

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MURATA MANUFACTURING CO., LTD.,
Petitioner,

v.

INERGETIC AB,
Patent Owner.

IPR2019-00502
Patent 6,467,349 B1

Before THU A. DANG, GARTH D. BAER, and
MONICA S. ULLAGADDI, *Administrative Patent Judges*.

ULLAGADDI, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

Murata Manufacturing Co., Ltd. (“Petitioner”) requested an *inter partes* review of claims 20, 22–25, 30, 31, and 33 (“the challenged claims”) of U.S. Patent No. 6,467,349 B1 (Ex. 1001, “the ’349 patent”). Paper 1 (“Petition” or “Pet.”). Inergetic AB (“Patent Owner”) did not file a preliminary response.

On July 12, 2019, we entered a Decision on Institution (“Institution Decision” or “Inst. Dec.,” Paper 7) instituting an *inter partes* review as to all of the challenged claims on all of the grounds set forth in the Petition.

After institution of trial, Patent Owner filed a Patent Owner Response (“PO Resp.,” Paper 11), to which Petitioner filed a Reply (“Reply,” Paper 14). Patent Owner filed a Sur-reply (“Sur-reply,” Paper 16). A hearing was held on April 16, 2020. The transcript of the hearing has been entered into the record. Paper 20 (“Transcript” or “Tr.”).

We have jurisdiction under 35 U.S.C. § 6. This final written decision is issued pursuant to 35 U.S.C. § 318(a). As explained below, we determine Petitioner has shown by a preponderance of the evidence that claims 20, 22–25, 30, 31, and 33 of the ’349 patent are unpatentable.

II. BACKGROUND

A. *Related Proceeding*

Petitioner and Patent Owner indicate that the ’349 patent is asserted in *Inergetic AB v. Murata Electronics North America, Inc.*, Case No. 3:18-CV-01686 (N.D. Tex. 2018). Pet. 1; Paper 5, 2.

B. *The ’349 Patent (Ex. 1001)*

The ’349 patent is titled “Arrangement for Measuring Angular Velocity” and issued on October 22, 2002. Ex. 1001, codes (45), (54). The

'349 patent discloses that the arrangement is comprised of body 1 that includes elongate beam 2, opposite ends of which are supported by pads 3, 4. *Id.* at 7:9–11. Elongate beam 2 “is configured so that it bends most easily in one predetermined direction—the ‘soft’ bending direction.” *Id.* at 7:16–17. In Figure 1 below, the '349 patent depicts elongate beam 2 with an inertia mass, alternatively referred to as oscillating mass 5, which is comprised of rectangular arms 6, 7 interconnected by transverse connecting bar 8. *Id.* at 7:32–38.

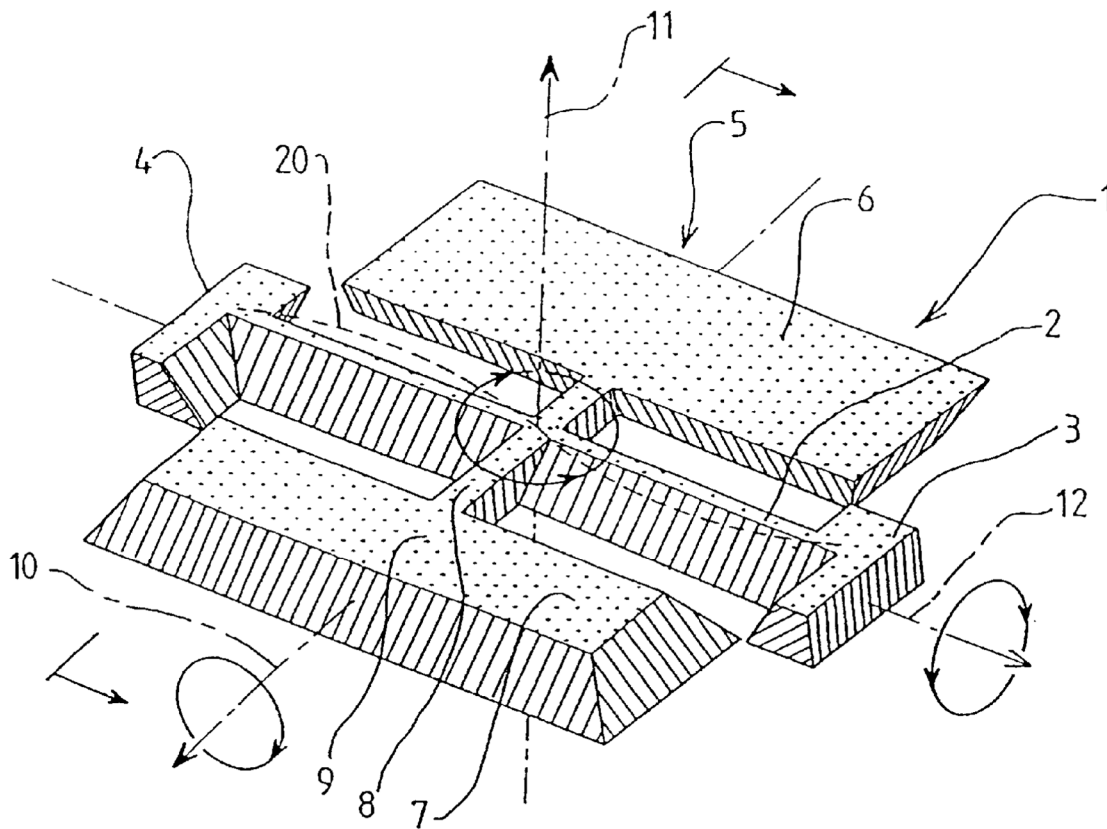


Figure 1 of the '349 patent illustrates the components of a sensor arrangement and associated excitation, detection and sensitivity axes.

Arms 6, 7 are excited by electrostatic forces, which tend to rotate them about the axis of transverse connecting bar 8. *Id.* at 7:54–59. Thus, “H'-shaped oscillating mass 5 tends to rock about the axis of the bar 8 with

a ‘see-saw’ motion,” which “applies a torsional rotation to the centre part of the beam 2.” *Id.* at 7:59–62. The ’349 patent discloses that the torsional rotation results in oscillating mass 5 oscillating about excitation axis 11, substantially within the plane of the substrate, “[b]ecause the beam 2 has a ‘soft’ bending direction which makes an acute angle with the plane of the substrate.” *Id.* at 7:62–66.

Subsequent to exciting oscillation mass 5, if body 1 is rotated about sensitivity axis 10, oscillating mass 5 begins to oscillate about detection axis 12. *Id.* at 8:3–7. The oscillation about detection axis 12 is measured to provide data concerning the rotation of body 1 and thus, the angular velocity of the rotation about sensitivity axis 10 may be determined. *Id.* at 8:8–11.

The ’349 patent discloses exciting oscillation mass 5 about excitation axis 11 via capacitive, thermal, and piezoelectric film-related techniques. *Id.* at 14:60–62. The ’349 patent further discloses detecting oscillation about detection axis 12 via capacitive, resonant sensor, piezoelectric, and piezo-resistive techniques. *Id.* at 15:13–15.

C. Challenged Claims

Challenged claim 20 is independent and challenged claims 22–25, 30, 31, and 33 depend from claim 20. Independent claim 20 is illustrative, and is reproduced below.

20. A sensor adapted to respond to a rotation, said sensor comprising

 a body formed from a substantially planar substrate, said body incorporating a beam having a longitudinal axis,

 the beam having two opposed ends, each end being adapted to be fixed in position, the beam being provided with inertia mass means connected to the beam,

the body being associated with means for exciting a first oscillation of the inertia mass means, that first oscillation being an oscillation about an oscillation axis,

there being means for detecting a second oscillation of the inertia mass means, substantially around an axis perpendicular to said oscillation axis, which second oscillation is caused by the Coriolis force which arises when the body is subjected to a rotation about an axis angularly displaced from perpendicular to the plane of said planar substrate, but perpendicular to the said axis of the beam,

wherein the inertia mass means comprises at least two discrete inertia masses, located at different positions spaced from each other along the length of the beam, the said two masses being excited to oscillate in anti-phase.

Ex. 1001, 17:7–25.

D. Proposed Grounds of Unpatentability

Petitioner advances the following challenges supported by the declaration of Dr. Darrin J. Young (Ex. 1003).

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
20, 22–25, 31	102, 103 ¹	Nose ²
20, 22–25, 30, 31	103	Nose, Yamashita ³

¹ The Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112-29, 125 Stat. 284, 287–88 (2011), amended 35 U.S.C. § 103, effective March 16, 2013. Because the application from which the ’349 patent issued was filed before this date, the pre-AIA version of § 103 applies.

² Nose was filed on June 5, 1995 and issued on March 30, 1999. Ex. 1005, [22], [45]. U.S. Patent Application No. 09/600,919, the application that matured into the ’349 patent, claims priority to PCT/SE99/00096 and entered the national phase on September 12, 2000 (i.e., the § 371 date). Ex. 1001, [21], [86]. The ’349 patent issued on October 22, 2002. *Id.* at [45]. Thus, Nose is prior art to the ’349 patent under 35 U.S.C. § 102(e). *See* Pet. 20.

³ Yamashita was filed on January 17, 1997 and issued on September 14, 1999. Ex. 1006, [22], [45]. Thus, Yamashita is prior art to the ’349 patent under 35 U.S.C. § 102(e). *See* Pet. 20.

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
33	103	Nose, Mattes ⁴
33	103	Nose, Yamashita, Mattes

Patent Owner supports its opposition with the declaration of Dr. Nils Einar Hedenstierna (Ex. 2001).

III. ANALYSIS

A. *Level of Ordinary Skill in the Art*

We review the grounds of unpatentability in view of the understanding of a person of ordinary skill in the art at the time of the invention. *Graham*, 383 U.S. at 17. Petitioner contends:

[T]he POSITA is someone knowledgeable of and familiar with MEMS/MEMS sensors, such as angular velocity sensors. That person would have (i) a Bachelor's degree in Electrical and/or Computer Engineering, or equivalent training, and (ii) approximately two years of experience working in hardware and/or software design and development related to MEMS/MEMS sensors, including the design and development of angular velocity sensors. Lack of work experience can be remedied by additional education, and vice versa.

Pet. 20–21 (citing Ex. 1001, 4:16–18, 8:24–29; Ex. 1003 ¶¶ 39–43). Patent Owner does not address the level of ordinary skill in the art. *See generally* PO Resp.

⁴ Mattes was published September 18, 1997 in the German language and thus is prior art under 35 U.S.C. § 102(a), according to Petitioner. *See* Pet. 20. To comply with 37 C.F.R. § 42.63(b), Petitioner submits a copy of the German-language document (Ex. 1008), an English translation (Ex. 1009), and an affidavit attesting to the accuracy of the translation (Ex. 1013). *See* Pet. 20. We refer to the English translation of Mattes (Ex. 1009) instead of Mattes itself (Ex. 1008).

Our conclusions rendered in this decision do not turn on selecting a particular definition for the level of ordinary skill in the art. We determine, on this record, that the level of ordinary skill proposed by Petitioner is consistent with the '349 patent and the asserted prior art. As such, we adopt Petitioner's proposal.

B. Claim Construction

For *inter partes* reviews filed on or after November 13, 2018, we apply the same claim construction standard used by Article III federal courts and the ITC, both of which follow *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc), and its progeny. *See* Changes to the Claim Construction Standard for Interpreting Claims in Trial Proceedings Before the Patent Trial and Appeal Board, 83 Fed. Reg. 51,340, 51,358 (Oct. 11, 2018) (amending 37 C.F.R. § 42.100(b) effective November 13, 2018) (now codified at 37 C.F.R. § 42.100(b) (2019)). Because the instant Petition was filed on December 21, 2018, we apply that standard here. Accordingly, we construe each challenged claim of the '349 patent to generally have “the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent.” 37 C.F.R. § 42.100(b).

We construe claim terms to the extent necessary for our unpatentability analysis. *See, e.g., Nidec Motor Corp. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (“[W]e need only construe terms ‘that are in controversy, and only to the extent necessary to resolve the controversy.’” (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))).

Consequently, we address below Petitioner's proposed constructions for the terms "inertia mass means" and "means for exciting" and "means for detecting." We also address Patent Owner's construction for beam.

1. "beam"

Independent claim 20 recites "[a] body incorporating a beam having a longitudinal axis, the beam having two opposed ends, each end being adapted to be fixed in position, the beam being provided with inertia mass means connected to the beam."

Petitioner did not propose a construction for the claim term beam in its Petition. *See generally* Pet. Patent Owner contends the claim term beam should be construed as "an elongate structure configured to bend." PO Resp. 9. Patent Owner further contends

In every instance that the "beam" is described in the specification, the beam bends. This makes sense because sensors such as those that are the focus of the claimed invention have components that bend and components that must remain rigid. In addition, the beam has an axis and is elongate. The beam clearly bends as part of the oscillating motion of the sensor disclosed in the specification. For these reasons, the term "beam" is not merely any structure, but a structure that bends.

Id. at 11 (citing Ex. 2001 ¶¶ 26, 30, 41). Patent Owner asserts that its expert, Dr. Hedenstierna, "explain[s] that the invented gyros work by having a bending beam and stiff masses," and that "[o]ne of ordinary skill in the art, reading the entire patent, would understand that the claimed beams must bend for the gyros to work." Sur-reply 7.

Petitioner responds that Patent Owner's proposed construction impermissibly imports limitations from the specification and, in any event, "does not define the claimed 'beam' with precision or particularity." Reply

2. Petitioner notes that “[a]s [Patent Owner’s] own expert acknowledged, ‘it is not described in Claim 20 that the beam bends.’” *Id.* at 3 (quoting Ex. 1017, 86:22–87:1, 13–20). Petitioner contends that “[b]y attempting to incorporate a feature defined in another claim⁵, [Patent Owner’s] construction violates the principle of claim differentiation.” *Id.* (citing *Wi-Lan USA, Inc. v. Apple, Inc.*, 830 F.3d 1374, 1391 (Fed. Cir. 2016)).

Petitioner further contends:

Nothing in the specification demonstrates a clear intent to limit claim 20 to a beam that is “configured to bend.” When the specification mentions “invention,” it does so in the context of an “aspect of this invention,” a “preferred embodiment of the present invention,” and generally as an “embodiment of the invention.” . . . This description in the specification is nowhere close to “words or expressions of manifest exclusion or restriction.”

No “words of manifest exclusion or restriction” appear in the prosecution history.

Reply 3–4 (citing-in-part Ex. 1001, 2:1; 3:23; 7:21–22, 34–35; 10:39, 44–45; 12:51–52; 13:8; *Cont’l Circuits LLC v. Intel Corp.*, 915 F.3d 788, 797 (Fed. Cir. 2019)).

Petitioner further contends that, “to the extent the Board believes a construction is necessary, the intrinsic evidence demonstrates that ‘beam’ should be construed as ‘an elongate support structure that extends continuously between two fixed ends.’” Reply 6.

The ’349 patent specification discloses that “beam 2 is configured so that it bends most easily in one predetermined direction—the ‘soft’ bending

⁵ The other claim Petitioner refers to is unchallenged claim 1, which Petitioner asserts that requires a beam that is “configured so that the beam bends most easily in one predetermined direction.” Reply 3.

direction.” Ex. 1001, 7:16–17; *see also id.* at 7:62–66, 8:48–50, 10:39–44, 11:24–29, 12:22–26 (describing beam 2 has having a soft bending direction which makes an acute angle with the substrate plane). The ’349 patent further discloses that “beam 2 executes a bending motion as shown by the bending line,” and “thus bends in one direction to have an ‘S’ configuration, and then bends in the opposite direction to have an inverted ‘S’ configuration.” *Id.* at 8:53–58; *see also id.* at 10:9–12 (describing beam 2 as executing “S” shape bending motion). Other disclosures of beam are with respect to, for example, “one aspect of the present invention” (*id.* at 2:1–22) and “the preferred embodiment of the present invention” (*id.* at 4:27–40).

We are not persuaded that the cited disclosures of the ’349 patent “‘clearly set forth a definition of the disputed claim term’ other than its plain and ordinary meaning.” *See Thorner v. Sony Comput. Entm’t Am. LLC*, 669 F.3d 1362, 1365 (Fed. Cir. 2012) (quoting *CCS Fitness, Inc. v. Brunswick Corp.*, 288 F.3d 1359, 1366 (Fed. Cir. 2002)). “We depart from the plain and ordinary meaning of claim terms based on the specification in only two instances: lexicography and disavowal.” *Hill-Rom Servs., Inc. v. Stryker Corp.*, 755 F.3d 1367, 1371 (Fed. Cir. 2014) (citing *Thorner*, 669 F.3d at 1365). “‘To act as its own lexicographer, a patentee must clearly set forth a definition of the disputed claim term other than its plain and ordinary meaning’ and must ‘clearly express an intent to redefine the term.’” *Id.* (quoting *Thorner*, 669 F.3d at 1365). “Disavowal requires that ‘the specification [or prosecution history] make[] clear that the invention does not include a particular feature,’ or is clearly limited to a particular form of the invention.” *Id.* at 1372 (alterations in original) (internal citations omitted).

None of the cited disclosures of the '349 patent support Patent Owner's proposed construction. *Id.* Like in *Hill-Rom*, there is neither "disclaimer or lexicography" nor "words of manifest exclusion or restriction." *Id.* For example, there is no disclosure "expressing the advantages, importance, or essentiality" of a beam as being configured to bend. *Id.* Nor is there disclosure of "language of limitation or restriction" with respect to the term beam—the '349 patent specification does not limit beam to something that *must* bend. *Id.* The prosecution history of the '349 patent does not indicate a disavowal of claim scope with respect to the claim term beam. *See generally* Ex. 1002.

In *ICU Med., Inc. v. Alaris Sys., Inc.*, 558 F.3d 1368, 1374 (Fed. Cir. 2009) cited by Patent Owner in support of its position, the Federal Circuit upheld the district court's construction of the claim term spike as "an elongated structure having a pointed tip for piercing the seal, which tip may be sharp or slightly rounded." The Court cited the district court's reasoning that "the specification 'repeatedly and uniformly describes the spike *as a pointed instrument for the purpose of piercing a seal inside the valve.*'" *Id.* at 1374–1375 (emphasis added). The Court found that "ICU offers no support from any intrinsic or extrinsic source in support of its claim that the ordinary meaning of spike would include a non-pointed structure such as a tube or a straw." *Id.* at 1376. Stated differently, the Court was not persuaded that the term spike should be construed more *broadly* than its plain and ordinary meaning, with respect to the shape of the tip, because nothing in the record supported such a construction.

As Petitioner alluded to during the oral hearing, the converse proposition exists in the present proceeding. In this case, we must look to

the specification to determine whether there is support for construing beam more *narrowly* than its plain and ordinary meaning, as Patent Owner proposes. The case law is clear, in this regard, as the Federal Circuit has “repeatedly held that it is ‘not enough that the only embodiments, or all of the embodiments, contain a particular limitation’ to limit claims beyond their plain meaning.” Reply 5 (citing *Unwired Planet, LLC v. Apple Inc.*, 829 F.3d 1353, 1359 (Fed. Cir. 2016)). There is nothing in the intrinsic record of the ’349 patent that suggests Patent Owner intended to *redefine* the term beam as Patent Owner proposes.

For the foregoing reasons, we construe the claim term beam in accordance with its plain and ordinary meaning, which *encompasses* “an elongate support structure that extends continuously between two fixed ends,” as Petitioner proposes.

2. “*inertia mass means*”

Independent claim 20 recites “a body . . . incorporating a beam . . . provided with inertia mass means . . . the body being associated with means for exciting a first oscillation of the inertia mass means . . . about an oscillation axis . . . wherein the inertia mass means comprises at least two discrete inertia masses, located at different positions spaced from each other along the length of the beam.”

Patent Owner contends that the claim term inertia mass means should be construed as “a rigid structure connected to the beam that oscillates.” PO Resp. 11. Patent Owner explains that:

As provided by the ’349 patent [] claim 20 . . . the function of the claim element is to oscillate. Dr. Hedenstierna further explains that the invention requires an oscillation created by a “see-saw” motion that applies torsion to the beam. . . . Dr. Hedenstierna also notes that the “beam” bends while the inertia

mass means must be stiff. . . . If the inertia mass means were not stiff, then the motion would not translate to the beam and the end result would not be an oscillation of the inertia mass about the vertical excitation axis which extends perpendicularly to the plane of the substrate. Instead, the structure would merely vibrate. *Id.*

Id. at 11–12 (citing Ex. 2001 ¶¶ 29, 30).

Petitioner responds to Patent Owner’s construction by arguing that Patent Owner’s construction:

[P]rovides no standard to evaluate what qualifies as a “rigid” structure. Indeed, any material would have some ability to bend; as Dr. Hedenstierna acknowledged, “nothing is completely stiff. Nothing is completely rigid.” This includes silicon, disclosed in the ’349 Patent as the material the inertia mass means are formed from.

Reply 7 (citing Ex. 1017, 99:13–23). Petitioner argues that the intrinsic record does not support Patent Owner’s position and that Patent Owner’s expert, Dr. Hedenstierna, is a biased witness whose testimony should be afforded little weight also because it is not supported by underlying evidence. *Id.* at 8.

Petitioner contends that “despite the use of the term ‘means’ in the claims, this phrase is not written in means-plus-function format (since there is no claimed function) and thus is not subject to Section 112, Paragraph 6.” Pet. 10. According to Petitioner,

The ’349 Patent specification states that the “inertia mass” is also referred to as an “oscillating mass.” Ex. 1001, 7:32-33. The “inertia mass” of FIG. 1 includes “a symmetrical body comprising two spaced apart parallel rectangular arms 6, 7 formed from the substrate.” *Id.*, 7:34-36. The arms 6, 7 of the “inertia mass” “are interconnected by a transverse connecting bar 8.” *Id.*, 7:36-39; Ex. 1003, ¶ 48.

Figure 4 includes two such “identical inertia masses ... 44, 45.” Ex. 1001, 10:55-56. “The masses are each symmetrical about the axis of the beam 41” and “evenly spaced along the beam 41.” *Id.*, 10:56-60. Each inertia mass has a respective “interconnecting bar 48” between respective “blocks 46, 47.” *Id.*, 10:61-65. Thus, the Figure 4 embodiment includes two such inertia masses, 44 and 45, with the structure described.

Id. at 10–11.

In our Institution Decision, we determined that “inertia mass means does not constitute a means-plus-function limitation because there is no corresponding function recited in claim 20 and because claim 20 specifies structure with respect to the inertia mass means, namely, that the ‘inertia mass means [is] connected to the beam,’ and that ‘the inertia mass means comprises at least two discrete inertia masses, located at different positions spaced from each other along the length of the beam.’” Dec. 7 (citations omitted).

Nowhere in the ’349 patent is there any disclosure of a rigid or stiff element, nor is there a disclosure of any synonymous term. *See generally* Ex. 1001. Neither the ’349 patent specification nor the prosecution history suggests that inertia mass means should be limited to something that must be rigid. We are further unpersuaded by Dr. Hedenstierna’s testimony in paragraphs 29 and 30—that the inertia mass means must be rigid—as it is unsupported by evidence. *See* 37 C.F.R. § 42.65 (“Expert testimony that does not disclose the underlying facts or data on which the opinion is based is entitled to little or no weight.”).

Dr. Hedenstierna essentially testifies that the claim term inertia mass means should be interpreted as Patent Owner proposes because Patent Owner’s invention would not work otherwise:

[T]he “beam” is soft and bends while the inertia mass means must be stiff. If the inertia mass means were not stiff, then the motion would not translate to the beam and the end result would not be an oscillation of the oscillation mass about the vertical excitation axis which extends perpendicularly to the plane of the substrate. Instead, the structure would merely vibrate.

Ex. 2001 ¶ 30; *see id.* ¶¶ 29, 31. Although we interpret the claims in light of the specification, we do not import limitations from the specification into the claims to make the claims “fit” the invention—it is the applicant’s challenge to draft claims that cover its invention during prosecution. We further note that Dr. Hedenstierna does not explain the purported difference between an oscillation and a vibration, and does not support such opinion with underlying evidence. *See* 37 C.F.R. § 42.65.

For the foregoing reasons, and based on our review of the complete trial record, we decline to construe inertia mass means as something that must be rigid, as Patent Owner urges us to do. With respect to the remainder of Patent Owner’s construction, “a rigid structure *connected to the beam that oscillates,*” we need not determine whether inertia mass means should be construed as Patent Owner proposes to resolve the controversy before us. *See Nidec*, 868 F.3d at 1017; *see also* §§ III.C, III.D (finding Nose teaches vibrators 22, 22’ that are connected to support beam 23 and that oscillate).

3. “*means for exciting a first oscillation of the inertia mass means*”

Independent claim 20 recites “means for exciting a first oscillation of the inertia mass means, that first oscillation being an oscillation about an oscillation axis.”

Petitioner contends that this limitation constitutes a means-plus-function limitation and that the ’349 patent discloses sufficient

corresponding structure associated with the function of “exciting a first oscillation of the inertia mass means.” Pet. 13. Petitioner proposes that this limitation should be construed as follows:

Function: Excite a first oscillation of the inertia mass means. Ex. 1003 ¶ 58.

Corresponding Structure: The structure of the means for exciting a first oscillation of the inertia mass means includes one or more capacitive plates, or alternative techniques for “active excitation” such as thermal or piezo-electric films, etc., and equivalents thereof, to achieve the function of exciting a first oscillation of the inertia mass means. Ex. 1003 ¶ 59.

Id. at 16. Petitioner further contends that:

The '349 Patent teaches that the capacitive plates that induce oscillation may be substituted by other approaches: “[s]etting the arrangement into oscillation requires active excitation, and there are [a] number of techniques available:--capacitive, thermal, piezo-electric films, etc.” Ex. 1001, 14:60-62 (and, more generally, 14:60-15:13); Ex. 1003, ¶¶ 56-57. The '349 Patent specifically identifies ZnO as a piezo-electric material that can be used to excite an oscillation provided there is “appropriate contacting.” Ex. 1001, 15:7-12.

Id. at 15–16.

Patent Owner concurs with Petitioner’s identification of the structure, but contends that the function should be “excit[ing] a first oscillation of the inertia mass means such that the means oscillates about an oscillation axis.”

PO Resp. 13. Patent Owner reasons that:

However, one of ordinary skill in the art would understand that the electrostatic forces generated by the means for exciting a first oscillation in this embodiment generates a force component in the horizontal plane that drive the first oscillation about an axis substantial perpendicular to the substrate. This is the only way

that the first oscillation oscillates about an oscillation axis, as described in the '349 patent.

Id. (citing Ex. 2001 ¶ 35).

Petitioner notes, in its Reply, that adding the phrase “such that the means oscillates about an oscillation axis” to the construction of the claim term inertia mass means is redundant, because claim 20 “already recites ‘means for exciting a first oscillation of the inertia mass means, that first oscillation being an oscillation about an oscillation axis.’” Reply 9–10.

With regard to the *function*, upon further review of the claim language and based upon the complete trial record, we conclude that the function for the “means for exciting” is to excite a first oscillation of the first inertia mass means about an oscillation axis.

With regard to the *corresponding structure*, Petitioner presents a detailed analysis of the embodiments of the '349 patent, arguing that Figure 2 and the accompanying description disclose that “an oscillation is induced in the inertia mass when a potential is applied to ‘capacitative plates’ 15, 16, 18, and 19.” Pet. 13–14 (citing Ex. 1001, 8:40–45). Petitioner also argues that the embodiment shown in Figure 4 and the accompanying description discloses that “oscillation is induced with ‘capacitative plates,’ plates 63, 64, 65, 66, 68, 69, 71, and 71.”⁶ *Id.* at 14 (citing Ex. 1001, 11:47–61). Petitioner further argues that the '349 patent discloses inducing oscillation via a number of techniques, including “capacitative, thermal, piezo-electric films, etc.” *Id.* at 15 (citing Ex. 1001, 14:60–15:13; Ex. 1003 ¶¶ 56, 57).

⁶ The reference to elements “71, and 71” is a typographical error. The '349 patent refers to elements 70 and 71.

We have reviewed the portions of the '349 patent cited by Petitioner and, based on the complete trial record, we find that the specification discloses sufficient structure corresponding to the recited function. Namely, the '349 patent discloses applying active excitation via “capacitative, thermal, piezo-electric films, etc.” structural elements that results in oscillation of the inertia mass means (also referred to as oscillation means 5 in the specification). *See* Ex. 1001, 14:60–15:13. We construe this limitation to include these corresponding structural elements, as identified by Petitioner, as well as equivalents thereof. *See* Pet. 15–16.

4. *“means for detecting a second oscillation of the inertia mass means”*

Independent claim 20 recites “means for detecting a second oscillation of the inertia mass means, substantially around an axis perpendicular to said oscillation axis.”

Petitioner contends that this limitation constitutes a means-plus-function limitation and that the '349 patent discloses sufficient corresponding structure associated with the function of “detecting a second oscillation of the inertia mass means.” Pet. 16–17. Petitioner proposes that “means for detecting a second oscillation of the inertia mass means” should be construed as follows:

Function: Detecting a second oscillation of the inertia mass means. Ex. 1003¶ 65.

Corresponding Structure: The structure of the means for detecting a second oscillation of the inertia mass means includes one or more capacitative plates, or alternative techniques for detection including resonant stress sensors, piezoelectric, piezo-resistive, etc., and equivalents thereof, for achieving the function of detecting a second oscillation of the inertia mass means. Ex. 1003, ¶ 66.

Id. at 19.

With regard to the *corresponding structure*, Petitioner presents a detailed analysis of the embodiments of the '349 patent, arguing that “[w]hen the oscillating masses 44 and 45 tend to rotate about the longitudinal axis of the beam of FIGs. 4 and 5, ‘[t]his rotation may be detected by the capacitors 72, 73, 74, 75, since, one block of each oscillating mass 44 will approach the adjacent capacitive plate, whereas the other block of that oscillating element will move away from the adjacent capacitive plate.’” *Id.* at 17 (citing Ex. 1001, 12:34–44). Petitioner further argues that the “’349 Patent teaches that the capacitive plates used to detect the oscillation may be substituted by other approaches as well: ‘[j]ust as in the case of excitation, a number of principles are available for detection of the oscillation, capacitive, resonant stress sensors, piezoelectric, piezo-resistive and so on.’” *Id.* at 18 (citing Ex. 1001, 15:13–15; Ex. 1003 ¶¶ 63, 64).

Patent Owner does not dispute Petitioner’s identification of either the function or the corresponding structure.

We have reviewed the portions of the '349 patent cited by Petitioner and, based on the complete trial record, we find that the specification discloses sufficient structure corresponding to the recited function. Namely, the '349 patent discloses “capacitive, resonant stress sensors, piezoelectric, piezo-resistive” structural elements that allow for detection of oscillation of the inertia mass means. *See* Ex. 1001, 15:13–15. We construe this limitation to include these corresponding structural elements, as identified by Petitioner, as well as equivalents thereof. *See* Pet. 13–16.

C. Principles of Law

A claim is unpatentable under 35 U.S.C. § 103(a) 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). 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) objective evidence of nonobviousness, i.e., secondary considerations. *See Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

“A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference.” *Verdegaal Bros., Inc. v. Union Oil Co. of California*, 814 F.2d 628, 631 (Fed. Cir. 1987).

“In an [*inter partes* review], the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable.” *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3) (requiring *inter partes* review petitions to identify “with particularity . . . the evidence that supports the grounds for the challenge to each claim”)). The burden of persuasion never shifts to Patent Owner. *See Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015) (citing *Tech. Licensing Corp. Videotek, Inc.*, 545 F.3d 1316, 1326–27 (Fed. Cir. 2008)) (discussing the burden of proof in an *inter partes* review). Furthermore, Petitioner cannot

satisfy its burden of proving obviousness by employing “mere conclusory statements.” *In re Magnum Oil Tools Int’l, Ltd.*, 829 F.3d 1364, 1380 (Fed. Cir. 2016).

Thus, to prevail in an *inter partes* review, Petitioner must explain how the prior art discloses the challenged claims or how the proposed combinations of prior art would have rendered the challenged claims unpatentable. We determine whether the information presented in the Petition establishes, by a preponderance of the evidence, that the challenged claims are anticipated by the asserted prior art or would have been obvious over the proposed combinations of prior art.

We analyze the challenges presented in the Petition in accordance with the above-stated principles.

D. Challenges Applying Nose Alone

Petitioner contends that claims 20, 22–25, and 31 are obvious over Nose under 35 U.S.C. § 103. Pet. 21–58. Petitioner also contends that these claims are anticipated under 35 U.S.C. § 102 by Nose. *Id.* at 58–59. For the reasons that follow, we are persuaded that Petitioner establishes, by a preponderance of the evidence, that claims 20, 22–24, and 31 are unpatentable as obvious over Nose. We are also persuaded that Petitioner establishes, by a preponderance of the evidence, that claims 20, 22–24, and 31 are unpatentable as anticipated by Nose.

We are not, however, persuaded that Petitioner establishes, by a preponderance of the evidence, that claim 25 is unpatentable as anticipated or obvious over Nose.

1. *Overview of Nose*

Nose concerns an angular velocity sensor having cantilever beams.
Ex. 1005, code (54).

2. *Anticipation of Independent Claim 20*

“A sensor adapted to respond to a rotation.”

Petitioner contends Nose discloses “an angular velocity sensor for detecting an angular velocity by utilizing [the] occurrence of a Coriolis force corresponding to the angular velocity of rotation of a vibrator[.]” Pet. 21 (quoting Ex. 1005, 1:10–15) (emphasis omitted). Petitioner further contends “Nose teaches that the sensor is adapted to respond to a rotation,” because Nose discloses that “vibrator 22 vibrates in the X-direction with an amplitude proportional to the angular velocity Ω of rotation” about the Y-axis. *Id.* at 22 (quoting Ex. 1005, 4:24–31) (emphasis omitted). Patent Owner does not challenge Petitioner’s assertions in this regard.

We are persuaded by Petitioner’s arguments and cited evidence, as summarized above, and we find that Nose teaches claim 20’s preamble.⁷

“said sensor comprising a body formed from a substantially planar substrate, said body incorporating a beam having a longitudinal axis, the beam having two opposed ends, each end being adapted to be fixed in position.”

Petitioner contends that Nose discloses that the sensor comprises a body because it describes cantilevered beams—vibrators 22, 22’ that are arranged in parallel and “integrally formed on a vibrator substrate 21 . . . such that the central portions of the vibrators are supported by a support beam 23.” *Id.* at 23 (quoting Ex. 1005, 6:37–42) (citing Ex. 1003 ¶¶ 81, 82).

⁷ The panel need not decide whether the preamble is limiting, because Petitioner shows that Nose discloses the recitation in the preamble.

Petitioner further contends that “Nose teaches that the body is formed from a substantially planar substrate: ‘[v]ibrators 22, 22’ . . . are integrally formed on a vibrator substrate 21 made of a semiconductor substrate such as silicon.” *Id.* at 24 (quoting Ex. 1005, 6:37–42) (emphasis omitted).

Petitioner asserts that, although Nose does not use the term “planar,” vibrator substrate 21 is depicted in Figure 8 in a manner which would have been recognized by a person of ordinary skill in the art as being substantially planar. *Id.* (citing Ex. 1005, Fig. 8).

Petitioner further contends that Nose’s support beam 23 has a “longitudinal axis [that] extends along a second axis perpendicular to the longitudinal directions of said first and second cantilever beams.” *Id.* at 26 (quoting Ex. 1005, 8:58–60 (claim 9)). Petitioner argues that Nose’s “support beam 23 has two ends, and these ends are opposed to each other,” and that “each end is fixed in position.” *Id.* at 27 (citing Ex. 1005, Fig. 8 (annotated); Ex. 1003 ¶ 90). That is, Petitioner explains that “the support beam 23 is fixed to the substrate at both beam ends along its longitudinal axis . . . with the substrate 21 generally.” *Id.* (citing Ex. 1005, Fig. 8; Ex. 1003 ¶ 91).

According to Patent Owner, the beam recited in independent claim 20 must be configured to bend, while Nose’s beam must be rigid to prevent loss of vibrations. PO Resp. 18 (citing Ex. 2001 ¶ 42). Patent Owner further contends that a piezoelectric drive constitutes a support base for Nose’s support beam 23, and that piezoelectric materials were known by persons of ordinary skill in the art to be stiff “so as to allow movement with an applied voltage.” *Id.*

As discussed above in Section III.A.2, we disagree with Patent Owner's construction for the claim term beam because the intrinsic record does not support construing this term as being configured to bend. Dr. Hedenstierna's supporting testimony does not persuade us to adopt Patent Owner's construction for the term beam either. *See* Ex. 2001 ¶ 42. Dr. Hedenstierna's testimony that "the support beam of Nose . . . could not be flexible and bend," and instead, "the support beam should be rigid to cause as little loss in vibration as possible" is unpersuasive with respect to the adopted construction for the claim term beam and further, is not supported by underlying evidence. *Id.*; *see* 37 C.F.R. § 42.65.

We are persuaded that Nose's depiction of vibrator substrate 21 in Figure 8 constitutes an express disclosure of "a body formed from a substantially planar substrate," as recited in claim 20. *See* Ex. 1005, Fig. 8. We are further persuaded that Nose's support beam 23 constitutes an express disclosure of the beam recited in claim 20. Accordingly, we are persuaded by Petitioner's contentions and the cited evidence and find that Nose discloses the body limitation as claimed.

"the beam being provided with inertia mass means connected to the beam."

Petitioner contends Nose's vibrators 22 and 22' are provided with "end portions 22a, 22b, 22a', 22b'." Pet. 30 (citing Ex. 1005, 6:42–44). Vibrators 22, 22' oscillate "in a Z-direction perpendicular to the surface of the vibrator substrate 21." *Id.* (quoting Ex. 1005, 6:44–47; Ex. 1003 ¶¶ 96, 97). According to Petitioner, "Nose discloses that the inertia mass means (vibrators) are connected to the beam," because "the vibrators are formed on

the substrate ‘such that the central portions of the vibrators are supported by a support beam 23.’” *Id.* (quoting Ex. 1005, 6:37–42) (emphasis omitted).

According to Patent Owner, “Nose does not teach or suggest *rigid* inertia mass means” because “Nose teaches four cantilever beams that vibrate in the Z-direction,” and thus, “are designed to bend up and down in unison.” PO Resp. 19 (citing Ex. 1005, 5:48–52; Ex. 2001 ¶ 44) (emphasis added). Patent Owner specifically argues that vibrator 22 bends because of Nose’s disclosure that “both end portions 22a, 22b of the vibrator 22 move in the Z-direction with the same phase while both end portions 22a’, 22b’ of the vibrator 22’ move opposite to that of the end portions 22a, 22b with the same phase.”⁸ *Id.* (quoting Ex. 1005, 6:3–7) (citing Ex. 2001 ¶ 44).

As discussed above in Section III.A.2, we disagree with Patent Owner’s construction for the claim term inertia mass means because the intrinsic record does not support construing inertia mass means as being rigid. Nor does Dr. Hedenstierna’s supporting testimony persuade us to adopt Patent Owner’s construction for inertia mass means. *See* Ex. 2001 ¶ 44. Dr. Hedenstierna’s testimony that “[r]ather than the support beam bending and the inertia mass means remaining rigid, as in the claimed invention of the patent at issue, Nose teaches that the cantilevers bend and the support beam is rigid” is unpersuasive with respect to the adopted construction for the claim term inertia mass means and further, is not supported by underlying evidence. *Id.*; *see* 37 C.F.R. § 42.65.

We are persuaded by Petitioner’s contentions and the cited evidence and find that Nose discloses the inertia mass means limitation as claimed.

⁸ Patent Owner also refers to vibrator 22 and its constituent end portions 22a, 22b, 22a’, and 22b’ as cantilever beams. *See* PO Resp. 16.

“the body being associated with means for exciting a first oscillation of the inertia mass means, that first oscillation being an oscillation about an oscillation axis.”

According to Petitioner, Nose discloses that “the body is associated with the piezoelectric element drive 31 (the means for exciting a first oscillation of the inertia mass means)” because “piezoelectric element drive 31 is formed ‘on the substrate 33 by patterning.’” Pet. 37 (quoting Ex. 1005, 6:4–7). Petitioner argues that “Nose further teaches that the body is associated with the coils (another means for exciting a first oscillation of the inertia mass means)” because “[c]oils for drive 24a and 24b are formed on either end portion of the vibrator 22.” *Id.* at 38 (quoting Ex. 1005, 3:32–35) (emphasis omitted). “Since Nose teaches that the vibrator 22 is ‘integrally formed’ along with the ‘support beam 23 ... on a vibrator substrate 21 made of a semiconductor substrate such as silicon,’ Nose discloses that the coils on the vibrators are associated with the body.” *Id.* (quoting Ex. 1005, 3:27–29, 6:37–40) (citing Ex. 1003 ¶ 115).

Petitioner contends, with respect to a *single* vibrator embodiment depicted in Figure 7 of Nose, that Nose discloses “an amplitude voltage is applied to the piezoelectric element drive 31 ... to vibrate the vibrator 22,” and the “excitation voltage is controlled at the resonance frequency of the vibrator 22.” Pet. 31 (quoting Ex. 1005, 6:14–20). According to Petitioner, “piezo-electric films were known and acceptable as the structure for the ‘means for exciting’” because the ’349 patent explicitly discloses that “there are [a] number of techniques available:--capacitative, thermal, *piezo-electric films*, etc.” *Id.* at 33 (quoting Ex. 1001, 14:60–62) (citing Ex. 1003 ¶ 106). Petitioner argues that “Nose’s piezoelectric element drive thus satisfies both

the function and structure elements of the ‘means for exciting’
limitation.” *Id.* at 32 (citing Ex. 1003 ¶¶ 103, 107).

Nose discloses a piezoelectric drive element in connection with the single vibrator embodiment of Figures 6 and 7 and *electromagnetic drive coils* in conjunction with the dual vibrator embodiment disclosed in Figure 8. Petitioner further argues that:

Nose expressly discloses an equivalent to the claimed excitation structures, namely Nose’s “driving coil[s].” These coils are placed near each end portion of each inertia mass means (instead of using piezoelectric element drives) to perform the claimed function of excite a first oscillation of the inertia mass means. As the ’349 Patent acknowledged, there were multiple techniques available to set the masses into oscillation at the time of filing: “there are number of techniques available:--capacitative, thermal, piezo-electric films, **etc.**” *Electromagnetic techniques were an example of the “etc.” from the ’349 Patent, as would have been recognized by a POSITA, and an “equivalent” as follows.*

Id. at 34–35 (citing Ex. 1001, 14:60–62; Ex. 1003 ¶¶ 108, 112; Ex. 1005, 6:42–47) (emphasis added). Petitioner also notes that Nose explicitly discloses that the embodiment shown in Figures 6 and 7 is one in which “a piezoelectric element drive 31 is *substituted* for the [electromagnetic drive] coils.” *Id.* at 32 (quoting Ex. 1005, 5:65–6:1) (citing Ex. 1003 ¶ 104) (emphasis added). Accordingly, we are persuaded that Nose’s electromagnetic drive coils disclosed in connection with the dual vibrator embodiment depicted in Figure 8 are equivalents of the corresponding structures of “capacitative, thermal, and piezo-electric” that accomplish the claimed function of exciting oscillation.

Finally, Petitioner contends that, in Nose, “the oscillation is ‘such that the amplitude of the vibration becomes constant in a Z-direction

perpendicular to the surface of the vibrator substrate 21.” *Id.* at 38 (quoting Ex. 1005, 6:16–20, 44–51) (citing Ex. 1005, Fig. 8; Ex. 1003 ¶ 118) (emphasis omitted). Petitioner explains that the ordinarily skilled artisan would have understood that “this vibration in the z-direction (caused by either piezoelectric or electromagnetic coil drives) demonstrates an oscillation about the x-axis illustrated in FIG. 8.” *Id.* Petitioner argues that because “Nose teaches the vibration with corresponding velocity V in the z-direction about the support beam 23, and therefore about an oscillation axis (the x-axis), Nose discloses this limitation.” *Id.* at 40 (citing Ex. 1003 ¶ 121).

First, Patent Owner contends Nose’s disclosure that “end portions 22a and 22b at a given point of time may move up whereas at the same time the end portions 22a’ and 22b’ may move down or vice versa,” does not constitute “oscillating about an axis” because it is “merely movement of the end portions 22a, 22b and 22a’ and 22b’ in the same direction” and “is not a ‘see-saw’ like the movement of inertia mass means 44 and 45 of the ‘349 patent.” PO Resp. 21–22 (citing Ex. 1005, 6:47–51; Ex. 2001 ¶¶ 45, 46). Second, Patent Owner asserts that “Nose thus teaches two beams that bend like a C, which prevents rotation around any axis in this configuration.” *Id.* at 22 (citing Ex. 2001 ¶ 46). Patent Owner’s expert, Dr. Hedenstierna, testifies that “the two beams bend like a C and there is no rotation about an axis” and that “Nose does not teach or suggest oscillating rotation or a see-saw motion about an axis because Nose does not create a rotation.” Ex. 2001 ¶ 46.

Neither a “see-saw” motion nor a rotation about an axis is required by independent claim 20. Independent claim 20 instead recites “a first

oscillation of the inertia mass means, that first oscillation being an oscillation about an oscillation axis.”

With respect to Patent Owner’s first contention about the “see-saw” motion, we noted, during the hearing, that the ’349 patent discloses three distinct oscillations, whereas the claim only recites two distinct oscillations. During the hearing, we sought to shed light on the correspondence between three oscillations disclosed in the ’349 patent specification and the two oscillations recited in claim 20:

JUDGE ULLAGADDI: That section [in column 7, line 54 through column 8, line 11] appears to describe three different oscillations and there’s only two in the claim. So the first [oscillation disclosed] in column 7 is the seesaw motion of the H-shaped mass, 5.

MR. CHAVOUS: Uh-huh.

JUDGE ULLAGADDI: But then there’s a torsional rotation applied to the center beam and the mass 5 oscillates in the substrate plane. Lastly, if there’s a rotation around the sensitivity axis, the mass oscillates in the detection plane. So I see three oscillations there. There’s two oscillations in the claim. Why do we need to construe the claim to necessarily incorporate the oscillation due to bending?

MR. CHAVOUS: Because the oscillation is bending. The seesaw oscillation is what is in the claim and that seesaw oscillation is what is caused -- is -- causes the -- it’s caused by the bending of the beam and that’s what’s in the claim. So it’s that oscillation where the beam, and if you look at Figure -- one moment. I’m going to get you the figure. If you go to Figure 4, you’ll see that the beam is a dotted line 50 in Figure 4 and that dotted line 50 is how the beam is bending and that bending creates that seesaw motion and that creates the oscillation in the plane.

* * *

MR. CHAVOUS: . . . I mean, those are two different -- and I believe -- but, Your Honor, I guess I'm confused on your question because it still requires a beam to bend. All three oscillations, I believe, still require a soft beam.

Tr. 27:21–28:23. Patent Owner does not persuade us that both the see-saw motion oscillation and the oscillation in the substrate plane are required by claim 20 or, more particularly, that both are encompassed by the claimed “first oscillation.” It is not clear, on the record before us, that there is even a correspondence between the “see-saw” motion disclosed in the '349 patent and one of the two distinct oscillations recited in the claims.

With respect to Patent Owner's second contention, we understand Patent Owner to take the position that the claimed “oscillation about an axis” requires a rotation. Aside from not being specifically required by recitation of the claims as we explained above, Patent Owner does not present evidence that would support the argument that the ordinarily skilled artisan would have construed the claim term oscillation, in light of the '349 specification, in a manner that would require a rotation.

Accordingly, even though end portions 22a and 22b of Nose's vibrator 22 bend in a “C” shape (as well as end portions 22a' and 22b' of vibrator 22'), we find that the vibratory motion in Nose discloses an “oscillation *about* an oscillation axis” as recited in claim 20 because the motion represents a regular change in position in the z-direction, relative to a central point of support beam 23, which is coincident with Nose's x-axis (i.e., what Petitioner cites as teaching the oscillation axis). Pet. 40 (citing Ex. 1003 ¶ 121).

We are persuaded by Petitioner's contentions and the cited evidence and find that Nose discloses the means for exciting limitation as claimed.

“there being means for detecting a second oscillation of the inertia mass means, substantially around an axis perpendicular to said oscillation axis.”

With respect to the function of “detecting a second oscillation of the inertia mass means, substantially around an axis,” Petitioner contends that “[w]hen an angular velocity Ω of rotation about the Y-axis is applied ... both end portions 22a, 22b of the vibrator 22 and both end portions 22a', 22b' of the vibrator 22' phase oppositely vibrate in the X-direction.” Pet. 40 (quoting Ex. 1005, 6:60–7:1) (emphasis omitted). Petitioner argues that the ordinarily skilled artisan would have recognized that “this vibration in the x-direction . . . demonstrates an oscillation about the z-axis illustrated in FIG. 8.” *Id.* With respect to the limitation that the axis is “perpendicular to said oscillation axis,” Petitioner further contends that “[t]he z-axis, the axis about which the ‘second oscillation’ occurs in Nose, is perpendicular to the x-axis,” about which the first oscillation occurs “as further illustrated in FIG. 8's illustration of the X, Y, and Z axes.” *Id.* at 41 (citing Ex. 1003 ¶ 125).

With respect to the structure corresponding to the means, Petitioner contends that Nose discloses that strain gauges “are provided in the vicinity of the support beam 23 of the respective vibrators 22, 22', . . . so that the vibration of the vibrators 22, 22' in the X-direction can be detected.” Pet. 42 (quoting Ex. 1005, 6:55–59) (citing Ex. 1003 ¶¶ 127, 128) (emphasis omitted). According to Petitioner, “Nose's strain gauges fall within the scope of the corresponding structure taught by the '349 Patent” because “Nose's strain gauges are an example of a piezo-resistive sensor.” *Id.* at 42–43 (citing Ex. 1003 ¶ 129; Ex. 1012, 1). Petitioner contends, thus, “Nose

teaches strain gauges (i.e., piezoresistive sensors) that detect oscillation of the vibrators in the x-axis direction, about the z-axis that is perpendicular to the x-axis (the oscillation axis).” *Id.* at 44 (citing Ex. 1003 ¶ 131).

For the means for detecting limitation, Patent Owner presents substantially the same arguments presented above with respect to the means for exciting limitation. Namely, Patent Owner argues that “[b]ecause Nose does not teach oscillating around an axis as recited in claim 20, Nose does not teach or suggest exciting a first oscillation of the inertia mass means or means for detecting a second oscillation of the inertia mass means.” PO Resp. 24 (emphasis omitted). For the reasons discussed above with respect to the “means for exciting” limitation, we find Patent Owner’s argument distinguishing Nose’s C-shaped bending motion from the claimed “a second oscillation of the inertia mass means, substantially around an axis” on the basis that Nose’s motion is not a rotation to be unpersuasive.

We find Nose’s vibratory motion of end portions 22a, 22b of the vibrator 22 and end portions 22a’, 22b’ of the vibrator 22’ represents a regular change in position in the x-direction, relative to a central point of Nose’s z-axis as illustrated in Figure 8, and thus discloses “a second oscillation of the inertia mass means, substantially around an axis.” The arc-shaped path of end portions 22a, 22b and end portions 22a’, 22b’ envelops the z-axis and is therefore *substantially around* the z-axis. We have reviewed the cited portions of Dr. Young’s declaration and credit the testimony explaining that an ordinarily skilled artisan would have understood strain gauges to be an example of the piezoresistive sensors disclosed in the ’349 patent because Dr. Young’s testimony is supported by evidence (*see* Ex. 1012, 1).

We are persuaded by Petitioner's contentions and the cited evidence and find that Nose discloses the means for detecting limitation as claimed.

“which second oscillation is caused by the Coriolis force which arises when the body is subjected to a rotation about an axis angularly displaced from perpendicular to the plane of said planar substrate, but perpendicular to the said axis of the beam.”

Petitioner contends that, in Nose, “the second oscillation is caused by the Coriolis force” because the application of “an angular velocity Ω of rotation about the Y-axis” results in “Coriolis forces F_c work[ing] on the end portions 22a, 22b, 22a', 22b' of the vibrators 22, 22' ... in the X-direction.” Pet. 44 (quoting Ex. 1005, 6:60–7:1) (emphasis omitted). Petitioner explains that “the Coriolis forces F_c cause the ‘second oscillation’ in the x-direction (and, therefore, about the z-axis),” and that “an angular velocity Ω of rotation is ‘about the Y-axis’ which, as shown in FIG. 8 . . . is angularly displaced from perpendicular to the plane of the substrate, as well as perpendicular to the axis of the beam[.]” *Id.* Patent Owner does not challenge Petitioner's assertions in this regard.

We are persuaded by Petitioner's contentions and the cited evidence and find that Nose discloses the second oscillation is caused by the Coriolis force as claimed.

“wherein the inertia mass means comprises at least two discrete inertia masses, located at different positions spaced from each other along the length of the beam, the said two masses being excited to oscillate in anti-phase.”

Petitioner contends “Nose discloses the first inertia mass with vibrator 22, and the second inertia mass with vibrator 22'.” *Id.* at 45–46. According to Petitioner, “Nose discloses that the vibrators 22, 22' are located at different positions spaced from each other along the length of the beam 23,

‘such that the central portions of the vibrators are supported by a support beam 23.’” *Id.* at 46 (quoting Ex. 1005, 6:40–42). Petitioner further notes that “vibrators 22, 22’ are located along the length of the x-axis, which is coincident with the length of the beam 23.” *Id.* (citing Ex. 1003 ¶ 138).

Petitioner argues “Nose discloses that the vibrators 22, 22’ are excited to oscillate in anti-phase” because both “end portions 22a, 22b of the vibrator 22 move in the Z-direction with the same phase while both end portions 22a’, 22b’ of the vibrator 22’ move [in the] opposite [direction] . . . with the same phase.” Pet. 47 (citing Ex. 1005, 6:47–51; Ex. 1003 ¶ 142). Patent Owner does not challenge Petitioner’s assertions in this regard.

Having reviewed the cited evidence and Petitioner’s arguments, we find that Nose discloses that “the inertia mass means comprises at least two discrete inertia masses, located at different positions spaced from each other along the length of the beam,” as recited in claim 20.

With respect to the “oscillate in antiphase” limitation, Patent Owner contends that

[T]he end portions 22a, 22b and 22a’ and 22b’ of the two vibrators 22 and 22’ also move in a direction perpendicular to the substrate 21, but, opposite to each other. Hence, end portions 22a and 22b at a given point of time may move up whereas at the same time the end portions 22a’ and 22b’ may move down or vice versa.

PO Resp. 21 (citing Ex. 1005, 6:47–51). Patent Owner even acknowledges that “Nose however teaches that the vibrators 22 and 22’ move up and down in opposite phase.” *Id.* at 24. Both Petitioner’s and Patent Owner’s contentions persuade us that Nose discloses “the said two masses being excited to oscillate in anti-phase,” as recited in claim 20.

We are persuaded by Petitioner's contentions and the cited evidence and find that Nose discloses that "the said two masses [are] excited to oscillate in anti-phase" as claimed.

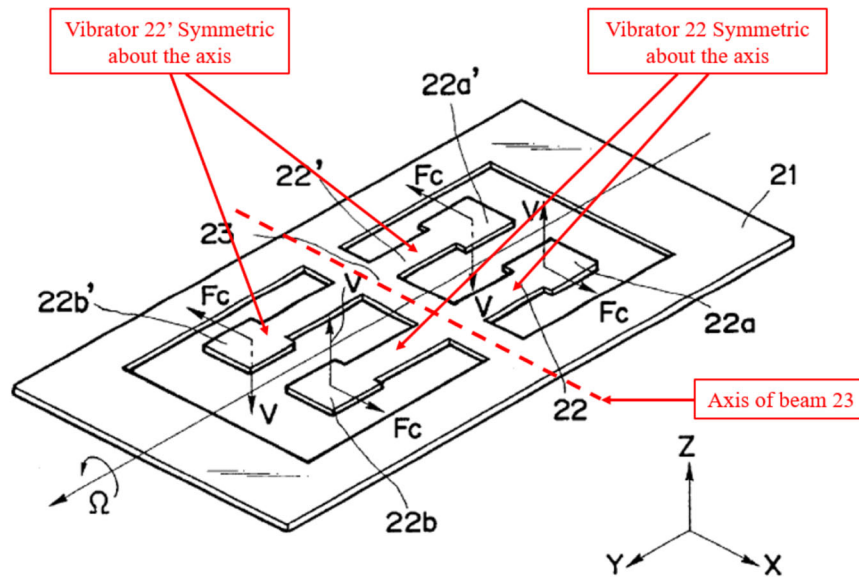
For the foregoing reasons, and based on our review of the complete record, we are persuaded that Petitioner establishes that claim 20 is anticipated by Nose by a preponderance of the evidence.

3. *Anticipation of Dependent Claim 22*

Claim 22 recites that "there are two inertia masses, the two inertia masses are symmetrically disposed on the beam, each inertia mass being located at a position between the centre part of the beam and a respective end of the beam."

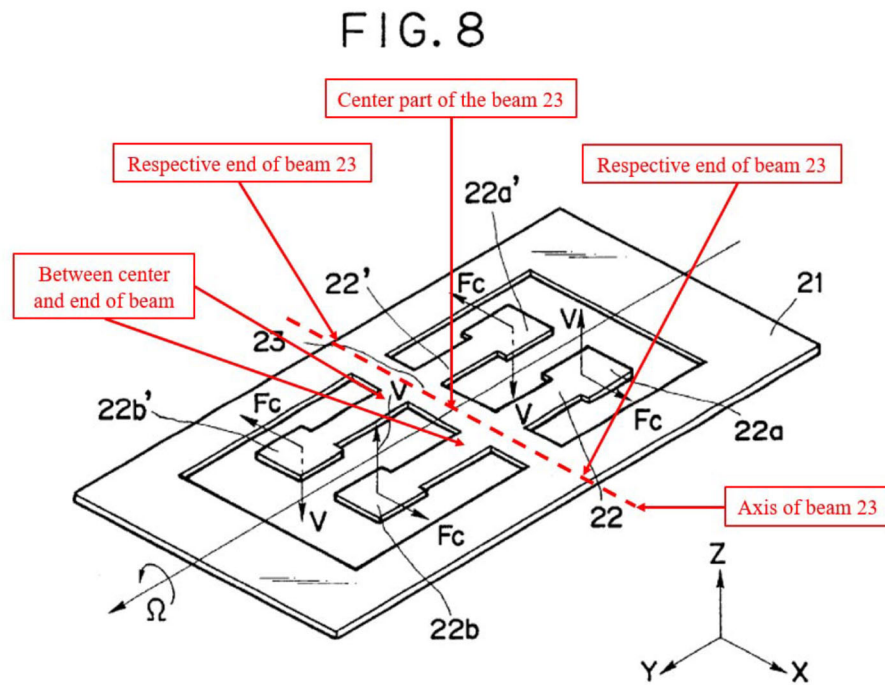
Petitioner first contends that "Nose discloses that the two inertia masses are symmetrically disposed on the beam." Pet. 48 (citing Ex. 1005, 2:40–46). Petitioner quotes a portion of Nose that discloses "the first and second cantilever beams being formed in symmetry with each other with a symmetry axis being on a fixed end side thereof." *Id.* (quoting Ex. 1005, 2:46–48) (citing Ex. 1003, ¶¶ 148, 149) (emphasis omitted). Petitioner's annotated version of Nose's Figure 8, reproduced below, illustrates how Nose's vibrator 22 and vibrator 22' are symmetric about support beam 23.

FIG. 8



Petitioner's Annotated Version of Nose's Figure 8. Pet. 49.

Petitioner next contends that "Nose discloses that each inertia mass is located at a position between the 'centre' part of the beam and a respective end of the beam" and presents another annotated version of Nose's Figure 8, reproduced below. *Id.* at 48–50; *see id.* at 49 (citing Ex. 1003 ¶ 152).



Petitioner's Annotated Version of Nose's Figure 8. Pet. 50.

Petitioner's annotated version of Nose's Figure 8 (from page 50 of the Petition) illustrates how vibrator 22 is situated between one end of support beam 23 and the center of support beam 23 that coincides with the axis marked with omega. *See* Pet. 50. Petitioner's annotated Figure 8 similarly illustrates how vibrator 22' is situated between the other end of support beam 23 and the center of support beam 23. *Id.* Patent Owner does not challenge Petitioner's assertions with respect to claim 22.

We are persuaded by Petitioner's contentions and the cited evidence and find that Nose discloses the limitations recited in claim 22. As such, we are persuaded, by a preponderance of the evidence, that Nose anticipates claim 22.

4. *Anticipation of Dependent Claim 23*

Claim 23 recites that "the two inertia masses are identical and symmetrical about the axis of the beam."

Petitioner contends that “the cantilever beams for a given vibrator are symmetrical to each other in Nose” because Nose discloses “*the first and second cantilever beams being formed in symmetry with each other* with a symmetry axis being on a fixed end side thereof.” *Id.* at 51 (quoting Ex. 1005, 2:40–48) (bolding omitted). According to Petitioner, “[t]he fixed end side of each cantilever beam for a given vibrator is a part of the beam 23 of FIG. 8, and therefore Nose’s symmetry axis is coincident with the axis of the beam 23.” *Id.* at 51; *see id.* at 51–52 (citing Ex. 1003 ¶¶ 155, 157). Nose’s Figure 8 depicts vibrator 22 and vibrator 22’ being bisected by support beam 23, and as Nose’s vibrator 22 and vibrator 22’ are symmetrical, they are identical (and are depicted as such in Nose’s Figure 8). *See* Ex. 1005, Fig. 8. Patent Owner does not challenge Petitioner’s assertions with respect to claim 23.

We are persuaded by Petitioner’s contentions and the cited evidence and find that Nose discloses the limitation recited in claim 23. As such, we are persuaded, by a preponderance of the evidence, that Nose anticipates claim 23.

5. *Anticipation of Dependent Claim 24*

Claim 24 recites that “said inertia mass means comprises two elements, located respectively on either side of the beam, within the plane of the substrate, the two elements being interconnected by a connecting bar, the central portion of the connecting bar being unitary with a portion of the beam.”

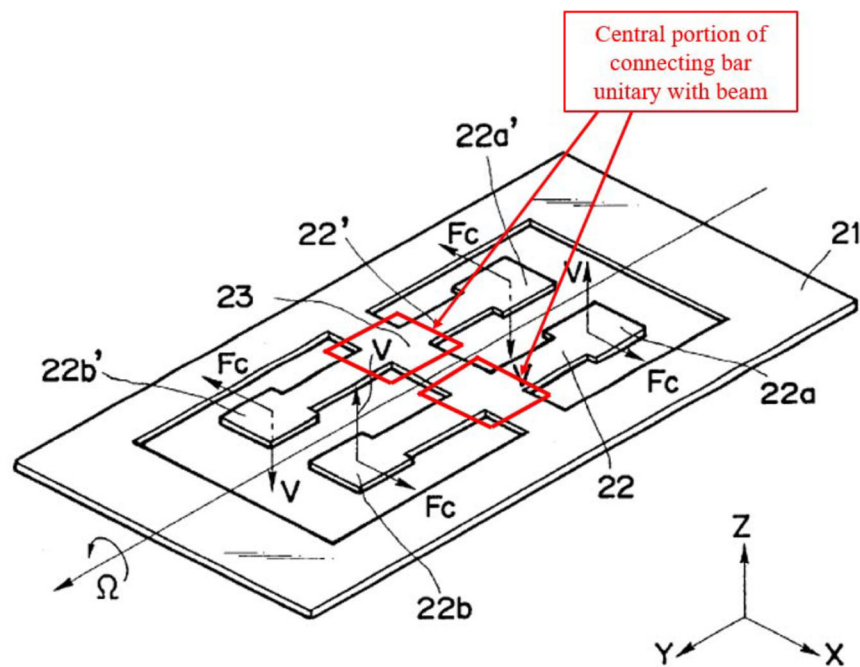
With respect to the recitation of “inertia mass means compris[ing] two elements,” located respectively on either side of the beam, Petitioner contends that “Nose discloses that each vibrator has two cantilever beams

(“elements”) on either side of the beam 23” because it discloses “*a first cantilever beam ... having a fixed end and a vibrating end* supported capable of vibrating relative to the fixed end, *a second cantilever beam ... having a fixed end and a vibrating end* supported capable of vibrating relative to the fixed end.” *Id.* at 53 (quoting Ex. 1005, 2:40-46) (citing Ex. 1003 ¶ 160).

With respect to the recitation of “within the plane of the substrate,” Petitioner further contends that “Nose discloses that each cantilever beam is within the plane of the substrate” because “[e]ach vibrator (with the disclosed cantilevered beams) is ‘integrally formed on a vibrator substrate 21 . . . such that the central portions of the vibrators are supported by a support beam 23.’” *Id.* (quoting Ex. 1005, 6:37–42); *see id.* at 53–54 (quoting Ex. 1005, 3:26–29) (citing Ex. 1003 ¶¶ 161–63).

Finally, with respect to the recitation of “the two elements being interconnected by a connecting bar, the central portion of the connecting bar being unitary with a portion of the beam,” Petitioner presents another annotated version of Nose’s Figure 8, reproduced below, to “illustrate[] that the fixed end of each cantilevered beam (‘the central portion of the connecting bar’) is unitary with a corresponding portion of the support beam 23.” *Id.* at 56.

FIG. 8



Petitioner's Annotated Version of Nose's Figure 8. Pet. 56.

Patent Owner does not challenge Petitioner's assertions in connection with claim 24. We are persuaded by Petitioner's contentions and the cited evidence and find that Nose discloses the limitation recited in claim 24. As such, we are persuaded, by a preponderance of the evidence, that Nose anticipates claim 24.

6. *Anticipation of Dependent Claim 25*

Claim 25 recites that "the first oscillation may be caused by an excitation force which is substantially perpendicular with said plane."

Petitioner contends that "the 'first oscillation' in Nose is caused by either a 'piezoelectric element drive 31' or 'driving coil,' where with either source of excitation the vibration is performed 'such that the amplitude of the vibration becomes a constant in a Z-direction perpendicular to the surface of the vibrator substrate 21.'" Pet. 57 (citing Ex. 1005, 6:14–20,

6:42–47; Ex. 1003 ¶ 173) (emphasis omitted). Petitioner contends that, “because Nose’s piezoelectric element drive or coils cause the vibrator to vibrate in a direction perpendicular to a surface of the substrate, Nose teaches this limitation.” *Id.* (citing Ex. 1003 ¶ 175). Patent Owner does not challenge Petitioner’s assertions in connection with claim 25.

Petitioner’s contentions address the direction of the oscillation—not the direction from which the excitation force is applied. *See id.* To the extent that Petitioner relies on a theory of inherency to support its contention about the application direction of the excitation force, neither Petitioner nor its Declarant, Dr. Young, establishes that the direction from which the excitation force is applied is *necessarily* the same as the direction in which the first oscillation occurs.

Accordingly, we are not persuaded by Petitioner’s contention that cited evidence discloses the limitation recited in claim 25, and thus, we are not persuaded that Nose anticipates claim 25.

7. *Anticipation of Dependent Claim 31*

Claim 31 recites that “the body is formed from silicon.” Petitioner contends that “Nose teaches forming the substrate from ‘a semiconductor substrate such as silicon,’” and that “Nose specifically teaches that the body is formed from ‘a substrate, a first cantilever beam ... a second cantilever beam.’” *Id.* at 58 (quoting Ex. 1005, 2:39–48, 3:26–29) (emphasis omitted); *see id.* (quoting Ex. 1005, 2:41–42, 44–46) (citing Ex. 1003 ¶¶ 178, 179). Patent Owner does not challenge Petitioner’s assertions in connection with claim 31.

We are persuaded by Petitioner’s contentions and the cited evidence and find that Nose discloses the limitation recited in claim 31. As such, we

are persuaded, by a preponderance of the evidence, that Nose anticipates claim 31.

8. *Obviousness of Independent Claim 20*

The Federal Circuit has held that “a disclosure that anticipates under § 102 also renders the claim invalid under § 103, for anticipation is the epitome of obviousness.” *Connell v. Sears, Roebuck & Co.*, 722 F.2d 1542, 1548 (Fed. Cir. 1983) (internal citations and quotation marks omitted). Our conclusion, that Petitioner establishes independent claim 20 is anticipated by Nose by a preponderance of the evidence informs our conclusion, here, that Petitioner establishes claim 20 is obvious in view of Nose by a preponderance of the evidence. *See* Pet. 21–58.

Patent Owner relies on the same arguments for the anticipation challenge to claim 20, 22–25, and 31 over Nose as it does for the obviousness challenge to these claims over Nose. PO. Resp. 14–25. We find those arguments to be unpersuasive for the reasons discussed above.

With respect to the “means for exciting” limitation, we are persuaded by Petitioner’s contention that “it would have been obvious to a POSITA to replace the drive mechanism of Figure 8 (electromagnetic drive coils) with the drive mechanism of Figures 6/7 (piezoelectric element drive) to arrive at the claimed invention,” because such “is a simple substitution” that “was both known and predictable.” Pet. 32. More particularly, we are persuaded, that

[I]t would have been obvious to a POSITA to repeat the piezoelectric element drive 31 with additional, parallel vibrators 22, such as FIG. 8’s parallel vibrators 22, 22’ (a mere duplication of parts). Nose itself teaches that “[t]he present invention may be applicable to many widely different embodiments in addition to the embodiments as described above.” Ex. 1005, 7:21-23.

Each vibrator 22, 22' would receive its own piezoelectric element drive 31 as its support base and source of excitation. The support beam 23 would maintain its mechanical integrity with the use of the piezoelectric element drive 31 at each vibrator 22, 22' just as with the use of electromagnetic coils in FIG. 8's embodiment.

Id. at 32–33. We determine Petitioner's rationale for combining embodiments of Nose is supported by sufficient rational underpinnings based on the express disclosures of Nose. Ex. 1005, 5:65–6:1 (“[A] piezoelectric element drive 31 is *substituted* for the [electromagnetic drive] coils.”) (emphasis added).

With respect to the “body formed from a substantially planar substrate” recitation of claim 20, we are persuaded that it would have been obvious to the ordinarily skilled artisan that Nose's substrate is substantially planar based on Nose's illustration of the substrate in Figure 8. Pet. 25 (citing Ex. 1003 ¶¶ 84, 85). We are further persuaded that “Nose teaches that the vibrator 22 is ‘integrally formed’ along with the ‘support beam 23 ... on a vibrator substrate 21 made of a semiconductor substrate such as silicon,’ [and thus,] Nose discloses that the coils on the vibrators are associated with the body.” *Id.* at 38 (quoting Ex. 1005, 3:27–29, 6:37–40) (citing Ex. 1003 ¶ 115).

For the foregoing reasons, and based on our review of the complete record, we are persuaded that Petitioner establishes that claim 20 is rendered obvious by Nose by a preponderance of the evidence.

9. *Obviousness of Dependent Claims 22–24 and 31*

As set forth in Sections III.D.3 through III.D.5 and III.D.7, we are persuaded that Nose discloses the subject matter of claims 22–24 and 31, respectively, and thus, anticipates claims 22–24 and 31. As anticipation is

the epitome of obviousness, we are further persuaded that Nose teaches the subject matter of claims 22–24 and 31 and renders obvious these claims, by a preponderance of the evidence. *See Connell*, 722 F.2d at 1548.

10. Obviousness of Dependent Claim 25

As discussed above in Section III.D.6, Petitioner’s contentions address the direction of the oscillation, not the direction from which the excitation force is applied. *See* Pet. 57. Neither Petitioner nor its Declarant, Dr. Young, contends that a person of ordinary skill in the art would have understood that the direction of oscillation is the same as the direction from which the excitation force is applied. Accordingly, we are not persuaded that Petitioner establishes that Nose renders obvious claim 25, by a preponderance of the evidence.

E. Obviousness over Nose and Yamashita

1. Overview of Yamashita

Yamashita concerns a “small-sized vibratory angular velocity sensor, and making use of anisotropic etching characteristics of [a] single crystal silicon substrate.” Ex. 1006, [57]. The sensor drives and oscillates a vibrator via electrostatic force. *Id.* at 4:48–51.

2. Independent Claim 20

For the challenge based on Nose and Yamashita, Petitioner relies on Nose in the same manner as set forth with respect to challenges based on Nose alone, except with respect to the limitation that recites “sensor comprising a body formed from a substantially planar substrate.” Pet. 59–70. For this limitation, Petitioner relies on the combination of Nose and Yamashita. *Id.* at 60–62. Petitioner also relies on the combination of Nose

and Yamashita with respect to the limitation that recites “means for exciting a first oscillation of the inertia mass means.” *Id.* at 63–69.

With respect to the “substantially planar substrate” limitation, Petitioner contends that “Nose’s sensor substrate is depicted as flat silicon,” and that “Yamashita demonstrates that it was known for a silicon substrate to have a flat (i.e., ‘planar’) surface,” because “Yamashita teaches a ‘vibrator including four masses having at least two parallel flat planes,’ or in other words[, a] substrate [that] has parallel flat planes.” *Id.* at 60 (citing Ex. 1006, 2:14–15, 47–48) (emphasis omitted). According to Petitioner, “[t]his silicon substrate is formed of a ‘double-side polished type’ with a given thickness.” *Id.* (citing Ex. 1006, 5:61–64; Ex. 1003 ¶ 193).

As rationale for combining, Petitioner contends that “a POSITA would have recognized the desirability of Nose’s silicon substrate being ‘flat’ (that is, planar) as taught by Yamashita.” *Id.* at 61 (citing Ex. 1003 ¶¶ 195, 196). Petitioner argues that

A planar substrate as taught by Yamashita is desirable because it permits sensors, such as Nose’s sensors, “to be produced from sheets of material using inexpensive mass production techniques.” . . . A POSITA would have recognized that Yamashita’s teaching of using silicon with a flat (planar) surface would be understood from the disclosure in Nose, as well as desirable, so that many sensors of small geometry “may be constructed on a single semiconductor chip,” which facilitates the economic use of sensors “with consequent greatly improved reliability and performance” for systems using such small sensors.

Id. at 61–62 (citing Ex. 1007, 2:6–8, 10–20; Ex. 1003 ¶ 196).

Patent Owner argues that Yamashita does not cure the deficiencies of Nose with respect to claims 20, 22–25, and 31. However, as discussed

above in Section III.D, we were not persuaded by Patent Owner’s arguments that Nose alone does not teach or suggest these elements. So we do not reiterate those arguments here.

We are persuaded that the cited portions of Yamashita teach a planar substrate. The underlying evidence, U.S. Patent No. 4,598,585 to Boxenhorn (Ex. 1007, “Boxenhorn”) cited by both Petitioner and Petitioner’s Declarant, Dr. Young, in support of the above-quoted rationale discloses that “[t]he planar geometry of the invention permits inertial sensors to be produced from sheets of material using inexpensive mass production techniques,” and that “the sensors may be formed by stamping a single sheet of material such as steel or aluminum.” Ex. 1007, 2:6–10. Accordingly, we are persuaded that Petitioner’s rationale for combining Nose and Yamashita is sufficiently supported by rational underpinnings, as evidenced by Boxenhorn.

With respect to the “means for exciting” limitation, Petitioner contends that “to the extent that Patent Owner argues that Nose’s piezoelectric driving of the inertia mass means, or the electromagnetic driving of the inertia mass means, are not a literal or ‘equivalent’ corresponding structure, this limitation would have been obvious in view of the combination of Yamashita with Nose.” Pet. 64 (citing Ex. 1003 ¶ 228).

According to Petitioner, “Yamashita teaches exciting an oscillation of . . . a ‘vibrator’ (a cantilevered beam)” via “electrostatic force ‘by utilizing electrodes 110, 115 formed above and below the end portion of the masses 102.’” *Id.* (citing Ex. 1006, code (57)). Petitioner argues “Yamashita teaches that the electrodes are formed above or below the end portions of the masses ‘which make pairs with the masses 102 of each silicon vibrator to

form capacitors” and further teaches “driving the electrodes to produce a force in the z-axis direction.” *Id.* (citing Ex. 1006, 5:33–39, 8:13-19, 10:64–65; Ex. 1003 ¶¶ 229, 230). Petitioner further argues that, “[i]n the combination, Nose’s piezoelectric driving, or electromagnetic coil driving, is replaced by Yamashita’s electrostatic driving [] to achieve Nose’s vibrations in the z-direction” and “Nose provides excitation voltage to the electrodes disposed above the end portions of the vibrators 22, 22’ from the power source.” *Id.* at 64–65 (citing Ex. 1003 ¶ 231). Petitioner further argues that

Accordingly, the capacitors in the Nose-Yamashita combination are means for exciting a first oscillation of the inertia mass means because (1) they cause an active excitation of the ends of each vibrator 22, 22’ (inertia mass means) to achieve the same function, and (2) they cause active excitation by way of electrostatic interaction (i.e., using capacitive plates), which corresponds to the ’349 Patent’s description of supplying a potential to capacitive plates. Finally, (3) the excitation of the ends of each vibrator 22, 22’ are an “oscillation” of each vibrator.

Id. at 65 (citing Ex. 1001, 8:40–45; Ex. 1003 ¶ 232).

As another rationale for combining Nose and Yamashita, Petitioner contends that a “POSITA would have recognized that applying Yamashita’s electrostatic drive teachings to Nose’s system would also be nothing more than a mere substitution of parts (e.g., Nose’s electromagnetic coil drive with Yamashita’s electrostatic drive teachings).” *Id.* at 66 (citing Ex. 1003 ¶ 235). Petitioner argues that Nose and Yamashita are analogous art, the combination would have produced a predictable result. *Id.* at 65–66. According to Petitioner “it would have been obvious to apply Yamashita’s electrostatic driving of vibrators to drive Nose’s vibrators in the z-direction,” because Nose teaches that “the driving element may be exchanged from

electromagnetic coils to other types, such as ‘a piezoelectric element drive 31 . . . to vibrate the vibrator 22.’” *Id.* at 66 (citing Ex. 1005, 5:65–7:1).

For the foregoing reasons, we are persuaded that the cited portions of Yamashita teach electrostatically driving masses 102 with electrodes 115 and 116, and thus, that the combination of Yamashita and Nose teaches applying an electrostatic drive mechanism to vibrate Nose’s vibrators 22, 22’ in the z-direction. We are further persuaded that Nose motivates the substitution of one type of drive system with another (*see* Ex. 1005, 5:65–7:1), and accordingly, that Petitioner’s rationale for combining is supported by sufficient rational underpinnings.

We have reviewed Petitioner’s arguments and evidence concerning independent claim 20 and are persuaded that Petitioner establishes, by a preponderance of the evidence, that claim 20 is obvious in view of Nose and Yamashita.

3. *Obviousness of Dependent Claims 22–24 and 31*

With regard to dependent claims 22–24 and 31, Petitioner relies on substantially the same arguments and evidence as set forth with respect to the obviousness and anticipation challenges to these claims over Nose alone. Pet. 70–71. For substantially the same reasons set forth above (*see* Sections III.D.3 through III.D.5, III.D.7, III.D.9), we are persuaded that the cited evidence and Petitioner’s arguments establish that claims 22–24 and 31 are unpatentable as obvious over the combination of Nose and Yamashita by a preponderance of the evidence.

4. *Obviousness of Dependent Claim 25*

Claim 25 recites that “the first oscillation may be caused by an excitation force which is substantially perpendicular with said plane.”

According to Petitioner,

Yamashita teaches exciting an oscillation using electrostatic force. A “vibrator” (a cantilevered beam) is “excited by electrostatic force by utilizing electrodes 110, 115 formed above and below the end portion of the masses 102.” Ex. 1006, Abstract; 4:48-51. Yamashita teaches the electrodes producing a force in the z-axis direction. Id., 8:13-19, 10:64-65 (the force produced from a driving electrode is in the z-axis direction); Ex. 1003, ¶ 301.

Whatever the excitation source (whether piezoelectric, electromagnetic coil, or electrostatic teachings), . . . because Nose’s piezoelectric element drives or coils cause the vibrator to vibrate in a direction perpendicular to a surface of the substrate, and Yamashita teaches causing an electrostatic force in the z-axis direction (with Nose), Nose (and Nose in combination with Yamashita) teaches this limitation. Ex. 1003, ¶ 303.

Pet. 71–72.

Yamashita discloses that elements

115 to 117 are electrodes made of Pt/Ti, etc., formed on the lower surface of the upper glass 109 or the upper surface of the lower glass 114 by a technique of PVD (physical vapor deposition) such as vacuum deposition or sputtering, which make pairs with the masses 102 of each silicon vibrator to form capacitors.

Ex. 1006, 5:34–39.

Patent Owner does not specifically address the challenge to claim 25 over Nose and Yamashita.

We are persuaded by Petitioner’s arguments because we find that Figure 1 of Yamashita also depicts electrodes 115 and 116 as being below masses 102. Petitioner apparently relies on the same rationales for

combining Nose and Yamashita as set forth above for independent claim 20. *See* § III.E.2. For the same reasons discussed above with respect to claim 20, we are persuaded that Petitioner presents a rationale for combining Nose and Yamashita that is supported by sufficient rational underpinnings.

Accordingly, having reviewed Petitioner’s arguments and evidence concerning independent claim 25 and are persuaded that Petitioner establishes, by a preponderance of the evidence, that claim 25 is unpatentable as obvious over the combination of Nose and Yamashita.

5. *Obviousness of Dependent Claim 30*

Claim 30 recites “the body is formed from a mono-crystalline substrate.” Petitioner contends that Nose teaches “a semiconductor substrate such as silicon by ... anisotropic etching” and that “[a]lthough Nose does not explicitly disclose that the silicon is mono-crystalline silicon, it was well-known and obvious to use mono-crystalline silicon” because “[p]iezoresistive strain gauges achieve [a] higher gauge factor when implemented in single-crystal silicon, therefore higher sensitivity, than nonsingle-crystal silicon (i.e., polysilicon).” Pet. 72–73 (citing-in-part Ex. 1003 ¶¶ 306, 307; Ex. 1005, 3:26–29; Ex. 1012, 3–4) (emphasis omitted). Petitioner contends that Yamashita’s sensor “is a small-sized vibratory angular velocity sensor, and making use of anisotropic etching characteristics of single crystal silicon substrate.” *Id.* at 73 (citing Ex. 1003 ¶ 308; Ex. 1006, code (57); Ex. 1011, code (57)) (emphasis omitted).

As rationale for combining Nose and Yamashita, Petitioner contends that Nose seeks to achieve “an angular velocity sensor which can be effectively driven while having a high detectivity,” that “such ‘high detectivity’ is known in the art to be achievable with a high ‘Q factor’,” and

that “Yamashita teaches achieving a larger Q factor ‘when the vibrator is formed of single crystal silicon . . . since the internal loss is extremely small.” *Id.* at 73–74 (emphases omitted) (citing-in-part Ex. 1003 ¶ 309; Ex. 1005, 2:25–28; Ex. 1006, 3:4–6, 8:58–64). According to Petitioner, “[a] POSITA would have been motivated to implement Nose’s silicon substrate as a ‘single crystal silicon’ to minimize internal material loss for higher sensitivity to assist in meeting Nose’s goal,” and because “single-crystal silicon was more desirable than polysilicon in which to form piezo-resistive strain gauges, such as those in Nose, to achieve higher sensitivity.” *Id.* at 74 (citing Ex. 1003, ¶¶ 310, 311; Ex. 1012, 4–5).

Patent Owner does not specifically address the challenge to claim 30 over Nose and Yamashita.

The cited portion in Nose discloses that one of the objects of the invention is to “provide an angular velocity sensor which can be efficiently driven while having a *high detectivity*.” Ex. 1005, 2:25–28 (emphasis added). The cited portion in Yamashita describes how, by matching a vibration frequency with a resonance frequency of a vibrator, one can obtain a dislocation amount that is multiplied by the Q factor, and that the Q factor can exceed 10,000 when the vibrator is formed of “single crystal silicon” because “the internal loss is extremely small.” Ex. 1006, 8:55–64. We are persuaded that Petitioner’s rationale for combining Nose and Yamashita is sufficiently supported by rational underpinnings based on the cited, express disclosures in Nose and Yamashita that would have motivated the ordinarily skilled artisan to modify the teachings of Nose with Yamashita as Petitioner asserts.

Dr. Young’s testimony—that piezo-resistive strain gauges formed of single-crystal silicon achieve higher sensitivity than those formed of polycrystalline silicon—also sufficiently motivates the combination of Nose and Yamashita because the testimony is supported by underlying evidence in *Temperature-independent Pressure Sensors Using Polycrystalline Silicon Strain Gauges*,” by Schäfer (Ex. 1012, “Schäfer”). Ex. 1012, 3–4 (“The piezoresistive sensitivity of the examined films is . . . clearly smaller in polysilicon than in monocrystalline silicon.”).

We have reviewed Petitioner’s arguments and evidence concerning independent claim 30 and are persuaded that Petitioner establishes, by a preponderance of the evidence, that claim 30 is obvious in view of Nose and Yamashita.

F. Challenges Applying Mattes

1. Overview of Mattes

Mattes discloses “a method and an arrangement for detecting a vehicle roll-over,” which “can be detected in timely fashion and with a high degree of reliability.” Ex. 1009, 2:1–3.⁹

2. Obviousness of Dependent Claim 33 over Nose and Mattes

Dependent Claim 33 recites “[a] sensor according to claim 20 mounted on a motor vehicle to control deployment of a safety device.”

With respect to the challenge applying Nose and Mattes, Petitioner contends “Mattes improves the reliability of rollover detection with ‘at least one rotation rate sensor.’” Pet. 75 (citing Ex. 1009, 2:7–11). Petitioner

⁹ Mattes (Ex. 1009) does not include line numbers. We follow the same convention as Petitioner, in citing to Mattes, by setting forth page numbers and determined line numbers.

argues Mattes teaches that “[s]ignaling a rollover results in ‘activation of the safety mechanisms’ including roll-over bars, belt tensioners, airbags, seat locking mechanisms, etc.” *Id.* (citing Ex. 1009, 1:6–7, 6:20–23; Ex. 1003 ¶ 318). Petitioner relies on Nose to teach an angular velocity sensor and Mattes to teach mounting the sensor on a motor vehicle and controlling deployment of a safety device. *Id.* at 77–78 (citing Ex. 1009, 1:5–8; 2:7–22; Ex. 1003 ¶ 320).

As to rationale for combining, Petitioner asserts that “[t]he combination would have been nothing more than the combination of known elements using known methods to yield predictable results.” *Id.* at 76 (citing Ex. 1003 ¶ 319). According to Petitioner, “[a] POSITA would have been motivated to turn to Mattes in order to achieve the benefit of *improved* accuracy and reliability of rollover detection in using Nose’s angular velocity sensor.” *Id.* at 76–77 (citing Ex. 1003 ¶ 321) (emphasis added). We understand Petitioner to take the position that the rotation rate sensor in Mattes could be replaced with or implemented by Nose’s angular velocity sensor. *Id.* at 76 (citing Ex. 1009, 1:5–8, 2:7–22) (“Mattes teaches using an angular velocity from a “rotation rate sensor” (such as Nose’s angular velocity sensor) in a vehicle to assist in controlling activation of one or more safety mechanisms.”). The testimony of Dr. Young, Petitioner’s Declarant, substantially mirrors the arguments set forth in the Petition. *See* Ex. 1003 ¶¶ 318–23.

Patent Owner argues that Mattes does not cure the deficiencies of Nose with respect to claim 33. PO Resp. 29. However, as discussed above in Section III.D, we are not persuaded by Patent Owner’s arguments that

Nose alone does not teach or suggest these elements. So we do not reiterate those arguments here.

We are persuaded by Petitioner’s rationale for combining the teachings of Nose with Mattes because it would have been understood by the ordinarily skilled artisan to be nothing more than the combination of known elements using known methods yielding predictable results. As such, we find that the combination of Nose and Mattes teaches the limitation recited in claim 33. We are persuaded that Petitioner establishes that claim 33 is unpatentable as obvious over the combination of Nose and Mattes (*see* Pet. 75–79) by a preponderance of the evidence.

3. *Obviousness of Dependent Claim 33 over Nose, Yamashita, and Mattes*

With respect to the challenge applying Nose, Yamashita, and Mattes, Petitioner contends “[t]he addition of elements from Yamashita does not impact the reasons to combine Nose with Mattes and the same reasons to combine apply.” *Id.* at 79 (citing Ex. 1003 ¶¶ 319–23, 333); *see id.* at 80 (citing Ex. 1003, ¶¶ 324–32, 334, 335).

Patent Owner argues that Mattes does not cure the deficiencies of Nose with respect to claim 33. PO Resp. 29. However, as discussed above in Section III.D, we were not persuaded by Patent Owner’s arguments that Nose alone does not teach or suggest these elements. So we do not reiterate those arguments here.

We are persuaded that the combination of Nose, Yamashita, and Mattes teaches the limitation recited in claim 33 for reasons substantially similar to the reasons discussed with respect to the challenge to claim 33 applying Nose and Mattes. *See* § III.F.2. We are persuaded that Petitioner establishes that claim 33 is unpatentable as obvious over the combination of

Nose, Yamashita and Mattes (*see* Pet. 75–79) by a preponderance of the evidence.

IV. CONCLUSION

We conclude that Petitioner has established, by a preponderance of the evidence, that claims 20, 22–24, and 31 of the '349 patent are unpatentable as anticipated by Nose and as obvious over Nose. We also conclude that Petitioner has not established, by a preponderance of the evidence, that claim 25 is unpatentable as either anticipated by Nose or obvious over Nose. Further, we conclude that Petitioner has established, by a preponderance of the evidence, that claims 20, 22–25, 30, and 31 are unpatentable as obvious over the combination of Nose and Yamashita. We also conclude that Petitioner has established, by a preponderance of the evidence, that claim 33 is unpatentable as obvious over the combination of Nose and Mattes and over the combination of Nose, Yamashita, and Mattes.

The chart below summarizes our conclusions.

Claims	35 U.S.C. §	Reference(s)/ Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
20, 22–25, 31	102	Nose	20, 22–24, 31	25
20, 22–25, 31	103	Nose	20, 22–24, 31	25
20, 22–25, 30, 31	103	Nose, Yamashita	20, 22–25, 30, 31	
33	103	Nose, Mattes	33	
33	103	Nose, Mattes, Yamashita	33	

Claims	35 U.S.C. §	Reference(s)/ Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
Overall Outcome			20, 22–25, 30, 31, 33	

V. ORDER

It is, therefore,

In consideration of the foregoing, it is hereby:

ORDERED that claims 20, 22–25, 30, 31, 33 of the '349 patent have been shown by a preponderance of the evidence to be *unpatentable*; and

FURTHER ORDERED that, because 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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Patent 6,467,349 B1

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