

Case IPR2023-01003

Patent No. 9,226,090

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

META PLATFORMS, INC.,
Petitioner,

v.

EIGHT KHZ, LLC,
Patent Owner.

Case IPR2023-01003
Patent 9,226,090

PATENT OWNER'S 7-PAGE CLAIM CONSTRUCTION BRIEF

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Based on the specification and claim language itself, the ‘090 claims plainly require HRTF processing by virtue of disclosing a “sound localization point ... away from and proximate to the [listener],” (hereinafter “an SLP AFAPT”).

I. HRTF PROCESSING: DISCLOSED BY CLAIM LANGUAGE ITSELF

An SLP AFAPT is a common term among all claims. *See* 1[b], 8[b], 15[d]. Claims 1 and 15 alter the SLP of the binaural sound from its originally captured SLP to an SLP AFAPT. Claim 8 synthesizes an SLP AFAPT “from where the origin of the voice of” a talker occurs. Altering a binaural sound’s SLP to a location AFAPT or synthesizing an SLP AFAPT for non-binaural sounds requires HRTF processing.

Claim 1 captures binaural sound of “a talking person”¹ via an electronic earphone at the talking person’s head. *See* 1[a]. Petitioner’s expert admitted that “without any other processing,” the SLP for the binaural sound captured this way is “in the middle in front of [the listener’s] face.” In 1[b], an SLP AFAPT is designated, and in 1[c] the binaural sound captured in 1[a] is adjusted to alter its SLP from “in the middle in front of [the listener’s] face” to the SLP designated in 1[b], such that “the binaural sound originates ... from the [SLP]” designated. HRTF processing is inherent in 1[c] to alter the SLP of the captured binaural voice to an SLP AFAPT.

¹ Claim 1 requires a talking person; thus, the sound captured necessarily includes the talking person’s voice.

Claim 15 requires capturing a binaural voice of a talker with a WED worn by the talker. *See* 15[b]. Per the specification, “earpieces, headphones, earphones, electronic glasses, hearing aids, and electronic devices that fit into or near the ear” are examples of such a WED. Ex.2011, 59. Thus, like Claim 1’s sound, the SLP of the talker’s voice captured by Claim 15’s WED is located inside the listener’s head or in front of their mouth. *Id.*, 60. 15[d] requires adjusting the captured binaural voice “in order to position” its SLP “to a location that is [AFAPT], wherein the [SLP] represents an origin of the binaural voice.” Differently put, claim 15 alters the SLP of the captured binaural voice from inside the listener’s head to a location AFAPT. Accordingly, HRTF processing is inherent in 15[d]. Further, Petitioner’s expert agrees that 15[d] discloses binaural synthesis. *See* Ex.2031, 39:7-21.

Claim 8 never requires the talker’s voice be captured as binaural. But 8[b] requires designating an SLP AFAPT “from where an origin of a voice of the [talker] occurs.” In a call executed in 8[c] the talker’s voice originates from the SLP simulated in 8[b]. This SLP is a “fixed location.” In other words, claim 8 synthesizes a fixed SLP AFAPT from where the talker’s voice originates. Thus, HRTF processing is inherent in 8[b], which synthesizes a fixed SLP AFAPT.

II. SPECIFICATION REQUIRES HRTF PROCESSING FOR SYNTHESIZING OR ALTERING AN SLP AFAPT

Contrary to Petitioner’s position, the sound in ‘090 claims must originate from an SLP AFAPT. As its lexicographer, PO defined SLP as a “position that is

determined to be a location, an origin, or a place of emanation of sound.” Ex.1001, 41:40-44; *see also* 3:38-41 (describing SLP as a point “from where the sound emanates or originates”); 6:16-19 (“The [SLP] can represent an origin of a sound, such as a voice of a person ... as if the person were located at this point and speaking.”). For static sounds, an SLP is identified with its “azimuth [], elevation [], and distance from the listener[,]” i.e., (r, θ, ϕ) . *Id.*, 3:46-50.

The specification explains that adjustments to the SLP of a binaural sound require altering the originally captured SLP to a new SLP. *See id.*, 5:18-31 (“[T]he binaural sound is processed to change the [SLP] from being two feet away from the listener to being thirty feet away from the listener.”). Non-binaural sounds also have a “perceived” SLP that “is at or near the device emitting the sound, such as an electronic speaker.” *Id.*, 3:41-46. This means that for a listener wearing a WED or electronic earphones, the SLP of the non-binaural sound is inside the listener’s head where the electronic speakers are located. For adjusting the perceived SLP of a non-binaural sound, one must “modify or move the [SLP] to a location that is apart from and away from the device emitting the sound.” *Id.* The specification refers to this as binaural synthesis. *Id.*, 28:45-60. The specification expressly provides that any alteration or synthesis of an SLP necessarily requires using HRTFs:

A location of sound and/or a direction to the sound can be altered or created [i.e., synthesized] using one or more of head-related transfer functions (HRTFs), accounting for differences in arrival times between the ears (interaural time differences), differences in amplitude

or level of the sound between the ears (interaural level differences), asymmetrical spectral reflections from parts of the body (such as torso, shoulders, and pinnae), phase delays, group delays, and a ratio of the direct signal to the reverberated signal.²

Id., 3:59-67. The specification further states that “[t]he HRIRs and transformed HRTFs³ enable sound to be convolved such that a location of the sound or [SLP] can be changed. A listener hears the convolved sound as if it had originated from the [SLP].” *Id.*, 2:63-67. Similarly, the specification explains that synthesizing an SLP and source localization for a sound source requires processing with HRTFs: “Fourier transform of the HRIRs, $h(t)$, for an impulse at a source generates the HRTFs, $H(f)$, that enable source localization. HRTFs ... can be stored and processed to synthesize binaural signals from a sound source.” *Id.*, 28:37-44.

Mathematically, convolving a sound with frequency f to change its SLP from $(r_1, \theta_1, \varphi_1)$ inside the listener’s head to $(r_2, \theta_2, \varphi_2)$ **AFAPT** requires a transformation function that maps $(r_1, \theta_1, \varphi_1)$ to $(r_2, \theta_2, \varphi_2)$ while maintaining the spectral domain of the sound. *See id.*, 5:28-31 (“[M]oving the [SLP] includes changing one or more of

² **Petitioner seeks to distort this excerpt by omitting “accounting for.”** As clarified in the oral hearing, the adjective clause starting with “accounting for” modifies “one or more of HRTFs.” It is an established scientific fact—admitted by Petitioner’s expert—that **HRTFs account for ITD, ILD, reflection, reverberation, refraction (i.e., phase delay), and the shape of the torso, shoulders, and ears**. *See* Ex.2016, 248:6-249:6 (“If you have the HRTFs, that means you have ITD, ILD, and spectral modifications.”); Ex.1003, ¶¶52-53 (“These factors are captured in ... HRTFs.”).

³ Applying Fourier transformation to an HRIR (head-related impulse response), a time-based function, yields an HRTF in frequency domain. *See* Ex.1001, 28:33-42

localization of a vertical elevation of the sound, a horizontal elevation of the sound, and a distance to an origin of the sound.”). The specification explicitly discloses HRTFs as such functions: “HRTFs are functions of frequency and three spatial variables.” *Id.*, 28:24-32. Importantly, the specification discloses no other functions that can synthesize or alter a sound’s SLP to a location **AFAPT**.

Petitioner mistakes adjustments altering the SLP to position it **AFAPT** for those that leave the SLP unchanged.⁴ The ‘090 Patent keeps the two separate. For example, in Fig. 2, Block 200 details adjustments to the SLP of the sound to position it **AFAPT**: “[T]he listener of the sound ... designates where an origin of the sound will occur. This location for the origin of the sound can be **different from a localization point when the sound was recorded or captured**.” *Id.*, 5:47-57. In contrast, Block 220 describes adjusting the sound as the listener moves relative to the SLP. *Id.*, 6:46-52. Crucially, Block 220 does not alter the SLP, as the sound “continues to ... originate from the [SLP] even as the listener moves.”⁵ *Id.*

To clarify, PO never argued ITD and ILD are unusable for localization. The specification provides an example where an SLP is designated by ILD and ITD adjustments. *Id.*, 38:10-56 (designating SLPs for three speakers by adjusting ITD and ILD). **However, Petitioner overlooks a crucial detail: that example is confined**

⁴ *E.g.*, changing a sound’s volume, intensity, or ITD does not change its SLP.

⁵ Similarly, 8[b]-[c] assign a “fixed” SLP, but 8[d] alters the voice’s ITD not its SLP.

to inside-the-head localization, and never addresses synthesizing or altering a captured SLP to an SLP AFAPT. The example clarifies that the SLPs designated by adjusting ITD and ILD are in the listener's head: "the listener perceives the first caller off to the right side of his face, the second caller to the left side of his face, and the third caller between the first and second callers." *Id.*, 38:32-37. Specifically, the "third SLP is designated for the third speaker to be directly between the ears of the listener at a point inside his head."⁶ *Id.* Nowhere in the specification is there an example of using ITD and ILD to synthesize or alter a sound's SLP to a position AFAPT, as expressly required by the claims.

III. EXTRINSIC EVIDENCE SUPPORTS PO'S POSITION

Consistent with the specification, PHOSITA understand localizing a sound at an SLP AFAPT (i.e., sound externalization, (Ex.2011, ¶9)) necessitates HRTF processing. Experts agree that an SLP AFAPT is external to the listener. Ex.2016, 191:18-193:19; Ex.2011, ¶62. Dr. Begault has repeatedly testified that without binaural sound and HRTF processing one cannot have externalization, notably over headphones. Ex.2011, ¶22; Ex.1051, 67:24-70:10. Thus, in Dr. Begault's view HRTF processing is inherent in an SLP AFAPT. Ex.2011, ¶¶22, 70, 79(b), 86.

⁶ This example is consistent with PO's argument during the oral hearing that ITD- and ILD-based localization would create "'within-the-head', lateralized percept," which "stands in contrast to" the "externalized" percept resulted from HRTF processing. Paper 53 (Slides ##97-99); Sur-Reply, 6-7 (citing Ex.1025); Ex.1025, 5.

Petitioner's district court expert testified an SLP is "created [i.e., synthesized] with the use of the HRTF." Ex.2015, 19:13-22. She testified "positioning an SLP to a different location" requires using a different HRTF corresponding to the new location. *Id.*, 22:3-23:4. She further stated, "I would use an HRTF in any program in which I wanted to render 3D audio digitally." *Id.*, 45:15-46:24.

Regarding claims 1 and 15, Petitioner's expert could not cite a single example of altering a binaural sound's SLP without a "***magic HRTF box***." Paper 53 (Slide #23). Moreover, Petitioner fails to explain how the talker's non-binaural voice in claim 8 could be presented to the listener at an SLP ***AFAPT*** absent HRTF processing. Notably, its expert testified that "processing non-binaural content with the left and right HRTFs" results in localizing sound at a "desired placement angle and position" (i.e., an SLP ***AFAPT***). Ex.1003, ¶55.

A PHOSITA would understand, as Petitioner's expert does, that "simulat[ing] external sound sources at an SLP in an empty space" requires "simulat[ing] head-related signals." *Id.*, ¶46. This is because "[s]patial information is [] encoded onto the[se] signals ... through a combination of direction-dependent and direction-independent filters [i.e., HRTFs]." *Id.*, ¶53. Petitioner's own evidence shows the "first step" for externalization is "to measure directional transfer functions [i.e., HRTFs]," because they "contain all the information needed to simulate the localization of sound sources in the free field, [i.e., externalization]." Ex.1026, 154.

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CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. §42.6(e), the undersigned hereby certifies that the above-captioned Eight KHZ LLC's Patent Owner Brief was served via electronic mail, as authorized by Petitioner's Mandatory Notices, on November 12, 2024 at the following email correspondence addresses of record:

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