

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

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

Petitioners

v.

STATON TECHIYA, LLC,

Patent Owner

Case IPR2024-01004

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

Petition for *Inter Partes* Review of

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

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PETITIONERS' EXHIBIT LIST

Exhibit No.	DESCRIPTION
1001	U.S. Patent 11,710,473 (“’473pat.”)
1002	Declaration of Dr. Kyriakakis (“Kyriakakis”)
1003	Curriculum Vitae of Dr. Kyriakakis
1004	File History of U.S. Patent 11,710,473
1005	U.S. Provisional Application 60/885,917
1006	U.S. Application 17/321,892 (“’892App”)
1007	U.S. Patent 11,244,666 (“’666 patent”)
1008	File History of U.S. Patent 11,244,666
1009	File History of U.S. Appl. No. 90/019,169, Samsung Electronics Co., Ltd. and Samsung Electronics, America, Inc., Request for <i>Ex Parte Reexamination</i> of U.S. Pat. No. 11,244,666, Date: Feb. 24, 2023
1010	Family Tree for the ’473 Patent
1011	Order on Claim Construction issued in <i>Staton Techiya, LLC et al. v. Samsung Electronics Co., Ltd. et al.</i> , 2:21-cv-00413-JRG-RSP (E.D. Tex. Dec. 17, 2023)
1012	Order Granting Proposed Docket Control Order in <i>Staton Techiya, LLC et al. v. Samsung Electronics Co., Ltd. et al.</i> , 2:23-cv-00319 (E.D. Tex. Feb. 8, 2023)
1013	Letter from Nikhil Krishnan to Thomas J Friel, Jr.
1014	RESERVED
1015	RESERVED
1016	RESERVED

Exhibit No.	DESCRIPTION
1017	RESERVED
1018	RESERVED
1019	RESERVED
1020	RESERVED
1021	RESERVED
1022	RESERVED
1023	U.S. Patent 4,455,677 (“ <i>Fox</i> ”)
1024	U.S. Patent 4,827,458 (“ <i>d’Arc</i> ”)
1025	EP0495653A (“ <i>Smiedt</i> ”)
1026	U.S. Patent 5,647,011 (“ <i>Garvis</i> ”)
1027	U.S. Patent 6,782,106 (“ <i>Kong</i> ”)
1028	Sumit Basu et al., <i>Smart Headphones: Enhancing Auditory Awareness Through Robust Speech Detection and Source Localization</i> , 5 IEEE INT’L CONF. ON ACOUSTICS SPEECH & SIGNAL PROCESSING PROC. 3361 (2001)
1029	Florian Mueller & Matthew Karau, <i>Transparent Hearing</i> , CHI ’02 EXTENDED ABSTRACTS ON HUM. FACTORS IN COMPUTING SYS. 730 (2002)
1030	U.S. Publication 2001/0046304A1 (“ <i>Rast</i> ”)
1031	U.S. Patent 4,947,432 (“ <i>Topholm432</i> ”)
1032	U.S. Patent 5,202,927 (“ <i>Topholm927</i> ”)
1033	RESERVED
1034	RESERVED

Exhibit No.	DESCRIPTION
1035	RESERVED
1036	Excerpts from ROBERT OSHANA, DSP SOFTWARE DEVELOPMENT TECHNIQUES FOR EMBEDDED AND REAL-TIME SYSTEMS (2006) (“ <i>Oshana</i> ”)
1037	RESERVED
1038	RESERVED
1039	RESERVED
1040	RESERVED
1041	RESERVED
1042	RESERVED
1043	RESERVED
1044	RESERVED
1045	RESERVED
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1051	U.S. Patent 7,903,826 (“ <i>Boersma</i> ”)
1052	U.S. Publication 2018/0160211 (“ <i>Kirsch</i> ”)
1053	U.S. Publication 2015/0195641 (“ <i>DiCenso</i> ”)

Exhibit No.	DESCRIPTION
1054	U.S. Publication 2008/0181419 (“ <i>Goldstein</i> ”)
1055	U.S. Publication 2020/0380945 (“ <i>Woodruff</i> ”)
1056	Exhibit A06 to Techiya’s Infringement Contentions and Claim Chart for U.S Patent 11,710,473
1057	U.S. Publication 2006/0120545A1 (“ <i>Rasmussen</i> ”)
1058	<i>Kuo</i> , et al., “Active Noise Control: A Tutorial Review,” In Proc. IEEE 87(6) (June 1999) (“ <i>Kuo</i> ”)

LISTING OF CHALLENGED CLAIMS

Claim 1	
1.pre	A device that can control ambient passthrough in an earpiece comprising:
1.1	a first memory that stores instructions; and
1.2	a processor that executes the instructions to perform operations, the operations comprising:
1.3	communicatively connecting to an earpiece, wherein the earpiece includes a first microphone, a second microphone, a speaker, a second memory and an earpiece processor;
1.4	sending an audio content gain value and an ambient sound gain value to the earpiece; and
1.5	sending an audio content signal to the earpiece,
1.6	wherein the earpiece processor applies the audio content gain value to the audio content signal to generate a modified audio content signal,
1.7	wherein the earpiece processor applies the ambient sound gain value to an ambient sound signal to generate a modified ambient sound signal, and
1.8	wherein the earpiece processor mixes the modified ambient sound signal with the modified audio content signal to generate a mixed signal.
Claim 2	
2	The device according to claim 1, wherein the earpiece processor calculates a noise level based upon a first microphone signal from the first microphone, wherein the earpiece processor modifies the mixed signal based upon the noise level.
Claim 3	
3	The device according to claim 1, wherein the earpiece processor generates the ambient sound signal from a first microphone signal from the first microphone.

Claim 4	
4	The device according to claim 1 further including a user interface.
Claim 5	
5	The device according to claim 1, wherein the earpiece processor applies an ambient gain to a first microphone signal from the first microphone to generate the ambient sound signal.
Claim 6	
6	The device according to claim 1, wherein the device is a portable communication device.
Claim 7	
7	The device according to claim 6, where the device portable communication device is at least one of a phone, a watch, a tablet, earpiece, a laptop computer or a combination thereof.
Claim 8	
8.pre	A device that can control ambient sound passthrough comprising:
8.1	a first microphone that measures a first acoustic environment to generate a first microphone signal;
8.2	a second microphone that is positioned closer to a user's ear canal than the first microphone when the device is worn, where the second microphone generates a second microphone signal;
8.3	a speaker;
8.4	a memory that stores instructions; and
8.5	a processor that executes the instructions to perform operations, the operations comprising:
8.6	receiving an audio content signal;
8.7	modifying the audio content signal to generate a modified audio content signal;
8.8	modifying the first microphone signal to generate a modified first microphone signal;

8.9	modifying the second microphone signal to generate a modified second microphone signal;
8.10	generating an ambient sound signal from at least one of the modified first microphone signal, the modified second microphone signal or a combination thereof;
8.11	detecting an acute sound by analyzing at least one of the modified first microphone signal, the modified second microphone signal or a combination thereof;
8.12	modifying the modified audio content signal if an acute sound is detected to generate a new modified audio content signal;
8.13	generating a mixed signal by mixing the ambient sound signal with the modified audio content signal or the new modified audio content signal; and
8.14	sending the mixed signal to the speaker.
Claim 9	
9	The device according to claim 8, wherein the operations further comprise: determining if the acute sound is a user's voice by analyzing the temporal and spectral characteristics of at least one of the modified first microphone signal, the modified second microphone signal or a combination thereof.
Claim 10	
10	The device according to claim 9, wherein the operations further comprise: generating a noise signal from at least one of the modified first microphone signal, the modified second microphone signal, or both; generating a noise reduction signal.
Claim 11	
11	The device according to claim 10, wherein the operations further comprise: mixing the noise reduction signal with the mixed signal to generate a new mixed signal, and sending the new mixed signal to the speaker instead of the mixed signal.

Claim 12	
12	The device according to claim 11, wherein the operations further comprise: sending a modified ambient signal to the speaker instead of the new mixed signal if the user's voice is detected.
Claim 13	
13	The device according to claim 9, wherein the operations further comprise: sending a modified ambient signal to the speaker instead of the mixed signal if the user's voice is detected.
Claim 14	
14	The device according to claim 9, wherein the operations further comprise: detecting whether the acute sound is at least one of a warning sound, siren, voice, specific noise type, or a combination, by analyzing the spectrum of at least one of the modified first microphone signal, the modified second microphone signal, the modified ambient sound signal, or a combination.
Claim 15	
15	The device according to claim 14, wherein the operations further comprise: decreasing a volume of the modified audio content signal when a warning or siren is detected.
Claim 16	
16	The device according to claim 14, where the operations further comprise: sending a notification signal to the speaker if the acute sound is a warning sound or siren.
Claim 17	
17	The device according to claim 16, wherein the warning sound is at least one of a bell, an emergency vehicle, the sound of a security system or a combination thereof.
Claim 18	
18	The device according to claim 14, wherein if an alarm is detected it is at least one of a police siren, an ambulance siren, a car honking or a combination thereof.

Claim 19	
19	The device according to claim 8, wherein the operations further comprise: decreasing a volume of the modified audio content signal when a user's voice is detected.
Claim 20	
20	The device according to claim 8, wherein the acute sound is a voice.

I. INTRODUCTION

Samsung Electronics Co., Ltd., and Samsung Electronics America, Inc. (“Samsung” or “Petitioners”) request *inter partes* review (“IPR”) of claims 1-20 (“Challenged Claims”) of U.S. Patent No. 11,710,473 (“’473 patent”).

II. GROUNDS FOR STANDING

Petitioners certify that the ’473 patent is available for IPR and that Petitioners are not barred or estopped from requesting IPR to challenge the claims on the grounds herein.

III. STATEMENT OF PRECISE RELIEF REQUESTED FOR EACH CLAIM CHALLENGED

Petitioners respectfully request review and cancellation under 35 U.S.C. §311 of the Challenged Claims in view of:¹

Ground	Claims	Basis
1	1-7	§103: <i>Kirsch</i> and <i>DiCenso</i>
2	8-20	§103: <i>Goldstein</i> and <i>Woodruff</i>

As discussed in §VII.A, the Challenged Claims are not entitled to priority before February 3, 2022. As shown in the table below, each of the references discussed herein were published before February 3, 2022.

¹ Petitioners do not concede that any Challenged Claims satisfy other requirements for patentability that cannot be raised in IPR.

Reference	Date	AIA Art At Least Under
U.S. 2018/0160211 (“ <i>Kirsch</i> ”)	June 7, 2018 (Published)	§102(a)(1)
U.S. 2015/0195641 (“ <i>DiCenso</i> ”)	July 9, 2015 (Published)	§102(a)(1)
U.S. 2008/0181419 (“ <i>Goldstein</i> ”)	July 31, 2018 (Published)	§102(a)(1)
U.S. 2020/0380945 (“ <i>Woodruff</i> ”)	Dec. 3, 2020 (Published)	§102(a)(1)

IV. OVERVIEW OF THE ’473 PATENT

A. The Specification

The ’473 patent generally discloses an earpiece that “detects acute sounds” and “allows the acute sounds to be reproduced in an ear canal.” ’473*pat.*, 1:27-32, 2:29-31; FIG. 1. The earpiece includes Ambient Sound Microphone (ASM) 111, Ear Canal Receiver (ECR) 125 or speaker, and Ear Canal Microphone (ECM) 123. *Id.*, 5:3-6. The earpiece also includes a processor operatively coupled to the ASM 111, ECR 125, and ECM 123. *Id.*, 5:39-43.

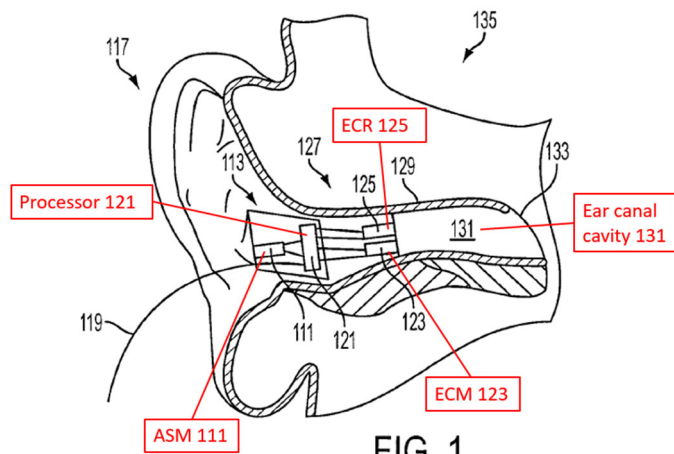


FIG. 1

’473*pat.*, FIG. 1 (annotated)²

² All emphases and annotations throughout are added unless otherwise noted.

Figure 2 is a block diagram of the earpiece, including an “audio interface 212” to “to receive audio content ... and deliver the audio content to the processor 206.” *Id.*, 5:59-62.

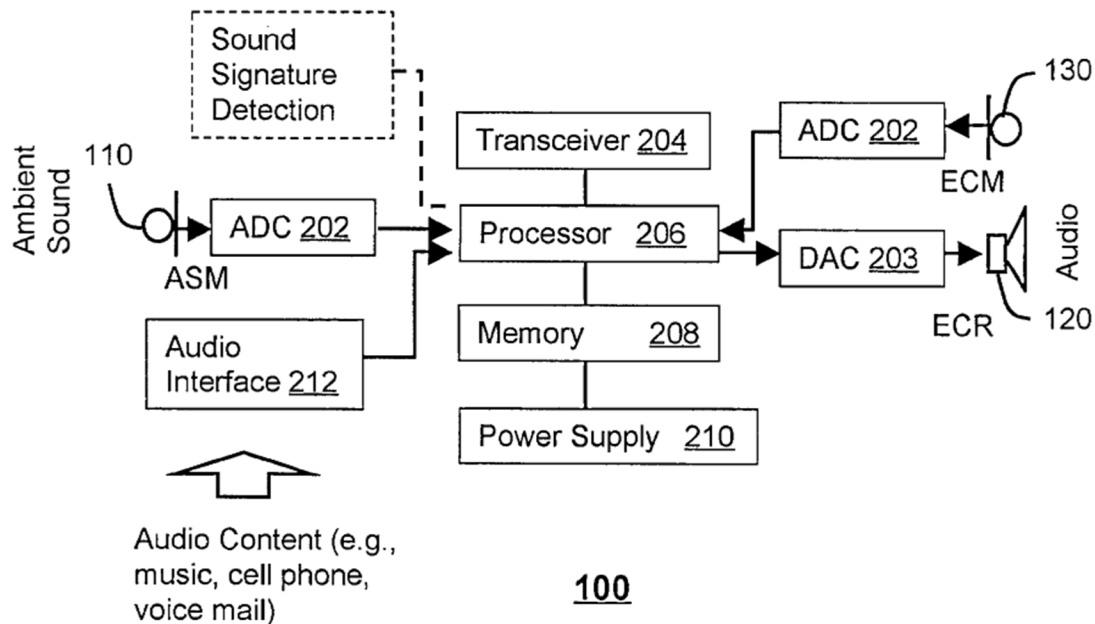


FIG. 2

'473pat., FIG. 2

The '473 patent discloses various methods illustrated in Figures 3-10, each of which “can be implemented in a single earpiece, a pair of earpieces, headphones, or other suitable headset audio delivery devices.” *See, e.g., id.*, 4:11-28. Relevant to this Petition, Figures 3 and 4 show a method for acute sound detection, and Figure 9 discloses a method for maintaining constant audio content level (ACL) to internal ambient sound level (iASL). *Id.*, 4:11-14, 4:24-26. The '473 patent discloses that if “an acute sound is detected within the ambient sound, the earpiece 100 activates

‘sound pass-through’ to reproduce the ambient sound in the ear canal by way of the ECR 125.” *Id.*, 7:28-31. The processor can also “lower a volume of the audio content responsive to detecting an acute sound.” *Id.*, 5:62-67.

B. Prosecution History

The ’473 patent issued from U.S. Application No. 17/592,143 (the “’143 application” or “’143App.”), filed on February 3, 2022 and claims priority through a chain of non-provisional applications to a provisional application filed on January 22, 2007. ’473*pat.*, Cover. The ’473 patent’s parent application is U.S. 17/321,892 (the “’892 application” or “’892App.”) filed on May 17, 2021. *Id.*

1. Prosecution history of issued claim 1

As originally filed, there were two independent claims 1 and 6. EX1004 at 48-49. Independent claim 1 recited, in relevant part:

- a “wearable device that can control ambient passthrough in an earpiece comprising”:
 - “a processor configured to execute ... instructions to perform operations” including
 - “communicatively connecting to an earpiece...,”
 - “sending *a mixing value* to the earpiece” and
 - “sending an audio content signal to the earpiece.”

Id., 48.

On December 22, 2022, the Office issued a non-final office action rejecting claims 1-17 under §112. *Id.*, 786-792. The examiner explained that “[t]he written disclosure as filed does not even mention a ‘mixing value’, what structure is used to provide such a value, nor how such a value is used to mix the ambient sound signal and the audio content signal.” *Id.*, 788-789.

In response, the applicant amended the claims in various ways, including to remove the “mixing value” limitation. *Id.*, 887-896. As amended, claim 1 recited “sending an audio content gain value and an ambient sound gain value to the earpiece.” *Id.* The applicant identified paragraph [0069] and Figure 9 of the ’143App. specification as support for the amendments to claim 1. *Id.*, 894.

On April 20, 2023, the examiner mailed an *Ex parte Quayle* action allowing claims 1-20. *Id.*, 897-904. The examiner stated that the prior art does not disclose “an earpiece processor [that] receives an audio content gain value and a ambient sound gain value, to form the modified signals and mix the modified signals” as required by claim 1. *Id.*, 899-900. The examiner did not provide any explanation for how or why the applicant’s claim amendments were supported by the ’143 application. *See id.*

In a 312 Amendment dated April 20, 2023 (the same day as the *Ex parte Quayle* action), the applicant amended claim 1 to remove the “display” limitation

and various other amendments. *Id.*, 927. On May 23, 2023, the examiner mailed a Notice of Allowance. *Id.*, 934.

2. Prosecution history of issued claim 8

Issued claim 8 corresponds to prosecution claim 6. *See* EX1004 at 943. As originally-filed, claim 6 recited, in relevant part,

- “[a] wearable device that can control ambient passthrough comprising:
 - “a processor configured to execute ... instructions to perform operations, the operations comprising:
 - “generating an ambient sound signal from at least one of the modified first microphone signal, the modified second microphone signal or a combination of both;”
 - “detecting an acute sound by analyzing at least one of the modified first microphone signal, the modified second microphone signal or both, and if an acute sound is detected, determining whether the acute sound is a user’s voice”
 - generating a mixed signal by mixing the ambient sound signal with the modified audio content signal, and if a user’s voice is detected modifying the modified audio content signal before forming the mixed signal; and”
 - “sending the mixed signal to the speaker.”

Id., 48-49.

As noted above, on December 22, 2022, the Office issued a non-final office action rejecting claims 1-17 “as failing to comply with the enablement requirement.” *Id.*, 786-792. With respect to claim 6, the examiner explained that it “sets forth that a mixed signal is generated by mixing ambient sound signal with a modified audio content signal and ‘if a user's voice is detected modifying the modified audio content signal before forming the mixed signal’. The written disclosure as filed does not teach such an arrangement as set forth.” *Id.*, 789. The examiner did not elaborate on his rejection any further.

In the March 22, 2023 response to the office action, the applicant removed the limitation that the examiner identified. *Id.*, 890.

On April 20, 2023, the examiner mailed an *Ex parte Quayle* action allowing claims 1-20. *Id.*, 897-904. With respect to claim 6, the examiner identified *Boersma* as the closest prior art and noted that although *Boersma* teaches detecting an acute sound, *Boersma* does not disclose “a device controlling ambient sound passthrough that includes the use of in combination first and second microphones, the signals produced by each being modified; generating an ambient sound signal from these modified signal(s), modifying a modified audio content signal if an acute sound is detected to generate a new modified audio content signal; generating a mixed signal from the ambient sound signal and the modified or new modified audio content signal which is then sent to the speaker as set forth in claim 6.” *Id.*, 900.

V. LEVEL OF ORDINARY SKILL IN THE ART

A person of ordinary skill in the art at the time of the alleged invention of the '473 patent ("POSITA"), which for purposes of this proceeding is no earlier than January 22, 2007, would have had a Bachelor's of Science degree (or equivalent) in electrical engineering, computer science, or a similar field and two years of experience in the design of digital audio systems and associated signal processing such as voice or speech processing and/or acoustic pattern recognition. *Kyriakakis*, ¶19. A greater amount of education could compensate for fewer years of work experience, and vice versa. *Id.* This is the appropriate level of skill whether the claims are entitled to priority as of January 22, 2007 or February 3, 2022. *Id.*

VI. CLAIM CONSTRUCTION

Petitioners are unaware of any "prior claim construction determination" related to the '473 patent. *See* 37 C.F.R. §42.100(b).

Petitioners note that, as to the parent '666 patent, the District Court in the Eastern District of Texas has construed certain claim terms (EX1011) and that, in an *ex parte* reexamination of the '666 patent (90/019,169), the examiner asserted that various claim terms should be interpreted subject to §112, ¶6 (EX1009). The claim terms at issue in the District Court claim construction and *ex parte* re-examination are not present in the '473 patent because the '473 patent claims do not recite a "a

processor that is configured to execute the instructions to perform operations,” and PO does not contend that §112 ¶6 applies. *See* EX1056.

Given the close correlation and substantial identity between the prior art references and the Challenged Claims, no express constructions of the claims are necessary. Thus, the claims should be given their plain and ordinary meaning.³ *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc).

VII. DETAILED EXPLANATION OF GROUNDS

A. The Challenged Claims are Not Entitled to a Priority Date Earlier than February 3, 2022

The Board can consider the challenged claims’ priority date. *See Parus Holdings, Inc. v. Google LLC*, 70 F.4th 1365, 1374 (Fed. Cir. 2023). A priority claim to an earlier application is valid only if the earlier application, inter alia, provides adequate written description for the claims pursuant to §112. 35 U.S.C. §120; *Anascape, Ltd. v. Nintendo of Am., Inc.*, 601 F.3d 1333, 1335 (Fed. Cir. 2010) (“To obtain the benefit of the filing date of a parent application, the claims of the later-filed application must be supported by the written description in the parent ‘in sufficient detail that one skilled in the art can clearly conclude that the inventor invented the claimed invention as of the filing date sought.’”) (quotations omitted).

³ Petitioners reserve all rights to raise claim construction arguments and other arguments in any parallel or future litigation concerning the ’473 patent.

“[T]he critical inquiry is whether the applicant has provided a description that in a definite way identifies the claimed invention in sufficient detail that a person of ordinary skill would understand that the inventor was in possession of it at the time of filing.” *Alcon Rsch. Ltd. v. Barr Labs., Inc.*, 745 F.3d 1180, 1190–91 (Fed. Cir. 2014) (quotations omitted).

Here, Petitioners demonstrate that numerous limitations of both the independent and dependent claims lack written description support in the ’892 application (the ’473 patent’s parent application), but the analysis would be no different if any other application in the ’473 patent’s priority chain were considered.

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

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

Claim 1 recites “a device” that includes a memory and processor that executes instructions to perform operations including “communicatively connecting to an earpiece” and “sending an audio content gain value and an ambient sound gain value to the earpiece” and wherein the earpiece processor “applies the audio content gain value to the audio content signal” and “applies the ambient sound gain value to an ambient sound signal.” ’473pat., 13:58-66. This is part of the limitation that the examiner considered an important distinction over the closest prior art of record. EX1004 at 899-900. No such device is disclosed in the ’892App.

During prosecution, the applicant stated that the support for that limitation could be found in paragraph [0069] and Figure 9 of the '143App. EX1004 at 894. The corresponding paragraphs and Figure of the '892App. (also paragraph [0069] and Figure 9) do not disclose such a device. EX1006 at 13, 51; *Kyriakakis* ¶103. To be sure, '892App. paragraph [0069] describes a step of the method shown in Figure 9 for calculating “AGC coefficients,” but the '892App. only discloses that the method can be performed “in a single earpiece, a pair of earpieces, headphones, or other suitable headset audio delivery devices” ('892App. ¶[0066]), and there is no hint that the “AGC coefficients” can be calculated by a processor separate from an earpiece processor and then sent to the earpiece. *Kyriakakis* ¶104.

PO may argue that the '892App. discloses in paragraph [0040] that “[t]he earpiece 100 can further represent a single operational device or a family of devices configured in a master-slave arrangement, for example, a mobile device and an earpiece. In the latter embodiment, the components of the earpiece 100 can be reused in different form factors for the master and slave devices.” This disclosure is insufficient. *Kyriakakis* ¶105. Paragraph [0040] leaves all details of any potential “master-slave arrangement” up to the creativity of the public. *Id.* There is no hint of an arrangement in which “gain values” are sent from a processor to an earpiece. *Id.* Even if paragraph [0040] rendered claim 1 obvious, that is not enough. *Tronzo v. Biomet, Inc.*, 156 F.3d 1154, 1158 (Fed. Cir. 1998).

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

Even if the Board finds that the '892App. discloses a device with a processor that sends “gain values” to an earpiece, there is no disclosure of a device that sends *both* an audio content signal *and* the claimed gain values to an earpiece. *Kyriakakis* ¶106. The '892App. discloses that the earpiece includes an “audio interface” which can “receive the audio content from at least one among a portable music player, a cell phone, and a portable communication device.” '892App. ¶[0044]. There is no disclosure that the same device that transmits audio content can also send the claimed “gain values.” *Kyriakakis* ¶106.

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

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

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

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

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

A POSITA would have understood that the plain language of this limitation encompasses (1) combining the signals from two ambient sound microphones together or (2) combining a signal from an ASM and an ECM. *Kyriakakis* ¶109. The '892App. does not disclose combining any microphone signals together, let alone combining an ASM and an ECM signal together, or performing the claimed “generating” and “detecting” steps in connection with combined microphone signals. *Id.* Claims 9 and 14 include similar limitations and are not supported by the '892App. for the same reason. *Id.*

This feature was considered important by the examiner in distinguishing over the closest prior art. EX1004 at 900 (The examiner noting that although *Boersma* teaches detecting an acute sound, *Boersma* does not disclose, among other things, “a device ... that includes the use of in combination first and second microphones, the

signals produced by each being modified; generating an ambient sound signal from these modified signal(s).”).

Moreover, PO’s infringement contentions in the parallel district court case show that PO’s infringement theory hinges at least in part on a combination of microphone signals. EX1056 at 124-128 (PO’s evidence referring to how the accused Galaxy Buds products purportedly “combine signals from both microphones and enable User Voice Pick Up to produce clear audio” and “[d]epending on the noise level, Galaxy Buds select and combine audio from the inner or outer microphone”).

A POSITA would have understood that a step for combining microphone signals would have been meaningfully more complex and would have at least required an additional processing step that is not disclosed in the ’892App. *Kyriakakis* ¶111. A POSITA would have understood that combining the ambient microphone signals to encompass what is known in the art as beamforming. *Id.* ¶111 (citing *Woodruff* ¶[0024]). Beamforming would have had benefits that the named inventors of the ’892App. did not envision or describe, such as reducing noise in the ambient signal passed through to the user and providing the user with an ambient signal focused on the ambient sound of interest rather than all ambient sound. *Kyriakakis* ¶111.

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

Claims 10 (and claims 11 and 12, by virtue of their dependency from claim 10) require “generating a noise reduction signal.” *’473pat.*, 14:62-15:9. A POSITA would have understood a “noise reduction signal” to be a signal that, when mixed with a noisy signal, has the effect of reducing noise. *Kyriakakis* ¶112. There is no disclosure in the *’892App.* of generating a “noise reduction signal.” At best, the *’892App.* includes certain references to “noise reduction” in the context of describing the “noise reduction rating” of the earpiece “due to physical and sealing properties of the earpiece.” *’892App.* ¶[0043]. A POSITA would have understood that these references do not relate to a processor generating a “noise reduction signal.” *Kyriakakis* ¶112.

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

Claim 11 requires “mixing the noise reduction signal with the mixed signal to generate a new mixed signal, and sending the new mixed signal to the speaker instead of the mixed signal.” *’473pat.*, 15:1-5. Because there is no disclosure of “generating a noise reduction signal,” there is no disclosure of mixing that noise reduction signal with another “mixed signal.” At best, the method of Figure 9 discloses a step related mixing audio content and an ASM signal. *’892App.* ¶[0069],

FIG. 9 (step 940). There is no additional, separate step for further mixing a “noise reduction signal.” *Kyriakakis* ¶113.

B. Ground 1: *Kirsch* and *DiCenso* Render Obvious Claims 1-7

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

Kirsch and *DiCenso* are analogous to the '473 patent because they are within the same field of endeavor of the '473 patent and reasonably pertinent to one or more problems addressed by the '473 patent. As detailed below, *Kirsch* and *DiCenso* have similar, complementary disclosures, and a POSITA would have been motivated to combine their teachings in a manner than renders claims 1-7 obvious and would have had a reasonable expectation of success in doing so. *Kyriakakis* ¶¶114-138. As detailed below, *Kirsch* discloses a functional system diagram for an audio system that mixes processed audio signals obtained from ambient microphones and obtained from an audio playback device (e.g., music) in a selective manner. *Kirsch* discloses that its audio system is for a personal listening device (e.g., earbuds), that it may be implemented with a digital signal processor, and that the parameters of the system may be controlled by a remote smartphone application. *DiCenso* discloses a wearable device (e.g., earbuds) that communicate with a remote mobile device (e.g., smartphone) to receive both music and preferences related to the relative mix of ambient sounds and music. A POSITA would have recognized that *DiCenso*'s

system was a suitable environment in which to implement *Kirsch*'s audio system. *Kyriakakis* ¶114.

a. Overview of *Kirsch*

Kirsch discloses “an audio processing system for a personal listening device,” such as earbuds. *Kirsch*, Abstract, ¶[0002]. As background, *Kirsch* explains that earbuds provide an “acoustic seal” which improves the quality of the user’s acoustic experience, but that causes a problem because the user may not hear important environmental sounds. *Id.* ¶¶[0002]-[0003]. *Kirsch* acknowledges that a known solution for that problem is to “electronically mix audio from the environment with the audio signal received from the playback device.” *Id.* ¶[0004]. But there is a drawback with that solution: “the listener typically hears all audio from the environment rather than just the specific environmental sounds that the listener desires to hear.” *Id.* ¶[0004]. Thus, *Kirsch* explains that “a more effective technique for providing both playback audio and environmental sound to a personal listening device would be useful.” *Id.* ¶[0005].

Kirsch discloses “an audio processing system for a personal listening device” that may be implemented with a “central processing unit (CPU), digital signal processor (DSP), a microcontroller, an application-specific integrated circuit (ASIC), or any device or structure configured to process data and execute software applications.” *Id.* ¶¶[0006], [0016]. The system includes a “set of microphones ...

integrated into the personal listening device and configured to receive a first set of audio signals from an environment.” *Id.* More particularly, the system includes a left microphone array 105(0) and a right microphone array 105(1) that receive audio from the physical environment in the vicinity of the user’s left ear and right ear, respectively. *Id.* ¶[00117], FIG. 1. Each array includes at least two microphones. *Id.*

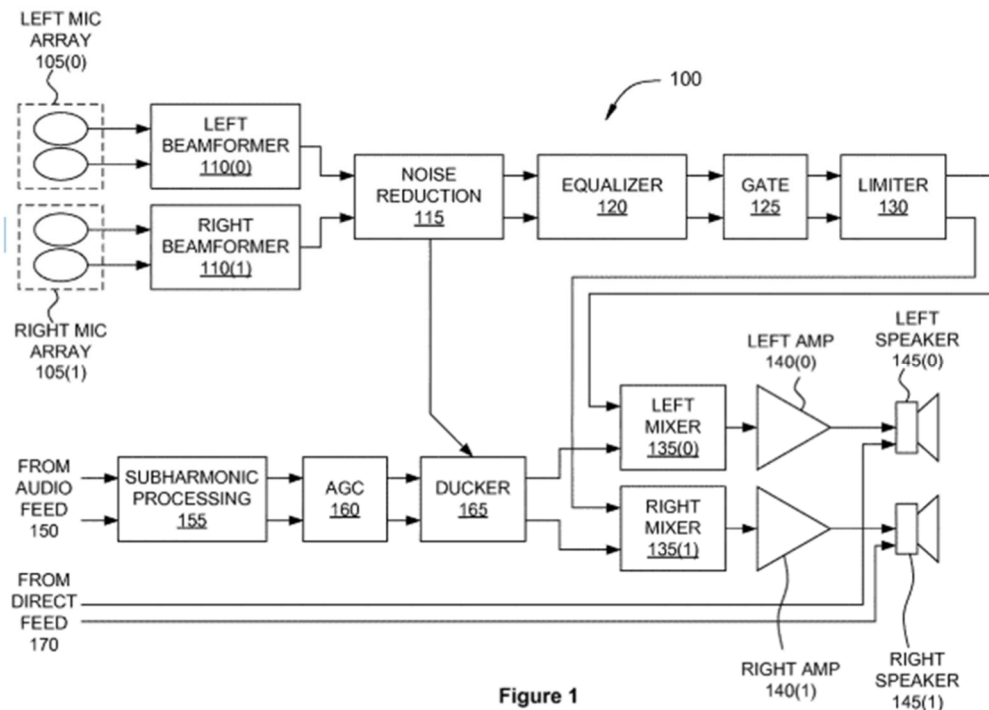


Figure 1

Kirsch, FIG. 1.

Audio signals from the microphones and audio signals from a playback device and audio feed (such as music) are mixed and output to the user. *Kirsch*, Abstract, ¶[0031]. The audio signals from the microphone arrays are received and processed by several modules that, in sum, reduce steady-state noise and only pass signals of interest from the environment to the left mixer 135(0) and a right mixer 135(1).

Kyriakakis ¶¶117-123. Particularly relevant for this Petition are the beamforming modules, the noise reduction modules, and the mixers:

- **“Beamformers 110(0) and 110(1)** receive audio signals from microphone arrays 105(0) and 105(1)” and “process the received audio signals according to one of a number of modes” *Id.* ¶[0018]. “In some embodiments, the signal received from one of the microphones in microphone arrays 105(0) and 105(1) is digitally delayed and then subtracted from the signal from another one of the microphones in the microphone arrays 105(0) and 105(1).” *Id.* ¶[0019]. The beamformers may “amplify signals originating from certain directions while attenuating signals originating from other directions.” *Id.* ¶[0020].
- **The noise reduction module 115** “analyzes the received audio signal, suppresses signals determined to be of less interest, such as steady-state or noise signals, and passes signals determined to be signals of interest, such as transient signals.” *Id.* ¶[0021]. “In general, steady-state signals may correspond to background noise, including, without limitation, traffic din, hum, hiss, rain, and wind.” *Id.* ¶[0021]. “On the other hand, transient signals may correspond to signals of interest, including, without limitation, human speech, honking automobile horns, and sirens.” *Id.* ¶[0022]. “These types of important sounds emanating from the environment are typically characterized as an audio signal that has a high audio level relative to the average background audio level and is intermittent, acting as

an interruption.” *Id.* ¶[0024]. “Noise reduction 115 may pass such transient signals to equalizer 120 and optionally may amplify the transient signals.” *Id.* ¶[0022].

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

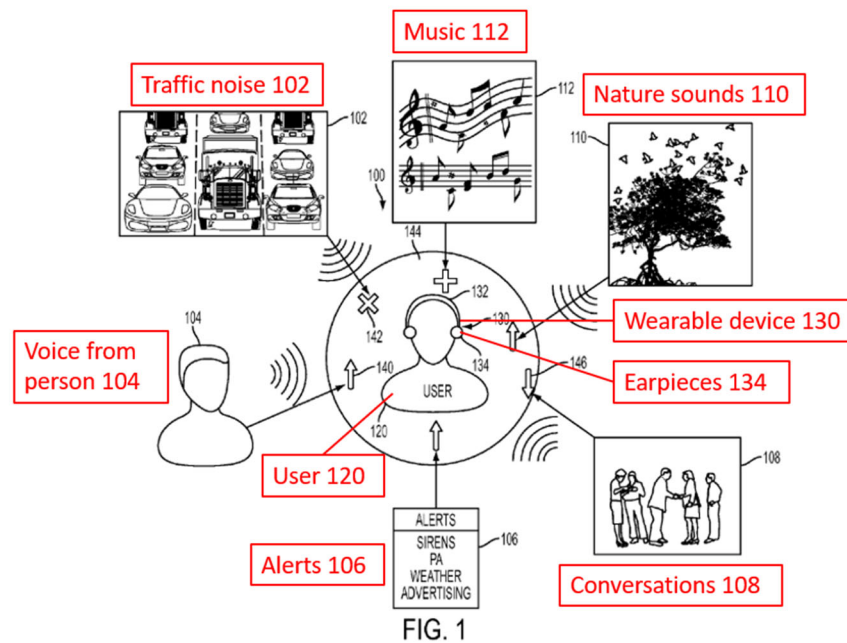
Kirsch discloses that “the listener may control certain functions or set certain parameters of audio processing system 100” including volume settings, “via an application that executes on a computing device, including, without limitation, a smartphone, a tablet computer, or a laptop computer” that communicates with the audio processing system via, for example, Bluetooth. *Kirsch* ¶[0035]; *Kyriakakis* ¶124.

b. Overview of *DiCenso*

DiCenso “relates to systems and methods for a user controllable auditory environment using wearable devices such as ... in-ear devices, for example, to

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

With reference to Figure 1, *DiCenso* discloses a system 100 that “includes a user 120 surrounded by an ambient auditory environment including a plurality of types or groups of sounds.” *Id.* ¶[0019]. “[S]ystem 100 includes a wearable device 130.” *Id.* ¶[0022]. The wearable device “may be implemented by ... ear buds 134,” which each contain a speaker and “one or more microphones” such as “an ambient microphone to detect ambient sounds” and an “internal microphone used in a closed loop feedback control system for cancellation of user selected sounds.” *DiCenso* ¶[0022], FIG. 1.



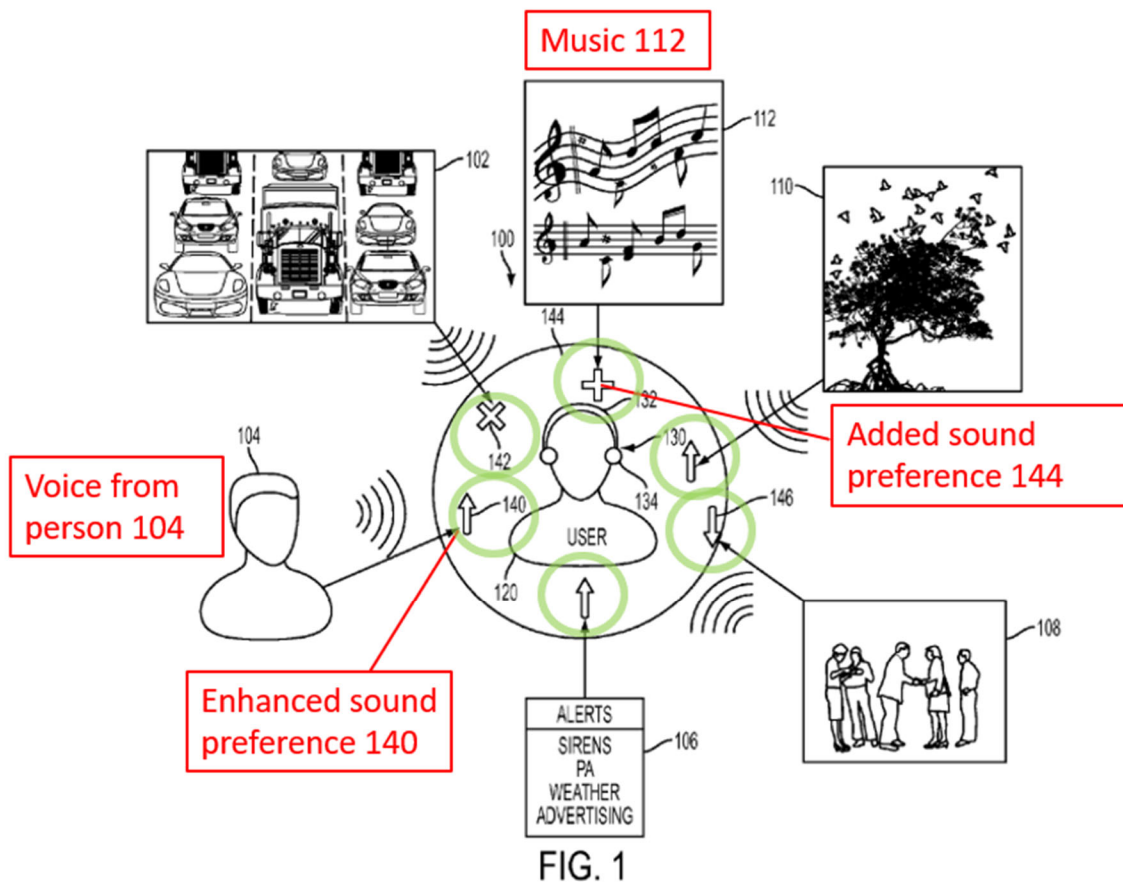
DiCenso, FIG. 1 (annotated)

DiCenso also refers to the earbuds 134 as “earpieces 134” which may be “configured for positioning around a respective ear of user 120.” *Id.* “In one embodiment, earpieces 134 are in-the-ear devices.” *Id.* More particularly, the earpieces 134 “may be implemented by highly miniaturized devices that fit completely in the ear canal.” *Id.* ¶[0024]. “[E]arpieces 134 may isolate the user from the ambient auditory environment ..., while, at the same time, reproducing only the desired sound sources either with or without enhancement or augmentation.” *Id.* ¶[0025]; *see also id.* ¶[0023].

DiCenso further explains that “wearable device 130 ... includes ... a microprocessor-based digital signal processor (DSP).” *Id.* ¶[0022]. A POSITA

would have understood *DiCenso* to disclose or suggest that at least one of the two earpieces includes the processor. *Kyriakakis* ¶128. This is because *DiCenso* discloses that the wearable device 130 “may be implemented within earpieces 134” (*id.* ¶[0025]), and that the earpieces 134 may be implemented to “fit completely in the ear canal” (*id.* ¶[0024]). In other words, because the wearable device may be implemented within the earpieces, and the earpieces may be implemented completely within the ear canal, a POSITA would have understood that at least one of the two earpieces contains a processor. *Kyriakakis* ¶128. This is underscored by *DiCenso*’s method in Figure 2, which explains that the user’s preferences “get communicated to the in-ear devices” (*DiCenso*, FIG. 2 (block 230)) and that “the in-ear devices apply the user’s preferences” (*DiCenso*, FIG. 2 (block 240)) which suggests to a POSITA that at least one of the in-ear earpieces includes its own processor and circuitry for receiving and applying the user’s preferences to audio signals. *Kyriakakis* ¶1278.

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



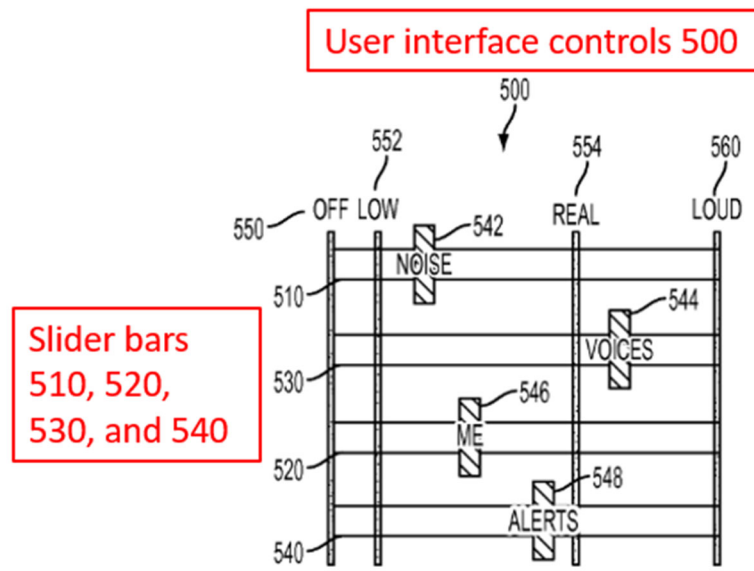
DiCenso FIG. 1 (annotated)

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

other audio streams (phone calls, recordings, spoken language digital assistant, etc.).” *Id.* ¶[0030].

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

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



DiCenso FIG. 5 (annotated)

DiCenso further discloses various use cases for its system. In one example, “[a] user is about to go for a run” and “[s]he sets the wearable device preferences using a user interface on her smartphone.” *Id.* ¶[0062]. “She decides to keep hearing the traffic noise to avoid being hit by a vehicle, however she chooses to dim it down.” *Id.* She selects a playlist to be streamed in her ears at a certain volume from her smartphone or another external device and she chooses to enhance the sound of birds and nature to make this run even more enjoyable.” *Id.* Thus, *DiCenso* discloses an embodiment in which a user may set the preferences for her auditory environment from the same smartphone that streams a playlist to her ears. *Id.*

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

A POSITA would have been motivated to combine *Kirsch* and *DiCenso* in a manner that renders claims 1-7 obvious and would have had a reasonable expectation of success. *Kyriakakis* ¶¶134-138. *Kirsch* and *DiCenso* are similar and complement each other in multiple ways. *Id.* ¶133. For example, both *Kirsch* and *DiCenso* are generally directed to controlling the ambient sounds that the user hears through a set of earbuds or earpieces. *DiCenso*'s teachings advance *Kirsch*'s objectives by providing more fine-tuned control over the ambient sounds that are output to the user than what *Kirsch* provides. *Id.* In particular, while *Kirsch* generally discloses passing transient sounds of interest to the user, *DiCenso* provides a system for selectively amplifying or attenuating certain sounds of interest specifically, such as only sirens but not car horns. *Id.*

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

advantageously be used to implement *Kirsch*'s audio processing system to mix audio signals in a user-controlled manner. *Id.* ¶135.

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

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

wearable device receiving user's preferences for controlling the audio processing system). *Id.* ¶137.

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

2. Claim 1

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

To the extent the preamble is limiting, *Kirsch* in combination with *DiCenso* discloses or suggests it. *Kyriakakis* ¶¶139-141.

As detailed in §VII.B.1.b, *DiCenso* discloses a smartphone with a user interface that allows the user to set auditory preferences communicated to a wearable device implemented by earpieces. The preferences are used to, for example, amplify or attenuate particular sounds from the ambient auditory environment. *DiCenso* ¶[0046]. Moreover, the combination renders obvious *DiCenso*'s earpiece processor applying the preferences to amplify or attenuate specific sounds of interest from the environment and adjust the weight given to the sound of interest by *Kirsch*'s mixer.

This is consistent with how a POSITA would have understood how a smartphone (“a device”) would “control ambient passthrough in an earpiece.” *Id.* ¶140

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

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

Kirsch in combination with *DiCenso* discloses or suggests this feature. *Kyriakakis* ¶¶142-144.

DiCenso discloses that the smartphone with the user interface has a microprocessor with an associated memory. *DiCenso* ¶¶[0005], [0006], [0033], [0039]; *Kyriakakis* ¶143. *DiCenso* discloses that the functions ascribed to the user interface on the smartphone such as setting auditory preferences, and communicating the preferences to the earpieces, “may be performed by hardware and/or software executed by a programmed microprocessor” and that the software may be stored in a computer-readable storage medium (i.e., a memory) that stores “executable instructions.” *Id.* ¶[0031]; FIG. 2; *Kyriakakis* ¶143.

Accordingly, a POSITA would have understood the *Kirsch-DiCenso*

combination to disclose or suggest that the smartphone includes a microprocessor and memory for implementing the functions related to setting user preferences with the user interface and communicating them to the earpiece (“a first memory that stores instructions; and a processor that executes the instructions to perform operations”). *Kyriakakis* ¶144.

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

Kirsch in combination with *DiCenso* discloses or suggests this feature. *Kyriakakis* ¶¶145-149.

DiCenso discloses that the “[w]earable device 130, which may be implemented within earpieces 134, may ... be equipped with wireless communication ... to connect with various external sound sources [and] an external user interface.” *DiCenso* ¶[0025]. As detailed in §VII.B.1.b, *DiCenso* discloses implementing a user interface with a smartphone (the “device”) for inputting user preferences, and *DiCenso* further explains that the “[u]ser preferences are then communicated to the DSP associated with earpieces 134 through wired or wireless technology.” *Id.* ¶[0023]; *see also id.* ¶[0034], FIG. 2 (step 230). In view of these disclosures, a POSITA would have understood *DiCenso* to disclose or suggest that the processor of the smartphone executes instructions to “communicatively connect”

to at least one of *DiCenso*'s earpieces. *Kyriakakis* ¶146.

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

Moreover, as also detailed in §VII.B.1.b, a POSITA would have understood that at least one of the two earpieces contains a processor. A POSITA would have understood that processors, and digital signal processors in particular, commonly include a memory for storing programs and/or data. *Id.* ¶148 (citing *Oshana* at xi, 124).

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

a second memory and an earpiece processor”). *Id.* ¶149.

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

Kirsch in combination with *DiCenso* discloses or suggests these features. *Kyriakakis* ¶¶150-159.

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

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

DiCenso explains that the user preferences may be applied to “sounds from the ambient auditory environment **and/or** external sources.” *Id.* ¶[0046]. A POSITA would have understood that “sounds from the ambient auditory environment” are “ambient sounds” and that, in the *Kirsch-DiCenso* combination, correspond to

Kirsch's signals of interest from the environment. *Kyriakakis* ¶153. That is, a POSITA would have understood the combination to disclose or suggest using *DiCenso's* user interface to capture user preferences including a gain value for *Kirsch's* signals of interest from the environment. *Id.*

A POSITA would have understood *DiCenso's* “sounds from ... external sources” refers to a sound signal from an external device such as streaming music. *DiCenso* ¶[0005], [0041], [0042], [0049], [0062], [0074], [0076]; *Kyriakakis* ¶154. In other words, *DiCenso* discloses using the user interface to capture the user's preferences (e.g., a gain value) regarding the volume of sounds provided by external sources such as steaming music. *Kyriakakis* ¶154. The *Kirsch-DiCenso* combination discloses or suggests using *DiCenso's* user interface to capture the user's preferences including a gain value regarding *Kirsch's* playback audio signal. *Id.*

Kirsch's signals of interest from the environment constitute “ambient sounds” within the meaning of the '473 patent, and *Kirsch's* playback audio signals constitute “audio content” within the meaning of the '473 patent. '473pat., 3:8-10; *Kyriakakis* ¶155.

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

discloses or suggests communicating a gain value to be applied to ambient sounds (“ambient sound gain value”) and a gain value to be applied to audio content (“audio content gain value”) to the earpiece processor. *Id.* ¶157.

DiCenso discloses an embodiment in which the user’s smartphone captures and sends the user’s preferences as well as an “audio content signal.” *Id.* ¶[0062]; *Kyriakakis* ¶158. In particular, *DiCenso* describes a use case in which a user “sets the wearable device preferences using a user interface on her smartphone.” *Id.* The user dims down traffic noise, and “selects a playlist to be streamed in her ears at a certain volume from her smartphone.” *Id.* The playlist streamed in her ears at a certain volume from her smartphone discloses or suggests transmitting an “audio content signal” to the earpiece. *Kyriakakis* ¶158.

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

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

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

Kyriakakis ¶¶160-164.

As detailed in §VII.B.1.c, the *Kirsch-DiCenso* combination renders obvious *DiCenso*'s earpiece processor receiving the user's preferences from the smartphone and applying the user's preferences to control the weights applied by *Kirsch*'s mixers to the audio signals representing the sound of interest and playback audio.

A POSITA would have understood that the signal representing the sound of interest to be an “ambient sound signal” within the context of the '473 patent because it represents sounds in the ambient environment. '473pat., 6:40-49; *Kyriakakis* ¶162. A POSITA would have understood that *Kirsch*'s audio playback signal is an “audio content signal” within the context of the '473 patent because it represents sounds from an audio playback device. '473pat., 12:29-32; *Kyriakakis* ¶162.

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

based on the audio content gain value received from *DiCenso*'s smartphone user interface and it modifies the music signal. *Id.* ¶163. Similarly, a POSITA would have understood that applying the weight to the signal of interest from the environment constitutes “appl[ying] the ambient sound gain value to an ambient sound signal to generate a modified ambient sound signal.” *Id.* A POSITA would have understood that after *Kirsch*'s mixers apply the applicable weights to the signal of interest, the mixers output the mixed signal. *Id.*

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

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

Kirsch in combination with *DiCenso* discloses or suggests this claim.
Kyriakakis ¶¶165-169.

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

As also detailed in §VII.B.1.a, the noise reduction module identifies signals of interest, which are “typically characterized as an audio signal that has a high audio level relative to the average background audio level and is intermittent, acting as an interruption.” *Kirsch* ¶[0024]. “If noise reduction 115 detects such a signal, then noise reduction 115 transmits a corresponding signal to ducker 165” (*id.* ¶[0024]) and the ducker “reduces, or ducks, the audio from the playback device when a signal

of interest is received from the environment” and “the listener more readily hears signals of interest from the environment” (*id.* ¶[0033]).

In view of the above disclosures, a POSITA would have understood *Kirsch* to disclose or suggest that its audio processing system calculates an “average background noise level” based upon a signal from an external microphone and reduces the audio from the playback device when it detects a transient sound above the background noise level. *Kyriakakis* ¶168. In this way, *Kirsch* discloses modifying the mixed signal based upon the average background noise level. *Id.*

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

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

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

Kyriakakis ¶¶170-174.

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

A POSITA would have understood that the signal representing a sound of interest was generated through multiple processing steps. *Kyriakakis* ¶173. More particularly, as explained in §§VII.B.1.a and VII.B.3, a POSITA would have understood *Kirsch* to disclose an embodiment in which one of the signals from one of the microphones in the array (a “first microphone signal from a first microphone”) is sent to the noise reduction module. *Kirsch* discloses that the noise reduction module may “amplify” a signal of interest before passing it to the equalizer. *Kirsch* ¶[0022] (“Noise reduction 115 may pass such transient signals to equalizer 120 and optionally may amplify the transient signals.”). A POSITA would have understood that amplifying a signal includes applying a gain to the signal. *Kyriakakis* ¶173. A

POSITA would have understood that the gain applied by the noise reduction module is an “ambient gain” because it is applied to a signal representing a sound from the environment (“ambient sound”). *Id.*

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

5. Claim 4: The device according to claim 1 further including a user interface.

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

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

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

C. Ground 2: *Goldstein* in combination with *Woodruff* Render Obvious Claims 8-20

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

Goldstein shares a specification with the ’473 patent and therefore discloses the same earpiece and methods summarized above in §IV.A. *Goldstein* also shares a specification with the ’892App. Thus, as detailed in §VII.A.2, although *Goldstein* discloses some limitations of claims 8-20, *Goldstein* does not disclose others. *Kyriakakis* ¶177.

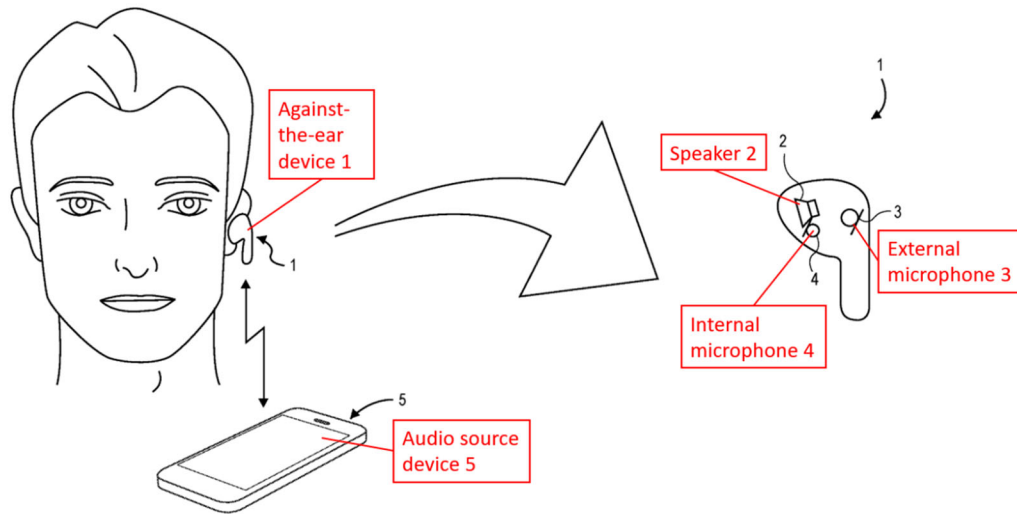
Woodruff is analogous to the ’473 patent because it is within the same field of endeavor of the ’473 patent and reasonably pertinent to one or more problems addressed by the ’473 patent. A POSITA would have been motivated to combine *Goldstein* with *Woodruff* in a manner that renders claims 8-20 obvious and would have had a reasonable expectation of success in doing so. *Kyriakakis* ¶¶178-193. *Woodruff* discloses several features of the challenged claims that are not disclosed

by *Goldstein*. Namely, aspects related to combining microphone signals and noise reduction signals. *Kyriakakis* ¶177.

a. Overview of *Woodruff*

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

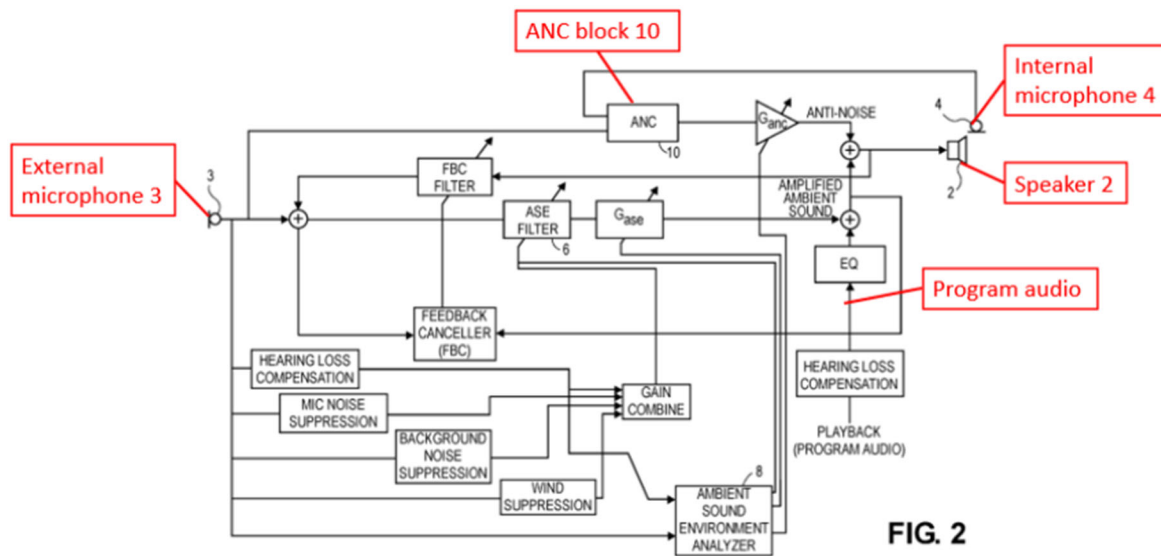
Woodruff therefore discloses “an audio system that has an ambient sound enhancement function.” *Id.* ¶[0004]. Figure 1 shows an “against-the-ear device 1” in which *Woodruff*’s ambient sound enhancement function is implemented. *Id.* ¶[0020].



Woodruff FIG. 1 (annotated)

“The against-the-ear device 1 has [a] speaker 2..., an external microphone 3 ..., and an internal microphone 4.” *Id.* ¶[0020]. “These may all be integrated in a housing of the against-the-ear device, along with the transducers and the electronics that process and produce the transducer signals (output microphone signals and an input audio signal to drive the speaker 2.)” *Id.* This is similar to the earpiece disclosed by *Goldstein*. *Kyriakakis* ¶180.

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



Woodruff, FIG. 2 (annotated)

In operation, “[a]mbient sound in an acoustic environment ... is picked up by the external microphone 3” and “[i]ts output, digitized microphone (audio) signal is then filtered by an [ambient sound enhancement (ASE)] filter 6.” *Id.*

¶[0022]. A “gain combine process combines information from various detectors, to determine the transfer function of the ASE filter 6.” *Id.* “These detectors may provide information about ... the hearing profile of the user (hearing loss compensation block.)” *Id.* “Such information is then used by the gain combine process, to determine how to configure the ASE filter 6” which may be “tuned for compensating the user’s hearing loss.” *Id.*

After the ASE filter 6, the ambient sound “is filtered in a frequency-dependent transparency gain block G_{ase} , which is controlled by an ambient sound environment analyzer 8 according to the hearing profile of the user (based on input

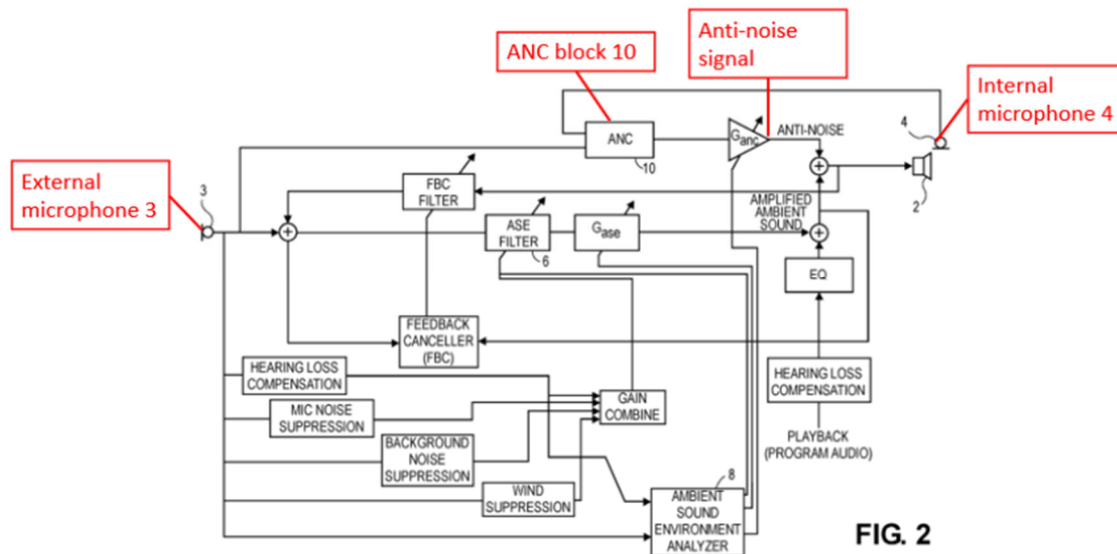
from the hearing loss compensation block.).” *Id.* ¶[0025], FIG. 2; *Kyriakakis* ¶183.

“When the ambient sound enhancement function is active ..., [an] ambient sound environment analyzer 8 may detect that the ambient sound environment changes from quiet to loud.” *Id.* ¶[0026]. In response, “the analyzer 8 signals the G_{ase} gain block to reduce its gain, and it may do so in accordance with a hearing profile of the user.” *Id.* ¶[0026]. After the transparency gain block G_{ase} , “[t]he ambient sound content is then combined with a playback signal which contains program audio” and “[t]his combined audio signal then drives the speaker 2, thereby reproducing the ambient sound.” *Id.* ¶[0025]. Other examples of user context that may be detected by the sound environment analyzer 8 include “the type of ambient sounds that are being picked up, e.g., fire alarm, mechanical machine noise, city street sound, highway noise, construction site noise, train subway noise, babble, nature sounds, television, etc.” *Id.* ¶¶[0033], [0037].

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

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

“The ANC block 10 is ... based on a hybrid feedforward and feedback algorithm (using input from both the external microphone 3 (also referred to as the reference microphone) and the internal microphone 4 (also referred to as the error microphone).” *Id.* ¶[0029]. And as shown in *Woodruff* Figure 2, ANC block 10 takes as its input a signal from the external microphone and internal microphone and outputs an anti-noise signal. *Id.* FIG. 2; *Kyriakakis* ¶187. The anti-noise signal is input to a gain G_{anc} block. *Id.* ¶[0030]. “In response to detecting that the ambient sound changes from quiet to loud, the analyzer 8 signals [the] G_{anc} block to raise the level of the produced anti-noise (during reproduction of the ambient sound).” *Id.*



Woodruff, FIG. 2 (annotated)

Woodruff notes that although the figures show a single microphone symbol for external microphone 3 and internal microphone 2) ... the sound pickup channel may be the result of combining multiple microphone signals, e.g., by a beamforming process performed on a multi-channel output from a microphone array.” *Id.* ¶[0024].

b. Motivation to combine

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

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

Goldstein discloses that its earpiece may fully occlude the ear canal. *Goldstein* ¶[0033]. A POSITA would have understood that such earpieces cause an “occlusion effect” which is uncomfortable to users, and that it would have been advantageous to reduce the occlusion effect. *Kyriakakis* ¶191 (citing *Rasmussen* ¶[0002]). *Woodruff* discloses that its anti-noise signal mitigates the occlusion effect. *Woodruff* ¶[0029] (“The anti-noise delivered into the user's ear may mitigate some of the occlusion effect (caused by the against-the-ear device blocking the ear.).”).

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

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

2. Claim 8

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

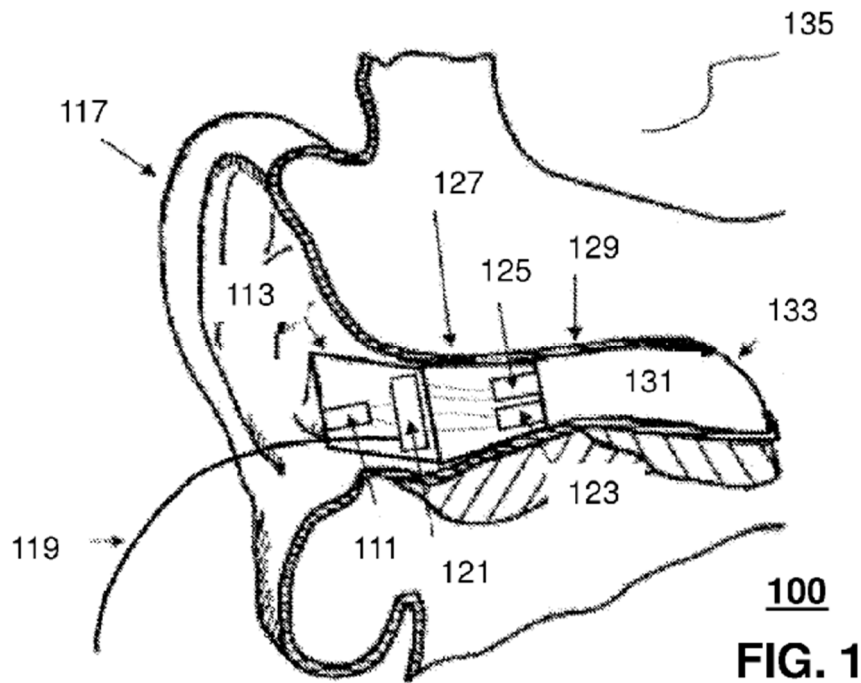
To the extent the preamble is limiting, *Goldstein* discloses or suggests this feature. *Kyriakakis* ¶¶194-195. For example, *Goldstein* discloses “a single earpiece, a pair of earpieces, headphones, or other suitable headset audio delivery device” that implement “a method 300 for acute sound detection and reproduction.” *Goldstein* ¶[0041]. *Goldstein* further explains that “[i]f at step 310, an acute sound is detected within the ambient sound, the earpiece 100 activates ‘sound pass-through’ to reproduce the ambient sound in the ear canal by way of the ECR 125.” *Id.* ¶[0046].

Accordingly, a POSITA would have understood *Goldstein* to disclose or suggest an earpiece, pair of earpieces, or headphones (“a device”) that can detect an

acute sound and activate sound pass-through to reproduce the ambient sound in the ear canal (“that can control ambient sound passthrough”). *Kyriakakis* ¶195.

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

Goldstein discloses or suggests these features. *Kyriakakis* ¶¶196-206. For example, *Goldstein* discloses an earpiece 100 that includes Ambient Sound Microphone (ASM) 111, Ear Canal Receiver (ECR) 125 or speaker, and Ear Canal Microphone (ECM) 123. *Goldstein* ¶[0034]. The earpiece also includes a processor operatively coupled to the ASM 111, ECR 125, and ECM 123. *Id.* ¶[0036]. “All transducers ... can receive or transmit audio signals to a processor 121.” *Id.* ¶[0035]. A POSITA would have understood *Goldstein*’s reference to “[a]ll transducers” to include the ASM and ECM because microphones are transducers. *Kyriakakis* ¶198. The earpiece also includes a memory that “can store program instructions for execution on the processor.” *Id.* ¶[0036], FIG. 2.



Goldstein, FIG. 1

Goldstein discloses an embodiment in which “a pair of earpieces” carry out the disclosed methods. *See, e.g., Goldstein* ¶[0053]. In such an embodiment, a POSITA would have understood that the ASM in one earpiece may be the claimed “first microphone” and that the ASM in the other earpiece in the user’s other ear meets the claimed “second microphone.” *Kyriakakis* ¶200. This interpretation is consistent with how similar claim language was interpreted during prosecution of U.S. Patent 11,244,666—a parent to the ’473 patent that shares a specification with the ’473 patent—where the applicant was required to amend the claims to require an ear canal microphone. *See* EX1008 at 117, 76-84, 68-75; *Kyriakakis* ¶¶201-205. In particular, the applicant distinguished the prior art by amending the limitation

reciting “a second microphone configured to measure an acoustic environment closer the [*sic*] ear canal of a wearer than that measured by the first microphone” to further require that the second microphone have “a second microphone port that is configured to face toward the user when the earphone is inserted.” EX1008 at 73. The applicant explained that the amendment was meant to clarify that the “second microphone” was “an ear canal microphone (ECM).” *Id.* at 73-74. No such limitation is present in claim 8 of the ’473 patent. Thus, the “second microphone” need not be an “ear canal microphone.” *Kyriakakis* ¶205.

Accordingly, a POSITA would have understood *Goldstein* to disclose or suggest an earpiece including an ambient sound microphone that outputs an audio signal (“a first microphone that measures a first acoustic environment to generate a first microphone signal”), a second earpiece with a second ambient sound microphone that outputs an audio signal (“a second microphone that is positioned closer to a user’s ear canal than the first microphone when the device is worn, where the second microphone generates a second microphone signal”), an ear canal receiver (“speaker”), a memory that stores program instructions to be executed by a processor (“a memory that stores instructions; and a processor that executes the instructions to perform operations”). *Id.* ¶206.

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

Goldstein discloses or suggests these features. *Kyriakakis* ¶¶207-209. *Goldstein* discloses that “[t]he earpiece 100 can include an audio interface 212 operatively coupled to the processor 206 to receive audio content, for example from a media player or cell phone, and deliver the audio content to the processor 206.” *Goldstein* ¶[0037]. *Goldstein* further discloses a method “for maintaining constant audio content level (ACL) to internal ambient sound level (iASL)” in which one step is to “receive[] as input an Audio Content signal 902, e.g. a music audio signal from a portable Media Player or mobile-phone, which is processed with analog and digital signal processing system as shown in step 908.” *Goldstein* ¶[0067]. Figure 9 block 908 states “SIGNAL, ADC, EQ, GAIN etc.” *Id.*, FIG.9. A POSITA would have understood that EQ refers to a step for equalizing the signal, and that equalizing a signal modifies the signal. *Kyriakakis* ¶208.

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

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

Goldstein discloses or suggests these features. *Kyriakakis* ¶¶210-213.

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

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

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

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

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

Kyriakakis ¶¶214-216.

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

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

second microphone signal or a combination thereof”). *Id.* ¶216.

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

Goldstein in combination with *Woodruff* discloses or suggests this feature. *Kyriakakis* ¶¶217-219. *Goldstein* discloses in Figure 4 a method for acute sound detection. *Goldstein* ¶¶[0021], [0022]. The first step of the method is to “condition and compensate the ambient sound signal for the ASM 111 transducer.” *Id.* ¶[0054]. As discussed in §VII.C.2.d, this constitutes modifying the first and second microphone signals to generate modified first and second microphone signals. *Goldstein* discloses detecting an acute sound in the modified microphone signals in blocks 408-428 of the method of Figure 4. *Goldstein* ¶¶[0054]-[0056].

Accordingly, a POSITA would have understood the *Goldstein-Woodruff* combination to disclose or suggest a method for detecting an acute sound by analyzing at least one of the two modified ASM signals (“detecting an acute sound by analyzing at least one of the modified first microphone signal, the modified second microphone signal”). *Kyriakakis* ¶219.

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

Goldstein in combination with *Woodruff* discloses or suggests this feature. *Kyriakakis* ¶¶220-222.

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

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

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

Goldstein in combination with *Woodruff* discloses or suggests this feature. *Kyriakakis* ¶¶223-226. *Goldstein* discloses in Figure 9 a method for “maintaining constant audio content level (ACL) to internal ambient sound level (iASL)” and that, after the gain processing steps 928 and 936, the ASM and audio content signals are mixed. *Goldstein* ¶[0069]. A POSITA would have understood that in the *Goldstein-*

Woodruff combination, the mixing step 940 would have mixed the audio content signal with the beamformed, hearing loss compensated ambient sound signal (“ambient sound signal”). *Kyriakakis* ¶224. *Goldstein* further discloses that after the audio content signal and ambient sound signal are mixed, the mixed signal is reproduced with the ear canal receiver (the “speaker”) in block 944. *Goldstein* ¶[0070].

Accordingly, a POSITA would have understood the *Goldstein-Woodruff* combination to disclose or suggest mixing the audio content signal with the beamformed, hearing-loss compensated signal (“generating a mixed signal by mixing the ambient sound signal with the modified audio content signal or the new modified audio content signal”) and reproducing the mixed signal to the ear canal receiver (“and sending the mixed signal to the speaker”). *Kyriakakis* ¶226.

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

Goldstein in combination with *Woodruff* discloses or suggests this claim. *Kyriakakis* ¶¶227-229. *Goldstein* discloses that “the earpiece 100 looks for temporal and spectral characteristics in the ambient sound for detecting acute sounds” and that “the processor 206 is actively listening for presence of acute sounds before

identifying the type of sound source.” *Goldstein* ¶[0047]. *Goldstein* further discloses estimating the proximity of an acute sound to “determine[] whether it is the user’s voice that generates the acute sound when the user speaks, or whether it is an external sound such as a vehicle approaching the user.” *Id.* ¶[0052].

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

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

Goldstein in combination with *Woodruff* discloses or suggests these claims. *Kyriakakis* ¶¶230-234.

As detailed in §VII.C.1.b, the *Goldstein-Woodruff* combination discloses or suggests *Goldstein*’s earpiece processor generating an anti-noise signal based on a

hybrid feedforward and feedback algorithm and mixing it into the signal output to the speaker.

A POSITA would have understood that for *Woodruff*'s ANC block 10 to output an anti-noise signal, the system generates a noise signal. *Kyriakakis* ¶232 (citing *Kuo* at 954-955, FIG. 18). A POSITA would have understood that an “anti-noise signal” is a “noise reduction signal” because when the anti-noise signal is mixed with a noisy signal, it has the effect of reducing noise. *Id.* A POSITA would have understood that the *Goldstein-Woodruff* combination renders obvious generating the anti-noise signal “from at least one of the modified first microphone signal, the modified second microphone signal, or both” because *Woodruff* discloses that the ANC block 10 takes as its input a signal from the environmental microphone 3 and the internal microphone 4, which in the combination are the equalized microphone signals from the ASM (i.e., the “first” and “second” modified microphone signal”) and ECM, respectively. *Id.* ¶233.

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

signal to the speaker (“mixing the noise reduction signal with the mixed signal to generate a new mixed signal, and sending the new mixed signal to the speaker instead of the mixed signal.”). *Id.* ¶234.

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

Goldstein in combination with *Woodruff* discloses or suggests this claim. *Kyriakakis* ¶¶235-240.

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

Goldstein discloses detecting an acute sound and then making a determination as to whether the acute sound originated with the user. *See Goldstein* ¶¶[0052], [0056], FIG. 3 (blocks 314, 316), FIG. 4 (block 436). *Goldstein* further discloses that if the acute sound originated with the user, a hysteresis is invoked and the processor decides of the processor recently invoked pass-through; if so, then the processor invokes the passthrough system. *Id.* ¶[0056], FIG. 4 (blocks 432, 440). Thus, *Goldstein* discloses a method in which, if a user’s voice is detected, and if pass-through was recently activated, then the passthrough system is invoked. *Kyriakakis* ¶238.

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

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

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

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

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

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

Kyriakakis ¶¶242-244.

As explained in §VII.C.2.f, *Goldstein* discloses analyzing the modified first or second microphone signals for the acute sound. *Goldstein* further discloses “the earpiece 100 looks for temporal and spectral characteristics in the ambient sound for detecting acute sounds” and that the acute sounds may correspond to “the on-set of a warning sound (e.g., bell, emergency vehicle, security system, etc.), siren (e.g., police car, ambulance, etc.), voice (e.g., “help”, “stop”, “police”, etc.), or specific noise type (e.g., breaking glass, gunshot, etc.).” *Goldstein* ¶[0036], [0047].

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

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

Goldstein in combination with *Woodruff* discloses or suggests this claim. *Kyriakakis* ¶¶245-246. *Goldstein* discloses that “the processor can lower a volume of the audio content responsive to detecting an acute sound.” *Id.* ¶[0037]. As explained in §VII.C.2.d, *Goldstein* discloses equalizing the audio content signal upon receiving it to generate a “modified audio content signal.” And as explained in §VII.C.7, the acute sound may correspond to a warning sound such as a siren.

Accordingly, a POSITA would have understood the *Goldstein-Woodruff* combination to disclose or suggest lowering a volume of an equalized audio content signal (“decreasing a volume of the modified audio content signal”) if an acute sound is detected (“when a warning or siren is detected.”). *Kyriakakis* ¶246.

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

Goldstein in combination with *Woodruff* discloses or suggests this claim. *Kyriakakis* ¶¶247-248. *Goldstein* discloses that “[t]he earpiece 100 can also present an audible notification to the user indicating that an external sound source generating the acute sound has been detected.” *Id.* ¶[0052]. A POSITA would have understood that presenting an audible notification to the user sends a notification signal to the

speaker. *Kyriakakis* ¶247. And as explained in §VII.C.7, the acute sound may correspond to a warning sound such as a siren.

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

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

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

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

Goldstein in combination with *Woodruff* discloses or suggests this claim. *Kyriakakis* ¶250. *Goldstein* discloses that the acute sound may correspond to a “siren (e.g., police car, ambulance, etc.).” *Goldstein* ¶[0036]. A POSITA would have

understood that a siren is a type of alarm. *Kyriakakis* ¶250. Accordingly, a POSITA would have understood the *Goldstein-Woodruff* combination to disclose or suggest detecting an acute sound that corresponds to a siren that may be a police siren (“wherein if an alarm is detected it is at least one of a police siren”). *Id.*

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

Goldstein in combination with *Woodruff* discloses or suggests this claim. *Kyriakakis* ¶¶251-253.

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

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

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

Goldstein in combination with *Woodruff* discloses or suggests this claim. *Kyriakakis* ¶254. *Goldstein* discloses that the acute sound may correspond to a voice. *Goldstein* ¶[0036]. Accordingly, a POSITA would have understood *Goldstein* to disclose or suggest that the acute sound may correspond to a voice (“wherein the acute sound is a voice”). *Kyriakakis* ¶254.

VIII. SECONDARY CONSIDERATIONS

There is no evidence in the ’473 patent’s prosecution history or elsewhere supporting any secondary considerations arguments, or evidence of nexus of such alleged evidence to the Challenged Claims. *See generally* EX1004; *Kyriakakis* ¶255. To the extent PO asserts the existence of any secondary considerations in its responses, Petitioners reserve the right to address any such evidence.

IX. THE DISCRETIONARY FACTORS FAVOR INSTITUTING TRIAL

A. 35 U.S.C. §314(a)

In June 2022, the USPTO issued updated discretionary denial guidance in view of the *Fintiv* factors and expressly noted that the PTAB will not discretionarily deny institution when, as here, Petitioners present a *Sotera* stipulation. (EX1013).

B. 35 U.S.C. §325(d)

The Board should not exercise its discretion under §325(d) to deny institution. *Kirsch*, *DiCenso*, and *Woodruff* were not previously considered by the Office. To the extent PO argues that the examiner implicitly considered the priority date challenges in this petition or that he was otherwise required to by the M.P.E.P., the examiner did not do so or clearly erred in his analysis because, as shown, the '892 application does not provide written description support for the limitations discussed in §VII.A.

Petitioners acknowledge that, during prosecution, the examiner rejected the then-pending independent claims for non-compliance with §112. *See* §IV.B. With respect to as-filed claim 1, the examiner explained that the “mixing value” term was not described in the '143 application. In response, the applicant amended the claims to include the recited “sending an audio content gain value and an ambient sound gain value to the earpiece.” To the extent the examiner considered the written description support for this limitation in the '892 application, the examiner

materially erred for the reasons discussed in §VII.A.1.a. In particular, the only written description support identified by PO during prosecution related to the method in Figure 9 makes no reference to “gain values,” let alone that they are sent to an earpiece from a different device. Indeed, the ’892 application only discloses that the method of Figure 9 may be implemented “in a single earpiece, a pair of earpieces, headphones, or other suitable headset audio delivery devices.” ’892App. ¶[0066].

X. MANDATORY NOTICES UNDER 37 C.F.R. §42.8

A. Real Parties-in-Interest

Petitioners identify themselves as the real parties-in-interest.

1. Related Matters

To the best of Petitioners’ knowledge, the ’473 patent has only been involved in the following district court litigation:

- *Staton Techiya, LLC v. Samsung Electronics Co., Ltd. et al.*, 2:23-cv-00319-JRG-RSP (E.D. Tex.), filed July 10, 2023.

Attached to this petition as EX1010 is a chart identifying all patents/applications that are in the same family as the ’473 patent.

B. Lead and Backup Counsel

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C. Service Information

Please address all correspondence to lead and back-up counsel at the addresses shown above. Petitioners consent to electronic service by email at the following addresses:

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D. Power of Attorney

Powers of attorney are filed herewith according to 37 C.F.R. §42.10(b).

XI. FEES

Petitioners concurrently electronically submits the required fees for this Petition. The Board is authorized to charge Arnold & Porter Kaye Scholer LLP's deposit account, No. 50-2387, for any fee deficiency.

Date: June 12, 2024

Respectfully submitted,

/Ali R. Sharifahmadian/

Ali R. Sharifahmadian (Reg. No. 48,202)
Counsel for Petitioners

CERTIFICATE OF COMPLIANCE

The undersigned hereby certifies that the foregoing Petition for *Inter Partes* Review contains 13,928 words, excluding those portions identified in 37 C.F.R. §42.24(a), as measured by the word-processing system used to prepare this paper.

/Ali R. Sharifahmadian/
Ali R. Sharifahmadian (Reg. No. 48,202)
Lead Counsel

CERTIFICATE OF SERVICE

I certify that on June 12, 2024, I caused a true and correct copy of the foregoing Petition for *Inter Partes* Review of U.S. Patent No. 11,710,473 and supporting exhibits to be served via overnight delivery on the Patent Owner at the following correspondence address of record as listed on Patent Center:

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