

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

META PLATFORMS, INC., LG ELECTRONICS INC., and
SONY ELECTRONICS INC.,

Petitioners,

v.

JAWBONE INNOVATIONS, LLC,

Patent Owner.

Patent No. 8,019,091

Filing Date: September 18, 2003

Issue Date: September 13, 2011

Inventor: Gregory C. Burnett and Eric F. Breitfeller

Title: VOICE ACTIVITY DETECTOR (VAD)-BASED
MULTIPLE-MICROPHONE ACOUSTIC NOISE SUPPRESSION

PATENT OWNER'S RESPONSE

Case No. IPR2023-01127

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EXHIBIT LIST

Exhibit No.	Description of Document
2001	Joint Motion to Dismiss, <i>Jawbone Innovations, LLC v. Apple Inc.</i> , No. 6:21-cv-00984-ADA, Dkt. 110 (W.D. Tex. Dec. 23, 2022)
2002	Declaration of Akbar M. Sayeed, Ph.D.
2003	CV of Akbar M. Sayeed, Ph.D.
2004	Transcript of the Deposition of Richard M. Stern, Ph.D., taken March 26, 2024

I. INTRODUCTION

Petitioner¹ proposes three combinations that allegedly render the claims of the '091 Patent obvious: two different combinations of Ikeda with Puthuff and a combination of Ikeda with Alcivar. A POSITA would not make any of the combinations.

At the outset, it is undisputed that Petitioner's base reference, Ikeda, was intended to overcome the need for an "outside" sensor, such as the ones used in Puthuff's pickup circuit and Alcivar's transmission switch. As explained below, a POSITA would not have been motivated to undo Ikeda's inventive improvement over the prior art by including an outside sensor. This issue applies to all the proposed combinations.

Moreover, Petitioner's second combination of Ikeda and Puthuff uses Puthuff's combined acoustic/accelerometer pickup in place of Ikeda's acoustic microphone. As explained below, Ikeda's acoustic-based noise cancellation, which Petitioner does not propose to change, would not function properly when used with the mixed modality signal. Petitioner's second combination of Ikeda and Puthuff

¹ The Petitioners in this consolidated proceeding are Meta Platforms, Inc. ("Meta") and Sony Electronics Inc. ("Sony") (collectively, "Petitioner"). LG Electronics, Inc. was terminated from this proceeding on March 29, 2024. Paper No. 24.

thus would not properly denoise and thus, fail to operate for its intended purpose.

Finally, a POSITA would further not make the Ikeda/Alcivar combination because it would not result in a useful device. Alcivar is intended to overcome high levels of near-field noise, such as that experienced in a diving mask. By contrast, the various proposed “noisy environments” on which Petitioner relies (such as a restaurant, train station, airport, etc.) all contain low levels of near-field noise. Incorporating Alcivar thus provides no benefit.

Accordingly, for the reasons explained below with the support of the Declaration of Dr. Akbar M. Sayeed (Ex. 2002), the Board should issue a Final Written Decision finding no claims unpatentable.

II. THE '091 PATENT

The '091 Patent, entitled “Voice Activity Detector (VAD)-Based Multiple-Microphone Acoustic Noise Suppression,” was filed on September 18, 2003, and issued on September 13, 2011. The '091 Patent discloses inventions for “[a]coustic noise suppression . . . in multiple-microphone systems using Voice Activity Detectors (VAD).” '091 Patent, Abstract. Ex. 2002, ¶¶ 31-32.

The '091 Patent teaches, describes, and claims systems and methods for detecting and processing a desired signal in the presence of acoustic noise using a noise removal algorithm. '091 Patent, 1:16-18; FIG. 2. The '091 Patent’s claimed invention uses multiple microphones to obtain both: i) signal with some noise and

ii) noise with some signal. *Id.*, 3:20-38. The '091 Patent also uses a voice activity detector (VAD) that examines human tissue vibration to determine when the user is speaking. *Id.*, 3:39-50. The VAD may include, at least, an accelerometer, a skin surface microphone in physical contact with the skin of a user, a human tissue vibration detector, a radio frequency (RF) vibration and/or motion detector/device, an electroglottograph, an ultrasound device, an acoustic microphone used to detect acoustic frequency signals corresponding to the user's speech directly from the skin of the user, an airflow detector, and a laser vibration detector. *Id.* at 3:39-50. Ex. 2002, ¶¶ 34-35.

When the VAD indicates a lack of voicing activity, the system generates one or more transfer functions associated with noise in the environment. *Id.*, 4:28-51. In embodiments, the system generates one or more transfer functions when the VAD indicates that voicing activity is present; those functions are associated with the signal. *Id.*, 4:52-5:12. The calculated transfer functions are used to remove noise from the received acoustic signals. *Id.*, 5:13-37. Ex. 2002, ¶¶ 36-40.

III. THE RELEVANT ALLEGED PRIOR ART

A. Ikeda (U.S. Patent No. 5,978,824)

U.S. Patent No. 5,978,824 (Ex. 1003, “Ikeda”) discloses a noise canceler which “includes a signal-to-noise power ratio estimator.” Ex. 1003, Abstract. “The estimator 10 estimates the signal-to-noise [sic] power ratio of the main signal from the mean power of a desired signal contained in the main signal [sic] and a mean power of a noise signal also contained in the main signal.” *Id.* “In addition, the estimator estimates the signal-to-noise power ratio of the reference signal from the mean power of a desired signal contained in the reference signal and the mean power of a noise signal [sic] also contained in the reference signal.” *Id.* Ikeda uses two microphones, a first microphone for a main signal and a second microphone for a reference signal. *Id.*, 4:48-56. Ex. 2002, ¶ 41.

Ikeda explains that the adaptive filters of the prior art system are updated when the desired signal component $S(z)$ and the noise component $N(z)$, respectively, are absent or negligible:

[T]he conventional noise canceler updates the coefficient of the adaptive filter 3 and learns the acoustic characteristic of noise in sections where the noise signal $N(z)$ is present and the desired signal component $S(z)$ is absent or negligibly small. Further, the noise canceler updates the coefficient of the adaptive filter 4² and

² The identification of 4 appears to be typographical error.

learns a Signal distortion correction filter in sections where the desired signal component $S(z)$ is present and the noise component $N(z)$ is absent or negligibly small. It is therefore necessary to detect the above sections where the desired signal component $S(z)$ is absent (or little) and the sections where the noise signal component $N(z)$ is absent (or little) and to command the adaptive filters to perform leaning [sic] in such sections from the outside.

Ex. 1003, 3:32-45. Ex. 2002, ¶ 42.

Ikeda identifies that the drawback to the prior art conventional system is that:

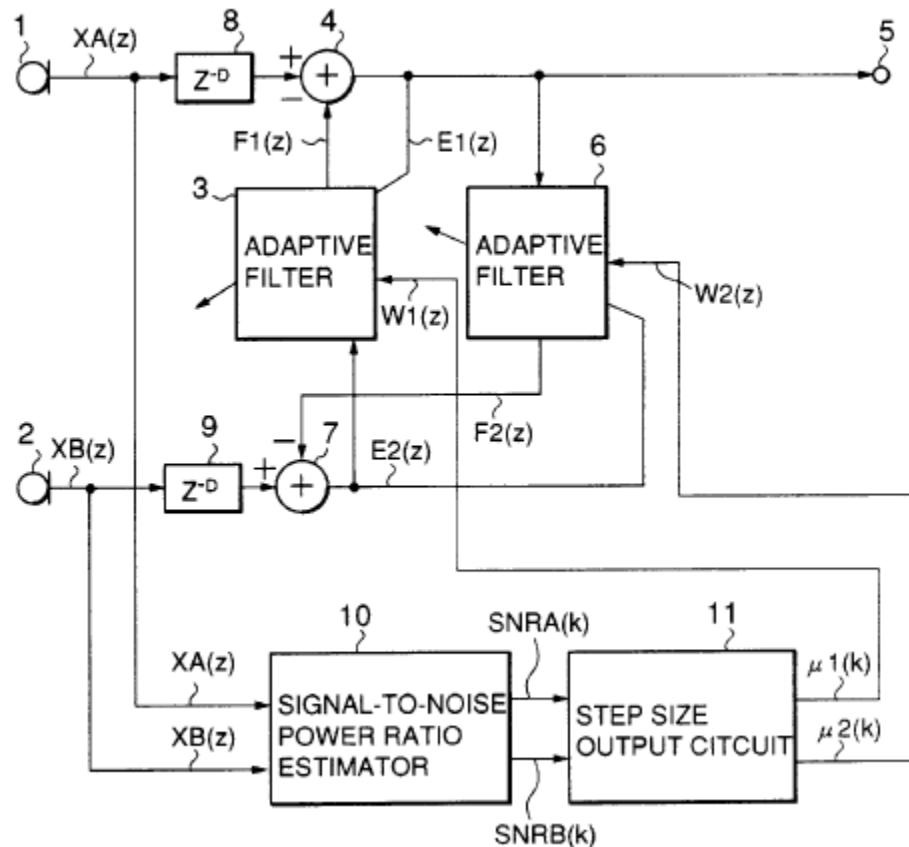
[I]t is, in many cases, difficult to command the adaptive filters to perform learning *from the outside* in accordance with the level of the desired signal and that of the noise signal, depending on the situation in which the noise canceler is located. With the conventional noise canceler, a sufficient noise canceling ability and a sufficient distortion correction characteristic are not achievable unless adequate learning sections are indicated to each adaptive filter for the learning purpose.

Ex. 1003, 3:46-54 (emphasis added). Thus, Ikeda contends that prior art which uses “outside” sensors for obtaining information needed to adjust the adaptive filters for adequate noise cancellation is insufficient. Ex. 2002, ¶ 43.

To solve this problem, Ikeda discloses that “an object of the present invention to provide a noise canceler capable of achieving a sufficient noise canceling ability

and reducing signal distortion *even when adequate learning sections cannot be indicated from the outside.*” Ex. 1003, 3:57-61 (emphasis added). To do so, Ikeda uses a Signal To Noise Power Ratio Estimator. *Id.*, Abstract, 3:62-4:25, 7:18-9:10; Fig. 1. Ex. 2002, ¶ 44.

Ikeda includes two microphones. One microphone is intended to capture the desired main signal $X_A(z)$; a second microphone captures the “reference” signal $X_B(z)$. Ex. 1003, 4:48-5:5; Fig. 1. Ex. 2002, ¶ 45.



Ex. 1003, Fig. 1.

$X_A(z)$ includes two components: the desired signal $S(z)$ and the noise $N(z)$. *Id.*, 5:5-38. $X_B(z)$ also contains these two components. *Id.* Ikeda illustrates these signal components through equations 10 and 11.

$$X_A(z) = G_A(z)N(z) + H_A(z)S(z) \quad \text{Eq. (10)}$$

$$X_B(z) = G_B(z)N(z) + H_B(z)S(z) \quad \text{Eq. (11)}$$

Id., 5:35-39. H_A , H_B , G_A , and G_B are acoustic transfer characteristics. *Id.* Ex. 2002, ¶ 46.

Ikeda's system estimates the signal-to-noise ratio for both the main and reference microphones. Ex. 1003, 7:18-8:12. It then provides that information (as $SNRA(k)$ and $SNRB(k)$) to the step size output circuit, which alters the step size, $\mu_1(k)$ and $\mu_2(k)$, for the adaptive filters 3 and 6, respectively. *Id.*, 8:13-9:10. This enables the filters to adapt based on the strength of the desired signal, and without the use of outside sensors. *Id.*, 9:14-18 ("The noise canceler therefore insures rapid convergence and allows a minimum of signal distortion to occur ***without resorting to a command customarily input from the outside*** for commanding the learning operation of filters." (emphasis added)). Ex. 2002, ¶¶ 47-51.

Ikeda explains that this use of signal-to-noise ratios, instead of outside sensors, is its main advance over the prior art.

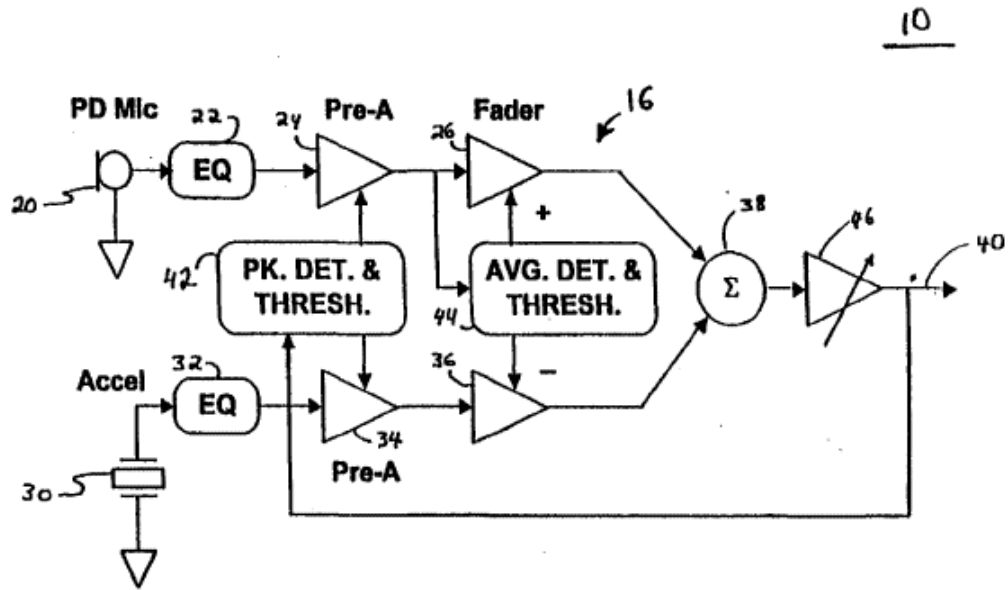
These advantages are derived from a unique configuration in which a relation in size between a desired signal, which is an

interference signal for an adaptive filter used to estimate the noise signal of the main signal from the estimated signal-to-noise power ratio of the main signal, and the noise signal to be canceled is determined. This relation is used to control a step size to be fed to the adaptive filter.

Ex. 1003, 9:18-24. Ex. 2002, ¶ 52.

B. Puthuff (International Patent App. Pub. No. WO2000/021194)

International Patent Application Pub. No. WO2000/021194 (Ex. 1004, “Puthuff”) describes a “pickup system (10) [that] utilizes both sound pressure disturbances sensed by a microphone (20) and bone conduction sensed by a vibration sensor (30) such as an accelerometer, velocity sensor or displacement sensor to pick up and faithfully transmit a talker’s voice despite acoustically noisy ambient environments.” Ex. 1004, Abstract. Puthuff’s system “senses the microphone signal amplitude” and adjusts the system gain and balance to “smoothly fade in the microphone signal and fade out the vibration sensor signal as ambient noise increases.” *Id.* Ex. 2002, ¶ 53.



Ex. 1004, Fig. 1.

Puthuff's output signal 40 therefore contains a mix of both acoustic and non-acoustic signals. *Id.*, 9:1-11:5; Fig. 2. Ex. 2002, ¶ 54.

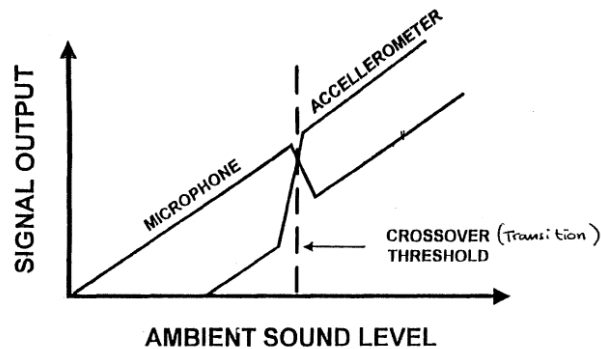


Fig. 2

Ex. 1004, Fig. 2.

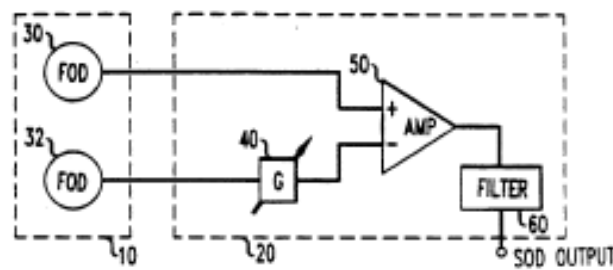
C. Alcivar

U.S. Patent No. 3,746,789 (Ex. 1005) (“Alcivar”) is directed to a voice-activated transmit switch for divers. Ex. 1005, 1:5-20. Alcivar uses a “tissue-conduction microphone 54 to generate a transmitter keying signal.” *Id.* 4:65-67. The tissue-conduction microphone must be placed against the skin of the user, preferably near the larynx. *Id.*, 4:67-5:15. The microphone is further isolated from outside noises by layers of noise-reducing fabric. *Id.* 5:16-5:31. Ex. 2002, ¶ 55.

D. Bartlett (U.S. Patent No. 5,473,684)

U.S. Patent No. 5,473,684 (Ex. 1006, “Bartlett”) discloses a “Noise-Canceling Differential Microphone Assembly.” Ex. 1006, Title. Bartlett is directed to “an improved SOD [second order differential] microphone that overcomes the deficiencies of the prior art by responding to the speaker's voice like a FOD [first order differential] microphone (i.e., with respect to the dependence of voice response on distance from the speaker's lips), but responding to the far field noise like a SOD microphone.” *Id.*, 2:14-19. Ex. 2002, ¶ 56.

FIG. 1



Bartlett's SOD microphone receives signals from two first order differential microphones and then combines them together to form a directional microphone signal. Ex. 1006, 2:33-3:5. Ex. 2002, ¶ 57.

Bartlett further reduces noise with an adaptive filter. *Id.*, 6:56-7:3. Bartlett detects when speech is present when the amplitude of the microphone output is above a predetermined threshold. Ex. 1006, 7:3-17. Ex. 2002, ¶ 58.

E. Hussain

A New Metric For Selecting Sub-Band Processing in Adaptive Speech Enhancement Systems, by Amir Hussain, Douglas R. Campbell, and Thomas J. Moir discusses a “multi-microphone adaptive speech enhancement system employing diverse sub-band processing.” Ex. 1007, at 2611. Ex. 2002, ¶ 59.

F. Sasaki (U.S. Patent No. 5,471,538)

U.S. Patent No. 5,471,538 (Ex. 1008, “Sasaki”) discusses a dual microphone system. Ex. 1008, Abstract. Sasaki's system includes a “first microphone for picking up a desired sound and a second microphone with directionality in which sensitivity is low to the desired sound arrival direction.” *Id.* The signal from “the second microphone is supplied to a subtracting circuit through an adaptive filter.” *Id.* “The subtracting circuit subtracts an output signal of the adaptive filter from the sound signal coming from the first microphone.” Ex. 2002, ¶ 60.

IV. CLAIM CONSTRUCTION

Patent Owner agrees that no claim terms require construction.

V. LEVEL OF ORDINARY SKILL IN THE ART

Patent Owner agrees with Petitioner's proposed level of skill in the art: "a minimum of a bachelor's degree in computer engineering, computer science, electrical engineering, mechanical engineering, or a similar field, and approximately three years of industry or academic experience in a field related to acoustics, speech recognition, speech detection, or signal processing. Work experience could substitute for formal education and additional formal education could substitute for work experience. Pet. at 13 (internal citations omitted). Ex. 2002, ¶¶ 29-30.

VI. ARGUMENT

A. Legal Standard

The question of obviousness is resolved on the basis of underlying factual determinations, including: (1) the scope and content of the prior art, (2) any differences between the claimed subject matter and the prior art, (3) the level of skill in the art, and (4) where in evidence, so called secondary considerations. *Graham v. John Deere Co. of Kansas City*, 383 U.S. 1, 17–18 (1966). A claim is only unpatentable under 35 U.S.C. § 103 if "the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having

ordinary skill in the art to which said subject matter pertains.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007) (quoting 35 U.S.C. § 103).

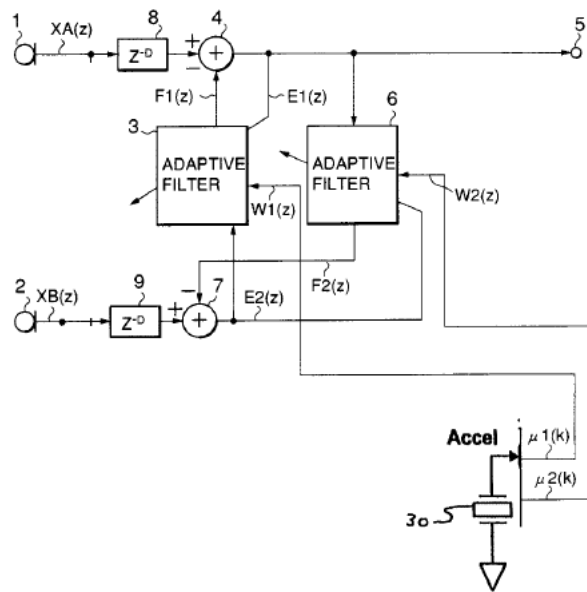
“An invention is not obvious simply because all of the claimed limitations were known in the prior art at the time of the invention. Instead, we ask ‘whether there is a reason, suggestion, or motivation in the prior art that would lead one of ordinary skill in the art to combine the references, and that would also suggest a reasonable likelihood of success.’” *Forest Lab ’ys, LLC v. Sigmapharm Lab ’ys, LLC*, 918 F.3d 928, 934 (Fed. Cir. 2019). “Of course, concluding that the references are within the scope and content of the prior art to be considered for obviousness does not end the inquiry. *Graham* makes clear that the obviousness inquiry requires a determination whether the claimed invention would have been obvious to a skilled artisan.” *Apple Inc. v. Samsung Elecs. Co.*, 839 F.3d 1034, 1050 n.14 (Fed. Cir. 2016).

“Although the *KSR* test is flexible, the Board ‘must still be careful not to allow hindsight reconstruction of references . . . without any explanation as to how or why the references would be combined to produce the claimed invention.’” *TriVascular, Inc. v. Samuels*, 812 F.3d 1056, 1066 (Fed. Cir. 2016) (citation omitted). Further, an assertion of obviousness “cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.” *KSR*, 550 U.S. at 418 (quoting *In re*

Kahn, 441 F.3d 977, 988 (Fed. Cir. 2006)); *accord In re NuVasive, Inc.*, 842 F.3d 1376, 1383 (Fed. Cir. 2016) (stating that “conclusory statements” amount to an “insufficient articulation[] of motivation to combine”; “instead, the finding must be supported by a ‘reasoned explanation’” (citation omitted)); *In re Magnum Oil Tools Int’l, Ltd.*, 829 F.3d 1364, 1380 (Fed. Cir. 2016) (“To satisfy its burden of proving obviousness, a petitioner cannot employ mere conclusory statements. The petitioner must instead articulate specific reasoning, based on evidence of record, to support the legal conclusion of obviousness.”).

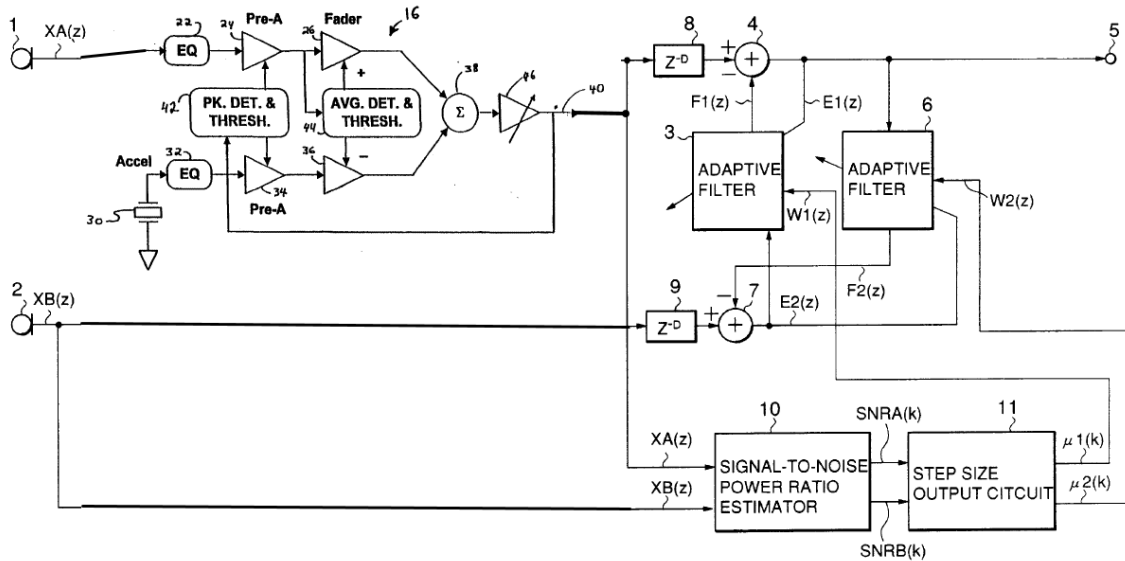
B. GROUND 1: Ikeda in View of Puthuff Does Not Render Obvious Claims 1-8, 11-14, 16, and 18-20

Petitioner argues that a POSITA would be motivated to combine Ikeda and Puthuff in two ways. In the first combination, Petitioner uses Puthuff’s accelerometer in place of Ikeda’s signal-to-noise power ratio estimator and step size output circuit. Pet., Ex. 2004, 34:9-35:4. The Figure below shows the proposed system.



Ex. 2002, ¶ 64.

In the second combination, Petitioner bodily incorporates Puthuff's entire circuit, except for the PD microphone into Ikeda. Pet., 34-36. The Figure below illustrates the second Ikeda/Puthuff combination. Ex. 2002, ¶ 65.



A POSITA would not have made either combination.

1. **A POSITA Would Not Modify Ikeda to Include Puthuff’s Outside Sensor in Place of Ikeda’s Signal-to-noise power ratio estimator and step size output circuit**
 - (a) **A POSITA Would Not Modify Ikeda to include an outside sensor because Ikeda’s invention is designed to obviate the need for one**

The stated objective of Ikeda is “to provide a noise canceler capable of achieving a sufficient noise canceling ability and reducing signal distortion even when adequate learning sections *cannot be indicated from the outside*.” Ex. 1003, 3:56-61 (emphasis added). To that end, Ikeda discloses a circuit that does not include or need an outside sensor. Indeed, as Petitioner’s expert admitted, Ikeda’s *objective* is to provide a system that does not need a command from the outside and succeeded in doing so. Ex. 2004, 26:11-27:24. As Petitioner’s expert aptly put it, “that’s the invention.” *Id.*, 26:21-27:13. Ex. 2002, ¶¶ 66-67.

On institution, the Board preliminarily found that Ikeda did not teach away from an outside sensor. Decision Granting Institution, Paper No. 10, 12-15 (P.T.A.B. Dec. 21, 2023). As discussed below, the fuller evidentiary record shows that Ikeda does, in fact, teach away. However, even if the statements in Ikeda do not rise to a teaching away, they are still highly relevant to whether a POSITA would have been motivated to combine Ikeda with Puthuff (or Alcivar). *Apple Inc. v. Samsung Elecs. Co.*, 839 F.3d 1034, n.15 (*en banc*) (“[E]ven if Plaisant does not teach away, its statements regarding users preferring other forms of switches are relevant to a

finding regarding whether a skilled artisan would be motivated to combine the slider toggle in Plaisant with the mobile phone in Neonode.”)

Ikeda explains that prior art conventional noise cancelers rely on a command from the outside, such as from a separate sensor. Ex. 1003, 3:32-55. However, depending on where the canceler is located, “it is, in many cases difficult to command the adaptive filters to perform learning from the outside in accordance with the level of the desired signal and that of the noise signal.” *Id.*, 3:46-50. Ikeda therefore seeks to provide a noise canceler that does not require or use a signal from the outside. Ex. 2002, ¶ 68. Ex. 2004, 25:5-22, 26:21-27:24.

A POSITA would understand that Puthuff’s sensor is the same sort of sensor that Ikeda counsels against and suffers from the same drawbacks. As Dr. Sayeed explains, Puthuff’s sensor would provide a command from the outside just as Ikeda describes. Ex. 2002, ¶ 69. Petitioner also agrees that the sensor Ikeda disparages is a “sensor other than the physical microphones.” Pet., 21. Moreover, Puthuff’s sensor would also not be able to command the filters to “perform learning . . . in accordance with the level of the desired signal and that of the noise signal.” Instead, Puthuff’s sensor could only command the filters based on vibrations, not on signal levels. Ex. 2002, ¶ 69. In other words, Puthuff’s sensor has no way to determine that the vibrations it senses indicate intelligible speech in the acoustic signals or that the level of the desired signal exceeds the level of the noise signal. *Id.* Thus, the use of an

outside sensor would create the outside sensor problems that Ikeda is specifically designed to overcome. A POSITA would not make such a combination *Google LLC v. Singular Computing LLC*, IPR2021-00155, Paper No. 57 at 75 (P.T.A.B. May 11, 2022) (citing *Chemours* and *TriVascular* and finding no motivation to combine where the combination would create “concerns that [the prior art] explicitly counsels against”).

Ikeda achieves its objective with a circuit that does not include or need an outside sensor. Instead, by using its signal-to-noise estimator and step-size circuit, Ikeda provides a noise canceler that does not require or use a command from an outside sensor. Ex. 1003, 9:11-18 (“The noise canceler therefore insures rapid convergence and allows a minimum of signal distortion to occur without resorting to a command customarily input from the outside for commanding the learning operation of filters.”). Both experts agree that Ikeda achieves this objective. Ex. 2002, ¶ 70. Ex. 2004, 27:14-24.

Ikeda describes its advance over the prior art as its “*unique configuration* in which a relation in size between a desired signal, which is an interference signal for an adaptive filter used to estimate the noise signal of the main signal from the estimated signal-to-noise power ratio of the main signal, and the noise signal to be canceled is determined. This relation is used to control a step size to be fed to the adaptive filter. This is also true with an adaptive filter for estimating the desired

signal of the reference signal from the estimated signal-to-noise power ratio of the reference signal; the noise signal is an interference signal while the desired signal is a signal to be canceled.” Ex. 1003, 9:18-29 (emphasis added). Ex. 2002, ¶ 71. A POSITA reading Ikeda would understand that Ikeda’s goal was to avoid the use of outside sensors, and that its unique configuration provides an advance over the prior art. Ex. 2002, ¶ 72. As Dr. Stern explained, “that’s the invention.” Ex. 2004, 26:21-27:13.

A POSITA would not have been motivated to revert Ikeda’s stated objective and advance of updating its adaptive filters without using outside sensors by adding Puthuff’s outside sensor as Petitioner teaches. Ex. 2002, ¶ 75. *TriVascular, Inc. v. Samuels*, 812 F.3d 1056, 1068 (Fed. Cir. 2016) (finding insufficient motivation to combine two references by “substitut[ing] the recessed barbs of [one reference] with the protuberances of [another reference], since [the petitioner’s] proposed substitution would destroy the basic objective of the barbs”); *Chemours Co. FC, LLC v. Daikin Indus., Ltd.*, 4 F.4th 1370, 1376-77 (Fed. Cir. 2021) (finding insufficient motivation to “increase [a prior art reference’s] melt flow rate to the claimed range,” in part because the reference “includes numerous examples of processing techniques that are typically used to increase melt flow rate, which [the reference] cautions should not be used due to the risk of obtaining a broader molecular weight distribution”).

Accordingly, a POSITA would not be motivated to make the first Ikeda/Puthuff combination.

(b) Ikeda Teaches Away From Petitioner's Combination

As explained above, Ikeda specifically seeks to avoid the use of outside sensors. Ikeda further teaches away from using such sensors. *Tec Air, Inc. v. Denso Mfg. Mich., Inc.*, 192 F.3d 1353, 1360 (Fed. Cir. 1999) (“A reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant . . . [or] if it suggests that the line of development flowing from the reference’s disclosure is unlikely to be productive of the result sought by the applicant.”).

As explained above, and confirmed by both parties’ experts, Ikeda is specifically designed to avoid the use of an outside sensor, such as Puthuff’s accelerometer. Ex. 2004, 25:1-22, 26:21-13 (“Q. I said so here Ikeda is summing up its invention as a system that doesn’t need to resort to a command from the outside; is that right? A. Right. And *what I’m saying here*, as I have said, is just – *that’s the invention. . . .*”); 27:14-24 (“But I think we agree Ikeda’s invention, just looking at Ikeda itself, *what Ikeda purports to invent is a system that doesn’t need a command from the outside; is that right?* A. *Yes, that’s indeed the objective, as you pointed*

out, and it accomplishes that objective and that’s a system that provides useful functionality in some circumstances but not in all circumstances.”) (emphases added). As Dr. Sayeed explains, a POSITA reading Ikeda would understand that Ikeda seeks to avoid outside sensors and would be discouraged from incorporating one. Ex. 2002, ¶ 76. Indeed, Ikeda explains that “it is . . . difficult to command the adaptive filters to perform learning from the outside. . .” and therefore, the “*object of the present invention* [is] to provide a noise canceler capable of achieving a sufficient noise canceling ability and reducing signal distortion *even when adequate learning sections cannot be indicated from the outside.*” Ex. 1003, 3:46-61 (emphases added).

Petitioner seeks to turn Ikeda on its head, arguing that “Ikeda discloses the need for accurately determining periods when a desired signal (e.g., voicing activity) is present and periods when a desired signal is absent for an adaptive noise canceler to function optimally.” Pet., 32. But the cited passage from Ikeda discusses the *problems with the prior art and its outside sensors*—a problem that Ikeda overcomes. Ex. 1003, 3:32-54. A POSITA would not immediately reintroduce the exact problem the invention is meant to overcome; a POSITA would be led in a different direction. Ex. 2002, ¶ 76. Even if Ikeda’s characterization of outside sensors as problems and use of SNR were not an *explicit* disparagement, a POSITA would still recognize them as an implicit disparagement that leads to different

approaches. *AstraZeneca AB v. Mylan Pharms. Inc.*, 19 F.4th 1325, 1337 (Fed. Cir. 2021) (finding implicit disparagement and teaching away when prior art reference identified problems in components of the claims of the patent at issue).

Thus, Ikeda teaches away from a separate outside sensor and a POSITA would not be motivated to combine it with Puthuff. Ex. 2002, ¶¶ 66-76.

**(c) Petitioner’s Suggested Motivations to Combine
Do Not Overcome Ikeda’s Disclosure**

While Petitioner does not expressly address Ikeda’s teaching away from a separate sensor, it proffers several purported motivations to combine. None of these suggestions are sufficient or supported by the evidence. Ex. 2002, ¶¶ 77-84.

First, Petitioner states that “Ikeda and Puthuff address the same problem—accurately detecting voice activity in noisy environments.” Pet., 32. Even if true, this does not supply any motivation to combine them—merely that both references existed. This is far from sufficient. *E.g.*, *Virtek Vision Int’l ULC v. Assembly Guidance Sys., Inc.*, -- F.4th --, No. 2022-1998, 2024 WL 1292734, at *3 (Fed. Cir. Mar. 27, 2024) (holding that “[t]he mere fact that these possible arrangements existed in the prior art does not provide a reason that a skilled artisan would have” made the suggested combination). Moreover, Puthuff is not directed towards detecting voice activity, but rather to outputting a signal that approximates a user’s voice. Ex. 2002, ¶ 78.

Second, Petitioner argues that “Ikeda discloses the need for accurately determining periods when a desired signal (e.g., voicing activity) is present and periods when a desired signal is absent for an adaptive noise canceler to function optimally.” Pet., 32. Therefore, Petitioner states, “a POSITA would have been motivated to look to other VAD methods” and “Puthuff further teaches that its vibration sensor reduces false triggering in noisy environments.” *Id.*, 33. But Petitioner provides no evidence, not even its expert’s testimony, that the vibration sensor would reduce “false triggering” compared to *Ikeda’s* system. Indeed, Puthuff’s discussion of false triggering is in comparison to a single microphone system—like Puthuff—but without a vibration sensor. Ex. 1004, 6:6-10. Ikeda’s design avoids any problem of false triggering. Petitioner’s argument is thus based on hindsight. Ex. 2002, ¶ 79.

Third, Petitioner simply states, citing Puthuff, that “a POSITA would have been motivated to use an accelerometer sensor in Ikeda’s system as an inexpensive, easy-to-find component for detecting voice activity.” Pet. 33. Even if true, the statement provides nothing more than that accelerometers were known at the time and does not provide an actual motivation to combine one with Ikeda. *Virtek Vision*, 2024 WL 1292734, at *3. Ex. 2002, ¶ 80.

Fourth, Petitioner again simply points out, in three separate but equivalent ways, that accelerometers were known in the art. Pet., 33-34. Petitioner’s statements

essentially restate its flawed conclusion that a POSITA would assume that Ikeda would benefit from an accelerometer. As shown above, a POSITA would not so assume. Ex. 2002, ¶ 81.

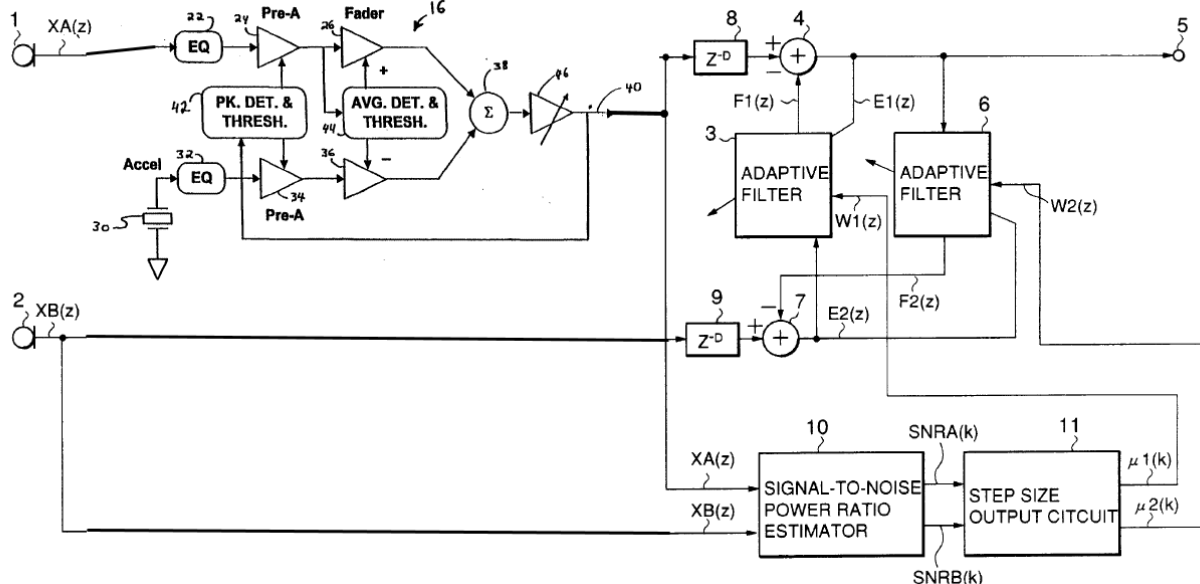
Finally, Petitioner states that “Puthuff expressly teaches that its vibration sensor is useful for ‘dual microphone’ systems.” Pet., 34 (citing Ex. 1004, 6:11-23). However, Puthuff there discusses its actual invention – the generation of a voice signal from a single acoustic microphone and a bone conduction sensor—not a signal for use in noise cancellation as in the ’091 Patent or Ikeda. The surrounding context shows that the discussion of “dual microphone” systems is with respect to “dual microphone *directional* pickup systems.” Ex. 2002, ¶ 82.

In sum, Petitioner’s proposed motivations to combine either are i) mere statements that accelerometers existed in the prior art; or ii) entirely dependent on the unsupported notion that a POSITA would have determined that Ikeda would benefit from the use of an accelerometer. As shown above, that notion is false. Thus, the proposed motivations are, whether taken singly or as a whole, insufficient. Accordingly, Petitioner has failed to show that a POSITA would be motivated to substitute Puthuff’s accelerometer for boxes 10 and 11 of Ikeda. Ex. 2002, ¶¶ 83-84.

2. The Second Ikeda/Puthuff Combination—Using Puthuff’s Output Signal as the Input to Ikeda’s System—Does Not Render Obvious Any Claims

Petitioner's second Ikeda/Puthuff combination would incorporate Puthuff's Fig. 1 system into Ikeda's Figure 1 system. Pet., 34-36. As Dr. Stern explained, this is a bodily incorporation of Puthuff's entire system, except for the input microphone. Ex. 2004, 38:12-18 ("Q. The entire body of Puthuff Figure 1 minus the PD microphone would be incorporated into Figure 1 of Ikeda; do I now have it right? THE WITNESS: Yes, that's correct.") (objection omitted).

The result of this incorporation would be a system where Puthuff's output signal 40 is fed into the XA(z) path of Ikeda. A combined Ikeda/Puthuff system is shown below (Ex. 2002, ¶¶ 85-86):



In Petitioner's proposed system, therefore, the signal-to-noise power ratio estimator would receive the "amplified, faded" signal from the microphone after it is "combined with the signal from the accelerometer 30 at the adder circuit 38." Pet., 34-35. In other words, Ikeda's main signal is composed of the faded-in and faded-out microphone and accelerometer signals. As Puthuff explains, this signal is shown in Puthuff Fig. 2 as a function of ambient sound. Ex. 1004, 7:6-9. Ex. 2002, ¶¶ 87-88.

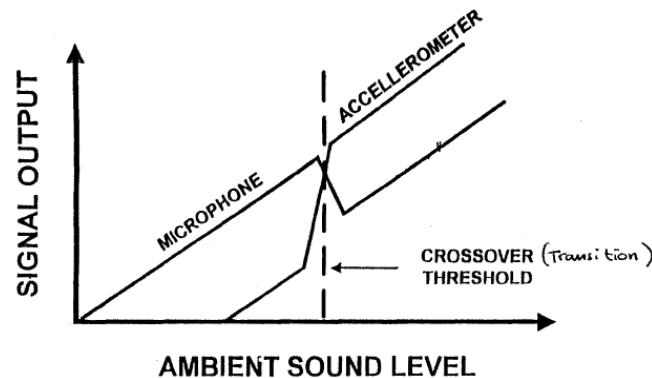


Fig. 2

As shown below, a POSITA would not combine Ikeda with Puthuff in this manner, both because Ikeda teaches away from using an outside sensor, and because the second Ikeda/Puthuff system would not denoise properly. Moreover, even if a POSITA made the combination, it does not meet the elements of the claims. Ex. 2002, ¶¶ 89-90.

(a) A POSITA Would Not Make the Second Ikeda/Puthuff Combination

As discussed above, Ikeda discourages the use of outside sensors. A POSITA would be discouraged from making the second Puthuff/Ikeda combination for the same reasons. Ex. 2002, ¶ 91.

Further, a POSITA would not make the second combination because it would be inoperable for its intended purpose; i.e., reducing noise. *McGinley v. Franklin Sports, Inc.*, 262 F.3d 1339, 1354 (Fed. Cir. 2001) (“If references taken in combination would produce a ‘seemingly inoperative device,’ we have held that such references teach away from the combination and thus cannot serve as predicates for a prima facie case of obviousness.”); *Arctic Cat Inc. v. Bombardier Recreational Prods. Inc.*, 876 F.3d 1350, 1360 (Fed. Cir. 2017) (“[I]n general, a reference will teach away if it suggests that the line of development flowing from the reference’s disclosure is unlikely to be productive of the result sought by the applicant.”).

Petitioner does not propose any alterations to the Ikeda circuit. Ikeda’s design assumes that its input signals are composed of: i) acoustic noise $N(z)$ and ii) acoustic signal $S(z)$. Ex. 1003, 5:31-37. This is explicitly shown in Ikeda’s Equations 10 and 11.

$$XA(z)=GA(z)N(z)+HA(z)S(z) \quad \text{Eq. (10)}$$

$$XB(z)=GB(z)N(z)+HB(z)S(z) \quad \text{Eq. (11)}$$

Ex. 1003, 5:31-38. Ex. 2002, ¶ 92.

Ikeda uses these equations to denoise with calculated transfer functions $W1(z)$ and $W2(z)$.

The above equations give $E1(z)$ and $E2(z)$, as follows:

$$E1(z) = [1 / \{1 - W1(z)W2(z)\}] \{HA(z) - W1(z)HB(z)\}S(z) + [1 / \{1 - W1(z)W2(z)\}] \{GA(z) - W1(z)GB(z)\}N(z) \quad \text{Eq. (12)}$$

$$E2(z) = [1 / \{1 - W1(z)W2(z)\}] \{HB(z) - W1(z)HA(z)\}S(z) + [1 / \{1 - W1(z)W2(z)\}] \{GB(z) - W1(z)GA(z)\}N(z) \quad \text{Eq. (13)}$$

Id., 5:39-50. As Ikeda sums up:

Therefore, if the following equations are satisfied:

$$W1(z) = GA(z)/GB(z) \quad \text{Eq. (14)}$$

$$W2(z) = HB(z)/HA(z) \quad \text{Eq. (15)}$$

then, there hold:

$$E1(z) = S(z) \quad \text{Eq. (16)}$$

$$E2(z) = N(z) \quad \text{Eq. (17)}$$

Id., 5:51-61. Ex. 2002, ¶ 93.

However, in the proposed system, $XA(z)$ includes **additional** inputs: the noise received from the accelerometer and the signal received from the accelerometer. $XB(z)$ remains the same. The two signals are thus representative of two **different**

environments. The adaptive filter that is updated according to $XB(z)$ will not account for the noise or signal received from the accelerometer. Ikeda's subtracter 4 will thus be operating on two incompatible signals and its result will be unpredictable, and likely result in distortion of the desired speech signal. A POSITA would not be motivated to make an Ikeda/Puthuff device that improperly cancels noise and actually worsens the output signal. Ex. 2002, ¶¶ 94-97.

For example, in a situation with high environmental noise, $XA(z)$ is composed mostly or entirely of accelerometer signals. The $N(z)$ *acoustic* noise component would be close to 0. However, the subtracter would still subtract out a full acoustic $N(z)$ as received at the reference microphone and as part of $XB(z)$. This subtraction would distort the desired signal in $XA(z)$. Ex. 2002, ¶ 98.

Accordingly, a POSITA would not make the second Ikeda/Puthuff combination because it would not cancel noise and would actually worsen the output signal. Ex. 2002, ¶ 99. *McGinley*, 262 F.3d at 1354.

(b) Petitioner's Combination Does Not Disclose or Render Obvious Generating Transfer Functions in Response to a Determination That Voicing Activity Is Absent from or Present in the Acoustic Signals as Required by Claims 11 and 18

The second Ikeda/Puthuff combination does not disclose or render obvious generating either transfer function in response to a determination that voicing activity is absent or present for a period of time, as required by Claims 11 and 18. Ex. 2002, ¶ 100.

The key flaw in Petitioner's logic is that the Ikeda SNR and Step Size units operate, in the combination, on the Puthuff acoustic/accelerometer signal. Thus, when the input to Ikeda (Puthuff's signal 40) is composed mostly or entirely of accelerometer signals, which occurs with high environmental noise (Ex. 1004, 5:13-16), the Ikeda circuit will act unpredictably. The SNR estimator will show a high SNR for $X_A(z)$, and a low SNR for $X_B(z)$, resulting in small step sizes u_1 and u_2 . Ex. 1003, 8:36-44, 8:58-63. Due to the mixed modalities of the two signals, there is no way to determine whether u_1 or u_2 will be larger, and thus which filter, if any, will be updated. In any event, the calculation of the transfer function will not be based on a determination that voicing activity is absent or present from the *acoustic* signals. Indeed, because the Ikeda circuit does not receive the acoustic signals from

microphone 1, it cannot make any determination as to what is in those signals. Ex. 2002, ¶ 101.

Thus, the second Ikeda combination does not render Claims 11 or 18 obvious.

(c) Petitioner’s Combination Does Not Disclose or Render Obvious “generating a voice activity detection (VAD) signal using the voice activity signal,” as Required by Claim 1

The second Puthuff/Ikeda combination fails to disclose or render obvious this limitation because the alleged VAD signal is not generated “using the voice activity signal.” Petitioner makes no argument that the second combination teaches this limitation—instead it relies solely on the combination where “Puthuff’s VAD *replaces* Ikeda’s VAD.” Pet., 41-43. While Petitioner argues that “Ikeda discloses this limitation,” there is no dispute that Ikeda alone lacks the “voice activity signal that includes information on vibration of human tissue associated with human voicing activity of a user” required by Claim 1. Ex. 2002, ¶¶ 104-106. Indeed, the Petition relies solely on Puthuff for that limitation. Pet., 41.

C. GROUND 2: Ikeda in View of Alcivar Does Not Render Obvious Claims 1-8, 11-14, 16, and 18-20

1. The Ikeda/Alcivar Proposed Combination

Petitioner proposes a combination of Ikeda and Alcivar where Alcivar’s tissue-conduction microphone and VAD” would replace Ikeda’s signal-to-noise

power ratio estimator and, “optionally,” its step size output circuit. Pet., 49-50. Dr. Stern testified similarly. Ex. 2004, 48:7-19.

The resulting device would have two microphones placed according to Ikeda’s instructions. *Id.*, 49:23-50:9. Because Ikeda describes its invention for use in a microphone or handset, a POSITA would understand that the main microphone is placed near the user’s mouth so as to effectively pick up speech and minimize outside noise. Ex. 2002, ¶ 111. The reference microphone would be placed further from the mouth. *Id.*

To add Alcivar’s throat microphone, a user would have to affix the microphone to his or her throat or chest. Ex. 1005, 4:66-5:8; Ex. 2004, 50:10-14 (“Q. So when we are adding the means disclosed by Alcivar, now we have a throat microphone that’s in physical contact with the user’s throat; correct? A. That’s correct.”). The Alcivar throat microphone would also have to be insulated from outside sounds, as described in Alcivar. Ex. 1005, 5:21-31; Ex. 2004, 44:19-45:11. Finally, the Alcivar microphone would be connected to the Ikeda system by a wire running from the throat to the rest of the device. *Id.*, 50:10-24 Ex. 2002, ¶¶ 112-14.

2. A POSITA Would Not Modify Ikeda to Include Alcivar’s Throat Microphone and Other Components

As discussed above with respect to Ground 1, upon reading Ikeda, a POSITA would be discouraged from introducing an outside sensor into Ikeda. *See supra*,

Section VI.A.B.1. For the same reasons, a POSITA would not modify Ikeda to include Alcivar’s throat microphone, which is an outside sensor. Ex. 2002, ¶ 116.

Further, a POSITA would not make the proposed Ikeda/Alcivar device because it would not be useful. Petitioner’s expert explained that the use cases for the device would be “noisy restaurant[s],” “train station[s],” “airport[s], just talking to a cell phone on the street.” Ex. 2004, 51:24-52:7. Alcivar is designed to obviate problems that occur with the extremely high *near-field* noise that occurs in a diving environment, such as loud breathing and gas flow noises within the diver’s mask. Ex. 1005, 1:5-20; 4:44-59. In contrast, a noisy restaurant or train station presents noise in the far-field. A noise in the far-field, however, can be countered by Ikeda’s invention. Ex. 2002, ¶¶ 117-18.

Accordingly, Petitioner has failed to show that this limitation is obvious.

3. Petitioner’s Proposed Motivations to Combine Are Not Sufficient

The Petition presents four supposed motivations to combine Alcivar with Ikeda. Pet., 50-51.

The first suggested motivation is “Ikeda and Alcivar address the same problem—accurately detecting voicing activity in noisy environments.” Pet., 50. Even if true, the mere existence of both references does not motivate a POSITA to combine them. *E.g., Virtek Vision*, 2024 WL 1292734, at *3 (holding that “[t]he

mere fact that these possible arrangements existed in the prior art does not provide a reason that a skilled artisan would have” made the suggested combination). Ex. 2002, ¶ 120.

Petitioner next suggests that a “POSITA would have been motivated to use a tissue-conduction microphone or other vibration sensor, as disclosed in Alcivar, instead of Ikeda’s method of detecting voicing activity because, as Alcivar explains, tissue-conduction microphones can ‘discriminate against unwanted noises . . . without having to resort to more elaborate signal processing techniques.’” Pet., 50. But as discussed above, Ikeda provides a system that can discriminate against unwanted noises. Moreover, there is no suggestion that Ikeda’s system is so “elaborate” that it would require the additional cost of a new sensor. Ex. 2002, ¶ 121.

Similarly, the statement that a “POSITA would have understood that a tissue-conduction microphone (e.g., vibration-based) VAD would be a cheaper, simpler option than Ikeda’s acoustic microphone-based VAD for determining periods when voicing activity is present” is also unsupported. Pet., 50. Petitioner and Dr. Stern provide no evidence that including the extra sensor and components of Alcivar is somehow cheaper than Ikeda’s circuit. Indeed, Petitioner proposes that all of Ikeda’s processing is done within a processor. Pet., 17-19. Thus, Ikeda’s signal-to-noise power estimation and step size output circuits would provide no additional cost. To the contrary, a POSITA would recognize that Alcivar’s throat microphone,

insulating material, and wire would require substantial additional costs for each device. Ex. 2002, ¶ 122.

Petitioner's third suggested motivation is "a POSITA would have used Alcivar's vibration-based VAD with Ikeda's system to detect voice activity because Alcivar's doing so would improve the accuracy of Ikeda's system in high-noise environments." Pet., 51. But Petitioner provides no evidence that Alcivar is any more accurate than Ikeda in any environment. Moreover, as discussed above, a POSITA would recognize that Alcivar provides no benefit in the "high noise environments" to which Petitioner refers (restaurants, train stations, airports, etc.). Alcivar is intended to deal with the extremely high *near-field noise* that occurs in a diving environment. As Alcivar explains, the diving environment presents loud breathing and gas flow noises that can trigger the microphone within the diver's mask. Ex. 1005, 1:5-20; 4:44-59. In contrast, a POSITA would know that the noise in, e.g., a restaurant is generally in the far-field and can be easily countered by Ikeda's unmodified invention. Ex. 2002, ¶¶ 118, 123-24.

Finally, Petitioner states that "the use of vibration sensors to detect voicing activity was well known." Pet., 51. But this would not motivate a POSITA to include a new sensor into Ikeda, particularly in view of Ikeda's statements discouraging such outside sensors. Ex. 2002, ¶ 125.

Accordingly, a POSITA would not be motivated to combine Alcivar with Ikeda.

D. GROUND 3: Ikeda, Puthuff or Alcivar, and Hussain Do Not Render Obvious Claims 3, 9, and 15

Ground 3 is directed to dependent claims. Petitioners' Ground 3 arguments do not address the deficiencies within its Ground 1 and Ground 2 arguments discussed above. Pet at 56-64. Accordingly, Petitioner has not shown that any claims are obvious under Ground 3. Ex. 2002, ¶ 127.

E. GROUND 4: Ikeda, Puthuff or Alcivar, and Sasaki Do Not Render Obvious Claims 10 and 17

Ground 4 is directed to dependent claims. Petitioner's Ground 4 arguments do not address the deficiencies within its Ground 1 and Ground 2 arguments discussed above. Pet at 64-69. Accordingly, Petitioner has not shown that any claims are obvious under Ground 4. Ex. 2002, ¶ 128.

F. GROUND 5: The Grounds 1-4 References and Bartlett Do Not Render Obvious Any Claims

Ground 5 relies on Grounds 1-4 and adds Bartlett to meet the processor limitations. Pet., 67. Petitioner's Ground 5 arguments do not address the deficiencies within its Ground 1 and Ground 2 arguments discussed above. Accordingly, Petitioner has not shown that any claims are obvious under Ground 5. Ex. 2002, ¶ 129.

VII. CONCLUSION

As discussed above, Petitioner's combinations fail to render obvious any claims. The Board should, therefore, issue a Final Written Decision finding all claims not unpatentable.

Respectfully submitted,

Dated: April 12, 2024

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CERTIFICATE OF WORD COUNT

The undersigned hereby certifies that the portions of the above-captioned PATENT OWNER'S RESPONSE specified in 37 C.F.R. § 42.24 has 6,930 words in compliance with the 14,000 word limit set forth in 37 C.F.R. § 42.24. This word count was prepared using Microsoft Word for Office 365.

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