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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.
Petitioner,

v.

THX LTD.
Patent Owner.

Case IPR2014-00235
Patent 7,433,483 B2

Before MICHAEL W. KIM, BARBARA A. PARVIS, and BRIAN P. MURPHY, *Administrative Patent Judges.*

MURPHY, *Administrative Patent Judge*.

FINAL WRITTEN DECISION
35 U.S.C. § 318(a); 37 C.F.R. § 42.73

I. INTRODUCTION

Apple Inc. ("Petitioner") filed a Petition (Paper 3, "Pet.") requesting *inter partes* review of claims 1–6, 8, 10, 16, and 18–20 of U.S. Patent No. 7,433,483 B2 (Ex. 1001, "the '483 patent"). We instituted an *inter partes* review of claims 1–3 of the '483 patent on the ground of obviousness under 35 U.S.C. § 103 over Tomonori,[1] Virva,[2] and Sadaie.[3] Paper 10, 28–29 ("Decision to Institute" or "Dec."). We did not institute an *inter partes* review of claims 4–6, 8, 10, 16, and 18–20 of the '483 patent. *Id.*

THX Ltd. ("Patent Owner") filed a Patent Owner Response (Paper 23, "PO. Resp."), and Petitioner filed a Reply (Paper 25, "Pet. Reply").

Patent Owner did not file a motion to amend claims, and neither party filed a motion to exclude evidence.

Petitioner relies on Declarations of Dr. Jeffrey S. Vipperman in support of its Petition (Ex. 1002) and Reply (Ex. 1017). Patent Owner relies on the Declaration of Dr. Stephen Elliott in support of its Response (Ex. 2007). Petitioner relies on deposition testimony of Dr. Elliott (Ex. 1016) in support of its Reply. Patent Owner relies on deposition testimony of Dr. Vipperman (Ex. 2017), including its Corrected Motion for Observation Regarding Cross-Examination of Dr. Vipperman (Paper 35,

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[1] EP744880 to Tomonori et al., issued Nov. 27, 1996 ("Tomonori," Ex. 1004).
[2] US 3,687,220 to Virva, issued August 29, 1972 ("Virva," Ex. 1009).
[3] WO 00/52958 to Sadaie et al., issued September 8, 2000 ("Sadaie," Ex. 1003). Sadaie is a Japanese language publication. Petitioner submitted the Japanese language publication as Exhibit 1010 and a certified English language translation as Exhibit 1003. All citations herein are to the English language translation in Exhibit 1003.

"PO Observ."), to which Petitioner filed a Response (Paper 36, "Pet. Resp. to PO Observ.").

We heard oral argument on February 18, 2015. A transcript is entered as Paper 38 ("Tr.").

We have jurisdiction under 35 U.S.C. § 6(c). This final written decision is entered pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73.

We determine Petitioner has shown by a preponderance of the evidence that claims 1 and 2 of the '483 patent are unpatentable under 35 U.S.C. § 103. We further determine Petitioner has not shown by a preponderance of the evidence that claim 3 of the '483 patent is unpatentable under 35 U.S.C. § 103.

A. Related Proceeding

The '483 patent is the subject of litigation in the Northern District of California, *THX, Ltd. v. Apple Inc.*, Civil Action No. 3:13-cv-01161. Pet. 1.

B. The '483 Patent

The '483 patent is directed to sound reproduction, and, in particular, narrow profile speaker configurations and systems. Ex. 1001, Title, 1:20–23. The '483 patent describes a speaker configuration having a relatively narrow sound output region relative to the size of the speaker face. *Id*. at 3:22–26, 5:17–20. Figure 1 of the '483 patent is reproduced below.

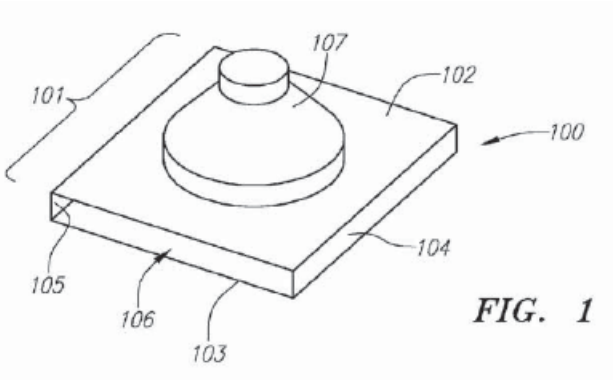

Figure 1, oblique frontal view of a narrow profile speaker.

As illustrated in Figure 1, above, narrow profile speaker unit 100 has speaker 107 supported by baffle 101 and mounting surface 102, sound reflecting surface 103 disposed in parallel orientation to mounting surface 102, and sidewalls 104 and 105. *Id.* at 5:57–64. Surfaces 102, 103, sidewalls 104, 105, and the back wall collectively define sound duct 115. *Id.* at 5:60–64. In operation, speaker 107 receives audio signals from a source such as CD players, cassette players, radios, and sound processors. *Id*. at 6:7–12. The primary acoustic output of sound waves from speaker 107 is directed toward sound reflecting surface 103, and mounting surface 102 acoustically isolates the speaker's rearward radiating sound waves from its forward radiating sound waves. *Id*. at 5:66–6:6. Sound waves output from speaker 107 are redirected and "turned" by ninety degrees such that they are channeled by the sound duct to output slot 106 and released "while retaining a sufficient degree of sound quality." *Id*. at 7:44–48.

Figure 3C illustrates an embodiment claimed in claim 1 of the '483 patent, and Figure 3C is reproduced below.

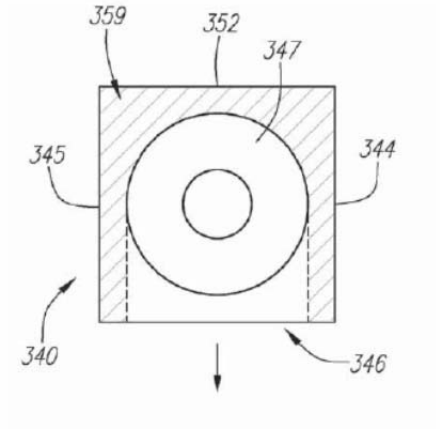

Figure 3C, sectional top view showing sound damping material.

In Figure 3C, above, sound damping material 359 is placed within the sound duct such that the sound damping material follows along back wall 352, contours around speaker cone 347, and "follows along sidewalls [344, 345] to the edge of output slot 346." *Id.* at 8:61–66. In this configuration, the sound damping material is "forming sides of the sound duct" as recited in claim 1. *Id.* at 30:5–6. "Sound output from speaker 347 emanates from output slot 346." *Id.* at 8:66–67. Sound damping material within the sound duct "may help prevent, e.g., undesirable interference or reflections within the duct . . . that may otherwise be caused by soundwaves reflecting from the backwall [] or back corners . . . [and] may . . . also help to prevent the creation of standing waves." *Id.* at 8:17–24 (as referenced at 9:1–2). Sound damping material according to the embodiment in Figure 3C also "may further reduce the possibility of reflection from sidewalls [344, 345] and/or standing (lateral) waves." *Id.* at 8:54–55 (as referenced at 9:1–2).

C. Claims

Claims 1–3 are reproduced below (emphases added):

1. A narrow profile sound system, comprising:

a drive unit disposed on a mounting surface, said mounting surface forming a barrier acoustically isolating the drive unit's forward radiation from its rearward radiation;

a sound reflecting surface facing the drive unit and substantially parallel with the mounting surface; and

sound damping material disposed between said sound reflecting surface and the mounting surface, the sound reflecting surface and the mounting surface defining a bottom and top of a narrow sound duct terminating in an elongate output slot, *with the sound damping material forming sides of the sound duct*, whereby forward radiation from the drive unit is turned at a substantially right angle and channeled along a straight path towards the output slot;

wherein the sound damping material forms an outer shape of the sound duct which reduces sound reflections at the end of the sound duct opposite the output slot and thereby mitigates standing waves.

2. The narrow profile sound system of claim 1, wherein sound emanating from the output slot is characterized by a wide horizontal dispersion angle and a narrow vertical dispersion angle as a result of the elongate shape of the output slot.

3. The narrow profile sound system of claim 1, wherein said sound damping material forms a back wall of the sound duct, said back wall substantially following a curved contour of a portion of a drive unit cone farthest opposite from the output slot.

Ex. 1001, 29:62–30:23.

II. ANALYSIS

A. Claim Construction

We determine the meaning of certain claim terms for purposes of this

decision. In an *inter partes* review, claim terms in an unexpired patent are given their broadest reasonable interpretation in light of the patent specification. 37 C.F.R. § 42.100(b); *In re Cuozzo Speed Techs., LLC,* 778 F.3d 1271, 1279–81 (Fed. Cir. 2015). Under the broadest reasonable interpretation standard, claim terms are given their ordinary and customary meaning, as would be understood by one of ordinary skill in the art in the context of the entire disclosure. *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). Any special definition for a claim term must be set forth in the specification with "reasonable clarity, deliberateness, and precision." *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994). We also must be careful not to read a particular embodiment appearing in the written description into the claim if the claim language is broader than the embodiment. *In re Van Geuns*, 988 F.2d 1181, 1184 (Fed. Cir. 1993). We construe the term below in accordance with these principles.

1. "sound reflecting surface"

The term "sound reflecting surface" is recited in independent claim 1 of the '483 patent. Petitioner does not offer a construction for "sound reflecting surface." In our Decision to Institute, we determined the broadest reasonable interpretation of "sound reflecting surface" is "a surface that redirects sound waves output from a speaker, not made of sound damping material." Dec. 11. Patent Owner states in its Response that "[f]or purposes of this proceeding, Patent Owner applies the Board's construction" (PO Resp. 6), but Patent Owner contests Petitioner's assertion that Tomonori discloses a "sound reflecting surface." PO Resp. 31–34. We maintain our construction of "sound reflecting surface" for the reasons provided below.

Claim 1 recites "a sound reflecting surface facing the drive unit and substantially parallel with the mounting surface" in which the drive unit (speaker) is disposed. Ex. 1001, 29:66–67. Such an arrangement is shown in Figure 2B, reproduced below.[4]

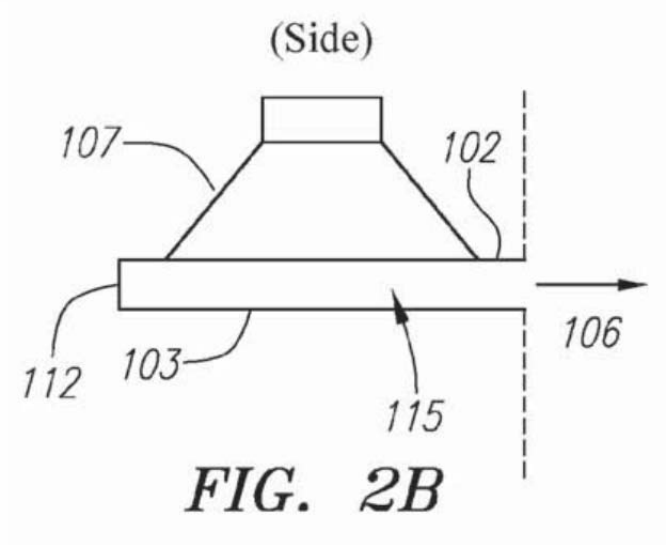

FIG. 2B

Figure 2B, sectional view of narrow profile speaker.

Figure 2B depicts a sectional view showing the recited arrangement of speaker 107 located in mounting surface 102 parallel to sound reflecting surface 103. *Id.* at 6:14–17, Fig. 2B. The'483 patent states that "a reflecting surface disposed immediately in front of the face of the speaker cone redirects the sound output, through a sound duct or otherwise, and causes the sound to emanate from a slot or other aperture." *Id*. at 3:27–30 (emphasis added). With regard to Figure 2B, sound reflecting surface 103 is described as follows:

[4] Figure 17B depicts a similar arrangement. Ex. 1001, 22:55–64, Fig. 17B.

> Preferably, the sound reflecting surface 103 is spaced at a distance from the front face of the speaker 107 such that the duct or chamber 115 defined by the surrounding sidewalls 104, 105 and backwall 112 does not permit soundwaves of the primary acoustic output from the speaker 107 to unfold significantly within the confines of the duct 115, as pressure effects will tend to cause the lateral soundwaves that emanate from the output slot 106 to have sound quality and dynamic range comparable to the soundwaves initially emitted from the speaker 107 itself.

Id. at 6:18–27.

In operation, sound is output from speaker 107 toward sound reflecting surface 103 and redirected through output slot 106, described as "[having] a relatively narrow profile." *Id.* at 6:28–30. The relative dimensions of output slot 106 "[are] generally configured so as to provide a narrower profile of the effective area from which the soundwaves emanate, as compared to the front face of the speaker[]." *Id.* at 6:40–43; *see also id.* at 5:16–20 ("a relatively narrow sound output region in relation to the size of the speaker face(s)"). The configuration described, including the relative dimensions of the output slot, describe the "narrow sound duct" recited in claim 1.

Claim 1 recites additional limitations that define a narrow profile sound duct: "the sound reflecting surface and the mounting surface defining a bottom and top of a narrow sound duct terminating in an elongate output slot." *Id.* at 30:2–5. The relative dimensions of the narrow sound duct are positive structural limitations of the claimed narrow profile sound system, which must be considered in context when defining the recited "sound reflecting surface." When read in context and in light of the specification,

portions of which are discussed immediately above, the narrow sound duct terminating in an elongate output slot has a sound reflecting surface (bottom) and a mounting surface (top) separated by a distance that is less than the distance between two side walls, in order to form the "elongate output slot." The claimed narrow profile structure outputs high quality sound by not permitting sound waves "to unfold significantly within the confines of the duct" and by generating "pressure effects" that will cause high quality lateral sound waves to emanate from the elongate output slot. *Id.* at 6:18–27.

Claim 1 further distinguishes the top mounting surface and bottom sound reflecting surface from sides of the narrow sound duct, reciting "sound damping material disposed *between* said sound reflecting surface and the mounting surface . . . with the sound damping material forming sides of the sound duct." *Id.* at 30:1–6 (emphasis added). The fact that sound damping material must be located "between" the sound reflecting surface and mounting surface and is "forming sides" of the narrow sound duct, indicates that sound damping material is not placed on the "sound reflecting surface." The sound reflecting surface may be made of a durable material such as "high impact plastic or aluminum, or any other suitable material." *Id.* at 9:52–55.

Figure 3C is again reproduced below.[5]

[5] Figure 17 A depicts a similar embodiment. Ex. 1001, Fig. 17A, 22:42–48.

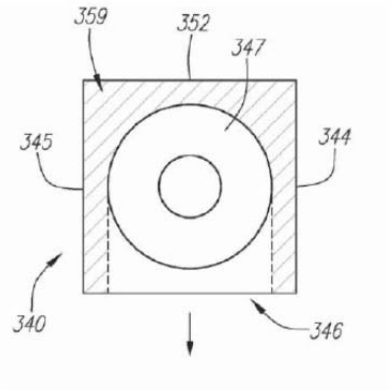

Figure 3C, sectional top view showing sound damping material.

In Figure 3C, above, sound damping material 359 is placed within the duct such that the sound damping material follows along back wall 352, contours around speaker cone 347, and "follows along sidewalls [344, 345] to the edge of output slot 346." *Id.* at 8:61–66. In this configuration, the sound damping material forms "sides of the sound duct" as recited in claim 1 and "forms a back wall of the sound duct . . . following a curved contour of a portion of a drive unit cone farthest opposite from the output slot" as recited in claim 3. *Id.* at 30:5–6.[6] Sound damping material along the back wall and sides of the narrow sound duct "may help prevent, e.g., undesirable interference or reflections within the duct . . . that may otherwise be caused by soundwaves reflecting from the backwall [] or back corners . . . [and] may . . . also help to prevent the creation of standing waves." *Id.* at 8:17–24 (as referenced at 9:1–2). Sound damping material along the sides of the narrow sound duct according to the embodiment in Figure 3C also "may

[6] The claims, therefore, separately recite and distinguish the sides of the narrow sound duct from the mounting surface, sound reflecting surface, and back wall.

further reduce the possibility of reflections from sidewalls [344, 345] and/or standing (lateral) waves." *Id.* at 8:54–55 (as referenced at 9:1–2). Sound damping material, in contrast to the material forming the sound reflecting surface, preferably comprises non-resonant material with sound absorbing qualities such as "expanded or compressed foam," "rubber," or "reinforced paper, fabric, or fiber." *Id*. at 8:32–40.

The language of claim 1 also distinguishes the function of sound damping material from that of a sound reflecting surface. A concluding wherein clause states, "wherein the sound damping material forms an outer shape of the sound duct which reduces sound reflections at the end of the sound duct opposite the output slot and thereby mitigates standing waves." *Id.* at 30:10–13. The recited claim language is consistent with the description in specification for the use of sound damping material.

In sum, the '483 patent describes and claims a sound reflecting surface that redirects sound waves output from the speaker towards the elongate output slot, whereas sound damping material absorbs standing waves inside the sound duct. The '483 patent goes to great lengths to distinguish a sound reflecting surface from a sound damping surface. Furthermore, given that "sound damping material" is different from a "sound reflecting surface" and both are recited as separate claim limitations, it follows that a sound reflecting surface is not made of sound damping material.

For the reasons given above, we construe "sound reflecting surface," in the context of claim 1 and in light of the '483 patent specification, as "a surface that redirects sound waves output from a speaker, not made of sound

damping material."

2. Other Terms

Petitioner proposes to construe additional claim terms. Pet. 11–14. We determine that no express construction of these additional terms is necessary for purposes of this decision.

B. Asserted Obviousness of Claims 1–3 over Tomonori, Virva, and Sadaie

1. Tomonori

Tomonori discloses a narrow profile television speaker designed to fill the "dead space" on either side of a cathode ray tube inside a television cabinet. Ex. 1004, Abstract, 1:10–18, Figs. 1, 22. A sound tube (duct) connected to the speaker guides sound waves to an elongated opening at the front side of the television cabinet. *Id.* Petitioner relies primarily on the embodiments shown in Tomonori's Figures 9, 10, and 16 in support of Petitioner's obviousness argument. Pet. 41–44.

Figure 10 is reproduced below:

FIG. 10

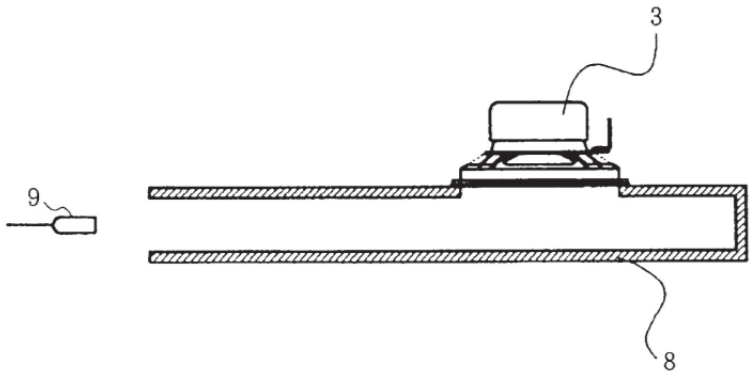

Figure 10, sectional view of a narrow profile speaker.

In Tomonori Figure 10, above, sound waves radiated from speaker 3 are redirected at a substantially right angle and channeled along sound tube 8 to an output aperture adjacent microphone 9. Pet. 43 (citing Ex. 1004, Figs. 9, 10, 16; Ex. 1002 ¶ 110). Tomonori discloses that "one of the problems of directing sound through a duct is the presence of standing waves inside the duct, which can degrade sound quality." *Id.* at 16 (citing Ex. 1004, 2:12–18; quoting Ex. 1002 ¶ 50). Tomonori discloses two solutions to the problem. Tomonori locates his speaker at an "anti-node," to prevent longitudinal standing waves, which corresponds to a distance that is 1/3 the length of the sound tube from the closed end. PO Resp. 30 (citing Ex. 1004, 6:1–11, 8:3–9, 8:57–9:5; Ex. 2007 ¶¶ 110–112). Tomonori also discloses packing the closed end of the sound tube with sound absorbing material "adapted to absorb standing waves." Pet. 16 (citing Ex. 1004, 1:57–2:5).

Figure 16 of Tomonori is reproduced below:

FIG. 16

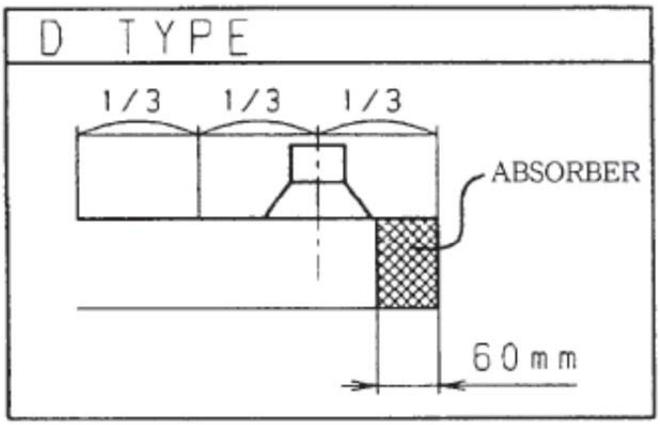

Figure 16, sectional view of a narrow profile speaker packed with sound absorbing material in the closed end.

Tomonori Figure 16, above, illustrates the placement of a speaker at an anti-node, located 1/3 the distance from the back wall of the sound tube, and sound absorbing material filling the closed end of the sound tube. *Id.* at 16, 42–43 (citing Ex. 1004, Fig. 16, 1:57–2:5, 8:14–25; Ex. 1002 ¶ 109). The sound absorbing material absorbs "sound waves returning upon reflection at the open end of the sound tube . . . whereby the resonance of standing waves is inhibited." *Id.* at 42.

Tomonori's Figure 17 charts frequency response for the speaker illustrated in Figure 16. PO Resp. 35 (citing Ex. 2007 ¶ 118). We reproduce annotated Figure 17 from Dr. Elliott's Declaration (Ex. 2007 ¶ 118) below.

FIG. 17

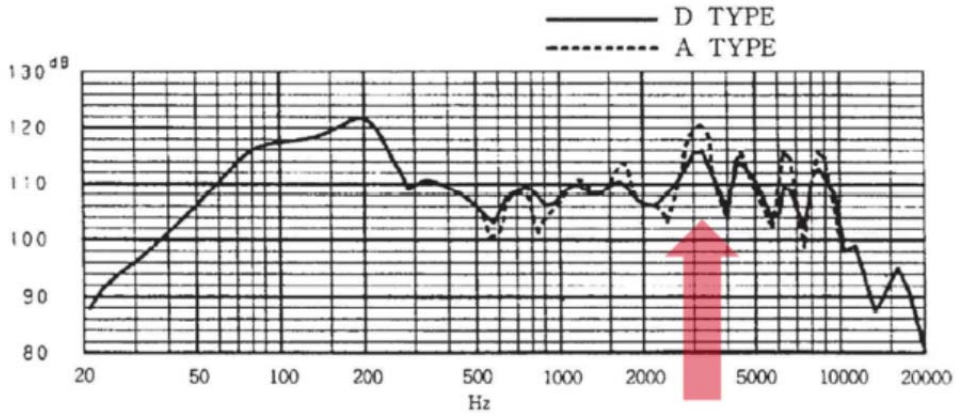

Figure 17, frequency response chart for the embodiment of Figure 16.

With regard to Figure 17, above, Tomonori discloses that "peak dips are effectively suppressed at medium to high frequencies" due to the sound-absorbing material in the closed end of the sound tube. PO Resp. 35 (citing Ex. 1004, 8:19–25). Tomonori's Figure 17 does show a peak dip at 3.4 kHz

(red arrow added by Dr. Elliott) and a smaller peak dip at 1.6 kHz. *Id.* (citing Ex. 2007 ¶ 118). Tomonori is otherwise silent with respect to the identified peak dips in Figure 17.

2. Differences Between Tomonori and Claim 1 of the '483 Patent

a. Petitioner's Argument

Petitioner asserts that Tomonori discloses all limitations of independent claim 1 except for "sound damping material forming sides of the sound duct." Pet. 41–44 (citing Ex. 1004, Figs. 9, 10, 16; Ex. 1002 ¶¶ 104–113). Petitioner argues it would have been obvious for one skilled in the art to extend the sound damping material of Tomonori, which is packed into the closed end of the sound duct (Ex. 1004, Fig. 16), to form sides of a sound duct. *Id*. at 44–45 (citing Ex. 1002 ¶¶ 112, 113).[7] Petitioner states that it was known to use sound damping material inside of a sound duct to prevent spurious resonances or standing waves (*id.* at 44 (citing Ex. 1004, 1:58–2:3; Ex. 1002 ¶ 112)), and Tomonori recognized that "the sound duct and components therein could be implemented in many different configurations" (*id.* (citing Ex. 1004, Figs. 1–22)). Petitioner further argues that Virva and Sadaie teach the use of sound damping material on the sides of a sound duct to suppress standing waves inside the duct, thereby

[7] Petitioner submits evidence that a person of ordinary skill in the art of speaker design would have a master's or undergraduate degree, including courses in acoustics, with at least two years of experience in speaker design or the equivalent. Pet. 10 n.1 (citing Ex. 1002 ¶ 12); *see id.* at 4–6 (citing Ex. 1002 ¶¶ 22–24 ("Technology Background")). Patent Owner does not challenge Petitioner's evidence. Based on the evidence of record, we agree with, and apply, Petitioner's definition of one of ordinary skill in the art of speaker design to our analysis.

providing a reason for one skilled in the art to extend the sound damping material of Tomonori to form sides of the sound duct. *Id*. at 44–45 (citing Ex. 1009, 3:42–46; Ex. 1003, 12, Figs. 12–18; Ex. 1002 ¶¶ 112, 113). With regard to Sadaie, in particular, Dr. Vipperman emphasizes Sadaie's disclosure that the use of sound damping material on the sides of Sadaie's narrow sound duct "enables the sharpness of a fundamental wave resonance of a standing wave determined by the length of the sound path 42 to be suppressed." *Id.* at 44 (citing Ex. 1002 ¶ 112).

b. Patent Owner's Argument

Patent Owner argues that Tomonori does not disclose the "sound reflecting surface" recited in claim 1 of the '483 patent, and that Tomonori does not support any reason to place sound damping material (derived from another reference) on the "sides of the sound duct," as recited in claim 1. PO Resp. 31–37. Patent Owner argues that, when construing "sound reflecting surface" in our Decision to Institute, we "made no finding that Tomonori disclosed a sound reflecting surface or materials for such a surface, and indeed Tomonori did not." *Id.* at 33. Patent Owner next argues that, given Tomonori's silence regarding the problem of vertical and lateral resonances interfering with quality sound reproduction, "there is no acoustic justification for preferentially placing sound damping material along the sidewalls as opposed to the top and bottom walls, as the '483 claims require."[8] *Id.* at 36.

[8] We note claim 1 requires that the bottom surface of the sound duct be a "sound reflecting surface" not made of sound damping material, in accordance with our claim construction. The claim language further recites

c. Analysis

Petitioner has provided substantial and persuasive evidence to support the finding that Tomonori discloses every limitation of the '483 patent claim 1, except Petitioner acknowledges Tomonori does not disclose "sound damping material forming sides of the sound duct." Pet. 41–44 (citing Ex. 1004, Figs. 1, 9, 10, 16, 1:12–35, 1:57–2:3, 3:6–12, 5:41–45, 6:20–31, 6:48–7:7, 8:14–25, 9:45–54; Ex. 1002 ¶¶ 104–112). Patent Owner argues that Tomonori does not disclose a "sound reflecting surface" or "sound damping material forming sides of the sound duct." PO Resp. 30–37. We address first Patent Owner's contention that Tomonori does not disclose a "sound reflecting surface" in accordance with our claim construction.

We have construed "sound reflecting surface" as "a surface that redirects sound waves output from a speaker, not made of sound damping

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placement of sound damping material "between" the mounting surface and sound reflecting surface, but the parties agree the claim language does not indicate clearly whether the mounting surface may or may not be made of sound damping material. Tr. 8:12–22 (MR. CAVANAUGH: "[I]t's not saying that the sound damping material either is not on the mounting surface or that it is."), 31:21–32:5 (MR. KELLEY: "It says there's a mounting face opposite, but it doesn't specify whether that's sound absorptive or reflective one way or the other in the claims."). We note the relevant '483 patent drawings do not show a top (mounting) surface lined with, or formed of, sound damping material. Ex. 1001, 8:4–16, 8:41–50, 8:56–66, 22:42–48, 22:55–23:3, Figs. 3A–C, 17A–C; Tr. 9:6–16, 32:6–10**.** By the same token, the '483 patent does not describe or claim the mounting surface as a type of sound reflecting surface, as suggested by Patent Owner in its Response. *See* PO Resp. 36; Pet. Reply 5–6. In any event, we need not decide the issue for purposes of this decision.

material." With regard to whether Tomonori discloses a surface that redirects sound waves output from a speaker, Figures 9, 10, and 16 show speaker 3 (the claimed "drive unit") disposed on a "mounting surface" (the top surface of the "narrow sound duct") that acoustically isolates the speaker's forward radiation from the speaker's rearward radiation. Pet. 41–42 (citing Ex. 1004, Figs. 1, 9, 10, 16, 5:41–45, 6:28–31; Ex. 1002 ¶¶ 105–107). The speaker faces the bottom surface of the narrow sound duct in a "substantially parallel" relationship. *Id.* at 42 (citing Ex. 1004, Figs. 9, 10, 16, 6:53–57, 6:28–31; Ex. 1002 ¶ 108). Figures 9 and 10 show microphone 9 located just outside the "elongate output slot" of Tomonori's "narrow sound duct" to capture the sound output and determine the sound pressure-frequency characteristics. *Id.* at 42 (citing Ex. 1004, 6:28–31, 6:53–57; Ex. 1002 ¶ 108); Ex. 1004, 6:58–7:2. Microphone 9 is oriented at approximately a 90° angle to the direction of forward radiation output from speaker 3. Ex. 1004, Figs. 9, 10, 16.

The frequency characteristics of Tomonori's Figure 16 embodiment are depicted graphically in Figure 17. Ex. 1004, Fig. 17. Tomonori describes the sound output from a similar speaker (without sound absorbing material (Figures 13A and 15)), as having "satisfactory sound pressure-frequency characteristics." Ex. 1004, 7:53–8:25. The geometry and acoustical output of Tomonori's sound duct depicted in Figures 9, 10, and 16, therefore, illustrate "forward radiation from the drive unit is turned at a substantially right angle and channeled along a straight path towards the output slot" as recited in claim 1. Pet. 43 (citing Ex. 1004, Figs. 9, 10, 16; Ex. 1002 ¶ 110).

For the reasons given above, we find Tomonori discloses the first part of our construction of the claimed "sound reflecting surface," namely a surface that redirects sound waves output from a speaker.

With regard to whether Tomonori discloses a sound reflecting surface not made of sound damping material, we noted previously that Tomonori packs sound damping material into the closed end of the sound duct behind the rear edge of the speaker cone, as shown in the cross-hatched area of Figure 16. Pet. 42–43 (citing Ex. 1004, Figs. 16, 17, 1:57–2:3, 3:6–12, 8:14–25, 9:45–54; Ex. 1002 ¶ 109). Accordingly, by necessary implication in view of (i) the absence of cross-hatched areas on the top, bottom, and side walls of the sound duct, and (ii) our analysis immediately above regarding Tomonori's ability to redirect sound waves at a substantially right angle toward the elongate output slot, we find the bottom surface of the narrow sound duct facing the speaker in Figure 16 is not made of sound damping material. *See* Pet. Reply 12. As Petitioner points out, Patent Owner's expert, Dr. Elliott, does not dispute the fact that Tomonori discloses a sound reflecting surface. *Id.*; *see* Ex. 1016, 104:6–8. We find, therefore, that Tomonori satisfies our claim construction for a "sound reflecting surface," namely a surface that redirects sound waves output from a speaker, not made of sound damping material.

For the reasons stated above, we agree with Petitioner that Tomonori Figure 16 discloses a "sound reflecting surface . . . defining a bottom . . . of a narrow sound duct," as recited in claim 1. Pet. 42–43 (citing Ex. 1004, Figs. 9, 10, 16, 6:53–57, 6:28–31; Ex. 1002 ¶¶ 108–110). The remaining

difference between claim 1 of the ’483 patent and Tomonori is the absence of “sound damping material forming sides of the sound duct” in Tomonori.

3. Whether Tomonori, Virva, and Sadaie provide a reason or motivation for one of skill in the art to use sound damping material to form sides of Tomonori’s sound duct

a. The use of sound damping material in the ’483 patent

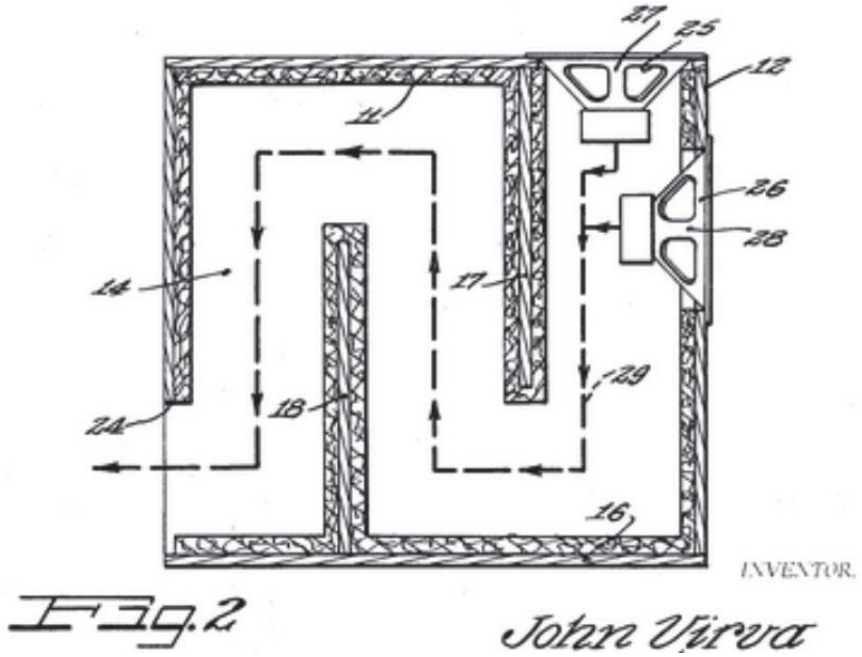
The ’483 patent describes unwanted resonances associated with standing waves inside a narrow sound duct. Ex. 1001, 8:6–66, 23:7–21. The ’483 patent describes the placement of sound damping material along the back wall of the sound duct to prevent “expansion of the sound waves in a rearward direction, and thereby reducing potential interference or other undesirable acoustic effects.” *Id.* at 22:64–23:3, Fig. 17B. Claim 1 recites “wherein the sound damping material forms an outer shape of the sound duct which reduces sound reflections at the end of the sound duct opposite the output slot and thereby mitigates standing waves.” *Id.* at 30:10–13.

The ’483 patent further describes placement of sound damping material on the side walls and, optionally, the back wall of the sound duct, but not on the bottom or top surfaces. *Id.* at 8:6–66, 22:42–23:3. Figures 17A–C of the ’483 patent illustrate an embodiment of claim 1 where sound damping material is placed on the side walls and back wall of a narrow sound duct terminating in an elongate output slot, but not on the top or bottom surfaces of the sound duct. *Id.* at 22:42–23:3, Figs. 17A–C. Claim 1 recites “sound damping material disposed between said sound reflecting surface and the mounting surface . . . . with the sound damping material forming sides of the sound duct.” *Id.*at 30:5–6.

b. Virva

Virva discloses a speaker enclosure where "all inside surfaces of the enclosure should be treated with acoustically absorbing material to prevent spurious resonances or standing waves from developing within the enclosure." Pet. 44 (citing Ex. 1009, 3:42–46; Ex. 1002 ¶ 112). Virva Figure 2 depicts a labyrinth or serpentine type speaker enclosure. PO Resp. 41; *see* Ex. 1009, 4:2–14; Ex. 2007 ¶ 32.

Virva's Figure 2 is reproduced below.



Virva Figure 2, labyrinth enclosure with sound damping material.

Virva's labyrinth-type speaker enclosure, above, is designed to provide a "loading" for the speakers to improve their low-frequency response at "the quarter wave length of a specific frequency, typically near the fundamental resonance of the loudspeaker." PO Resp. 37–38 (citing Ex. 1009, 1:51–56, 3:39–45; Ex. 2007 ¶¶ 32, 95). To avoid or limit

interference at mid-range or higher frequencies, sound damping material lines the walls of the labyrinth to damp out the higher frequency components of the signal. *Id.* at 39 (citing Ex. 2011, 76; Ex. 2007 ¶ 33). Virva discloses "a speaker enclosure where 'all inside surfaces of the enclosure should be treated with acoustically absorbing material to prevent spurious resonances or standing waves from developing within the enclosure.'" Pet. 44 (citing Ex. 1009, 3:42–46).

c. Sadaie

Sadaie describes a relatively small base-range speaker system. Ex. 1003, 2. Figure 3 of Sadaie illustrates a cross-sectional view of one embodiment of a speaker system. *Id*. at 5.

Figure 3 of Sadaie is reproduced below.

FIG. 3

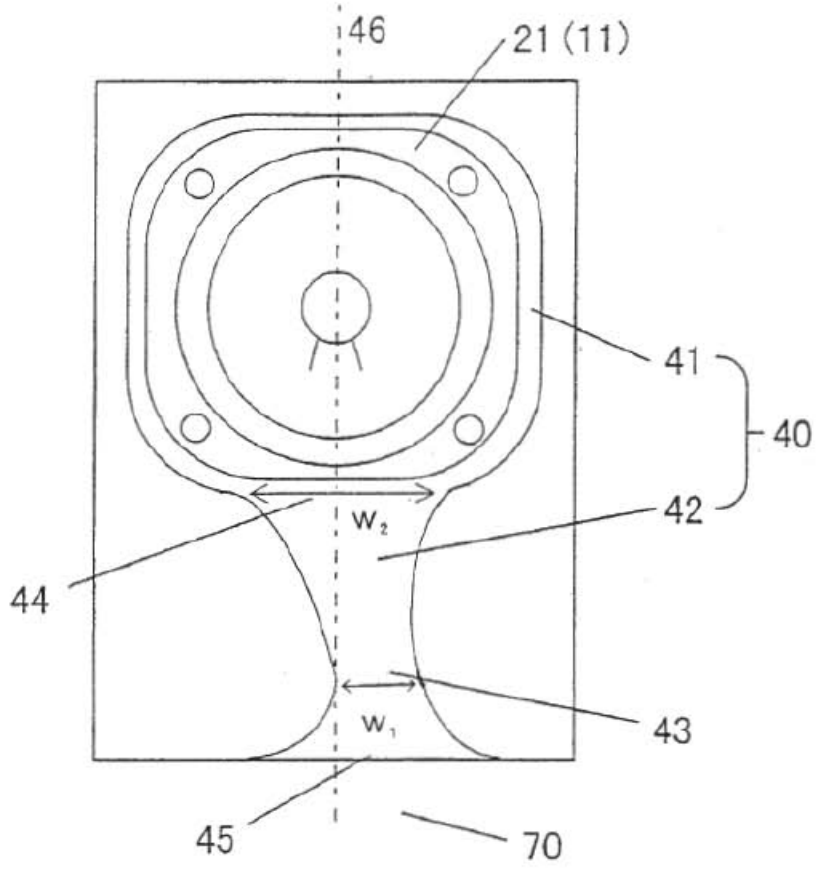


Figure 3, sectional view of Sadaie's speaker system.

As illustrated in Figure 3, above, the speaker system has speaker unit 21 mounted in an enclosure. *Id.* at 7. Sound guiding part 40 has sound source space 41 and "asymmetrical" (narrowing, curved) sound path 42. *Id.* at 8. Sound source space 41 surrounds speaker unit 21. *Id.* Sound waves radiated from speaker unit 21 are propagated through sound source space 41 and sound path 42 through output slot 45 to free space 70. *Id.*; Pet. 19 (citing Ex. 1003, 16). As best shown in the sectional views of Figures 17

and 18, Sadaie's sound guide forms a sound duct terminating in an output slot. Pet. 20 (citing Ex. 1003, 7, 8, 14–16, Figs. 16–18).

Sadaie teaches that, to maximize bass-range performance, sound is radiated into sound guide 40, which causes "high compression and expansion of the air," thereby lowering the fundamental frequency of the speaker. PO Resp. 48 (citing Ex. 1003, 3; Ex. 2007 ¶¶ 100–102). The high compression is created by narrowing the width of sound path 42, illustrated in Figure 3 above, such that the width of section 43 (W_1) is narrower than both section 44 (W_2) and exit section 45 (output slot) of sound path 42. *Id*. (citing Ex. 1003, 8; Ex. 2007 ¶¶ 101–103). Sadaie's speaker system is a type of bandpass enclosure designed to increase low-frequency output over a narrow frequency range. *Id.* at 49 (citing Ex. 1003, 2; Ex. 2007 ¶ 103).

Figure 14 illustrates a cross-sectional view of an alternative embodiment of Sadaie's speaker system (Ex. 1003, 11).

Sadaie's Figure 14 is reproduced below.

FIG. 14

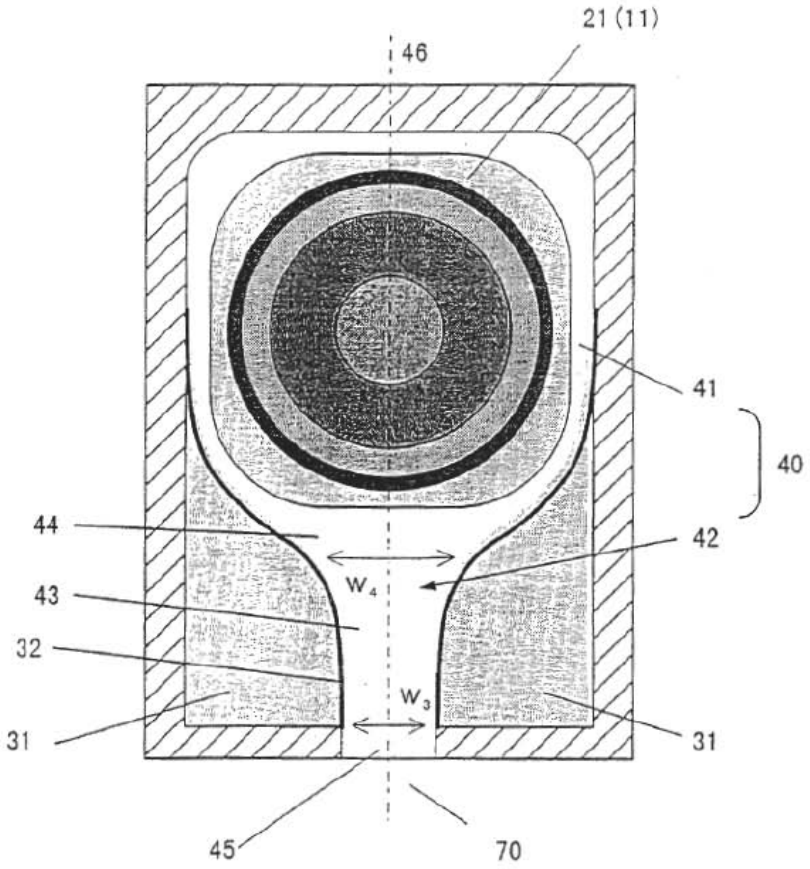


Figure 14, sectional view of Sadaie's speaker system.

In the embodiment of Figure 14, sound path 42 is configured from pressure absorbing material in the shaded areas of sections 31 and 32. Ex. 1003, 11. Sadaie explains that the pressure absorbing material "does not require sound absorbency but may have sound absorbency." PO Resp. 50 (citing Ex. 1003, 12–13); Pet. Reply 14. Sadaie uses pressure absorbing material to "mitigate overpressure . . . during large input" to obtain a "fast bass response." PO Resp. 50 (citing Ex. 1003, 12; Ex. 2007 ¶¶ 108, 124). Sadaie uses sound absorbency to absorb high frequency wind noise created

by the high pressure in the sound duct. *Id.* at 51–52 (citing Ex. 1003, 2, 12–13; Ex. 2007 ¶¶ 107, 130). Sadaie teaches that the pressure/sound absorbing material may be placed along the side walls but not the top and bottom of the sound duct, and the sound absorbing material on the sides was known "to further suppress standing waves inside a duct." Pet. 44 (citing Ex. 1002 ¶ 112). Petitioner, relying on Dr. Vipperman's Second Declaration, explains that "Sadaie distinguishes the side walls (intermediate section) from the top and bottom walls, and recites that damping material is placed on the side walls." Pet. Reply 14–15 (citing Ex. 1017 ¶¶ 22–26; Ex. 1003, 12–13).[9]

d. Analysis

Tomonori discloses sound damping material that fulfills the same function disclosed and claimed in the '483 patent (Ex. 1004, 1:57–2:8, 3:6-12, 8:14-25), even though it does not form the sides of the sound duct. Ex. 1002 ¶ 109. Petitioner's evidence establishes the use of sound damping material along the sides of a sound duct as a known configuration to

[9] Patent Owner's Response asserts that Sadaie teaches placement of sound damping material "on any or all sides of the duct without limitation to the sidewalls," but does not teach selective placement of pressure/sound damping material along the side walls, while avoiding placement of sound damping material on the bottom and top surfaces of the sound duct. PO Resp. 55–56. During the oral hearing, however, counsel for Petitioner explained Dr. Vipperman's testimony, that Sadaie teaches the placement of pressure/sound damping material on the sidewalls of the duct and not necessarily on the top and bottom surfaces. Tr. 11:14–13:9, 14:6–12**.** Counsel for Patent Owner acknowledged the point. Tr. 35:1–13 (JUDGE MURPHY: "It could be one side**.** It could be two sides. It could be all sides. It's not only all sides, right?" MR. KELLEY: "It is not only all sides, you're correct.").

suppress standing waves inside a duct. Pet. 44 (citing Ex. 1002 ¶ 112). Dr. Vipperman identifies the reason for Sadaie's use of side wall sound damping as enabling "the sharpness of a fundamental wave resonance of a standing wave determined by the length of the sound path . . . to be suppressed because a substantial length of the sound path cannot be primarily determined." Ex. 1002 ¶ 112 (citing Ex. 1003, 14). We agree with Petitioner's reasoning, therefore, that "[e]xtending the damping material of Tomonori along the sidewalls of the duct," as taught by Sadaie, would have been one of a limited number of known solutions further minimizing the presence of spurious resonances and standing waves inside the duct. *Id.* at 45 (citing Ex. 1002 ¶ 113).

The quoted statements of Petitioner and Dr. Vipperman with respect to Tomonori and Sadaie are consistent with the principles set forth in *KSR*.[10] Petitioner and Dr. Vipperman provide an analysis of why one of ordinary skill in the art of speaker design would have been motivated by Sadaie's disclosure of side wall sound damping to modify Tomonori's narrow sound duct, such that sound damping material forms the sides of the sound duct but not the bottom (sound reflecting) surface. In particular, Dr. Vipperman's Declaration provides a sufficient analysis to support the obvious modification of Tomonori's narrow profile speaker, by a speaker designer of ordinary skill, such that "sound damping material form[s] sides of the sound duct" to help suppress the presence of spurious resonances and standing waves inside the duct. Ex. 1002 ¶¶ 112, 113.

[10] *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398 (2007) ("*KSR*").

As noted in *KSR*, "[i]f a person of ordinary skill can implement a predictable variation, § 103 likely bars its patentability. For the same reason, if a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill." *KSR*, 550 U.S. at 417. Patent Owner does not contend that Sadaie's selective side wall sound damping technique would have been beyond the skill level of an ordinarily skilled speaker designer at the time of the '483 patent priority filing date. *See* PO Response 52–56. We find the quoted passage from *KSR* particularly applicable to the facts of the present case with respect to the combination of Tomonori and Sadaie.

Patent Owner acknowledges that Tomonori teaches the use of sound damping material to form the back wall of a narrow sound duct, which will absorb "sound waves returning upon reflection at the open end of the sound tube . . . whereby the resonance of standing waves is inhibited." PO Resp. 35 (citing Ex. 1004, 8:19–25, Fig. 17; Ex. 2007 ¶ 118); *see also* Pet. 42–43 (citing Ex. 1004, 8:14–25, Figs. 16, 17; Ex. 1002 ¶ 109); Pet. Reply 13 (citing Ex. 1016, 104:13–16). Although Tomonori does not acknowledge that there are lateral and vertical resonances in the sound output of Tomonori's Figure 16 embodiment (PO Resp. 35 (citing Ex. 2007 ¶ 118)), the desire to damp lateral resonances need not be the only reason why one of ordinary skill would use side wall sound damping in a sound duct. "In determining whether the subject matter of a patent claim is obvious, neither the particular motivation nor the avowed purpose of the

patentee controls. What matters is the objective reach of the claim." *KSR*, 550 U.S. at 419. Patent Owner's argument, that Sadaie uses side wall sound damping to suppress higher frequency wind noise but not the lower frequency sound that Sadaie's bandpass-type enclosure was designed to produce, fails to consider the objective reach of the claim. Pet. Reply 15; Pet. Resp. to PO Observ. No. 3, 2 ("[Patent Owner's] Observation is based on the assumption that the challenged claims require absorption at specific frequencies and absorption of lateral resonances. They do not." (citation omitted)). In sum, we are persuaded by Petitioner's argument that the claims are not so limited as Patent Owner's argument would require. *See, e.g.*, Pet. Reply 4 (noting the '483 patent "never discusses" Patent Owner's asserted innovation of a duct having a vertical dimension small enough to eliminate vertical resonances without sound damping and also suppress lateral resonances by minimizing the area of side wall sound damping); Tr. 82–83 (JUDGE MURPHY: "The sound damping material that is used to form the sidewalls, what standing waves or resonances would that suppress or mitigate? MR. CAVANAUGH: "I think if the claim is the guide, which it has to be, then it has to eliminate standing waves. The claim doesn't specifically say particular standing waves.").

We take a different view of Petitioner's asserted combination of Tomonori and Virva.

Virva's labyrinth-type speaker is designed to *generate*, rather than suppress, a low-frequency resonance (standing wave) to improve the speaker's low-end frequency response. PO Resp. 41; *see* Ex. 1009, 4:2–14; Ex. 2007 ¶¶ 32 (citing Ex. 2011, 76–77; Ex. 2013, 187), 121. In contrast,

"Tomonori aimed at the opposite goal, and took measures to prevent end-to-end [longitudinal] resonance across the length of the duct that Virva enables and relies upon." *Id.* (citing Ex. 1004, 2:51–3:5; Ex. 2007 ¶¶ 111, 112, 115, 121, 122). Virva's teaching, to line all inside surfaces of a labyrinth-type enclosure with sound damping material, does not teach one of ordinary skill to use sound damping material selectively to form sides of a narrow sound duct, while avoiding the use of sound damping material on at least the bottom (sound reflecting) surface. *Id.* at 43–45 (citing Ex. 2007 ¶¶ 127–129). Virva also shows a speaker system configured such that each speaker faces open space, rather than facing a substantially parallel sound reflecting surface as recited in claim 1, which means the recited "forward radiation" of the speaker output is not directed into a narrow sound duct terminating in an elongate output slot. *Id.* at 45 (citing Ex. 2007 ¶ 129; Ex. 1009, Fig. 1). The aforementioned differences between claim 1 of the '483 patent, Tomonori, and Virva are not addressed persuasively by Petitioner either in the Petition or in Petitioner's Reply.

In summary, we conclude Petitioner has satisfied its burden of proving by a preponderance of the evidence that one of ordinary skill in the art of speaker design would have been motivated by the combination of Tomonori and Sadaie to provide Tomonori's narrow sound duct with "sound damping material forming sides of the sound duct," as recited in claim 1 of the '483 patent. We further conclude Petitioner has not satisfied its burden of proving by a preponderance of the evidence that one of ordinary skill in the art of speaker design would have been motivated by the combination of Tomonori and Virva to provide Tomonori's narrow sound duct with "sound

damping material forming sides of the sound duct," as recited in claim 1 of the '483 patent.

4. Asserted Obviousness of Claim 2

Claim 2 depends from claim 1 and recites "wherein sound emanating from the output slot is characterized by a wide horizontal dispersion angle and a narrow vertical dispersion angle as a result of the elongate shape of the output slot." Ex. 1001, 30:14–18. We agree with Petitioner that Tomonori discloses an elongate output slot and emits sound characterized by a wide horizontal dispersion angle and a narrow vertical dispersion angle as a result of the elongate output slot. Pet. 44–46 (citing Ex. 1004, 2:12–18, 6:48–7:7, Figs. 1, 9, 10, 16; Ex. 1002 ¶ 114). Patent Owner does not address claim 2 separately from claim 1. We conclude Petitioner has shown by a preponderance of evidence that the combination of Tomonori and Sadai would have rendered claim 2 obvious to a person of ordinary skill in the art.

5. Asserted Obviousness of Claim 3

Claim 3 of the '483 patent recites "wherein said sound damping material forms a back wall of the sound duct, said back wall substantially following *a curved contour of a portion of a drive unit cone farthest opposite from the output slot*." Ex. 1001, 30:20–23 (emphasis added). The '483 patent illustrates various embodiments of claim 3 in Figures 3A-C. Figure 3C is representative and reproduced below.

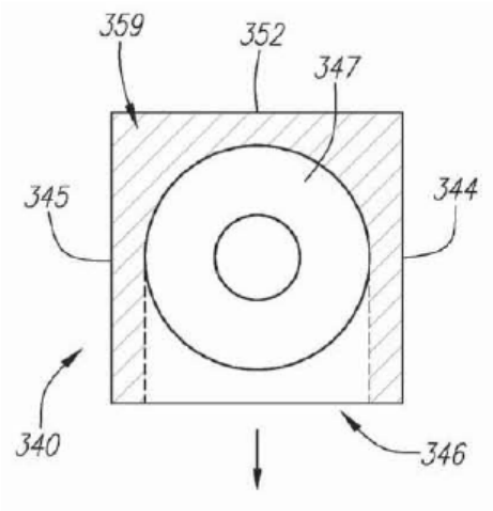


Figure 3C, sectional top view showing sound damping material forming back wall and following curved contour of speaker cone.

Figure 3C, above, depicts "sound damping material 359 follows along sidewalls [344], [345] to the edge of the output slot 346 and . . . is contoured to circumscribe the periphery of the cone of speaker [347]." Ex. 1001, 8:61–66. The line-shaded area of sound damping material follows the curved contour portion of speaker cone 347 farthest away from output slot 346, to form the recited back wall of the sound duct.

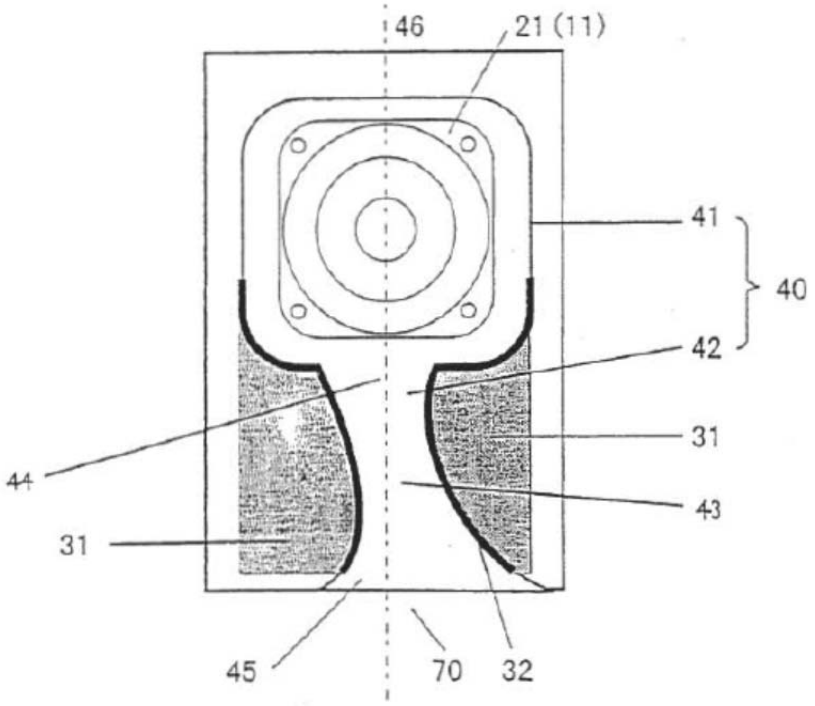
Petitioner states that Tomonori's Figure 16 illustrates sound damping material packed into the closed end of the sound duct and forming a back wall of the sound duct. Pet. 46 (citing Ex. 1004, 8:14–18, Fig. 16; Ex. 1002 ¶ 115). Tomonori's sound damping material, however, is not depicted or described as following a curved contour of a portion of the speaker cone farthest opposite the output slot, as recited in claim 3 of the '483 patent. *Id.*;

see Ex. 1004, Figs. 9, 16.[11] Petitioner argues that it would have been obvious for one skilled in the art to contour the sound damping material in Tomonori's sound duct to follow the curved rear edge of the speaker cone opposite the output slot (Pet. 46–47 (citing Sadaie, Ex. 1003, 3, 5, 9–15, Figs. 4, 12–18)), because straight and curved back walls "have both been commonly used in loudspeaker design with predictable results." *Id*. at 47 (citing Ex. 1002 ¶¶ 116, 117).

We agree with Patent Owner that Petitioner and Dr. Vipperman have not identified any examples in the prior art of *sound damping material* forming a back wall of a sound duct that follows a curved contour of a speaker cone. PO Resp. 58. Tomonori, Virva, and Sadaie do not depict, suggest, or teach sound damping material forming a curved back wall of the sound duct by "following a curved contour of a portion of a drive unit cone farthest opposite from the output slot," as recited in claim 3 of the '483 patent.[12] Figure 18 of Sadaie is representative and reproduced below.

[11] Virva also does not show sound damping material following a curved contour of a speaker cone to form the back wall of a sound duct.
[12] Petitioner and Dr. Vipperman cite Figure 4 of Sadaie, which shows a circular peripheral outer edge of Sadaie's sound guide, but sound damping material is not described or shown to form the back wall of Sadaie's sound guide in Figure 4 or in any other figure of Sadaie. *See* Ex. 1003. Figs. 1–18.

FIG. 18



Sadaie Figure 18, sectional view showing sound damping material.

The gray and black shaded areas of sections 31 and 32 depict pressure/sound damping material forming sidewalls of Sadaie's sound duct. Ex. 1003, 11–13. The sound damping material does not follow the curved portion of circular speaker cone 21 that is "farthest opposite from the output slot [45]" to form a back wall of the sound duct. PO Resp. 58. Dr. Vipperman relies on Sadaie's disclosure of a preferred embodiment where the "sound guiding part [40] has a sound source space [41] defined according to a peripheral edge portion of the above speaker unit," in support of his obvious-to-combine rationale. Ex. 1002 ¶ 116 (citing Ex. 1003, 3, 5, 9–15, Figs. 4, 12–18). Dr. Vipperman, however, does not explain why one of ordinary skill in the art would use the quoted teaching from Sadaie to modify the shape of the *sound damping material* in Tomonori's sound duct

to form the back wall of the sound duct by following the curved contour of a portion of the *speaker cone*, as recited in claim 3 of the '483 patent. *See* Pet. 46, 47 (citing Ex. 1002 ¶ 116–17). Petitioner's argument otherwise is unsupported in terms of presenting evidence of a reason for a speaker designer of ordinary skill to combine the cited references to achieve a narrow profile speaker with the limitations recited in claim 3. Therefore, we determine Petitioner has not established by a preponderance of evidence that there was sufficient motivation or reason for one of ordinary skill in the art to modify Tomonori in view of Virva and Sadaie to satisfy the limitations of claim 3 of the '483 patent.

For the reasons given above, we conclude Petitioner has not shown by a preponderance of evidence that Tomonori, Virva, and Sadaie would have rendered claim 3 obvious to a person of ordinary skill in the art at the time of the '483 patent priority application.

III. CONCLUSION

For the foregoing reasons, we determine Petitioner has established by a preponderance of the evidence that claims 1 and 2 of the '483 patent are unpatentable as obvious over Tomonori and Sadaie under 35 U.S.C. § 103. We further determine Petitioner has not established by a preponderance of the evidence that claim 3 of the '483 patent is unpatentable as obvious over Tomonori, Virva, and Sadaie under 35 U.S.C. § 103.

IV. ORDER

Accordingly, it is

ORDERED that claims 1 and 2 of the '483 patent have been shown by a preponderance of the evidence to be unpatentable;

FURTHER ORDERED that claim 3 of the '483 patent has not been shown by a preponderance of the evidence to be unpatentable.

This is a final written decision. Parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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