireless transceiver 155. *Id.*, 11:32-61.

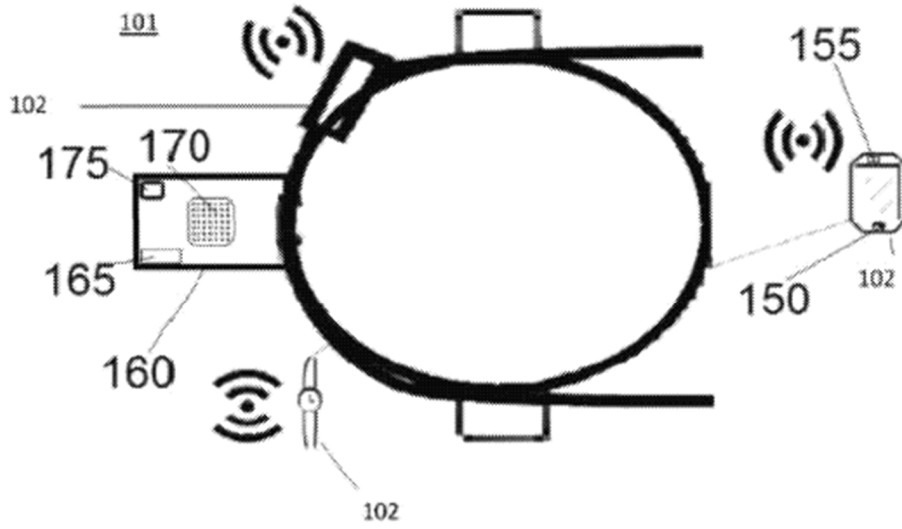


FIG. 1

Ex. 1001 ('016 patent), FIG. 1

41. The cluster also includes output device 160 with speaker 170 and communications mechanism 175. *Id.*, 12:53-12:67. The output device 160 “is located within said at least one cluster 101, such that audio control source 111 may alter the power supplied to said speaker 170 in real-time.” *Id.*, 12:64-67.

42. Figure 3 (reproduced below) illustrates audio control source 111 communicating with clusters. “The embodiment depicted [in figure 3] shows devices that sense audio signal energy within the confines of a single cluster and then sends data directly to an audio control unit and other clusters.” *Id.*, 13:1-8. The audio control source 111 adjusts connected output devices “to ensure high quality/fidelity

output.” *Id.*, 13:8-11. These output devices may include in-ear systems. *Id.*, 8:56-59, 10:45-47, 12:52-53, 18:1-3, FIG. 3 (element 112).

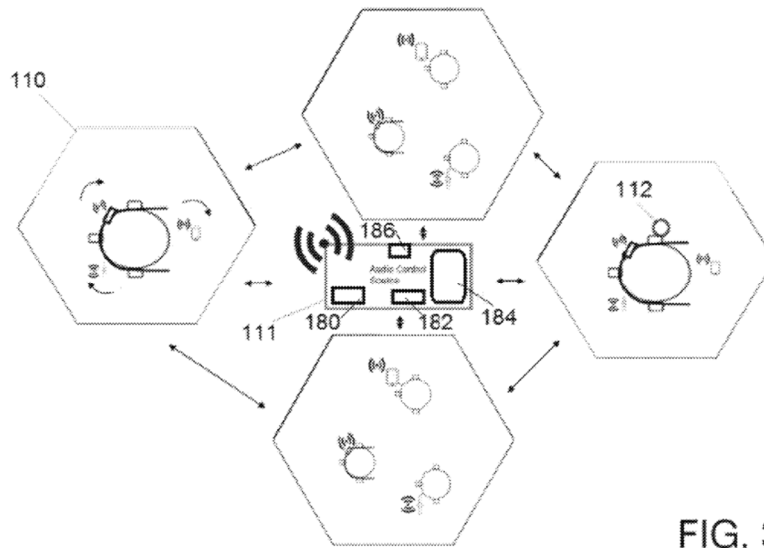


FIG. 3

Ex. 1001 ('016 patent), FIG. 3

43. The '016 patent states the system senses “both desired and undesired audio output signals” and subsequently analyzes these signals. *Id.*, 13:14-16. When its system determines that non-negligible audio output is present, it determines “if the predefined threshold or EQ setting is breached.” *Id.*, 13:20-23. Once the breached has been confirmed, “at least one computing device is chosen to communicate the breach to.” *Id.*, 13:32-34. Lastly, the system “adjusts audio levels at the at least one output device to transform undesired audio outputs to desired audio outputs.” *Id.*, 13:35-37. The '016 patent further describes that “if audio in the hazardous range has been detected, then one or more users are notified.” *Id.*, 17:4-6.

B. Prosecution History

1. The '016 Patent

44. The original application that issued as the '016 patent was filed on December 20, 2021. Ex. 1001 ('016 patent), Cover (code 22). The '016 patent states it is a continuation of Application No. 16/656,259 which issued as U.S. Patent No. 11,204,736, a continuation of Application No. 16/421,141 which issued as U.S. Patent No. 10,656,906, a continuation-in-part of Application No. 16/155,919, and a continuation-in-part of Application No. 14/862,304 which issued as U.S. Patent No. 10,127,005. *Id.* (code 63) The application claims priority to Provisional Application No. 62/054,286 filed September 23, 2014. *Id.* (code 60).

(21) Appl. No.: **17/555,813**

(22) Filed: **Dec. 20, 2021**

(65) **Prior Publication Data**

US 2022/0261213 A1 Aug. 18, 2022

Related U.S. Application Data

(63) Continuation of application No. 16/656,259, filed on Oct. 17, 2019, now Pat. No. 11,204,736, which is a continuation of application No. 16/421,141, filed on May 23, 2019, now Pat. No. 10,656,906, which is a continuation-in-part of application No. 16/155,919, filed on Oct. 10, 2018, now abandoned, which is a continuation of application No. 14/862,304, filed on Sep. 23, 2015, now Pat. No. 10,127,005.

(60) Provisional application No. 62/054,286, filed on Sep. 23, 2014.

Ex. 1001 ('016 patent), Cover (excerpted)

45. I understand that for purposes of this proceeding, I am to assume the priority date is September 23, 2014.

46. The original application was filed with twenty claims. Ex. 1004 (File History for the '016 patent), 68-73. In a Preliminary Amendment filed March 29, 2022, the applicant cancelled four dependent claims and added forty new claims. *Id.*, 109-148. The Examiner issued a Non-final Office Action on April 13, 2023 identifying issues with the specification and drawings and identifying certain claims as lacking written description support. *Id.*, 187-196. All claims were indicated as having allowable subject matter. *Id.* The applicant canceled the claims lacking written description support. *Id.*, 214-251. A Notice of Allowance issued September 27, 2023 with an Examiner's Amendment. *Id.*, 287-292. The '016 patent issued February 13, 2024. Ex. 1001 ('016 patent).

C. The Claims

47. The table below includes identifiers for the '016 patent claims and limitations, which are referenced throughout.

Claim 32	
32[pre]	A system comprising:
32[a]	at least one cluster of at least one computing device,
32[b]	the at least one computing device including:

32[b][i]	a sound sensing mechanism, configured to: detect a sensed energy, wherein the sensed energy comprises one or more sounds; and monitor one or more parameters selected from the group of (i) an amplitude of the one or more sounds and (ii) a frequency of the one or more sounds, wherein at least one of the monitored one or more parameters is aggregated over time; and
32[b][ii]	a wireless transceiver; and
32[c]	at least one output device, including:
32[c][i]	a power source for operating the output device;
32[c][ii]	a speaker for outputting sound;
32[c][iii]	and a communication mechanism,
32[d]	wherein the at least one computing device further comprises: a memory, containing computer-executable instructions for connecting to the at least one cluster and varying an output of the at least one output device; and
32[e]	a processor, for executing the computer-executable instructions and being capable of receiving an input from a user for manually adjusting a volume, wherein the computer-executable instructions include:
32[e][i]	determining if at least one of the monitored one or more parameters falls outside of a predetermined threshold;
32[e][ii]	if at least one of the monitored one or more parameters falls outside of the predetermined threshold, transmitting, to the at least one output device, an alert;

32[e][iii]	altering one or more of the one or more sounds so that at least one of the monitored one or more parameters does not fall outside of the predetermined threshold; and
32[e][iv]	outputting the one or more sounds on the at least one output device.
Claim 33	
33[a]	The system of claim 32, further comprising: an interfacing mechanism, the interfacing mechanism including:
33[b]	a network adapter, configured to transmit and receive electronic information through both wired and wireless communication; and
33[c]	at least one input mechanism, configured to: manipulate the interfacing mechanism; and
33[d]	vary the output of the at least one output device.
Claim 34	
34	The system of claim 32, wherein the sound sensing mechanism is selected from the group consisting of: an omnidirectional transducer, an ultrasonic transducer, an infrasonic transducer, and a microwave transducer.
Claim 35	
35	The system of claim 32, wherein the sensed energy includes infrasonic or ultrasonic soundwaves.

Claim 36	
36	The system of claim 32, wherein the predetermined threshold equates to a frequency or an amplitude determined to pose a risk of harm to a user's hearing capabilities.
Claim 37	
37	The system of claim 32, wherein the computer-executable instructions further include steps selected from the group consisting of: panning the sensed energy; and equalizing the sensed energy.
Claim 38	
38	The system of claim 32, further comprising: an in-ear device, wherein an audio output of the in-ear device auto-adjusts based on signal energy sensed within a cluster or surrounding clusters.
Claim 39	
39[pre]	A system comprising:
39[a]	at least one cluster of at least one computing device,
39[b]	the at least one computing device including:
39[b][i]	a sound sensing mechanism, configured to: detect a sensed energy, wherein the sensed energy comprises one or more sounds; and monitor one or more parameters selected from the group of (i) an amplitude of the one or more sounds and (ii) a frequency of the one or more sounds; and
39[b][ii]	a wireless transceiver; and
39[c]	at least one output device, including:

39[c][i]	a power source for operating the output device;
39[c][ii]	a speaker for outputting sound; and
39[c][iii]	a communication mechanism,
39[d]	wherein the at least one computing device further comprises: a memory, containing computer-executable instructions for connecting to the at least one cluster and varying an output of the at least one output device; and
39[e]	a processor, for executing the computer-executable instructions, wherein the computer-executable instructions include:
39[e][i]	determining if at least one of the monitored one or more parameters falls outside of a predetermined threshold;
39[e][ii]	if at least one of the monitored one or more parameters falls outside of the predetermined threshold, altering one or more of the one or more sounds so that at least one of the monitored one or more parameters does not fall outside of the predetermined threshold; and
39[e][iii]	outputting the one or more sounds on the at least one output device.
Claim 40	
40	The system of claim 39, wherein the sensed energy originates from an environment or from an in-ear device paired with the system.
Claim 41	
41	The system of claim 39, wherein an alert comprises an audio alert.

Claim 42	
42	The system of claim 41, wherein the alert comprises at least one of an audio alert and a visual alert.
Claim 43	
43	The system of claim 39, wherein at least one output device comprises a smart speaker.
Claim 44	
44	The system of claim 39, wherein the at least one output device comprises an infotainment system of a vehicle.

VIII. OVERVIEW OF THE PRIOR ART

48. I first note that the prior art references analyzed in the grounds below are analogous to the '016 patent because they are within the same field of endeavor and are reasonably pertinent to one or more problems addressed by the '016 patent. For example, the '016 patent describes a problem with exposure to loud sounds, that “[l]oud noises can often lead to stress and hearing loss.” Ex. 1001 ('016 patent), 9:7-11. One of the aims of the '016 patent is to “provide[] for a mobile cluster-based apparatus that analyzes, reports, and controls outputs based on a range of inputs over a swath of frequency bands, with distinct applications including sound output control, ... detection and reporting.” *Id.*, 10:4-10. The '016 patent discloses an in-ear embodiment of a system providing this capability.

In yet another preferred embodiment, various **in-ear systems** may be integrated into the present invention, software-defined and/or cognitive-defined based in-ear transceivers can be used to wirelessly communicate with an audio control source and thus, **the output of such an in-ear monitor can be autonomously adjusted after sensing audio output. A given output can be adjusted according to what is sensed** within specified location or what is sensed at external clusters. Similarly, to a software-defined and/or cognitive-defined based in-ear transceivers, an in-ear monitor system for use with the present invention will preferably comprise hardware such as, earphones, at least one body pack receiver, at least one mixer and at least one transmitter. These functions can also be adjusted and controlled via the audio control source of the present invention.²

Id., 8:48-62.

49. In my opinion, a person of ordinary skill in the art would have recognized that both *Goldstein873* and *Newham* are analogous art. One reason is that both are directed to earpieces.

50. For example, like the '016 patent, *Goldstein873* is directed to a system comprising earpieces for generating a personalized hearing experience.

² I added all **bold/italics/color** emphases and annotations unless I note otherwise.

Although some headphones have electronic circuitry and software to limit the level of audio delivered to the ear, they are not generally well received by the public as a result. Moreover, they do not take into account the person's environment or the person's hearing sensitivity. A need therefore exists for **enhancing the user's audible experience while preserving their hearing acuity in their own environment.**

Ex. 1005 (*Goldstein873*), [0005]; *see also id.*, [0006] (“Embodiments in accordance with the present provide a method and device for **personalized hearing.**”).

51. *Goldstein873*'s earpiece monitors the environment for sound signature matches.

The earpiece 100 can **continually monitor the environment for warning sounds**, or monitor the environment on a scheduled basis. In one arrangement, the earpiece 100 can increase monitoring in the presence of high ambient noise possibly signifying environmental danger or activity. The processor 206 can analyze each frame of captured ambient noise for features, compare the features with reference sounds in the database, and identify probable sound signature matches. If at step 716, a sound signature of a warning sound is detected in the ambient sound, the processor at step 718 can selectively attenuate at least a portion of the audio content, or amplify the warning sound. For example, spectral bands of the

audio content that mask the warning sound can be suppressed to increase an audibility of the warning sound.

Id., [0066].

52. Similarly, *Newham* is directed to a technique for balancing power consumption between wireless nodes by switching master-slave roles. Ex. 1006 (*Newham*), [0003]-[0004]. *Newham* discloses the wireless nodes may be headphones.

The terms “mobile device,” “**wireless node**” and “receiver device” are used interchangeably herein to refer to any one or all of cellular telephones, smartphones, personal or mobile multi-media players, watches, wrist displays, medical devices, **headsets**, **headphones**, speakers, microphones, and/or **any electronic device that includes circuitry for wirelessly sending and/or receiving information**.

Id., [0023].

53. *Brulle*, *Chaudhri*, *Smith*, and *Goldstein*⁸⁶⁴ are also analogous to the '016 patent. For example, *Brulle* is directed to a system that “flexibly delivers audio and video to vehicle passengers based on passenger preferences.” Ex. 1007 (*Brulle*), [0008]. *Brulle* discloses the system “may transmit to wireless headphones, hearing aids with a telecoil, or to other wireless devices.” *Id.*, [0035]. *Chaudhri* is directed to providing an audio file interface for a mobile device. Ex. 1008

(*Chaudhri*), [0004]. *Smith* is directed to an earpiece providing hearing enhancement and protection that may be adjusted or fine-tuned substantially in real time based, for example, on user selection of the types of noise to be attenuated and the corresponding level of attenuation. *See, e.g.,* Ex. 1009 (*Smith*), [0082], [0085], [0088]-[0089]. *Goldstein864* is directed to “an earpiece that monitors acoustic sound pressure level dose received by a user’s ear.” Ex. 1010 (*Goldstein864*), 1:12-15.

A. *Goldstein873* (Ex. 1005)

54. *Goldstein873* is generally directed to “an earpiece and method of operating an earpiece that monitors and safely adjusts audio delivered to a user’s ear.” Ex. 1005 (*Goldstein873*), [0002]. *Goldstein873* discloses an earpiece 100 that includes “an Ambient Sound Microphone (ASM) 110 to capture ambient sound, an Ear Canal Receiver (ECR) 120 to deliver audio to an ear canal 140, and an ear canal microphone (ECM) 130 to assess a sound exposure level within the ear canal.” *Id.*, [0024].

55. *Goldstein873* also discloses that the earpiece 100 further includes “a processor 206 operatively coupled to the ASM 110, ECR 120, ECM 130.” *Id.*, [0027]. *Goldstein873* discloses that earpiece 100 can “include an audio interface 212 operatively coupled to the processor 206 to receive audio content, for example from a media player.” *Id.*, [0029]. *Goldstein873* further discloses “a transceiver 204 that can support singly or in combination any number of wireless access technologies

including without limitation Bluetooth™, Wireless Fidelity (WiFi), Worldwide Interoperability for Microwave Access (WiMAX), and/or other short or long range communication protocol.” *Id.*, [0028].

56. *Goldstein873* explains that harmful noises exist in their environment and that this can cause hearing loss.

On a daily basis, people are exposed to potentially harmful noises in their environment, such as the sounds from television, traffic, construction, radio, and industrial appliances. Normally, people hear these sounds at safe levels that do not affect their hearing. However, **when people are exposed to harmful noises that are too loud or of prolonged duration**, hair cells in the inner ear can be damaged, causing **noise-induced hearing loss (NIHL)**. The hair cells are small sensory cells in the inner ear that convert sound energy into electrical signals that travel to the auditory processing centers of the brain. Once damaged, the hair cells cannot grow back. NIHL can be **caused by a one-time exposure to an intense impulse or burst sound**, such as an alarm, or **by continuous exposure to loud sounds over an extended period of time**.

Id., [0003].

57. *Goldstein873* explains that processor 206 can produce “audio from at least in part the ambient sound captured by the ASM 110, and actively monitor the

sound exposure level inside the ear canal 140” and “adjust the audio in the ear canal 140 to within a safe and subjectively optimized listening level range” in response “to monitoring the sound exposure level.” *Id.*, [0027].

B. *Newham* (Ex. 1006)

58. *Newham* is generally directed to “intelligently and dynamically [swapping] master/slave roles among wireless nodes (e.g., wireless earpieces) coupled to a wireless source device to optimize battery life in both wireless nodes.” Ex. 1006 (*Newham*), Abstract. *Newham* discloses that composite electronic devices are becoming more common and require wireless communication with multiple components.

As mobile device and wireless technologies continue to improve and grow in popularity, short-range wireless technologies are expected to supplant or replace the need for connecting devices together using cables or wires. As part of this evolution, **composite electronic devices made up of multiple independent wireless-enabled devices are beginning to emerge**, and it is **becoming more common for individual electronic components to require wireless communications with multiple components/devices**. Such communications may have a **disproportionate impact on the battery life of each constituent component in a composite electronic device**, and **distributing the energy consumption costs**

amongst constituent components of a composite electronic device may become an important and challenging design criterion.

Id., [0025].

59. This, according to *Newham* is of particular concern for “smaller components (e.g., headphone speakers) that have size or weight limits that prevent them from including larger and more powerful batteries,” for which “extensive use of RF radios may quickly deplete the component’s battery and cause the entire composite electronic device to become unusable.” *Id.*, [0026].

60. *Newham* discloses components of a composite electronic device.

FIG. 1 is a component block diagram illustrating an example composite electronic device 100 suitable for use with the various embodiments. The **composite electronic device 100 may include a first earpiece 102, a second earpiece 104, and a wrist display 106, each of which may be independently Bluetooth®-enabled.** Each component 102, 104, 106 may be individually paired to each of the other components via wireless communication links/pairings 116. These links/pairings 116 may be established at the factory so that the user perceives the composite electronic device 100 as a single component. In some embodiments, **the first earpiece 102 may be a left earpiece, and the second earpiece 104 may be a right earpiece.** In some embodiments, **the first earpiece 102**

**may be a right earpiece, and the second earpiece 104
may be a left earpiece.**

Id., [0041].

61. *Newham* also discloses that each of earpiece 102 and 104 “may include a speaker for generating sounds based on audio signals received from the wrist display 106, another earpiece 104, 102, or a third-party device (e.g., phone).” *Id.*, [0042]. *Newham* similarly discloses another embodiment that includes paired earpieces 206 and 208, and that “[i]n some embodiments, the phone 204 or wrist display 210 ... transmit the audio and/or control streams to the first earpiece 206, which may receive the wireless transmission and transmit a second stream to the second earpiece 208.” *Id.*, [0046].

62. *Newham* explains that, “[i]n such embodiments, the first earpiece 206, by operating as the master device, may both send and receive information in such streams, which may cause the first earpiece 206 to deplete its battery faster than the slave devices (e.g., second earpiece 208).” *Id.* *Newham* also explains that the reason for different power usage is due to the earpieces 206, 208 having asymmetrical roles, which “may result in the master device performing operations that consume a different amount of energy than the operations performed by the slave devices, causing one device to deplete its battery faster than the others.” *Id.*, [0040]. To compensate for this disparate battery depletion, *Newham* discloses that “the

earpieces 206, 208 may cooperate to dynamically swap master and slave roles in a manner that balances the load on each earpiece's battery." *Id.*, [0047].

IX. CLAIM CONSTRUCTION

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

X. SPECIFIC GROUNDS FOR CHALLENGE

64. In the sections below, I explain in detail how claims 32-44 of the '016 patent are obvious in view of the prior art. More particularly:

65. **Ground 1A** challenges claims 39-43 as obvious over the combination of *Goldstein873* and *Newham*.

66. **Ground 1B** challenges claim 44 as obvious over the combination of *Goldstein873*, *Newham*, and *Brulle*.

67. **Ground 2A** challenges claims 32, 33, and 36-38 as obvious over the combination of *Goldstein873*, *Newham*, and *Chaudhri*.

68. **Ground 2B** challenges claims 34 and 35 as obvious over the combination of *Goldstein873*, *Newham*, *Chaudhri*, and *Smith*.

A. Ground 1A: *Goldstein873* and *Newham* Render Obvious Claims 39-43

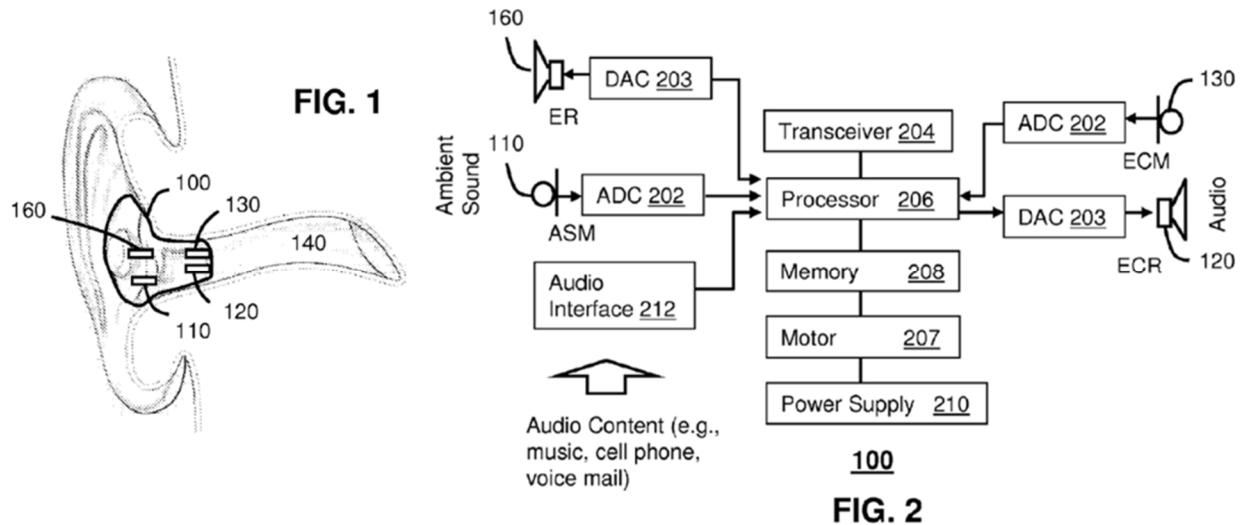
1. Claim 39

a. “A system comprising:”

69. I understand “[a] system comprising” is the preamble to claim 39. I have been asked to assume that the preamble is a claim limitation. Under that assumption, in my opinion, *Goldstein873* teaches this feature.³

70. *Goldstein873* discloses an earpiece 100 that “includes an Ambient Sound Microphone (ASM) 110 to capture ambient sound, an Ear Canal Receiver (ECR) 120 to deliver audio to an ear canal 140, and an ear canal microphone (ECM) 130 to assess a sound exposure level within the ear canal.” Ex. 1005 (*Goldstein873*), [0024]. Figures 1 and 2 of *Goldstein873* (reproduced below) depict earpiece 100 and its internal component blocks.

³ I use the term “teaches” to refer to both express teachings or those that, in my opinion, are fairly suggested to a person of ordinary skill in the art.



Ex. 1005 (*Goldstein873*), FIGs. 1, 2

71. *Goldstein873* discloses that the earpiece 100 can represent “a single operational device or a family of devices configured in a master-slave arrangement, for example, a mobile device and an earpiece,” and that “the components of the earpiece 100 can be reused in different form factors for the master and slave devices.” *Id.*, [0030]. *Goldstein873* further discloses that the earpiece 100 “can be connected via a wired connection to the media player, or via a wireless connection (e.g. Bluetooth),” including “a portable music player, a cell phone, a radio, a laptop, or any other mobile communication device.” *Id.*, [0054].

72. Accordingly, *Goldstein873* teaches an earpiece 100 (including its components) communicatively coupled to a mobile communication device (“a system”).

b. “at least one cluster of at least one computing device,”

73. In my opinion, *Goldstein873* teaches this feature.

74. *Goldstein873* discloses the earpiece 100 includes a processor 206 that can “utilize computing technologies” such as a digital signal processor (DSP).

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 further include **a processor 206 operatively coupled to the ASM 110, ECR 120, ECM 130, and ER 160** via one or more Analog to Digital Converters (ADC) 202 and Digital to Analog Converters (DAC) 203. **The processor 206 can produce audio from at least in part the ambient sound captured by the ASM 110, and actively monitor the sound exposure level inside the ear canal 140.** The processor responsive to monitoring the sound exposure level can adjust the audio in the ear canal 140 to within a safe and subjectively optimized listening level range. **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 a Flash, ROM, RAM, SRAM, DRAM or other like technologies **for controlling operations of the earpiece device 100.**

Ex. 1005 (*Goldstein873*), [0027].

75. In addition to *Goldstein873*'s express disclosure, a person of ordinary skill in the art would also have understood that an earpiece device that includes a processor comprises a "computing device." By September 2014, a person of ordinary skill in the art would have understood that a computer was "[a]ny device capable of processing information to produce a desired result." Ex. 1016 (*Computer Dictionary*), 3 (definition of "computer"). A person of ordinary skill in the art would have also recognized that computers may use integrated circuits. *Id.* (disclosing computers "in which **integrated circuits** replaced transistors.").⁴ A person of ordinary skill in the art would have further understood that "computers typically perform their work in three well-defined steps: (1) accepting input, (2) processing the input according to predefined rules (programs), and (3) producing output." *Id.*

76. By September 2014, a person of ordinary skill in the art would have also understood that DSPs were "[a]n **integrated circuit** designed for high-speed data manipulation and used in audio, communications, image manipulation, and other data acquisition and data control applications." *Id.*, 4. In my opinion, a person of ordinary skill in the art would have therefore considered *Goldstein873*'s earpiece 100 with a DSP to comprise a computing device. *See also* Ex. 1017 (*Oshana*), 7

⁴ I rely on *Computer Dictionary* to demonstrate the knowledge of a person of ordinary skill in the art. It is not part of the unpatentability ground.

("[A]n embedded system is a specialized computer system that is integrated as part of a larger system. Many embedded systems are implemented using digital signal processors.")⁵

77. *Goldstein873* also discloses a method for conducting a listening test (e.g., method 300) and a method for audio adjustment using sound pressure level (SPL) dose (e.g., method 600), each implemented by earpiece 100. *See* Ex. 1005 (*Goldstein873*), [0032] ("The method 300 for conducting a listening test can start at step 302 at which the earpiece 100 is inserted in user's ear."), [0043] ("The method 600 can begin in a state wherein the earpiece 100 is inserted in the ear canal and activated."). *Goldstein873* explains that both methods "can be implemented in a single earpiece, **a pair of earpieces**, or headphones." *Id.*, [0031], [0042]. As I discussed in §X.A.1.a, *Goldstein873* discloses the earpieces communicatively connected to, for example, a cell phone or other mobile communication device.

78. Accordingly, *Goldstein873* teaches a pair of earpieces communicatively connected to a mobile communication device ("at least one cluster") including at least a first earpiece 100 having a processor 206 utilizing

⁵ I rely on *Oshana* to demonstrate the knowledge of a person of ordinary skill in the art. It is not part of the unpatentability ground.

computing technologies such as a microprocessor, ASIC, and/or DSP (“of at least one computing device”).

c. “the at least one computing device including:

- (i) “a sound sensing mechanism, configured to detect a sensed energy, wherein the sensed energy comprises one or more sounds; monitor one or more parameters selected from the group of (i) an amplitude of the one or more sounds and (ii) a frequency of the one or more sounds;”**

79. In my opinion, *Goldstein873* teaches this feature.

80. *Goldstein873* discloses that “[e]arpiece 100 includes an Ambient Sound Microphone (ASM) 110 to capture ambient sound, an Ear Canal Receiver (ECR) 120 to deliver audio to an ear canal 140, and an ear canal microphone (ECM) 130 to assess a sound exposure level within the ear canal.” Ex. 1005 (*Goldstein873*), [0024]. *Goldstein873* also discloses that “processor 206 [is] operatively coupled to the ASM 110, ECR 120, ECM 130, and ER 160” *Id.*, [0027].

81. *Goldstein873* explains that “the ASM 110 captures ambient sound in the environment,” and that the “[a]mbient sound can correspond to environmental noise such as wind noise, traffic, car noise, or other sounds including alarms and warning cues.” *Id.*, [0043].

82. Accordingly, *Goldstein873* teaches earpiece 100 including an ASM 110 (“a sound sensing mechanism”) to capture ambient sound (“configured to detect

a sensed energy”) corresponding to environmental noise such as wind noise, traffic, car noise, or other sounds including alarms and warning cues (“wherein the sensed energy comprises one or more sounds”).

83. *Goldstein873* also explains that “the ECM 130 captures sound exposure level in the ear canal 140 attributed at least in part to pass-through ambient sound (e.g. residual ambient sound) and the filtered audio.” *Id.*, [0044].

84. Accordingly, *Goldstein873* also teaches earpiece 100 including an ECM 130 (“a sound sensing mechanism”) to detect sound exposure levels within the ear canal 140 (“configured to detect a sensed energy”) corresponding to pass-through ambient sound and filtered audio (“wherein the sensed energy comprises one or more sounds”).

85. Thus, in my opinion, a person of ordinary skill in the art would have understood *Goldstein873* to disclose earpiece 100 including an ASM 110 and an ECM 130 and that either the ASM 110 or the ECM 130 teaches the claimed sound sensing mechanism.

86. *Goldstein873* also discloses that “earpiece 100 can actively monitor a sound pressure level both inside and outside an ear canal” *Id.*, [0025]. *Goldstein873* explains that “ASM 110 of the earpiece 100 can **capture ambient sound levels** within the environment of the user, thereby permitting the processor 206 to monitor ambient sound within the environment while delivering audio

content.” *Id.*, [0055]. As I noted previously, *Goldstein873* also discloses that “the ECM 130 captures sound exposure level in the ear canal 140.” *Id.*, [0044].

87. Accordingly, a person of ordinary skill in the art would have recognized that *Goldstein873*’s earpiece 100 would monitor sound pressure levels both inside and outside an ear canal based on sound exposure levels captured by ECM 130 and ambient sound levels captured by ASM 110, respectively.

88. A person of ordinary skill in the art would also have understood ASM 110 and ECM 130 monitoring sound pressure levels to comprise monitoring an amplitude of the ambient sounds and the sounds within the ear canal, respectively. For example, while *Goldstein873* does not expressly disclose a formula for determining a sound pressure level (SPL), in my opinion, SPL is a well-understood term in the art and is based on an amplitude of a sound wave. *Goldstein864* is an example of a reference known to person of ordinary skill in the art that explains the formula for SPL:⁶

⁶ I rely on *Goldstein864* to demonstrate the knowledge of a person of ordinary skill in the art. It is not part of the unpatentability ground.

$$SPL = \beta(\text{dB}) = 10 \log \frac{I}{I_0} = 10 \log \frac{\Delta P^2}{\Delta P_0^2}$$

Ex. 1010 (*Goldstein864*), EQ. 1

89. As *Goldstein864* demonstrates, a person of ordinary skill in the art would have known that in the formula representing SPL, P_0 is a reference pressure, and “ ΔP is the root mean squared pressure amplitude in a measured pressure wave (e.g., using a transducer).” Ex. 1010 (*Goldstein864*), 8:49-53. A person of ordinary skill in the art would thus have understood SPL to be a function of amplitude (i.e., the root mean squared pressure amplitude in a measured pressure wave) captured using a transducer (such as ASM 110 or ECM 130). Because SPL is a well-understood and well-defined concept in the art, it is my opinion that a person of ordinary skill in the art would have understood that, for *Goldstein873*’s earpiece 100 to “actively monitor a sound pressure level both inside and outside an ear canal” (Ex. 1005 (*Goldstein873*), [0025]), ASM 110 capturing ambient sound levels would include capturing an amplitude of the ambient sound in the environment, and ECM 130 capturing sound exposure levels in ear canal 140 would include capturing an amplitude of the sounds in ear canal 140.

90. Accordingly, *Goldstein873* teaches that ASM 110 captures an amplitude of the ambient sounds in the environment (“monitor ... (i) an amplitude of the one or more sounds ...”) and that ECM captures an amplitude of sounds in ear canal 140 (“monitor ... (i) an amplitude of the one or more sounds ...”) to enable processor 206 to monitor sound pressure levels both outside and inside the ear canal.

(ii) “a wireless transceiver; and”

91. In my opinion, *Goldstein873* teaches this feature.

92. *Goldstein873* discloses earpiece 100 including “a transceiver 204 that can support singly or in combination any number of wireless access technologies” Ex. 1005 (*Goldstein873*), [0028].

93. Accordingly, *Goldstein873* teaches a transceiver supporting wireless access technologies (“a wireless transceiver”).

d. “at least one output device, including:”

94. In my opinion, *Goldstein873* in combination with *Newham* teaches this feature.

95. As I discussed in §X.A.1.b, a person of ordinary skill in the art would have understood *Goldstein873* to disclose a pair of earpieces including at least a first earpiece 100 having a processor 206. *Goldstein873* also discloses that earpiece 100 can represent “a single operational device or a family of devices configured in a master-slave arrangement, for example, a mobile device and an earpiece,” and that

“the components of the earpiece 100 can be reused in different form factors for the master and slave devices.” Ex. 1005 (*Goldstein873*), [0030].

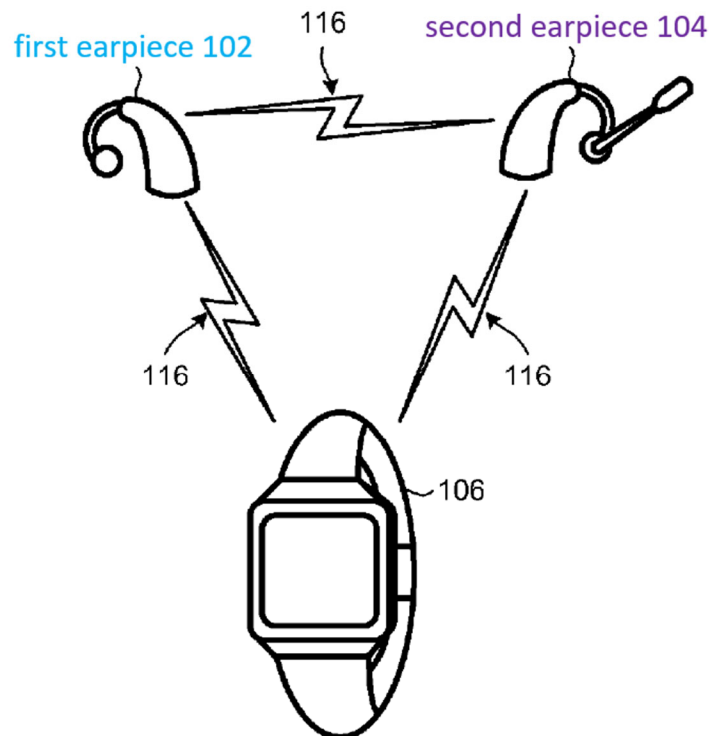
96. A person of ordinary skill in the art would have understood that *Goldstein873*’s example of the earpiece 100 being in a master-slave relationship with a mobile device was exactly that—only an example. In my opinion, a person of ordinary skill in the art would have understood *Goldstein873*’s disclosure to encompass earpiece 100 being in a master-slave arrangement with any number of other devices, including the other earpiece in the pair of earpieces contemplated by *Goldstein873*. Indeed, as I discuss below with respect to *Newham*, arranging an earpiece in a master-slave relationship with another earpiece was a commonly known configuration of “a family of devices configured in a master-slave arrangement.”

97. *Goldstein873*, however, does not focus on the implementation details relating to how the pair of earpieces contemplated by *Goldstein873* would operate in a master-slave arrangement. Thus, in my opinion, a person of ordinary skill in the art would have been motivated to look for additional information regarding how to implement *Goldstein873*’s pair of earpieces in a master-slave arrangement, and in so looking, would have readily identified *Newham*.

98. *Newham* is generally directed to “intelligently and dynamically [swapping] master/slave roles among wireless nodes (e.g., wireless earpieces)

coupled to a wireless source device to optimize battery life in both wireless nodes.”

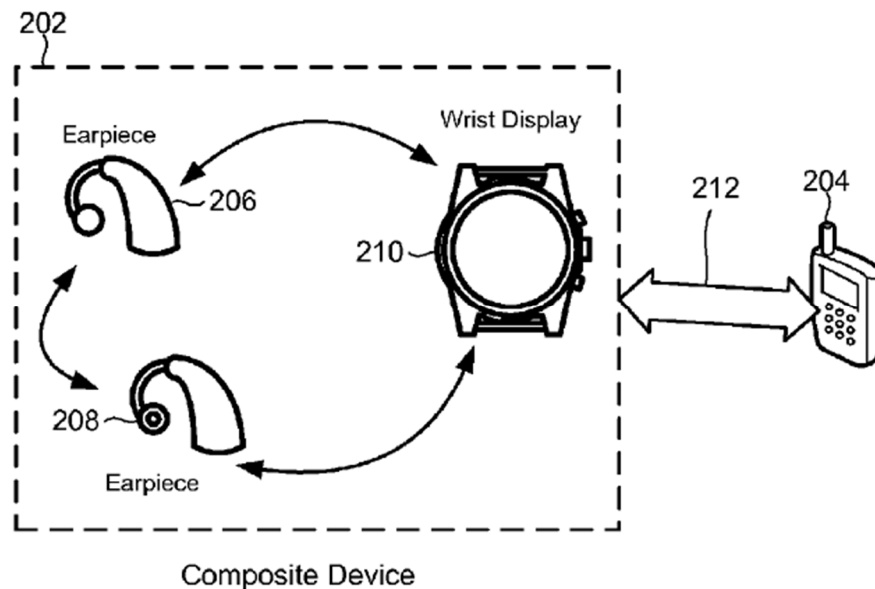
Ex. 1006 (*Newham*), Abstract. *Newham* discloses a “composite electronic device 100” that includes “a first earpiece 102, a second earpiece 104, and a wrist display 106, each of which may be independently Bluetooth ®-enabled.” *Id.*, [0041]. With respect to figure 1 (reproduced below), *Newham* explains that “the **first earpiece 102** may be a left earpiece, and the **second earpiece 104** may be a right earpiece,” or vice versa.



Ex. 1006 (*Newham*), FIG. 1 (annotated)

99. *Newham* explains that each earpiece 102 and 104 may “include a speaker for generating sounds based on audio signals received from the wrist display 106, another earpiece 104, 102, or a third-party device (e.g., phone).” *Id.*, [0042].

Newham also explains how such devices may be coupled together with respect to a configuration 200 depicted in figure 2 (reproduced below), comprising earpieces 206 and 208. *See id.*, [0045] (“FIG. 2 is a block diagram illustrating example wireless links and components in a configuration 200 suitable for implementing the various embodiments.”)



Ex. 1006 (*Newham*), FIG. 2

100. *Newham* further discloses that “[i]n some embodiments, the phone 204 or wrist display 210 may ... transmit the audio and/or control streams to the first earpiece 206, which may receive the wireless transmission and transmit a second stream to the second earpiece 208.” *Id.*, [0046]; *see also id.*, [0042] (“Each earpiece 102, 104 may include a speaker for generating sounds based on audio signals received from the wrist display 106, another earpiece 104, 102, or a third-party

device (e.g., phone).”). Thus, in my opinion, a person of ordinary skill in the art would have understood *Newham*’s disclosure to encompass the second earpiece (slave device) outputting an audio stream received from the first earpiece (master device).

101. *Newham* explains that “[i]n such embodiments, the first earpiece 206, by operating as the master device, may both send and receive information in such streams, which may cause the first earpiece 206 to deplete its battery faster than the slave devices (e.g., second earpiece 208).” *Id.*, [0046]. *Newham* further explains that the reason for different power usage is due to the “[m]aster and slave devices [having] asymmetrical roles.” *Id.*, [0040]. And so, the “asymmetrical roles may result in the master device performing operations that consume a different amount of energy than the operations performed by the slave devices, causing one device to deplete its battery faster than the others.” *Id.*

102. To compensate for this disparate battery depletion, *Newham* discloses that “the earpieces 206, 208 may cooperate to dynamically swap master and slave roles in a manner that balances the load on each earpiece’s battery.” *Id.*, [0047]. And to do so, *Newham* describes each earpiece including a processor within the device to implement various aspects of the method. *See, e.g., id.*, [0053] (“FIG. 3A illustrates an embodiment method 300 for dynamically swapping master and slave roles to balance the load on each wireless node device’s battery. The operations in method

300 and also methods 350, 400A, 400B, 400C, which are described below, may be accomplished by processors within wireless nodes or devices (e.g., left earpiece, right earpiece, wrist display, phone or combination thereof) configured with processor-executable instructions implementing the method, so references to each wireless node or device encompass the processor within the node or device.”).

103. In my opinion, a person of ordinary skill in the art would have appreciated that *Newham* describes a master-slave arrangement for a pair of earpieces as contemplated by *Goldstein*⁸⁷³. A person of ordinary skill in the art would have further recognized that *Newham* provides additional details regarding how to implement this master-slave arrangement to “dynamically swap master and slave roles in a manner that balances the load on each earpiece’s battery.” *Id.*, [0047].

104. Moreover, *Goldstein*⁸⁷³ already discloses an earpiece having a processor, a microphone, a speaker (and other components) similar in structure to *Newham*’s earpieces. Ex. 1005 (*Goldstein*⁸⁷³), [0024], [0027] (describing earpiece 100 including an Ambient Sound Microphone (ASM) 110, an Ear Canal Receiver (ECR) 120 to deliver audio to an ear canal 140, an ear canal microphone (ECM) 130, and a processor 206 operatively coupled to the ASM 110, ECR 120, and ECM 130), [0029] (also describing earpiece 100 as including a power supply 210 “for supplying energy to the components of the earpiece 100”); Ex. 1006 (*Newham*), [0064] (describing *Newham*’s wireless earpiece as including one or more physical buttons,

a speaker, and a microphone, all coupled to a processor, as well as a battery). To the extent that Patent Owner argues and the Board finds that *Goldstein873* does not disclose its pair of earpieces being identical in structure, it would have been obvious to a person of ordinary skill in the art to implement *Goldstein873*'s earpieces sufficiently similarly—e.g., each at least having a processor, a transceiver, a microphone, a speaker, and a power supply (e.g., a battery)—to enable the earpieces to be configured in a master-slave arrangement as taught by *Newham* so as to enable each earpiece to interchangeably operate as either a master device or a slave device. Thus, in my opinion, a person of ordinary skill in the art would have understood the *Goldstein873-Newham* combination to teach a pair of earpieces each comprising all the structure and functionality of *Goldstein873*'s earpiece 100.

105. A person of ordinary skill in the art would also have found the combination obvious because it would have amounted to the mere application of a known technique (dynamically swapping master and slave roles in a manner that balances the load on each earpiece's battery as taught by *Newham*) in similar devices (*Goldstein873*'s pair of earpieces) to obtain predictable results (to implement *Goldstein873*'s pair of earpieces in a master-slave arrangement).

106. A person of ordinary skill in the art would also have had a reasonable expectation of success in applying *Newham*'s teachings in this regard to *Goldstein873*. *Goldstein873* and *Newham* both disclose earpiece systems that

support Bluetooth and may operate in a master-slave arrangement. Ex. 1006 (*Newham*), [0039]; Ex. 1005 (*Goldstein873*), [0028]. A person of ordinary skill in the art would also have found it obvious to modify *Goldstein873* to implement *Newham*'s teachings by simply programming two of *Goldstein873*'s earpiece 100 to dynamically swap master and slave roles, as described in *Newham*. Indeed, *Newham* discloses that each earpiece operating in its described master-slave arrangement as including, like *Goldstein873*'s earpiece 100, a speaker for generating sounds (Ex. 1006 (*Newham*), [0042]) and a processor (*id.*, [0053]). Thus, modifying *Goldstein873* to incorporate *Newham*'s teachings by programming two of *Goldstein873*'s earpiece 100 to dynamically swap master and slave roles would have been straightforward and well within a person of ordinary skill in the art's ordinary skill, as *Newham* confirms by implementing this functionality in a device like *Goldstein873*'s.

107. Accordingly, the *Goldstein873-Newham* combination teaches a pair of earpieces 100 including a second earpiece 100 having a speaker configured to operate as a slave device to output an audio stream received from the master device ("at least one output device").

(i) “a power source for operating the output device;”

108. In my opinion, *Goldstein873* in combination with *Newham* teaches this feature.

109. *Goldstein873* discloses that earpiece 100 includes “power supply 210” that “utilize[s] common power management technologies such as replaceable batteries ... for supplying energy to the components of the earpiece 100 and to facilitate portable applications.” Ex. 1005 (*Goldstein873*), [0029]. *Newham* discloses that its earpieces cooperate “to dynamically swap master and slave roles in a manner that balances the load **on each earpiece’s battery.**” Ex. 1006 (*Newham*), [0047]; *see also id.*, [0064] (“The wireless earpiece 600 may further include a battery 616 coupled to an inductive charging circuit 618, and a coil antenna 620 which may be an inductive coil adapted to enable inductive charging of the battery 616.”). It is therefore my opinion that, when implementing *Newham*’s teachings in *Goldstein873*, a person of ordinary skill in the art would have found it obvious that both of the pair of earpieces 100 would include a power supply 210 (such as *Newham*’s battery 616) so as to allow each earpiece to be useable in “an active powered on state.” Ex. 1005 (*Goldstein873*), [0054]; *see also* §X.A.1.d (discussing that it would have been obvious to implement *Goldstein873*’s earpieces sufficiently

similarly in the *Goldstein873-Newham* combination so as to enable each earpiece to interchangeably operate as either a master device or a slave device).

110. Accordingly, the *Goldstein873-Newham* combination teaches a pair of earpieces 100 including a second earpiece 100 having a power supply 210 (“a power source”) to supply energy to the components of earpiece 100 (“for operating the output device”).

(ii) “a speaker for outputting sound; and”

111. In my opinion, *Goldstein873* in combination with *Newham* teaches this feature.

112. *Goldstein873* discloses that the earpiece 100 includes an “Ear Canal Receiver (ECR) 120 to deliver audio to an ear canal 140.” Ex. 1005 (*Goldstein873*), [0024]; *see also id.*, [0043] (“The processor 206 can mix the audio content with the filtered sound to produce filtered audio. The ECR can then deliver at step 610 the filtered audio to the user’s ear canal.”). As *Goldstein873* discloses that the ECR **delivers** audio to a user’s ear canal, a person of ordinary skill in the art would have understood the ECR to be a speaker. A person of ordinary skill in the art would have understood it was common in the art to refer to an “ear canal receiver” as a “speaker.”

113. For example, *Usher* shares a common inventor with *Goldstein873*, Steven Goldstein. Ex. 1011 (*Usher*); Ex. 1005 (*Goldstein873*),. *Usher* discloses an earpiece with components substantially similar to those of *Goldstein873*’s earpiece.

Ex. 1011 (*Usher*), [0009] (“[A]n **earpiece** can include an Ambient Sound Microphone (**ASM**) configured to capture ambient sound, an Ear Canal Microphone (**ECM**) configured to capture internal sound in an ear canal, an Ear Canal Receiver (**ECR**) operatively coupled to the processor and configured to deliver audio content to the ear canal, and a **processor operatively coupled to the ASM, the ECM and the ECR.**”), [0031] (“Earpiece 100 includes an Ambient Sound Microphone (ASM) 111 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.”). With respect to the ECR, *Usher* discloses that “[a]s a result of this seal, the **ECR (speaker) 125** is able to generate a full range bass response when reproducing sounds for the user.” *Id.*, [0031]. It is therefore my opinion that a person of ordinary skill in the art would have understood that an ECR of an earpiece equates to a speaker, as *Usher* confirms.⁷

114. Accordingly, the *Goldstein*⁸⁷³-*Newham* combination teaches a pair of earpieces 100 including a second earpiece 100 having an ECR 120 (“a speaker”) to deliver audio to an ear canal 140 (“for outputting sound”).

⁷ I rely on *Usher* to demonstrate the knowledge of a person of ordinary skill in the art. It is not part of the unpatentability ground.

(iii) “a communication mechanism”

115. In my opinion, *Goldstein873* in combination with *Newham* teaches this feature.

116. As I discussed in §X.A.1.d, each earpiece of the *Goldstein873-Newham* combination includes a transceiver.

117. Accordingly, the *Goldstein873-Newham* combination teaches a pair of earpieces 100 including a second earpiece 100 having a transceiver supporting wireless access technologies (“a communication mechanism”).

e. “wherein the at least one computing device further comprises: a memory, containing computer-executable instructions for connecting to the at least one cluster and varying an output of the at least one output device;”

118. In my opinion, *Goldstein873* in combination with *Newham* teaches this feature.

119. *Goldstein873* discloses that earpiece 100 includes “a processor 206 operatively coupled to the ASM 110, ECR 120, ECM 130, and ER 160,” and that “processor 206 can utilize computing technologies such as a microprocessor, [ASIC], and/or digital signal processor (DSP) with associated **storage memory 208** such as Flash, ROM, RAM, SRAM, DRAM ... for controlling operations of the earpiece device 100.” Ex. 1005 (*Goldstein873*), [0027]. In my opinion, a person of ordinary skill in the art would have recognized that, for processor 206 to control operations of earpiece device 100, associated storage memory 208 would include

code or instructions executable by processor 206. For example, *Oshana* confirms that a person of ordinary skill in the art would have known that embedded systems could include processors with software or hardware functional blocks. *See* Ex. 1017 (*Oshana*), 7, 9-10. *Oshana* discloses that for processors with software functional blocks, “[b]ecause instructions are executed from memory in the CPU, device functions can be changed without having to reset the device.” *Id.*, 10. *Oshana* confirms that a DSP is a type of processor that supports software processing blocks. *Id.*; *see also id.*, 13 (“One of the big advantages of DSP is the programmability of the processor, which allows important system parameters to be changed easily to accommodate the application.”). It is therefore my opinion that a person of ordinary skill in the art would have understood that code or instructions executable by *Goldstein873*’s processor would exist in the associated storage memory to provide the earpiece device’s functions.

120. *Goldstein873* also discloses “a transceiver 204 that can support singly or in combination any number of wireless access technologies.” *Id.*, [0028]. Meanwhile, *Newham* explains that each of first earpiece 102 and second earpiece 104 are “independently Bluetooth®-enabled” and “individually paired to each of the other components via wireless communication links/pairings 116.” Ex. 1006 (*Newham*), [0041]; *see also id.*, [0034]-[0035] (describing the Bluetooth pairing process). Thus, in the *Goldstein873-Newham* combination, *Goldstein873*’s processor

206, executing code or instructions stored in associated storage memory 208, establishes a wireless communication link between the pair of *Goldstein873*'s earpieces 100. A person of ordinary skill in the art would also have understood that a first earpiece 100—operating as a master device—pairing with a second earpiece 100—operating as a slave device—would include processor 206 of first earpiece 100 establishing a wireless communication link with second earpiece 100.

121. *Goldstein873* also discloses that processor 206 “responsive to monitoring the sound exposure level can adjust the audio in the ear canal 140 to within a safe and subjectively optimized listening level range.” Ex. 1005 (*Goldstein873*), [0027]. For example, *Goldstein873* discloses that “processor 206 can measure and monitor noise levels in the ambient sound,” “selectively filter out the measured noise from the ambient sound,” and “mix the audio content with the filtered sound to produce filtered audio.” *Id.*, [0043]. *Goldstein873* discloses that the ECR delivers “the filtered audio to the user's ear canal.” *Id.* *Goldstein873* also discloses that “the processor 206 can adjust (e.g. decrease/increase) a level of the filtered sound” based on the user’s personalized hearing level. *Id.*, [0049].

122. Moreover, when implementing *Goldstein873*'s earpiece 100 as a pair of earpieces configured in a master-slave arrangement, as taught by *Newham*, a person of ordinary skill in the art would have understood a first earpiece 100 operating as the master device would cause the same audio to be provided via the

speakers of both the first earpiece 100 and the second earpiece 100 operating as a slave device. For example, *Newham* explains that, while master devices may perform various processing operations, “[s]lave devices, on the other hand, may only be responsible for monitoring or polling a port to receive information from the master device.” Ex. 1006 (*Newham*), [0040]. A person of ordinary skill in the art would thus have recognized that a second earpiece 100 operating as a slave device would not independently monitor sound exposure levels and adjust the audio in the ear canal accordingly. A person of ordinary skill in the art would therefore have recognized that the processor 206 of first earpiece 100 would similarly adjust (e.g., decrease/increase) a level of the filtered sound that is provided via both the first earpiece 100 and the second earpiece 100.

123. Accordingly, the *Goldstein*⁸⁷³-*Newham* combination teaches the first earpiece 100 (“the at least one computing device”) having storage memory 208 for controlling operations of the earpiece device 100 (“a memory, containing computer-executable instructions”), wherein the first earpiece 100 is configured to establish a wireless communication link with a second earpiece 100 (“for connecting to the at least one cluster”) and adjust a level of filtered ambient sound played by the second earpiece 100 (“and varying an output of the at least one output device”).

f. “a processor, for executing the computer-executable instructions, wherein the computer-executable instructions include:”

124. In my opinion, *Goldstein873* in combination with *Newham* teaches this feature.

125. *Goldstein873* discloses earpiece 100 having a processor 206 that “utilize[s] computing technologies such as a microprocessor, [ASIC], and/or digital signal processor (DSP) with associated storage memory 208 ... for controlling operations of the earpiece device 100.” Ex. 1005 (*Goldstein873*), [0027].

126. Accordingly, the *Goldstein873-Newham* combination teaches the first earpiece 100 (“the at least one computing device”) having a processor 206 coupled to storage memory 208 for controlling operations of earpiece 100 (“for executing the computer-executable instructions”).

127. Moreover, because, as I discussed here and in §X.A.1.e, *Goldstein873*’s processor 206 operates by executing code stored in storage memory 208, the *Goldstein873-Newham* combination teaches that when the code stored in storage memory 208 is executed by processor 206, the processor performs operations that meet the claim elements I discussed in §§X.A.1.f(i)-X.A.1.f(iii) and the dependent claims discussed below.

(i) “determining if at least one of the monitored one or more parameters falls outside of a predetermined threshold;”

128. In my opinion, *Goldstein873* in combination with *Newham* teaches this feature.

129. *Goldstein873* explains that “[d]uring intense Environmental Noise (above an Effective Quiet level), the SPL Dose will increase. During time periods of negligible environmental noise, the SPL Dose will decrease according to an Ear Recovery Function.” Ex. 1005 (*Goldstein873*), [0045]. *Goldstein873* discloses processor 206 determining whether “the filtered audio is less than the Effective Quiet Level,” and, if so, “the processor 206 can decrease the SPL dose in accordance with a decay rate (e.g. exponential).” *Id.*, [0047]; *see also id.*, FIG. 6 (steps 616, 618). To do so, *Goldstein873* discloses ECM 130 capturing a sound pressure level in the ear canal (*see id.*, FIG. 6 (step 612)) and processor 206 comparing that sound pressure level to the effective quiet level (*see id.*, FIG. 6 (step 616)). As I discussed in §X.A.1.c(i), in my opinion, a person of ordinary skill in the art would have understood sound pressure level to be a function of amplitude. Thus, for reasons I discussed in §X.A.1.c(i), in my opinion, a person of ordinary skill in the art would have understood ECM 130 capturing a sound pressure level would comprise capturing an amplitude of the filtered audio in the ear canal and converting that amplitude into a sound pressure level.

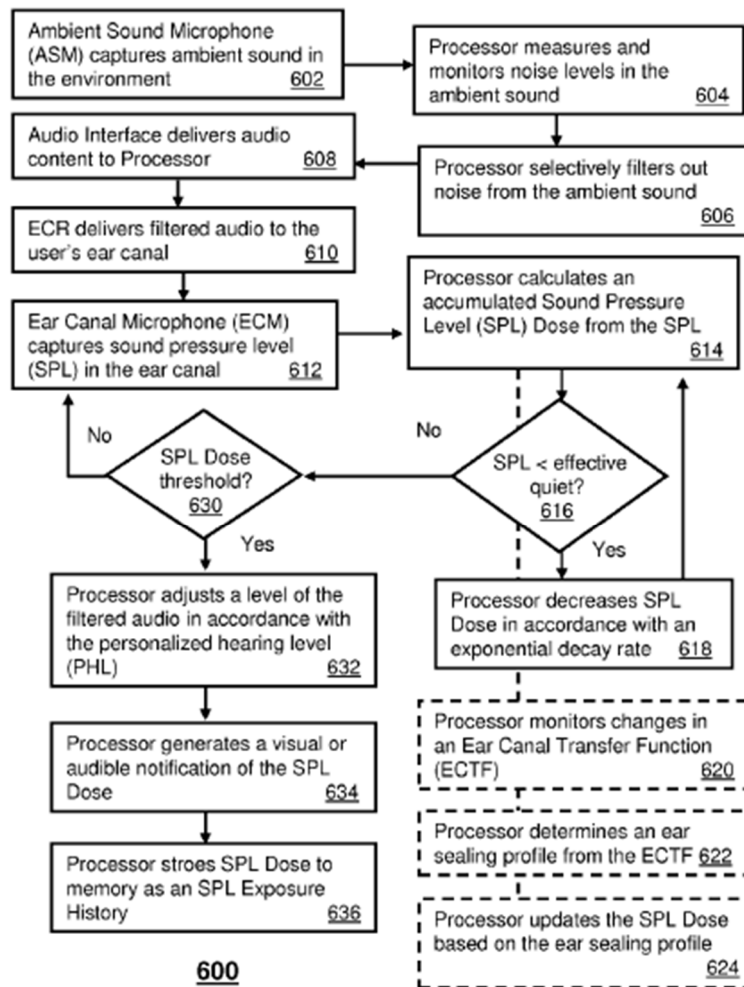


FIG. 6

Ex. 1005 (*Goldstein873*), FIG. 6

130. *Goldstein873* explains that the Effective Quiet level “can be defined as 74 dB SPL for the octave band centered at 4000 Hz, 78 dB SPL for the octave band centered at 2000 Hz, and 82 dB SPL for the octave bands centered at 500 Hz and 1000 Hz.” *Id.*, [0046]. *Goldstein873* explains that these numbers are “based on audiological research of growth and decay of temporary threshold shift (TTS), which is the temporary decrease in hearing sensitivity that arises from metabolic exhaustion

of the sensory cells of the inner ear from exposure to high levels of sound.” *Id.* *Goldstein873* also explains that “[s]ound exposure that results in a TTS is considered sufficient to eventually result in a permanent hearing loss.” *Id.*

131. A person of ordinary skill in the art would thus have understood *Goldstein873* to disclose the Effective Quiet level being a value predetermined based on audiological research. A person of ordinary skill in the art would also have understood *Goldstein873* discloses using the Effective Quiet level as a threshold indicator for intense environmental noise, exposure to which may eventually result in permanent hearing loss. Furthermore, in my opinion, a person of ordinary skill in the art would have understood *Goldstein873* to describe Effective Quiet level as a threshold sound pressure level. *See id.*, [0046] (“Effective Quiet can be defined as 74 dB SPL for the octave band centered at 4000 Hz, 78 dB SPL for the octave band centered at 2000 Hz, and 82 dB SPL for the octave bands centered at 500 Hz and 1000 Hz.”).

132. Accordingly, the *Goldstein873-Newham* combination teaches processor 206 determining whether a captured amplitude of a sound exceeds a predetermined value (“determining if at least one of the monitored one or more parameters falls outside of a predetermined threshold”) that causes a corresponding SPL to exceed the Effective Quiet level.

- (ii) **“if at least one of the monitored one or more parameters falls outside of the predetermined threshold, altering one or more of the one or more sounds so that at least one of the monitored one or more parameters does not fall outside of the predetermined threshold; and”**

133. In my opinion, *Goldstein873* in combination with *Newham* teaches this feature.

134. *Goldstein873* discloses that “the processor 206 can calculate a sound pressure level dose (SPL Dose) to quantify the sound exposure over time as it relates to sound exposure and sensorineural hearing loss.” Ex. 1005 (*Goldstein873*), [0044]. *Goldstein873* further discloses determining whether an SPL Dose threshold is exceeded. *See id.*, [0049], FIG. 6 (step 630). *Goldstein873* discloses that “[i]f the filtered sound exceeds the Effective Quiet level and the SPL Dose is not exceeded at step 630, the earpiece 100 can continue to monitor sound exposure level within the ear canal 140 at step 612 and update the SPL Dose.” *Id.*, [0049]. If, however, both are exceeded, *Goldstein873* discloses that “the processor 206 can adjust (e.g. decrease/increase) a level of the filtered sound” based on the user’s personalized hearing level. *Id.*

135. When adjusting the audio provided to the ear canal, *Goldstein873* discloses that “[t]he processor responsive to monitoring the sound exposure level can adjust the audio in the ear canal 140 to within a safe and subjectively optimized

listening level range.” *Id.*, [0027]; *see also id.*, [0050] (“[T]he processor 206 can make necessary gain adjustments to the reproduced audio content to ensure safe listening levels, and provide the earpiece 100 with ongoing information related to the accumulated SPL dose.”). As I discussed in §X.A.1.f(i), a person of ordinary skill in the art would have understood *Goldstein873* to disclose using the Effective Quiet level as a threshold indicator for intense environmental noise, exposure to which may eventually result in permanent hearing loss. Thus, to adjust the audio in the ear canal 140 to within a safe listening level range, a person of ordinary skill in the art would have understood *Goldstein873*’s earpiece 100 to adjust (e.g., decrease) a level of the filtered sound to a level below the Effective Quiet level. *See also Goldstein873*, claim 4 (describing selectively adjusting the audio based on the SPL Dose).

136. Accordingly, the *Goldstein873-Newham* combination teaches, responsive to determining that a captured amplitude of a sound exceeds a predetermined value (“if at least one of the monitored one or more parameters falls outside of the predetermined threshold”) that causes a corresponding SPL to exceed the Effective Quiet level and that an SPL Dose threshold has been exceeded, adjusting a level of the filtered sound delivered to the user’s ear canal by the ECR (“altering one or more of the one or more sounds”) and, in turn, the amplitude of the filtered sound to no longer exceed the predetermined value (“so that at least one of

the monitored one or more parameters does not fall outside of the predetermined threshold”) such that the corresponding SPL no longer exceeds the Effective Quiet level.

(iii) “outputting the one or more sounds on the at least one output device.”

137. In my opinion, *Goldstein873* in combination with *Newham* teaches this feature.

138. As I discussed in §§X.A.1.d and X.A.1.d(ii), the *Goldstein873-Newham* combination teaches a pair of earpieces 100 (“at least one cluster”) including a first earpiece 100 configured to operate as a master device (“of at least one computing device”) and a second earpiece 100 is configured to operate as a slave device (“at least one output device”), and that each of the pair of earpieces 100 would include an ECR 120 (“a speaker”) to deliver audio to an ear canal 140 (“for outputting sound”).

139. *Goldstein873* also discloses that processor 206 “responsive to monitoring the sound exposure level can adjust the audio in the ear canal 140 to within a safe and subjectively optimized listening level range.” Ex. 1005 (*Goldstein873*), [0027]. For example, *Goldstein873* discloses that “processor 206 can measure and monitor noise levels in the ambient sound,” “selectively filter out the measured noise from the ambient sound,” and “mix the audio content with the

filtered sound to produce filtered audio.” *Id.*, [0043]. *Goldstein873* discloses that the ECR delivers “the filtered audio to the user's ear canal.” *Id.* *Goldstein873* also discloses that “the processor 206 can adjust (e.g. decrease/increase) a level of the filtered sound” based on the user’s personalized hearing level. *Id.*, [0049]. For example, as I discussed in §X.A.1.f(ii), *Goldstein873* teaches that, responsive to determining that the filtered sound exceeds the Effective Quiet level and that an SPL Dose threshold has been exceeded, earpiece 100 adjusts (e.g., decreases) a level of the filtered sound to a level below the Effective Quiet level.

140. *Newham* also discloses that, when implementing its master-slave arrangement, audio and/or control streams may be transmitted to the first earpiece 102, “which may receive the wireless transmission and transmit a stream to the second earpiece 104.” Ex. 1006 (*Newham*), [0043]; *see also id.*, [0046] (“In some embodiments, the phone 204 or wrist display 210 may configured to transmit the audio and/or control streams to the first earpiece 206, which may receive the wireless transmission and transmit a second stream to the second earpiece 208.”). Thus, when implementing a master-slave arrangement as taught by *Newham*, a person of ordinary skill in the art would have understood processor 206 of the first earpiece operating as the master device to transmit the audio to the second earpiece 100 for delivering the audio to the ear canal via ECR 120 of second earpiece 100.

141. Accordingly, the *Goldstein873-Newham* combination teaches processor 206 of earpiece 100, responsive to determining that filtered sound exceeds the Effective Quiet level and that an SPL Dose threshold has been exceeded, adjusting the level of filtered sound and causing the filtered sound to be delivered to the ear canal of the user (“outputting the one or more sounds”) via the ECR of the second earpiece 100 (“on the at least one output device”).

2. Claim 40

a. “The system of claim 39, wherein the sensed energy originates from an environment or from an in-ear device paired with the system”

142. In my opinion, *Goldstein873* in combination with *Newham* teaches this claim.

143. *Goldstein873* discloses that “the ASM 110 captures ambient sound in the environment,” and that the “[a]mbient sound can correspond to environmental noise such as wind noise, traffic, car noise, or other sounds including alarms and warning cues.” *Goldstein873*, [0043]. *Goldstein873* further discloses that “the ECM 130 captures sound exposure level in the ear canal 140 attributed at least in part to pass-through ambient sound (e.g. residual ambient sound) and the filtered audio.” *Id.*, [0044]. *Goldstein873* also explains that the filtered audio may comprise audio content mixed with filtered ambient sound, and that the filtered audio is delivered to the ear canal 140 by ECR 120. *See id.*, [0043] (“The processor 206 can mix the audio

content with the filtered sound to produce filtered audio. The ECR can then deliver at step 610 the filtered audio to the user's ear canal."); *see also infra* §X.C.5 (discussing *Goldstein873*'s earpiece 100 teaching "an in-ear device").

144. Accordingly, the *Goldstein873-Newham* combination teaches earpiece 100 including an ASM 110 to capture ambient sound corresponding to environmental noise such as wind noise, traffic, car noise, or other sounds including alarms and warning cues ("wherein the sensed energy originates from an environment ...") and an ECM 130 to capture sound exposure levels attributed to pass-through ambient sound and filtered audio in the ear canal 140 ("or from an in-ear device paired with the system").

3. Claim 41

a. "The system of claim 39, wherein an alert comprises an audio alert."

145. In my opinion, *Goldstein873* in combination with *Newham* teaches this claim.

146. *Goldstein873* discloses that if "the filtered sound exceeds the Effective Quiet level, and the SPL Dose is exceeded at step 630, the processor 206 can adjust (e.g. decrease/increase) a level of the filtered sound" based on the user's personalized hearing level. Ex. 1005 (*Goldstein873*), [0049]. *Goldstein873* discloses that processor 206, upon determining that SPL Dose exceeds certain levels, "can

send a visual or audible warning indicating a first level SPL dose has been exceeded as shown in step 632.” *Id.*, [0051].

147. Accordingly, the *Goldstein873-Newham* combination teaches processor 206 sending an audible warning (“wherein an alert comprises an audio alert”) indicating a SPL Dose threshold has been exceeded.

4. Claim 42

a. “The system of claim 41, wherein the alert comprises at least one of an audio alert and a visual alert.”

148. In my opinion, *Goldstein873* in combination with *Newham* teaches this claim for the reasons I discussed in §X.A.3.

5. Claim 43

a. “The system of claim 39, wherein at least one output device comprises a smart speaker.”

149. In my opinion, *Goldstein873* in view of *Newham* teaches this claim.

150. As I discussed in §X.A.1.d, the *Goldstein873-Newham* combination teaches a pair of earpieces 100 (“at least one cluster”) including a first earpiece 100 configured to operate as a master device (“of at least one computing device”) and a second earpiece 100 is configured to operate as a slave device (“at least one output device”).

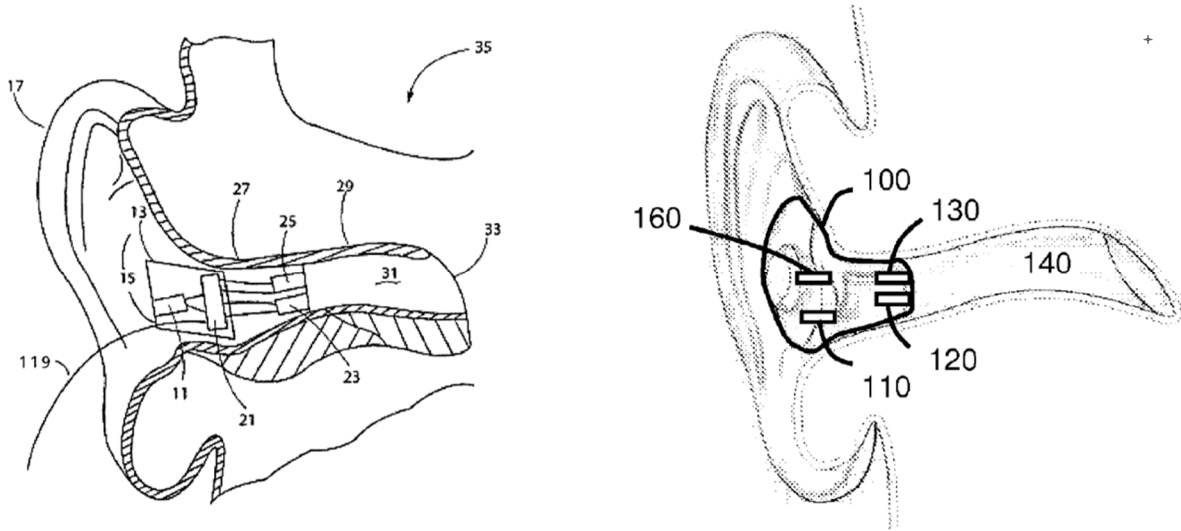
151. *Goldstein873* discloses that processor 206 of earpiece 100 “can utilize computing technologies such as a microprocessor, [ASIC], and/or digital signal

processor (DSP) with associated storage memory 208 ... for controlling operations of the earpiece device 100.” Ex. 1005 (*Goldstein873*), [0027]. Furthermore, *Goldstein873* discloses that “processor 206 can produce audio from at least in part the ambient sound captured by the ASM 110, ... actively monitor the sound exposure level inside the ear canal 140, ... [and] adjust the audio in the ear canal 140 to within a safe and subjectively optimized listening level range.” *Id.* *Goldstein873* also discloses that processor 206 performs the steps to implement a method for conducting a listening test (e.g., method 300) and a method for audio adjustment using sound pressure level (SPL) dose (e.g., method 600). *See generally id.*, [0031]-[0041] (describing processor 206 implementing method 300), [0042]-[0055] (describing processor 206 implementing method 600).

152. In my opinion, a person of ordinary skill in the art would have understood *Goldstein873*’s earpiece 100 to comprise a “smart speaker.” In my opinion, a person of ordinary skill in the art would have understood *Goldstein873*’s earpiece 100 to comprise a “smart speaker” for at least the reason that *Goldstein864*⁸—a related invention disclosure from the same inventor—expressly defines a similar device with comparable capability as “a smart device.”

⁸ I rely on *Goldstein864* to demonstrate the knowledge of a person of ordinary skill in the art. It is not part of the unpatentability ground.

153. For example, *Goldstein864* discloses a nearly identical earpiece as *Goldstein873*, as shown below in the side-by-side comparison of figure 2 of *Goldstein864* and figure 1 of *Goldstein873*.



Left: Ex. 1010 (*Goldstein864*), FIG. 2. Right: Ex. 1005 (*Goldstein873*), FIG. 1

154. *Goldstein864* discloses that its earpiece 13 (or in-the-ear acoustic assembly 13) depicted above, left includes “output transducer (speaker) 25” (corresponding to ECR 120 of *Goldstein873*), “an ear canal microphone (ECM) 23” (corresponding to ECM130 of *Goldstein873*), “Audio input 11 (also referred to herein as ambient sound microphone (ASM) 11)” (corresponding to ASM 110 of *Goldstein873*), “an ASIC 21 that undertakes at least a portion of the audio signal processing” (corresponding to processor 206 of *Goldstein873*), and “a transceiver for audio via the wired or wireless communication path 119” (corresponding to transceiver 204 of *Goldstein873*). Ex. 1010 (*Goldstein864*), 9:14-33.

155. Furthermore, *Goldstein864* discloses that “one exemplary embodiment of the invention is directed to measuring and determining the exposure of sound to the ear over time” by measuring “a sound pressure level (SPL) signal” and comparing it to a “effective quiet level.” *See* Ex. 1010 (*Goldstein864*), 5:55-6:15; FIG. 1. *Goldstein864* explains that “if the minimum level threshold is detected as being exceeded, a signal indicating a sound pressure level in excess of the minimum level threshold is output to begin a clock.” *Id.*, 6:18-22. *Goldstein864* further explains that “a listening fatigue calculator ... determines whether or not listening fatigue or hearing damage is likely to occur as a result of further exposure” and that “injury to the hearing mechanism ... can be either temporary or permanent so long as it is a result of the noise exposure is above PSL (e.g., Effective Quiet).” *Id.*, 7:12-21. *Goldstein864* further discloses an embodiment where “the signal from the listening fatigue calculator is output to an audio warning source 132, which outputs an audio warning to the user notifying the user that exposure to the sound source has reached critical levels.” *Id.*, 7:43-47.

156. In my opinion, a person of ordinary skill in the art would have understood that *Goldstein873* and *Goldstein864* share high degrees of similarity, are by same inventor, and employ very similar if not identical components, and similar algorithms to achieve the same purpose of SPL monitoring.

157. *Goldstein864* further explains that “it is well within the scope of at least one exemplary embodiment of the invention to provide substantially all of the functionality in an earpiece so that system 100 is a ‘**smart device.**’” Ex. 1010 (*Goldstein864*), 8:30-38. A person of ordinary skill in the art would have recognized *Goldstein873* similarly discloses earpieces, with many of the identical components as seen in *Goldstein864*, that also perform substantially similar functions to those disclosed by *Goldstein864*. Therefore, a person of ordinary skill in the art would have understood that the earpieces of the *Goldstein873-Newham* combination are “smart speaker[s]” as recited in the claim, as they are devices capable of performing complex computing tasks that also have a speaker component to output sounds.

158. Accordingly, the *Goldstein873-Newham* combination teaches a pair of earpieces including a second earpiece capable of performing complex computing tasks that also has a speaker component to output sounds (“a smart speaker”).

B. Ground 1B: *Goldstein873*, *Newham*, and *Brulle* Render Obvious Claim 44

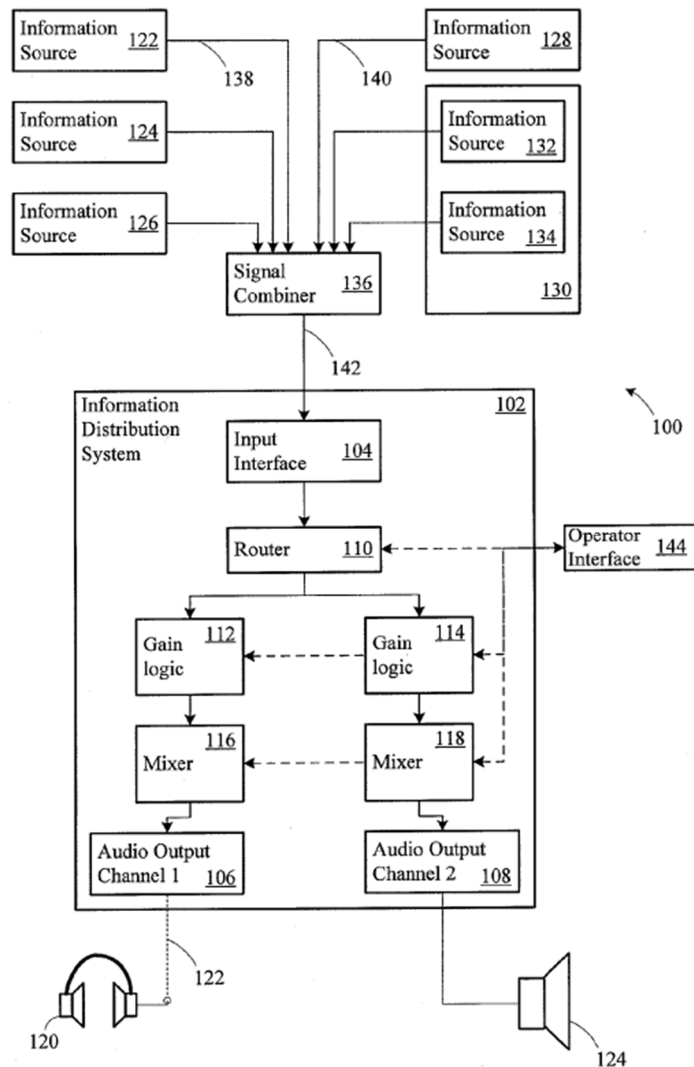
1. Claim 44

a. “The system of claim 39, wherein the at least one output device comprises an infotainment system of a vehicle.”

159. In my opinion, *Goldstein873* in combination with *Newham* and *Brulle* teaches this claim.

160. As I discussed in §§X.A.1.d and X.A.1.d(ii), the *Goldstein*⁸⁷³-*Newham* combination teaches a pair of earpieces 100 (“at least one cluster”) including a first earpiece configured to operate as a master device (“of at least one computing device”) and a second earpiece is configured to operate as a slave device (“at least one output device”), and that each of the pair of earpieces 100 would include an ECR 120 (“a speaker”) to deliver audio to an ear canal 140 (“for outputting sound”).

161. *Brulle* is generally directed to an “information distribution system [that] enhances the use and enjoyment of the vehicle audio/visual system.” Ex. 1007 (*Brulle*), [0008]. *Brulle* discloses that its “system flexibly delivers audio and video to vehicle passengers based on passenger preferences. ... The system accepts audio or video from multiple sources and selectively mixes and routes the audio and video to multiple destinations such as front and rear vehicle speakers or multiple displays.” *Id.* For example, *Brulle* discloses a configurable information distribution system 102, as shown in figure 1 (reproduced on the next page), that “includes an input interface 104, audio output channels 106 and 108, and a router 110,” as well as “gain logic 112 and 114 and mixers 116 and 118.” *Id.*, [0022]. *Brulle* also discloses a “headset 120 connect[ed] to the audio output channel 106 through a wireless connection 122,” and that a “speaker system 124 connect[ed] to the audio output channel 108.” *Id.*, [0023].

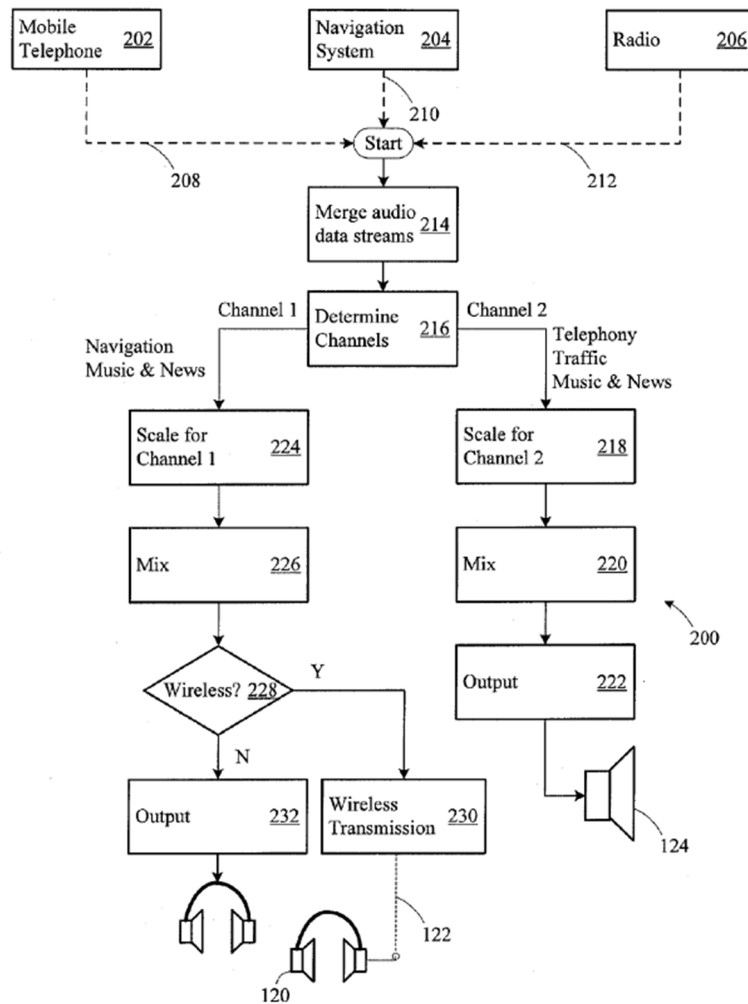


Ex. 1007 (*Brulle*), FIG. 1

162. Figure 2 of *Brulle* (reproduced on the next page) illustrates how an information distribution system 102 selectively routes information to vehicle passengers from a mobile telephone 202, a navigation system 204, and a radio 206. *See id.*, [0027], FIG. 2. *Brulle* discloses that data streams from each of mobile telephone 202, navigation system 204, and radio 206 are merged into a combined data stream that “includes data sequences of audio information obtained from the

mobile telephone 202, navigation system 204, and radio 206.” *Id.*, [0028]. *Brulle*’s information distribution system 102 then “determines which data sequences in the combined data stream to deliver to which output channels (Act 216). In the example shown in figure 2, the system 102 directs the navigation data stream 210 to the first audio output channel 106, and to the headset 120 connected to the first audio output channel 106.” *Id.*, [0029]. *Brulle* explains, however, that “[t]he router 110 may deliver any portion of the input data streams to any of the output channels.” *Id.*, [0030].

163. *Brulle* also discloses “[a] headset 120 connect[ed] to the audio output channel 106 through a wireless connection 122.” *Id.*, [0023]. For example, *Brulle* discloses that “[t]he system 102 may transmit to wireless headphones, hearing aids with a telecoil, or to other wireless devices.” *Id.*, [0035].



Ex. 1007 (*Brulle*), FIG. 2

164. A person of ordinary skill in the art would have been motivated to further modify the combined *Goldstein873-Newham* earpieces to utilize earpieces 100 within an information distribution system as described in *Brulle* to enhance the use and enjoyment of vehicle audio system while using earpieces 100. Indeed, both *Goldstein873* and *Brulle* are directed to systems and methods for providing personalized hearing to a user. For example, *Goldstein873* explains that it

“provide[s] a method and device for personalized hearing.” Ex. 1005 (*Goldstein873*), [0006]. Meanwhile, *Brulle* is directed to a system that flexibly delivers audio and video to individuals based on personal preferences. Ex. 1007 (*Brulle*), [0008].

165. Both *Goldstein873* and *Brulle* are also concerned with providing ambient sounds to the user’s ear. For example, *Goldstein873* describes “selectively mix[ing] the audio content with the ambient sound to produce the audio in accordance with a personalized hearing level (PHL).” Ex. 1005 (*Goldstein873*), [0007]. And *Brulle* explains that one information source in information distribution system 102 may comprise an external microphone. *See* Ex. 1007 (*Brulle*), [0037]. *Brulle* explains that “[t]he microphone may capture sound outside of the vehicle, including noise of interest (e.g., signal horns or emergency sirens),” and that “the passenger may receive noise that is of interest from outside the car, thereby informing the passenger of important environmental conditions (e.g., a passing ambulance).” *Id.*; *see also id.*, [0044] (describing using both external and internal microphones), [0050] (same).

166. In my opinion, a person of ordinary skill in the art would have found the combination obvious because it would have amounted to merely applying a known technique (*Brulle*’s teaching of utilizing wireless headphones or other wireless devices as output devices in a vehicle audio/visual system) to a known

device (*Goldstein873-Newham's* earpieces) ready for improvement to yield predictable results (to expand the functionality of *Goldstein873-Newham's* earpieces for use when traveling in a vehicle).

167. A person of ordinary skill in the art would also have had a reasonable expectation of success in modifying the *Goldstein873-Newham* earpieces for use within an information distribution system as described in *Brulle* as it would have amounted to merely programming processor 206 to interact with *Brulle's* system 102. *Goldstein873* also discloses earpiece 100 including “a transceiver 204 that can support singly or in combination any number of wireless access technologies including without limitation Bluetooth™, Wireless Fidelity (WiFi), Worldwide Interoperability for Microwave Access (WiMAX), and/or other short or long range communication protocol.” Ex. 1005 (*Goldstein873*), [0028]; *see also* Ex. 1007 (*Brulle*), [0034] (“[T]he system 102 may automatically detect and communicate with wireless devices that adhere to an established communication protocol, such as the Bluetooth protocol.”). A person of ordinary skill in the art would thus have understood *Goldstein873's* earpiece 100 to be suitable for use with *Brulle's* system 102.

168. A person of ordinary skill in the art would also have understood the *Goldstein873-Newham* earpieces utilized with *Brulle's* system 102 in a vehicle to receive data streams, for example, from each of a mobile telephone, a navigation

system, and radio, as described in *Brulle*, to comprise an infotainment system of a vehicle. Indeed, a person of ordinary skill in the art would have understood an “infotainment system” to comprise any “hardware/software products and systems which are built into, or can be added to vehicles, in order to enhance the vehicle occupant experience when it comes to providing audio and visual entertainment, as well as automotive navigation systems.” Ex. 1012 (*Tengstrand*), [0003]; *see also* Ex. 1013 (*Jeong*), [0035] (“An infotainment system is a system for providing a user with information and entertainment together.”).⁹

169. Accordingly, the *Goldstein*⁸⁷³-*Newham-Brulle* combination teaches a pair of earpieces including a first earpiece configured to operate as a master device and a second earpiece configured to operate as a slave device and to output sound (“at least one output device”), wherein the first earpiece and the second earpiece are configured to be used in a vehicle to receive data streams from a mobile telephone, a navigation system, and/or radio (“wherein the at least one output device comprises an infotainment system of a vehicle”).

⁹ I rely on *Tengstrand* and *Jeong* to demonstrate the knowledge of a person of ordinary skill in the art. They are not part of the unpatentability ground.

C. Ground 2A: *Goldstein*⁸⁷³, *Newham*, and *Chaudhri* Render Obvious Claims 32, 33, and 36-38

1. Claim 32

a. “A system comprising:”

170. I understand “[a] system comprising” is the preamble to claim 32. I have been asked to assume that the preamble is a claim limitation. Under that assumption, in my opinion, *Goldstein*⁸⁷³ teaches this feature for the reasons I discussed in §X.A.1.a.

b. “at least one cluster of at least one computing device,”

171. In my opinion, *Goldstein*⁸⁷³ teaches this feature for the reasons I discussed in §X.A.1.b.

c. “the at least one computing device including:”

- (i) “a sound sensing mechanism, configured detect a sensed energy, wherein the sensed energy comprises one or more sounds; and monitor one or more parameters selected from the group of (i) an amplitude of the one or more sounds and (ii) a frequency of the one or more sounds, wherein at least one of the monitored one or more parameters is aggregated over time; and”**

172. This feature is the same as element 39[b][i], except that it additionally recites “wherein at least one of the monitored one or more parameters is aggregated over time.” As to the portions of elements 32[b][i] and 39[b][i] that are common, *Goldstein*⁸⁷³ teaches these features for the reasons I discussed in §X.A.1.c(i).

173. As to the newly recited features in element 32[b][i], *Goldstein873* further discloses that processor 206 calculates SPL Dose, which represents “sound exposure over time” in order “to assess an acceptable level of sound exposure.” Ex. 1005 (*Goldstein873*), [0044]. *Goldstein873* explains that SPL Dose “indicates an individual’s cumulative exposure to sound pressure levels over time,” and that it “can be expressed as a percentage of a maximum time-weighted average for sound pressure level exposure.” *Id.*, [0045]. A person of ordinary skill in the art would have understood that SPL Dose is a value derived by aggregating SPL values over time, and thus a time aggregate of amplitudes.

174. Accordingly, *Goldstein873* also teaches that the ambient sound levels captured by ASM 110 and sound exposure levels captured by ECM 130, and corresponding SPL values, are aggregated over time to derive the SPL Dose calculated by processor 206 (“wherein at least one of the monitored one or more parameters is aggregated over time”).

(ii) “a wireless transceiver; and”

175. In my opinion, *Goldstein873* teaches this feature for the reasons I discussed in §X.A.1.c(ii).

d. “at least one output device, including:

176. In my opinion, *Goldstein873* in combination with *Newham* teaches this feature for the reasons I discussed in §X.A.1.d.

(i) a power source for operating the output device;

177. In my opinion, *Goldstein873* in combination with *Newham* teaches this feature for the reasons I discussed in §X.A.1.d(i).

(ii) a speaker for outputting sound; and

178. In my opinion, *Goldstein873* in combination with *Newham* teaches this feature for the reasons I discussed in §X.A.1.d(ii)

(iii) a communication mechanism;

179. In my opinion, *Goldstein873* in combination with *Newham* teaches this feature for the reasons I discussed in §X.A.1.d(iii).

e. “wherein the at least one computing device further comprises: a memory, containing computer-executable instructions for connecting to the at least one cluster and varying an output of the at least one output device;”

180. In my opinion, *Goldstein873* in combination with *Newham* teaches this feature for the reasons I discussed in §X.A.1.e.

f. “a processor, for executing the computer-executable instructions and being capable of receiving an input from a user for manually adjusting a volume, wherein the computer-executable instructions include:”

181. In my opinion, *Goldstein873* in combination with *Newham* and *Chaudhri* teaches this feature.

182. For the reasons I discussed in §X.A.1.f, *Goldstein873* in combination with *Newham* teaches a first earpiece 100 (“the at least one computing device”)

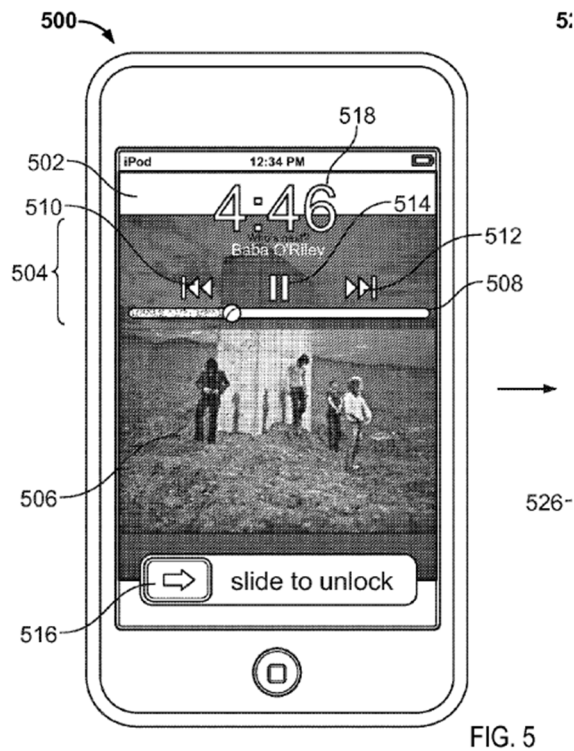
having a processor 206 coupled to storage memory 208 for controlling operations of earpiece 100 (“for executing the computer-executable instructions”).

183. *Goldstein873* also discloses that its earpiece 100 operates to receive “audio content from a media player,” and that “earpiece 100 can be connected via a wired connection to the media player, or via a wireless connection (e.g. Bluetooth) using the transceiver 204.” Ex. 1005 (*Goldstein873*), [0054]. For example, *Goldstein873* expressly discloses that the earpiece 100 can be connected to, and listen to music received from, “a portable media player 155 (e.g., iPod™, Blackberry™, and other devices as known by one of ordinary skill in the relevant arts).” *Id.*, [0057].

184. *Goldstein873* explains in its Background section that it is well known to use earpieces and headphones to play audio content from a media player. *See id.*, [0004] (“In the mobile electronic age, people are frequently exposed to noise pollution from cell phones (e.g., incoming phone call sounds), portable media players (e.g., message alert sounds), and laptops (e.g., audible reminder prompts).”). *Goldstein873* also acknowledges that a user may control the volume of such audio content. *See id.* (noting that a “user may even turn up the volume to hear the audio over the background noises,” exacerbating the risk of a user receiving potentially harmful audio). *Goldstein873*, however, does not focus on the implementation details relating to how to enable a user to manually control the volume of audio

content. Thus, a person of ordinary skill in the art would have been motivated to look for additional information regarding how to implement *Goldstein*⁸⁷³'s system to control the volume of audio content, and in so looking, would have readily identified *Chaudhri*.

185. *Chaudhri* is directed generally to providing “an audio file interface.” Ex. 1008 (*Chaudhri*), [0004]. *Chaudhri* discloses a “mobile device 100 or 101 [that] can present recorded audio and/or video files, such as MP3, AAC, and MPEG files. In some implementations, the mobile device 100 or 101 can include the functionality of an MP3 player, such as an iPod™.” *Id.*, [0062]; *see also id.*, FIG. 5 (reproduced below).



Ex. 1008 (*Chaudhri*), FIG. 5

186. *Chaudhri* also discloses an interface that includes “an indicator of the volume slide control 508 to change the volume level of the device 100 or 101 for a particular audio file playing on the device” *Id.*, [0075].

187. A person of ordinary skill in the art would have been motivated to modify the *Goldstein873-Newham* earpieces to interface with *Chaudhri*’s mobile device having the functionality of an MP3 player and would have had a reasonable expectation of success in doing so. A person of ordinary skill in the art would have appreciated that *Goldstein873* expressly teaches that its earpiece 100 is configured to receive audio content from a media player 155, and identifies an iPod specifically as an example of such media device. *See* Ex. 1005 (*Goldstein873*), [0057]. To that end, *Chaudhri* provides a media player such as an iPod suitable for use as media player with *Goldstein873-Newham*’s earpieces . A person of ordinary skill in the art would have considered applying *Chaudhri*’s teaching to the *Goldstein873-Newham* combination to amount to merely combining prior art elements (*Chaudhri*’s mobile device and the *Goldstein873-Newham* earpieces) according to known methods (*Goldstein873* teaches earpiece 100 interacting with a media player 155 such as, or similar to, an iPod) to yield predictable results.

188. It is my opinion that a person of ordinary skill in the art would also have recognized that, when the *Goldstein873-Newham* earpieces are paired with and interacts with *Chaudhri*’s mobile device, the user would be able to adjust the volume

of audio content via the volume slide control 508 on the mobile device, altering the sound level of said audio content played on the earpieces, as taught by *Chaudhri*.

189. Furthermore, in my opinion, a person of ordinary skill in the art would have understood that, when implementing *Goldstein873* earpieces in a master-slave arrangement, as taught by *Newham*, processor 206 of first earpiece 100 would receive user input entered via *Chaudhri*'s mobile device and control the output on the second earpiece 100 based on the received user input. For example, *Goldstein873* discloses processor 206 as configured “for controlling operations of the earpiece device 100.” Ex. 1005 (*Goldstein873*), [0027]. Additionally, *Newman* explains that, in the master-slave arrangement, “the first wireless node may begin relaying all or a portion of one or more of the received content streams via a signal to the second wireless node,” and, “[i]f desired, the first wireless node may also generate and/or transmit—to the second wireless node—one or more controls related to processing the relayed content streams via the signal.” Ex. 1006 (*Newham*), [0053]; *see also id.*, [0056] (describing the same).

190. Accordingly, the *Goldstein873-Newham-Chaudhri* combination teaches a first earpiece 100 (“the at least one computing device”) having a processor 206 coupled to storage memory 208 for controlling operations of earpiece 100 (“for executing the computer-executable instructions”) and receiving user input via a

media player to adjust the volume of audio content via a slide control (“and being capable of receiving an input from a user for manually adjusting a volume”).

191. Moreover, because as discussed herein and in §§X.A.1.e and X.A.1.f *Goldstein873*’s processor 206 operates by executing code stored in storage memory 208, the *Goldstein873-Newham* combination teaches that when the code stored in storage memory 208 is executed by processor 206, the processor performs operations that meet the claim elements discussed in §§X.C.1.f(i)-X.C.1.f(iv) and the dependent claims discussed below.

- (i) **“determining if at least one of the monitored one or more parameters falls outside of a predetermined threshold;”**

192. In my opinion, *Goldstein873* in combination with *Newham* and *Chaudhri* teaches this feature for the reasons I discussed in §X.A.1.f(i).

- (ii) **“if at least one of the monitored one or more parameters falls outside of the predetermined threshold, transmitting, to the at least one output device, an alert”**

193. In my opinion, *Goldstein873* in combination with *Newham*, and *Chaudhri* teaches this feature.

194. *Goldstein873* discloses that “the processor 206 can calculate a sound pressure level dose (SPL Dose) to quantify the sound exposure over time as it relates to sound exposure and sensorineural hearing loss.” Ex. 1005 (*Goldstein873*), [0044]. *Goldstein873* further discloses determining whether the SPL Dose is exceeded. *See*

id., [0049], FIG. 6 (step 630). *Goldstein873* discloses that “[i]f the filtered sound exceeds the Effective Quiet level and the SPL Dose is not exceeded at step 630, the earpiece 100 can continue to monitor sound exposure level within the ear canal 140 at step 612 and update the SPL Dose.” *Id.*, [0049]. If, however, both are exceeded, *Goldstein873* discloses that “the processor 206 can adjust (e.g. decrease/increase) a level of the filtered sound” based on the user’s personalized hearing level. *Id.* As I discussed in §X.A.3, *Goldstein873* also discloses processor 206 sending a visual or audible warning indicating an SPL Dose threshold has been exceeded.

195. A person of ordinary skill in the art would have recognized that it would have been obvious to provide an audible warning via the speakers of earpieces 100, such as ECR 120. Indeed, *Goldstein873* discloses that the earpiece 100 “can partially or fully occlude the ear canal 140 to provide various degrees of acoustic isolation,” and thus an audio warning delivered to devices outside of the ear-canal risks being blocked or attenuated by the earpiece 100 itself. Ex. 1005 (*Goldstein873*), [0024]. Additionally, one of the major issues to be addressed by *Goldstein873* is the concern that users are missing important audible cues when wearing headsets or earpiece. *Id.*, [0024]. Thus, a person of ordinary skill in the art would have been motivated to output warnings directed to the ear canal via ECR 120 to ensure such warnings are received by the user.

196. Accordingly, the *Goldstein873-Newham-Chaudhri* combination teaches, responsive to determining that a captured amplitude of a sound exceeds a predetermined value (“if at least one of the monitored one or more parameters falls outside of the predetermined threshold”) that causes a corresponding SPL to exceed the Effective Quiet level and that an SPL Dose threshold has been exceeded, processor 206 sending an audible warning to the ECR 120 of each of earpieces 100 for providing the audible warning directly to the ear canals of the user (“transmitting, to the at least one output device, an alert”).

(iii) “altering one or more of the one or more sounds so that at least one of the monitored one or more parameters does not fall outside of the predetermined threshold; and”

197. In my opinion, *Goldstein873* in combination with *Newham*, and *Chaudhri* teaches this feature for the reasons I discussed in §X.A.1.f(ii).

(iv) “outputting the one or more sounds on the at least one output device.”

198. *Goldstein873* in combination with *Newham*, and *Chaudhri* teaches this feature for the reasons I discussed in §X.A.1.f(iii).

2. Claim 33

a. The system of claim 32, further comprising: an interfacing mechanism, the interfacing mechanism including:

199. In my opinion, *Goldstein873* in combination with *Newham*, and *Chaudhri* teaches this feature. As I discussed in §X.A.1.f, the combination of at least *Goldstein873*, *Newham*, and *Chaudhri* teaches a first earpiece 100 having a processor 206 coupled to storage memory 208 for controlling operations of earpiece 100 and receiving user input via a media player 155 to adjust the volume of audio content via a slide control. Indeed, as explained in §X.A.1.f, a person of ordinary skill in the art would also have recognized that, when the *Goldstein873-Newham* earpiece are paired with and interacts with *Chaudhri*'s mobile device, the user would be able to adjust the volume of audio content via the volume slide control 508 on the mobile device, altering the sound level of said audio content played on the earpiece 100, as taught by *Chaudhri*.

200. Accordingly, the *Goldstein873-Newham-Chaudhri* combination teaches the *Goldstein873-Newham* earpieces interacting with *Chaudhri*'s mobile device (“an interfacing mechanism”) to receive user input to adjust the volume of audio content.

b. “a network adapter, configured to transmit and receive electronic information through both wired and wireless communication; and”

201. In my opinion, *Goldstein*873 in combination with *Newham*, and *Chaudhri* teaches this feature.

202. *Chaudhri* discloses a Peripheral Interface 306 coupled to Wireless Communication Subsystem 324 and I/O Subsystem 340. *See* Ex. 1008 (*Chaudhri*), [0054], FIG. 3 (reproduced below).

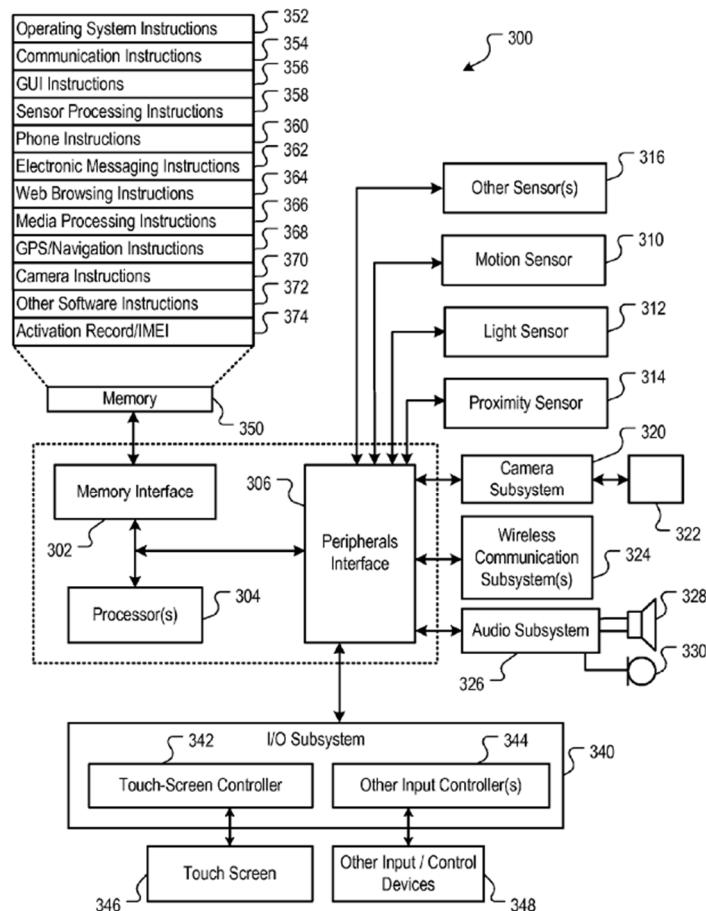


FIG. 3

Ex. 1008 (*Chaudhri*), FIG. 3

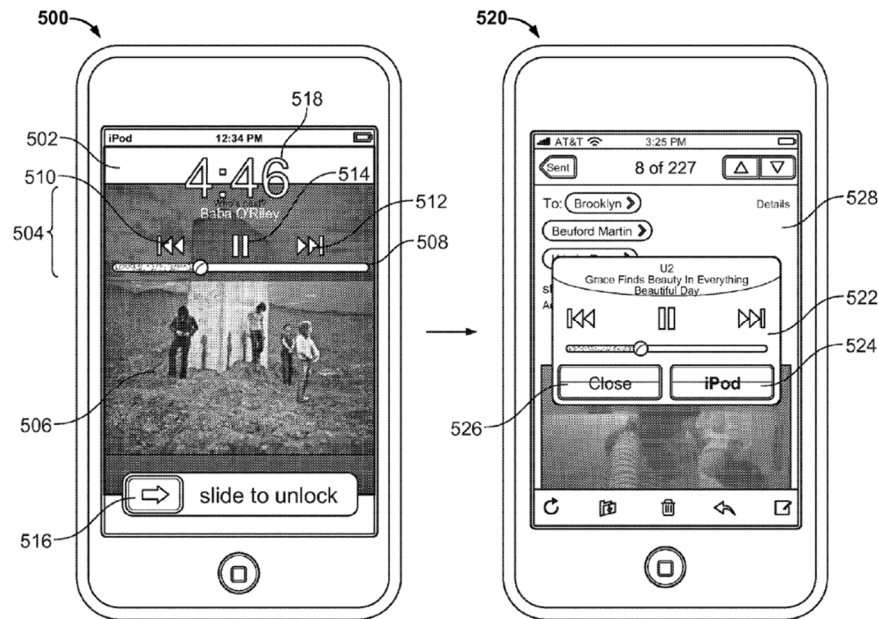
203. *Chaudhri* discloses that “[s]ensors, devices, and subsystems can be coupled to the peripherals interface 306 to facilitate multiple functionalities.” *Id.*, [0055]. *Chaudhri* also discloses that “[t]he other input controller(s) 344 can be coupled to other input/control devices 348, such as one or more buttons, rocker switches, thumb-wheel, infrared port, **USB port**, and/or a pointer device such as a stylus.” *Id.*, [0060]. A person of ordinary skill in the art would have understood that a USB port is a well-known connection interface for wired communication, and thus peripherals interface 306 is configured to transmit and received data via a wired connection by virtue of its connection to the USB port. *Chaudhri* also discloses “[c]ommunication functions can be facilitated through **one or more wireless communication subsystems 324**, which can include radio frequency **receivers and transmitters** and/or optical (e.g., infrared) receivers and transmitters.” *Id.*, [0057]. *Chaudhri* discloses that the “specific design and implementation” of the wireless communication subsystem 324 depends on the networks over which the device is intended to operate, and identifies “a GSM network, a GPRS network, an EDGE network, a Wi-Fi or WiMax network, and a Bluetooth™ network” as examples. *Id.* A person of ordinary skill in the art would have understood that peripherals interface 306 is configured to transmit and received data wirelessly by virtue of its connection to wireless communication subsystems 324.

204. Accordingly, the *Goldstein873-Newham-Chaudhri* combination teaches *Goldstein873-Newham*'s earpieces interacting with *Chaudhri*'s mobile device having a peripheral interface ("a network adapter") configured to communicate with both wired communication interfaces/controllers and wireless communication systems ("configured to transmit and receive electronic information through both wired and wireless communication").

c. at least one input mechanism, configured to manipulate the interfacing mechanism; and

205. In my opinion, *Goldstein873* in combination with *Newham*, and *Chaudhri* teaches this feature.

206. *Chaudhri* discloses an interface (e.g., as depicted in *Chaudhri*'s figure 5) that includes "an indicator of the volume slide control 508 to change the volume level of the device 100 or 101 for a particular audio file playing on the device." Ex. 1008 (*Chaudhri*), [0075].



Ex. 1008 (*Chaudhri*), FIG. 5.

207. *Chaudhri* also discloses that an “I/O subsystem 340 can include a touch screen controller 342 and/or other input controller(s) 344.” *Id.*, [0059]. *Chaudhri* also discloses that “[t]ouch screen 346 and touch screen controller 342 can, for example, detect contact and movement or break thereof using any of a plurality of touch sensitivity technologies.” *Id.*

208. Accordingly, the *Goldstein873-Newham-Chaudhri* combination teaches *Chaudhri*’s mobile device having a touch screen interface (“at least one input mechanism”) that allows the user to operate and manipulate the mobile device (“configured to manipulate the interfacing mechanism”).

d. vary the output of the at least one output device.

209. In my opinion, *Goldstein873* in combination with *Newham*, and *Chaudhri* teaches this feature for the reasons I discussed in §X.C.1.f.

3. Claim 36

a. “The system of claim 32, wherein the predetermined threshold equates to a frequency or an amplitude determined to pose a risk of harm to a user's hearing capabilities.”

210. In my opinion, *Goldstein873* in combination with *Newham*, and *Chaudhri* teaches this claim.

211. As I discussed above in §X.A.1.f(i), a person of ordinary skill in the art would have understood *Goldstein873* to disclose the Effective Quiet level being a value predetermined based on audiological research and using the Effective Quiet level as a threshold indicator for intense environmental noise, exposure to which may eventually result in permanent hearing loss. A person of ordinary skill in the art would thus have understood the Effective Quiet level to be a predetermined threshold for which exposure to sound levels exceeding it may result in permanent hearing loss. As I also discussed in §X.A.1.f(i), a person of ordinary skill in the art would also have understood *Goldstein873* to describe Effective Quiet level as a threshold sound pressure level and that sound pressure level is a function of amplitude.

212. Accordingly, the *Goldstein873-Newham-Chaudhri* combination teaches determining whether a captured amplitude of a sound exceeds a predetermined value that causes a corresponding SPL to exceed the Effective Quiet level, and that the predetermined value (“the predetermined threshold”) is an amplitude value (“equates to ... an amplitude”) at which corresponding sound pressure levels exceed the Effective Quiet level and may result in permanent hearing loss (“determined to pose a risk of harm to a user's hearing capabilities”).

4. Claim 37

- a. “The system of claim 32, wherein the computer-executable instructions further include steps selected from the group consisting of: panning the sensed energy; and equalizing the sensed energy.”**

213. In my opinion, *Goldstein873* in combination with *Newham*, and *Chaudhri* teaches this claim.

214. *Goldstein873* discloses that “the processor 206 can filter the sound of the user’s voice captured at the ASM 110 when the user is speaking such that the user hears himself or herself with a similar timbral quality as if the earpiece 100 were not inserted.” Ex. 1005 (*Goldstein873*), [0060]. For example, *Goldstein873* explains that “a voice activity detector within the earpiece 100 can identify when the user is speaking and filter the speech captured at the ASM 110 **with an equalization that compensates for the insertion of the earpiece.**” *Id.*; *see also id.*, [0026] (describing providing “personalized full-band width general audio reproduction within the

user's ear canal via timbral equalization”), [0061] (describing “allow[ing] the user to select an equalization filter”).

215. Accordingly, the *Goldstein873–Newham–Chaudhri* combination teaches that processor 206 of earpiece 100 filtering sounds with an equalization that compensates for the insertion of the earpiece (“equalizing the sensed energy”).

5. Claim 38

- a. **“The system of claim 32, further comprising: an in-ear device, wherein an audio output of the in-ear device auto-adjusts based on signal energy sensed within a cluster or surrounding clusters.”**

216. In my opinion, *Goldstein873* in combination with *Newham*, and *Chaudhri* teaches this claim.

217. Claim 38 does not limit where the in-ear device is in the claimed system or how it relates to the components recited in claim 32. The '016 patent also contemplates that “various in-ear systems may be integrated into the present invention,” including “an in-ear monitor.” Ex. 1001 ('016 patent), 8:48-62. For example, the '016 patent provides that “the output of such an in-ear monitor can be autonomously adjusted after sensing audio output.” *Id.* For example, “[a] given output can be adjusted according to what is sensed within specified location or what is sensed at external clusters.” *Id.* Accordingly, in my opinion, a person of ordinary skill in the art would have understood the plain and ordinary meaning of this claim to encompass as if claim 32 were written as “... at least one output device including

an in-ear device, wherein an audio output of the in-ear device auto-adjusts based on signal energy sensed within a cluster or surrounding clusters, the at least one output device including:”

218. *Goldstein873* discloses that the earpiece 100 is an in-ear device that “actively monitor[s] the sound exposure level inside the ear canal 140” and “adjust the audio in the ear canal 140 to within a safe and subjectively optimized listening level range.” Ex. 1005 (*Goldstein873*), [0027]. *Goldstein873* further discloses that the process for monitoring SPL Dose begins “in a state wherein the earpiece 100 is **inserted in the ear canal** and activated.” *Id.*, [0043]. *Goldstein873* explains that “processor 206 can produce audio from at least in part the ambient sound captured by the ASM 110, ... actively monitor the sound exposure level inside the ear canal 140, ... [and] adjust the audio in the ear canal 140 to within a safe and subjectively optimized listening level range.” *Id.*, [0027]. In my opinion, a person of ordinary skill in the art would have understood that because method 600 is a processor driven method, steps such as step 630 occur automatically.

219. Accordingly, the *Goldstein873–Newham–Chaudhri* combination teaches earpieces being inserted in the ear canal of the user (“an in-ear device”) and that processor 206 of earpiece 100 produces audio including ambient sound, actively monitors the user’s sound exposure level and adjusts the audio in the ear canal 140 to within a safe and subjectively optimized listening level range (“wherein an audio

output of the in-ear device auto-adjusts based on signal energy sensed within a cluster or surrounding clusters”).

D. Ground 2B: *Goldstein*873, *Newham*, *Chaudhri*, and *Smith* Render Obvious Claims 34 and 35

1. Claim 34

- a. “The system of claim 32, wherein the sound sensing mechanism is selected from the group consisting of: an omnidirectional transducer, an ultrasonic transducer, an infrasonic transducer, and a microwave transducer.”**

220. In my opinion, *Goldstein*873 in combination with *Newham*, *Chaudhri*, and *Smith* teaches this claim.

221. *Smith* discloses a system and method for providing both hearing enhancement and hearing protection. *See* Ex. 1009 (*Smith*), Abstract. *Smith* discloses that its earpiece 101 includes one or multiple microphones 102. *See id.*, [0020] (“[E]arpiece 101 can substantially contain a microphone 102 The microphone 102 can pick up ambient sound and can transduce the sound into a signal, such as an analog electronic signal.”), [0025] (“More than one microphone 102 can be used. Each microphone 102 can be comparatively more sensitive to a different portion of the audio spectrum. Thus, a plurality of different microphones 102 can provide desired sensitivity to substantially all or to some desired portion(s) of the audio spectrum.”). *Smith* discloses that the “[o]ne or more microphones 102 can be sensitive to one or more portions of the audio spectrum that are considered to be

outside of the audible range. For example, one microphone 102 can be sensitive to infrasound (such as sound having a frequency less than 20 Hz) and another microphone 102 can be sensitive to ultrasound (such as sound having a frequency greater than 20 kHz).” *Id.*, [0026].

222. *Smith* further discloses that “[s]uch sounds outside of the audible range can be converted to the audible range for enhanced hearing. Thus, infrasound can be up converted in frequency and ultrasound can be down converted in frequency to facilitate processing and/or human hearing.” *Id. Smith* also discloses that its system “can alert the user to otherwise inaudible sounds. Such sounds can be inaudible due to their frequency content and/or amplitude. Such inaudible sounds can be reproduced at an increased amplitude and/or different frequency so that they can be heard by the user.” *Id.*, [0027]. To do so, *Smith* discloses storing sound signatures for various sounds, including inaudible sounds. *See id.*, [0028] (“Such inaudible sounds or sound signatures representative thereof can be stored in a database (such as in the manner of environmental signatures).”). *Smith* also discloses comparing inaudible sounds to their sound signature stored in the database and providing an indication to the user if a match is found. *See id.*, [0029] (“Then, subsequently received inaudible sounds or their sound signatures can be compared to the sounds or sound signatures stored in the database. When a match is determined, the appropriate indication can be provided to the user.”). Thus, in my opinion, a person

of ordinary skill in the art would have understood *Smith* to disclose identifying sounds outside of the audible range and that doing so would include determining that the sound includes a frequency outside of the audible range—*e.g.*, less than 20 Hz or greater than 20 kHz.

223. A person of ordinary skill in the art would have been motivated to further modify *Goldstein873*'s earpieces 100 in view of *Smith* to determine, for example, when a sound includes a frequency greater than 20 kHz. Indeed, both *Goldstein873* and *Smith* are directed to systems and methods for providing an altered auditory environment for a user. For example, *Goldstein873* discloses that processor 206 “can selectively mix the audio content with the ambient sound to produce the audio in accordance with a personalized hearing level (PHL).” Ex. 1005 (*Goldstein873*), [0007]; *see also id.*, [0055]-[0056] (explaining how processor 206 selectively mixes audio content with ambient sound, for example, to permit audible environmental awareness). *Goldstein873* also discloses that processor 206 can filter various sounds in the ambient environment, for example, to permit audibility of the ambient sounds. *See, e.g., id.*, [0056], [0060]-[0061]. Like *Goldstein873*, *Smith* similarly discloses a system and method for modifying select sounds within an ambient environment. *See* Ex. 1009 (*Smith*), [0082] (“[A] user can select which types of noise are to be attenuated and the level of attenuation. For example, the user can select to attenuate gunshot noise by 12 dB, dog barking by 6 dB, and car noise

by 3 dB.”), [0085] (“[A] user can select which types of information are to be amplified and the level of amplification. For example, the user can select to amplify low level human voice (such as below 50 dB) by 18 dB, high level human voice (such as above 50 dB) by 9 dB, noise associated with furtive movements by 6 dB, and non-shooting gun noises (such as loading and cocking noises) by 3 dB.”).

224. A person of ordinary skill in the art would have recognized the benefit of implementing *Smith*’s teachings for processing inaudible sounds in *Goldstein873*’s system. For example, a person of ordinary skill in the art would have understood converting sounds outside the audible range to the audible range would provide enhanced hearing and an enhanced auditory environment. A person of ordinary skill in the art would also have understood that identifying inaudible sounds would enable such sounds to be altered (*e.g.*, reproduced at an increased amplitude and/or different frequency) and potentially replaced with other sounds, such as a warning or other identification. A person of ordinary skill in the art would thus have been motivated to modify *Goldstein873*’s earpiece 100 to cause processor 206 to also perform the additional processing steps described by *Smith* on ambient sounds captured by ASM 110.

225. A person of ordinary skill in the art would also have been motivated to modify *Goldstein873*’s earpiece 100 to incorporate additional microphones—for example, at least one microphone sensitive to infrasound and one microphone

sensitive to ultrasound—as taught by *Smith* to enable this additional capability taught by *Smith* in *Goldstein873*'s earpiece 100 for providing personalized hearing. A person of ordinary skill in the art would have recognized that including, for example, at least an ultrasound microphone in order to incorporate *Smith*'s teaching for identifying and processing otherwise inaudible sounds would promote, or at a minimum be consistent with, *Goldstein873*'s objective to permit audible environmental awareness. *See* Ex. 1005 (*Goldstein873*), [0007], [0055], [0064]. A person of ordinary skill in the art would also have had a reasonable expectation of success in incorporating such additional microphones into *Goldstein873*'s earpiece 100 at least because *Goldstein873* expressly contemplates having more than one microphone in each earpiece 100. *See id.*, [0024] (“Earpiece 100 includes an Ambient Sound Microphone (ASM) 110 to capture ambient sound, ... and an ear canal microphone (ECM) 130 to assess a sound exposure level within the ear canal.”).

226. The combination would have been obvious to a person of ordinary skill in the art because it would have amounted to mere use of a known technique (*Smith*'s teaching of identifying and processing inaudible sounds) to improve a similar system (*Goldstein873*'s earpiece 100 for providing personalized hearing) in the same way (by allowing the user to be aware of, for example, otherwise inaudible infrasonic and ultrasonic sounds).

227. A person of ordinary skill in the art would also have understood that a microphone sensitive to infrasound comprises an infrasonic transducer and that a microphone sensitive to ultrasound comprises an ultrasonic transducer. *Smith* discloses the availability of infrasonic and ultrasonic microphones. Ex. 1009 (*Smith*), [0026] (“one microphone 102 can be sensitive to infrasound ... and another microphone 102 can be sensitive to ultrasound”). *Smith* also discloses that the microphones “transduce the sound into a signal.” *Id.*, [0020] (“The microphone 102 can pick up ambient sound and can **transduce the sound into a signal, such as an analog electronic signal.**”). A person of ordinary skill in the art would have therefore understood *Smith*’s microphones are, at a minimum, a particular type of transducer.

228. For example, in a textbook titled “The Science of Sound,” a chapter includes a section titled “Microphones as Transducers” and states that “[a] microphone is a transducer that produces an electrical signal when actuated by sound waves.” Ex. 1018 (*Rossing*), 16.¹⁰ By September 2014, a person of ordinary skill in the art would have understood that microphones were devices that convert “sound

¹⁰ I rely on *Rossing* to demonstrate the knowledge of a person of ordinary skill in the art. It is not part of the unpatentability ground.

waves into analog electrical signals.” Ex. 1016 (*Computer Dictionary*), 5.¹¹ A person of ordinary skill in the art would have also understood that transducers were devices that convert “one form of energy into another.” *Id.*, 6 (“Electronic transducers either convert electric energy to another form of energy or convert nonelectric to electric energy.”). A person of ordinary skill in the art would therefore understand microphones, which convert sound waves into signals, are a particular type of transducer that turns a certain type of “nonelectric” energy into electrical energy.

229. Indeed, the '016 patent itself acknowledges that the sound-sensing mechanism is a microphone, and that a microphone is a type of transducer. Ex. 1001 ('016 patent), 14:12-14 (“At step 305, audio/noise is sensed by one or more audio sensing devices. According to an embodiment, the one or more sensing devices are microphones.”), 14:24-30 (“According to an embodiment, the present system may sense different types of phenomena (e.g., it may sense audio ***using an audio transducer such as a microphone***, it may include a smartwatch and/or other similar device that may be able to sense ultrasonic waves using an ultrasonic transducer, and/or the system may incorporate one or more various suitable types of transducers).”).

¹¹ I rely on *Computer Dictionary* to demonstrate the knowledge of a person of ordinary skill in the art. It is not part of the unpatentability ground.

230. Accordingly, the *Goldstein873-Newham-Chaudhri-Smith* combination teaches *Goldstein873*'s earpieces 100 including at least one ultrasonic microphone (“an ultrasonic transducer”) or infrasonic microphone (“infrasonic transducer”).

2. Claim 35

a. “The system of claim 32, wherein the sensed energy includes infrasonic or ultrasonic soundwaves.”

231. In my opinion, *Goldstein873* in combination with *Newham, Chaudhri, and Smith* teaches this claim for the reasons I discussed in §X.D.1.

XI. SECONDARY CONSIDERATIONS

232. I see no evidence in the '016 patent prosecution history or elsewhere supporting any secondary considerations arguments, or evidence of nexus of such alleged evidence to the challenged claims. To the extent the Patent Owner asserts the existence of any secondary considerations in its responses, I reserve the right to address any such evidence.

XII. CONCLUSION

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

234. 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.

235. 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.

236. 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: November 5, 2025

A handwritten signature in black ink, appearing to read "Chris Kyriakakis", is written above a horizontal line.

Chris Kyriakakis, Ph.D.