

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,
Petitioner,

v.

RESONANT SYSTEMS, INC.,
Patent Owner.

IPR2024-00983
Patent 11,152,882 B2

Before KARL D. EASTHOM, NORMAN H. BEAMER, and
BRIAN D. RANGE, *Administrative Patent Judges*.

BEAMER, *Administrative Patent Judge*.

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

I. INTRODUCTION

Apple Inc., Petitioner, filed a Petition (Paper 2, “Pet.”) requesting an *inter partes* review of claims 1–6, 10, 17, 19, and 20 of U.S. Patent No. 11,152,882 B2 (Ex. 1001, the “’882 patent”). Pet. 1. We instituted *inter partes* review of all the claims challenged in the Petition. Paper 8 (“Inst. Dec.”). Resonant Systems, Inc., Patent Owner filed a Patent Owner Response to the Petition. Paper 11 (“PO Resp.”). Petitioner filed a Reply and Patent Owner filed a Sur-Reply. Paper 15 (“Reply”); Paper 18 (“PO Sur-Reply”). An oral hearing was held on September 10, 2025, and a copy of the transcript was entered into the record. Paper 28 (“Tr.”).

We have jurisdiction over this *inter partes* review under 35 U.S.C. § 6. This Final Written Decision is entered pursuant to 35 U.S.C. § 318(a). Based on the complete record, we find that Petitioner has shown, by a preponderance of the evidence, that claims 1–6, 10, 17, 19, and 20 of the ’882 patent are unpatentable.

II. BACKGROUND

A. *Real Parties in Interest*

Each party identifies itself as a real party in interest. Pet. 76; Paper 4, 1.

B. *Related Matters*

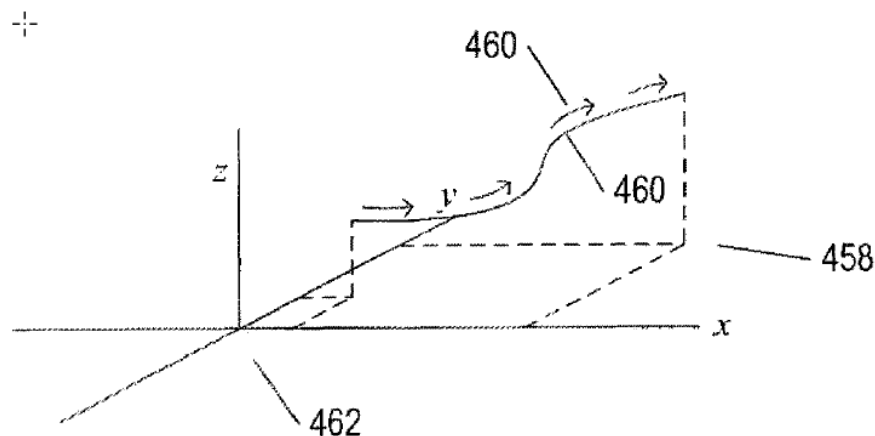
Patent Owner identifies *Resonant Systems, Inc. d/b/a Revel HMI v. Apple, Inc.*, No. 7:23-cv-00077 (W.D. Tex.) (the “Apple Litigation”) as a related matter. Paper 4, 1.

PTAB proceedings challenging related patents that may involve similar claim construction issues include the following: IPR2023-00992, IPR2023-00993, IPR2023-01025, IPR2024-00568, IPR2024-00569,

IPR2024-00570, IPR2024-00697, IPR2024-00698, IPR2024-00806,
IPR2024-00807, IPR2024-00808, IPR2025-00680, IPR2025-00823, and
IPR2025-01098.

C. The '882 Patent

The '882 patent relates to “vibration-generating devices and, in particular, to vibration modules that can be incorporated into a wide variety of different types of electromechanical devices and systems to produce predetermined vibration responses.” Ex. 1001, 1:14–18; *see also id.* code (57). The vibration generating devices are generally referred to in the '882 patent as oscillating resonant modules (“ORMs”), which include “linear resonant vibration modules.” *Id.* at 4:51–53; code (57). An ORM as used in the '882 patent refers to a weight, or mass, that oscillates back and forth along a path that is a segment of a space curve. *Id.* at 5:17–21. A general space curve segment path, according to the '882 patent, is illustrated in the portion of Figure 4C reproduced below. *Id.* at 6:12.



This figure depicts a space curve segment 460 plotted in a three-dimensional Cartesian coordinate system 462, along which a weight or mass of an ORM oscillates back and forth. Ex. 1001, 6:12–18. The path can be any particular

segment of a space curve, including a linear line or a circular or elliptical arc. *Id.* at Fig. 4D, 5:18–21, 6:31–36.

An example of an ORM using a linear path is illustrated in Figure 5A reproduced below:

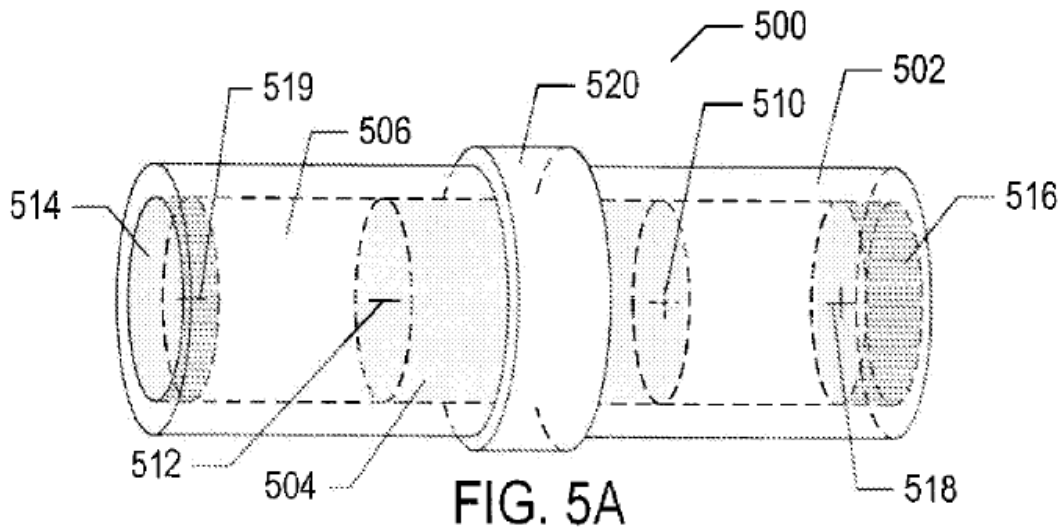


Figure 5A depicts cylindrical housing 502 forming cylindrical chamber 506, disk-like magnets 514 (left) and 516 (right) with negative and positive polarity, respectively, and conductive coil 520 encircling tube 502.

Ex. 1001, Figs. 5A–5G, 6:39–7:26. Magnets 514 and 516 repel magnet 504 when it moves to the extreme right or left according to a current supplied to coil 520 from a power source. *Id.* This current oscillates with an amplitude and frequency to create a changing magnetic field via coil 520, which in turn causes magnet 504 to change its direction and length of travel according to a user-specified amplitude and frequency of movement. *Id.*

The ORMs of the '882 patent have feedback control, so that the driving frequency produced falls close to the resonant frequency of the device in which the ORM is included, resulting in optimal power consumption with respect to the amplitude and frequency of vibration

produced by the ORM as well as maximal vibration energy of the device.

Ex. 1001, 4:62–5:1. An example of feedback control of an ORM is illustrated in Figure 45 reproduced below.

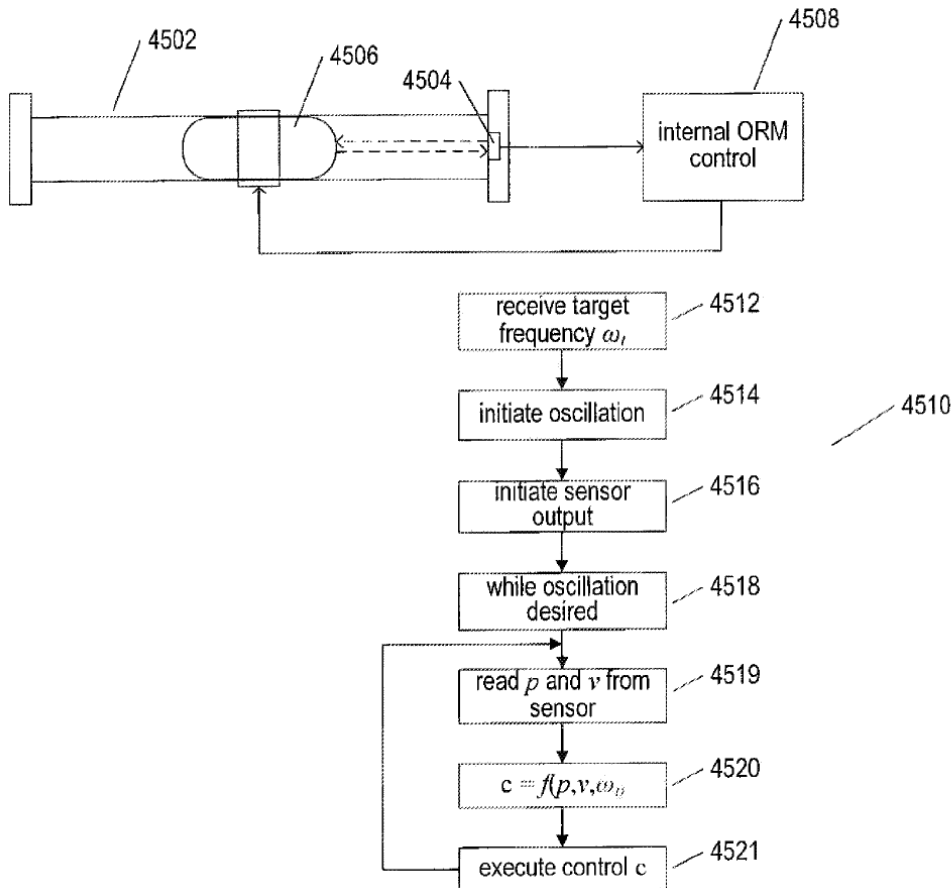


FIG. 45

Figure 45 depicts ORM 4502 with direct sensor 4504 that directly determines the position and velocity of the moving weight or mass 4506, which information is output to internal ORM control logic 4508 that can directly use the position and velocity information to update ORM control in order to achieve a target frequency ω_t . Ex. 1001, 31:19–28. Control-flow diagram 4510 depicts an algorithm in which target frequency ω_t is received in step 4512, the control initiates oscillation of the mass in step 4514, the control logic initiates sensor output in step 4516, the control logic continuously receives position and velocity data from the sensor and

executes immediate control based on that position and velocity data in the while-loop of steps 4518–4521. *Id.* at 31:28–37. The computation of the appropriate control is based on the target frequency ω_t , and the current position and velocity of the moving mass p and v , which computation may be made based on a predetermined function, $c=f(p,v,\omega_t)$ or based on tables with values. *Id.* at 31:44–48.

Direct sensing of position and velocity can be done using an ORM containing a series of apertures through which an illumination source shines light on a photodiode sensor, regularly spaced pressure or presence sensors, or Hall-effect electronic sensors — where the current position and velocity of the moving mass can be determined from the pattern of measurements at consecutive points in time. Ex. 1001, 31:57–32:13. Such methods of direct sensing of position and velocity are more accurate and timely provided than position and velocity data derived from indirect sensing and inference. *Id.* at 31:54–56.

D. Illustrative Claim

Independent claim 1 is illustrative of the challenged claims, and follows:

1. An oscillating resonant module comprising:
 - [a] an oscillation path, which represents a segment of a space curve, along which a point within a mass moves;
 - [b] a mass that is driven by energy supplied to the oscillating resonant module to oscillate back and forth along the oscillation path that represents a segment of a space curve;
 - [c] one or more sensors that output indications of the positions of the mass within the oscillation path at specific points in time; and;
 - [d] a control component that receives control signals input to the oscillating resonant module, receives outputs from the one or

more sensors, and controls oscillation of the mass to produce a vibration response according to the received control signals by generating, using one or more of the received sensor outputs, control outputs to an actuator that drives the mass to oscillate.

Ex. 1001, 32:52–33:3; Pet. vi (lettered markers in brackets by Petitioner).

E. Asserted Grounds of Unpatentability

Petitioner contends that claims 1–6, 10, 17, 19, and 20 are unpatentable as follows:¹

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1–6, 10, 17, 19, 20	103	Alexander, ² Cosper ³
1–5, 10, 17, 19, 20	103	Gregorio ⁴
1–5, 10, 17, 19, 20	103	Gregorio, Ramsay ⁵
3–6	103	Gregorio, Muramatsu ⁶
3–6	103	Gregorio, Ramsay, Muramatsu
1–5, 10, 17, 19, 20	103	Gregorio, Fuller ⁷

¹ The Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011) (“AIA”), amended 35 U.S.C. §§ 102, 103 effective March 16, 2013, which is before the ’882 patent’s effective filing date. *See* Ex. 1001, code (63). Therefore, the AIA version of Section 103 applies.

² Alexander, US 2013/0237751 A1, published Sep. 12, 2013. Ex. 1005.

³ Cosper et al., US 2008/0246532 A1, published Oct. 9, 2008. Ex. 1006.

⁴ Gregorio et al., US 7,843,277 B2, issued Nov. 30, 2010. Ex. 1007.

⁵ Ramsay et al., US 2008/0294984 A1, published Nov. 27, 2008. Ex. 1010.

⁶ Muramatsu, US 5,952,806, issued Sep. 14, 1999. Ex. 1009.

⁷ Fuller et al., US 2008/0001484 A1, published Jan. 3, 2008. Ex. 1008.

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1–5, 10, 17, 19, 20	103	Gregorio, Fuller, Ramsay
3–6	103	Gregorio, Fuller, Muramatsu
3–6	103	Gregorio, Fuller, Ramsay, Muramatsu

Pet. 1. Petitioner supports its challenges with a Declaration and a Supplemental Declaration of Dr. Blake Hannaford. Exs. 1003, 1018.

III. ANALYSIS OF PETITIONER’S CHALLENGES

A. *Legal Standards*

To prevail in its grounds for unpatentability during trial, Petitioner must demonstrate by a preponderance of the evidence that the claims are unpatentable. 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d). “In an IPR, 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) (2012) (requiring *inter partes* review petitions to identify “with particularity . . . the evidence that supports the grounds for the challenge to each claim”)). This burden of persuasion never shifts to the patent owner. *See Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015) (discussing the burden of proof in *inter partes* review).

A patent claim is unpatentable under 35 U.S.C. § 103 if the differences between the claimed subject matter 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 ordinary skill in the art; and (4) when in evidence, objective indicia of nonobviousness (also called secondary considerations), such as commercial success, long-felt but unsolved needs, and failure of others. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). We analyze the grounds based on obviousness in accordance with the above-stated principles.

B. Level of Ordinary Skill in the Art

Determining whether an invention would have been obvious under 35 U.S.C. § 103 requires resolving the level of ordinary skill in the pertinent art at the time of the effective filing date of the claimed invention. *Graham*, 383 U.S. at 17. The person of ordinary skill in the art is a hypothetical person who knows the relevant art. *In re GPAC Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995). Factors in determining the level of ordinary skill in the art include the types of problems encountered in the art, the sophistication of the technology, and educational level of active workers in the field. *Id.* One or more factors may predominate. *Id.*

Petitioner’s expert declarant contends that person of ordinary skill in the art (POSITA) “would have had a degree in mechanical engineering, electrical engineering, physics, or a related technical field, and at least 2–3 years of experience related to the design or development of vibration-generating systems; additional years of experience could substitute for the

advanced-level degree.” Ex. 1003 ¶ 27. Patent Owner offers “a similar level of ordinary skill in the art.” PO Resp. 2.

Based on a review of the record, we adopt Petitioner’s proposed level of ordinary skill in the art because it is consistent with the evidence of record, including the asserted prior art and ’882 patent specification.

C. Claim Construction

In *inter partes* reviews, the Board interprets claim language using the district-court-type standard, as described in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc). *See* 37 C.F.R. § 42.100(b) (2023). Under this standard, claim terms have their ordinary and customary meaning, as would be understood by a person of ordinary skill in the art at the time of the invention, in light of the language of the claims, the specification, and the prosecution history. *See Phillips*, 415 F.3d at 1313–14.

1. Preambles of Claims 1 and 10

Petitioner does not specifically address the issue of whether or not the preambles of the independent claims — which specify, *inter alia*, “oscillating resonant module[s]” — are limiting. *See generally* Pet. Patent Owner points out that, in the Apple Litigation, the parties agreed that the preambles of claims 1 and 10 are limiting. PO Resp. 6 (citing Ex. 2002, 10.) However, because an “oscillating resonant module” is required in the body of the independent claims, we do not need to address whether or not the preambles are limiting.

2. Control Component

For this proceeding, both parties raise the issue of the proper construction of the “control component” requirement of independent claims

1 and 10. Pet. 3–6; PO Resp. 6–9. Petitioner states that, for purposes of this proceeding, the requirement can be interpreted under its plain and ordinary meaning, given that the limitation does not recite “means for.” Pet. 3.

However, as Petitioner acknowledges and as Patent Owner relies on, both parties have asserted in the Apple Litigation that the “control component” requirement is a means-plus-function limitation subject to 35 U.S.C. §112(f), despite the fact that the control component limitation does not recite “means for.” Pet. 3 (citing Ex. 1012, 3–8; Ex. 1013, 13); PO Resp. 6–7. Indeed, the court in the Apple Litigation has concluded that the control component requirement is subject to 35 U.S.C. § 112(f), and has construed that requirement accordingly:

Function: receiving control signals input to the oscillating resonant module; receiving outputs from the one or more sensors; controlling oscillation of the mass to produce a vibration response according to the received control signals by generating, using one or more of the received sensor outputs, control outputs to an actuator that drives the mass to oscillate.

Structure: a microcontroller, a processor, a microprocessor, or a CPU that performs the algorithm shown in Figure 45 or the algorithm described in the corresponding text. *See, e.g.*, 31:19–32:13, and equivalents thereof.

Ex. 2001, 10; Ex. 2002, 40. Because of the Apple Litigation record, Petitioner presents its challenges in the alternative, first applying a plain meaning approach to the control component requirement, and also analyzing the requirement under the construction adopted in the Apple Litigation. Pet. 3–5.

We adopt the court’s construction in the Apple Litigation. 35 U.S.C. § 112(f) provides:

An element in a claim for a combination may be expressed as a means . . . for performing a specified function without the recital of structure, material, or acts in support thereof, and such claim shall be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof.

The presumption is that terms reciting “means” are subject to Section 112(f). *Williamson v. Citrix Online, LLC*, 792 F.3d 1339, 1348 (Fed. Cir. 2015). But if the term does not use the word “means,” then it is presumed not to be subject to Section 112(f). *Id.* “That presumption can be overcome, but only if the challenger demonstrates that the claim term fails to recite sufficiently definite structure or else recites function without reciting sufficient structure for performing that function.” *Samsung Elecs. Am., Inc. v. Prisia Eng’g Corp.*, 948 F.3d 1342 (Fed. Cir. 2020). “The correct inquiry, when ‘means’ is absent from a limitation, is whether the limitation, read in light of the remaining claim language, specification, prosecution history, and relevant extrinsic evidence, has sufficiently definite structure to a person of ordinary skill in the art.” *Apple Inc. v. Motorola, Inc.*, 757 F.3d 1286, 1298 (Fed. Cir. 2014).

When applicable, construing a means plus function limitation under 35 U.S.C. § 112(f) involves two steps: 1) identifying the claimed function and 2) identifying in the specification the corresponding structure that performs the claimed function. *Med. Instrumentation & Diagnostics Corp. v. Elekta AB*, 344 F.3d 1205, 1210 (Fed. Cir. 2003); *Cardiac Pacemakers, Inc. v. St. Jude Med., Inc.*, 296 F.3d 1106, 1119 (Fed. Cir. 2002).

“[S]tructure disclosed in the specification” is “‘corresponding’

structure,” “only if the specification or prosecution history *clearly links or associates* that structure to the function recited in the claim.” *B. Braun Med. Inc., v. Abbott Lab’s*, 124 F.3d 1419, 1424 (Fed. Cir. 1997) (emphasis added) (“Because Braun’s specification does not adequately disclose the valve seat as structure that holds the disc firmly in place, Braun has failed to particularly point out and distinctly claim that particular means.”). “This duty to link or associate structure to function is the *quid pro quo* for the convenience of employing [Section 112(f)].” *Id.* (citing *O.I. Corp. v. Tekmar Co.*, 115 F.3d 1576, 1583 (Fed. Cir. 1997)).

For Section 112(f) limitations implemented by a programmed general-purpose computer or microprocessor, the corresponding structure described in the patent specification must include an algorithm for performing the function, i.e., the corresponding structure is a processor and an algorithm. *See, e.g., Noah Systems Inc. v. Intuit Inc.*, 675 F.3d 1302, 1312 (Fed. Cir. 2012); *Aristocrat Techs. Australia PTY Ltd. v. Int’l Game Tech.*, 521 F.3d 1328, 1333 (Fed. Cir. 2008).

We agree with the court and the parties in the Apple Litigation “that ‘control component’ is a nonce phrase tantamount to using the word ‘means.’” Ex. 2002, 19 (citing *Dyfan, LLC v. Target Corp.*, 28 F.4th 1360, 1365 (Fed. Cir. 2022)). We also agree that the ’882 specification links the stated function of the control component requirement with the direct sensing of position and velocity algorithm depicted in Figure 45, discussed above in Section II.C. Ex. 1013, 17; Ex. 2001, 10; Ex. 2002, 40.

Patent Owner specifically asserts, and we agree, that based on this construction, the Figure 45 algorithm requires step 4519 (“read p and v from sensor”) and step 4520, which the specification describes as “the appropriate

control is computed based on the target frequency ω_t and the current position and velocity of the moving mass p and v .” PO Resp. 8 (citing Ex. 1001, 31:44–46).

3. *A Segment Of A Space Curve*

Independent claims 1 and 10 require a mass to oscillate back and forth on “a segment of a space curve.” Ex. 1001, 32:53–58, 33:46–52. The ’882 patent provides Figure 4C (reproduced above at page 3) as a general illustration of a space curve, and states that the segment of a space curve can be “any particular segment,” including a “linear path, or line segment.” *Id.* at 5:13–21. During the prosecution of the application that led to the ’882 patent, applicant stated that lines were part of a “plane curves” subset of the set of space curves. Ex. 1002, 147. Also, in the Apple Litigation, Patent Owner took the position that the claimed space curve can be linear. Ex. 1013, 7.

On the other hand, during prosecution, the Examiner allowed issuance of the ’882 patent over prior art that disclosed a mass that oscillated back and forth on a linear path. Ex. 1002, 123, 164 (distinguishing Elenga published application 2012/0133308 A1).⁸

We need not conclude one way or the other whether a straight line oscillation path satisfies the space curve requirement of the claims because, as discussed below, Petitioner relies on art that discloses nonlinear oscillation paths.

⁸ Elenga 2012/0133308 A1 issued as US 8,860,337, challenged in *Apple, Inc. v. Resonant Systems, Inc.*, IPR2024-00807 (“IPR807”). That patent, also assigned to Patent Owner here, only discloses linear vibration modules, with linear oscillation paths, identical to the disclosed linear examples in the ’882 patent. *Cf.*, Ex. 1001, Figs 5A–G, *with* IPR807, Ex. 1001, Figs. 4A–G.

D. Alleged Obviousness of Claims 1–6, 10, 17, 19, and 20 over Alexander and Cosper

Petitioner contends that claims 1–5, 10, 17, 19, and 20 would have been obvious over the combined teachings of Alexander and Cosper. Pet. 9–40.

1. Alexander

Alexander discloses a “linear actuator” and an actuator with “curvilinear motion” illustrated in Figures 1A and 7A, portions of which are reproduced below.

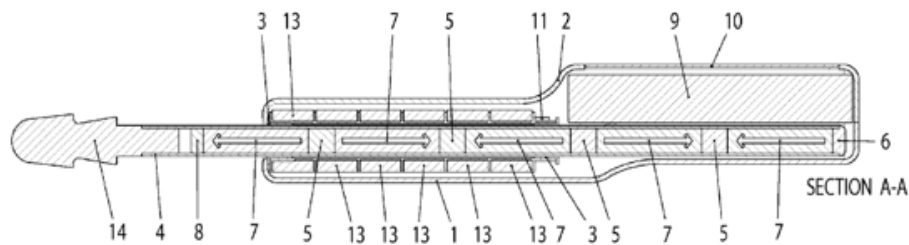


Figure 1A

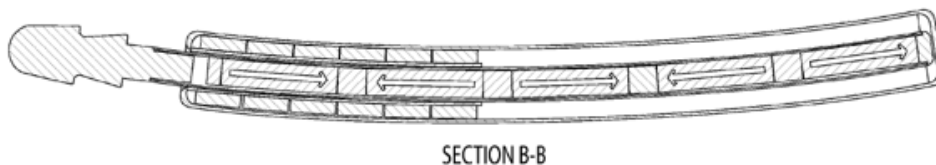


Figure 7A

Ex. 1005 ¶¶ 6, 15, 23, 50. The figures depict motor stators 13, which are wire coils forming a cylindrical chamber, within which is housing tube 4 containing magnets 7 separated by spacers 5. *Id.* ¶ 23. The arrows shown on magnets 7 indicate the orientation of the polarity of the magnets. *Id.* Magnets 7 slide inside of the coil assembly, and electrical current applied to coils 13 creates a magnetic field that reacts against the magnets inside of the tube, causing the magnets to slide one way or the other through the coil assembly. *Id.* ¶ 24. A feedback control system is used to control the

position and motion of the magnets using position sensors that measure the position of the tube and report the position of the tube to the control electronics. *Id.* ¶ 34. Alexander discloses that a variety of different position sensors may be used, including contact and non-contact position sensors, including a magnetic flux sensor. *Id.* ¶¶ 34–35. In addition to measuring position, speed is calculated from position over time. *Id.* ¶ 40. A user interface is provided to allow the user to select the speed, force, and other parameters of the actuator. *Id.*, Fig. 10, ¶ 59.

2. Cosper

Cosper discloses a mechanical resonant system depicted in Figure 1 reproduced below.

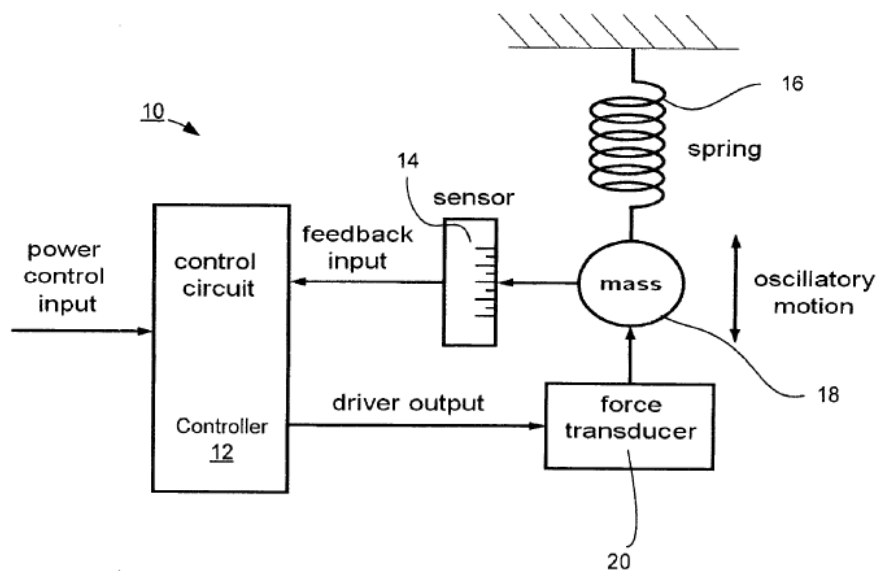


FIG. 1

Figure 1 is a schematic of control system 10 for use with a mechanical resonant subassembly system, including controller 12, sensor 14, bias spring 16, moveable mass 18, and force transducer 20. Ex. 1006 ¶ 49. Using feedback from sensor 14, controller 12 drives the oscillating mass at or near its resonance frequency via force transducer 20. *Id.* Sensor 14 may detect

position and velocity of the oscillating mass and may include “electrical sensors, electromagnetic sensors, optical sensors, induction sensors, photo sensors, or the like (classes of sensors may include: induction, electrical, photo, optical, electromagnetic, motion, ultrasonic, infrared, etc.).”

Ex. 1006 ¶ 50. Control circuit 12 automatically maintains the resonant frequency of the mass and bias subassembly at a desired frequency set-point.

Id. ¶ 55. User controls are provided to select or adjust the resonant frequency. *Id.* ¶ 106.

3. *The Combination of Alexander and Cosper*

a) *Petitioner’s Argument*

Petitioner argues that one of ordinary skill in the art would have been motivated to modify Alexander to utilize the feedback control of Cosper to facilitate oscillation at a resonant frequency, including the ability of Cosper to directly sense both position and velocity. Pet. 11–12. Petitioner’s expert testifies that the combination would have been motivated to maintain oscillation near a resonant frequency to facilitate enhanced system movement/vibration strength for a given amount of energy input, as described by Cosper, and to improve precision of oscillation output by implementing effective position sensing for feedback control. Ex. 1003 ¶¶ 65–74.

Petitioner’s expert testifies that the combination involves combining prior art elements according to known methods to yield predictable results. *Id.* ¶ 75–77.

b) Patent Owner's Response

(1) Non-Analogous Art

Patent Owner argues that Alexander is not analogous art to that of the '882 patent. PO Resp. 16–17.⁹ First, Patent Owner argues that Alexander is not from the same field of endeavor as the '882 patent, because the Alexander embodiments are directed to sex toys with non-resonant linear motors. *Id.* (citing Ex. 2009 ¶ 76).¹⁰ Patent Owner relies on the fact that “Alexander discloses a specific type of linear actuator that lacks any mechanical ability to store energy,” and therefore, Alexander does not have the ability to exhibit resonant behavior and “does not disclose an oscillating resonant module as claimed.” *Id.* at 11–12 (citing Ex. 1005 ¶¶ 23–25; Ex. 2009 ¶¶ 66–68).

Patent Owner also argues that Alexander is not analogous because it is not reasonably pertinent to the particular problem the inventors of the '882 patent were involved with. PO Resp. 17. Patent Owner contrasts the '882 patent's focus on control in the presence of resonance with the lack of any disclosure in Alexander regarding resonant behavior. *Id.* (citing Ex. 2009 ¶¶ 77–78).

⁹ Patent Owner does not argue that Cosper is not analogous art to the '882 patent, but does argue that Cosper is not analogous art to that of Alexander, and *vice versa*. PO Resp. 13–16. Whether or not these references are analogous to each other is irrelevant — the relevant question is whether or not the references are analogous to the '882 patent. *Donner Tech., LLC v. Pro Stage Gear, LLC*, 979 F.3d 1353, 1359 (Fed. Cir. 2020); *In re Bigio*, 381 F.3d 1320, 1325 (Fed. Cir. 2004).

¹⁰ Exhibit 2009 is the declaration of Patent Owner's expert, Keith W. Goossen, Ph.D.

(2) No Motivation To Combine

In addition to its non-analogous art arguments, Patent Owner also argues that a person of ordinary skill in the art would not have been motivated to combine Alexander and Cosper. PO Resp. 18–24. In particular, Patent Owner argues that there would be no reason to add Cosper’s ability to provide oscillation at a resonant frequency in Alexander because Alexander provides for a wide range of controllable oscillation amplitudes (“stroke length”), frequencies and patterns that would be impaired, rather than helped, by adding resonance, and furthermore that adding resonance requires power-wasting control to counteract spring/elastomeric restoring forces. *Id.* at 18–20 (citing Ex. 1005 ¶¶ 37–38, 40, 55, 59; Ex. 2009 ¶¶ 81–83).

Patent Owner further argues that a person of ordinary skill in the art would not have a reasonable expectation of success in the proposed combination. PO Resp. 20–24. In particular, Patent Owner argues that it would be impractical to add the necessary “bias members” (such as springs or magnets) to allow resonant frequency operation, given the available space in the Alexander housing tube, the required higher frequencies necessary for feasible resonant operation, and unpredictable nonlinear behaviors. *Id.* (citing Ex. 1005, Fig. 9B, ¶ 38; Ex. 2009 ¶¶ 81, 84–89).

c) Petitioner’s Reply

(1) Analogous Art

In reply, Petitioner argues that Alexander is in the same field of endeavor as the ’882 patent, given that both are “related to vibration-generating devices and, in particular, to vibration modules that can be incorporated into a wide variety of different types of electromechanical

devices and systems to produce predetermined vibration responses.”

Reply 2–3 (citing Ex. 1001, 1:11–16; Ex. 1005, Abstr., cl. 4, ¶¶ 37, 56; Ex. 1018 ¶¶ 8–9). Petitioner points out that neither the ’882 patent nor Alexander is limited to particular devices, and both “describe vibrating products for human physical interaction.” *Id.* at 3–4 (citing Ex. 1001, Abstr., Figs. 17–19; Ex. 1005, cls. 1–6; Ex. 1018 ¶ 10).

In addition, Petitioner argues that Alexander is pertinent to the same problems identified by the ’882 patent, including overcoming the unbalanced forces of electric motors. Reply 4–5 (citing Ex. 1001, 1:29–3:2; Ex. 1005 ¶ 22; Ex. 1018 ¶¶ 11–12). Petitioner also points out that the Examiner cited Alexander during the prosecution of the ’882 patent. *Id.* at 4 (citing Ex. 1002, 145–179). In addition, Petitioner offers that both the ’882 patent and Alexander describe feedback control techniques and the use of multiple sensors to characterize and generate oscillation according to predetermined profiles, and specify sinusoidal output. *Id.* at 5–6 (citing Ex. 1001, 24:47–48, 25:24; Ex. 1005 ¶¶ 34–35, 37, 39, 55; Ex. 1018 ¶¶ 13–14).

(2) Motivation To Combine

In regard to the motivation to combine Alexander and Cosper, Petitioner reiterates the advantages of introducing the ability to maintain resonant behavior in an Alexander device due to improved precision of oscillation output by implementing effective position sensing for feedback control and facilitating maximum magnitude with reduced input, yielding lighter weight, more compact design, and energy savings. Reply 10–11 (citing 1018 ¶¶ 20–22). Petitioner also dismisses Patent Owner’s attempts to question whether there would be a reasonable expectation of success, arguing that Patent Owner improperly dwells on specific structural aspects

of the Alexander embodiment, rather than the ability of one of ordinary skill to select dimensions and operating configurations to accommodate the resonance teachings of Cosper. *Id.* at 11–16 (citing Ex. 1003 ¶¶ 76–77; Ex. 1005 ¶¶ 23, 25–26; Ex. 1018 ¶¶ 23–27). Petitioner argues that “[s]electing a bias member and packaging it in a housing such as Alexander’s was not new, and a POSITA would have readily configured the bias member to accommodate a range of operating profiles, consistent with Alexander’s objectives, such as by selecting a bias member to promote resonance when operating near a middle of a maximum stroke length.” *Id.* at 15 (citing Ex. 1018 ¶ 26).

d) Patent Owner’s Sur-Reply

Patent Owner criticizes Petitioner’s analysis of the field of endeavor of the patent, and problems addressed by the patent, as overly broad and ignoring that the ’882 patent claims and summary are directed to “oscillating resonant modules,” whereas the Alexander sex toy disclosure is not. Sur-Reply 2–7 (citing Ex. 1001, 2:64–3:3, 32:52, 32:55, 33:40–41, 33:44; Ex. 1005, Fig. 1A, ¶¶ 38, 40, 54; Ex. 2009 ¶¶ 84–89). Patent Owner discounts the significance of Alexander being cited during the prosecution of the patent, given that the Examiner was persuaded to allow the patent in light of applicant’s arguments distinguishing Alexander, during which the issue of analogous art did not need to be, and was not, reached. *Id.* at 4–5 (citing Ex. 1002, 123–124, 153–154). Patent Owner also challenges the notion that both the patent and Alexander both describe physical contact as ignoring the significant difference between the specific sex toy application of Alexander as compared to the unrelated skin massage applications disclosed in the ’882 patent. *Id.* at 6–7. In regard to motivation to combine,

Patent Owner argues that Petitioner’s proposed redesign of Alexander to incorporate resonant behavior is conclusory, without support, and incompatible with the stated sex toy application of Alexander. *Id.* at 7–10 (citing Ex. 2009 ¶¶ 85, 88–89).

e) Analysis

(1) Analogous Art

Our reviewing court has stated that “[t]wo separate tests define the scope of analogous prior art: (1) whether the art is from the same field of endeavor, regardless of the problem addressed and, (2) if the reference is not within the field of the inventor's endeavor, whether the reference still is reasonably pertinent to the particular problem with which the inventor is involved.” *In re Bigio*, 381 F.3d 1320, 1325 (Fed. Cir. 2004) (citations and internal quotes omitted). While these two criteria are helpful in many instances, we must not lose sight of the key question at hand: what is “prior art” as that term is used in 35 U.S.C. § 103(a)? References that are “too remote to be treated as ‘prior art’” are excluded from the obviousness analysis. *In re Sovish*, 769 F.2d 738, 741, 226 (Fed. Cir. 1985). The non-analogous art test provides helpful insight on the underlying question of what is “prior art” within the meaning of the statute; we should not, however, be blind to the reality of the circumstances of the case before us. *In re Wood*, 599 F.2d 1032, 1036 (CCPA (1979). Nor should we adhere to rigid and mandatory formulas that overly limit the inquiry. *KSR Int’l Co.*, 550 U.S. at 419.

Focusing on the first of the two tests above, the test for analogous art “requires the PTO to determine the appropriate field of endeavor by reference to explanations of the invention's subject matter in the patent

application, including the embodiments, function, and structure of the claimed invention.” *In re Bigio*, 381 F.3d at 1325. We thus consider all explanations of the inventors’ subject matter while keeping in mind that prior art is analogous when it “is from the same field of endeavor, *regardless of the problem addressed*. . . .” *In re Bigio*, 381 F.3d at 1320 (emphasis added). Thus, “field of endeavor” should not be defined narrowly based only upon the specific problem addressed.

Moreover, when considering field of endeavor, we also remain cognizant of the adage that “the name of the game is the claim.” *In re Hiniker Co.*, 150 F.3d 1362, 1369 (Fed. Cir. 1998) (quoting Giles Sutherland Rich, *Extent of Protection and Interpretation of Claims—American Perspectives*, 21 Int’l Rev. Indus. Prop. & Copyright L. 497, 499 (1990)). The Supreme Court articulated this same sentiment when emphasizing that the patentee’s motivation and purpose do not control an obviousness determination:

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*. If the claim extends to what is obvious, it is invalid under § 103.

KSR, 550 U.S. at 419 (emphasis added).

Turning to the first test enumerated by *In re Bigio* (same field of endeavor), claim 1 is directed to a “oscillating resonant module” having an oscillation path, an oscillating mass, position sensors, and a control component that receives control signals and sensor outputs to control the oscillation of the mass. Ex. 1001, 32:52–33:3. Based on the breadth of claim 1 (and the other challenged claims), we agree with Petitioner that the

'882 Patent Specification's "Technical Field" section appropriately defines the '882 Patent's field of endeavor as "vibration modules that can be incorporated into a wide variety of different types of electromechanical devices." Ex. 1001, 1:15-17. We do not agree that the field is narrowly confined to oscillating resonant modules, as Patent Owner argues. Although that phrase is one element of the independent claims, those claims do not specifically require resonant operation — only dependent claim 20 requires "producing a resonant-frequency vibration mode." Ex. 1001, 34:59–60. Generally, the claims are broadly directed to vibration modules in accord with the stated "Technical Field" quoted above.

The preponderance of the evidence supports that Alexander is in the same field of endeavor as the '882 patent. Alexander is related to vibration-generating devices including vibration modules that can be incorporated into a wide variety of different types of electromechanical devices and systems to produce predetermined vibration responses. Reply 3 (citing Ex. 1004, 1:18–2:34, 2:59–32; Fig. 1; Ex. 1049 ¶ 10); Pet. 10 (citing, *e.g.*, Ex. 1004 6:3–6); Ex. 1003 ¶¶ 72–80. The fact that the preferred embodiment in Alexander is a sex toy does not impose the limitations that Patent Owner would accord it, such that Alexander would be outside the pertinent field of endeavor. Indeed, the broader claims of Alexander are directed generally to a "linear actuator." Ex. 1005, cls. 1–7.

Considering the second test, a preponderance of evidence also supports that Alexander is analogous art because it is reasonably pertinent to the particular problems with which the inventor was involved, including overcoming the unbalanced forces of electric motors, providing feedback control techniques and the use of multiple sensors to characterize and

generate oscillation according to predetermined profiles, and generating sinusoidal outputs. Reply 4–6 (citing Ex. 1001, 1:29–3:2, 24:47–48, 25:24; Ex. 1005 ¶¶ 22, 34–35, 37, 39, 55; Ex. 1018 ¶¶ 11–14). We find that Alexander is analogous art to the '882 Patent because it is reasonably pertinent to the particular problem with which the '882 Patent's inventor is involved.

(2) Motivation To Combine

We find that Petitioner has provided sufficiently articulated reasoning with rational underpinnings for the proffered combined teachings of Alexander and Cosper. Patent Owner's arguments are unpersuasive as focusing on specific details regarding the sex toy embodiment disclosed in Alexander, and the rotating motor embodiment of Cosper. "Combining the *teachings* of references does not involve an ability to combine their specific structures." *In re Nievelt*, 482 F.2d 965, 968 (CCPA 1973). "[T]he test is what the combined teachings of those references would have suggested to those of ordinary skill in the art." *In re Mouttet*, 686 F.3d 1322, 1332 (Fed. Cir. 2012); *In re Keller*, 642 F.2d 413, 425 (CCPA 1981). Furthermore, the artisan is not compelled to blindly follow the teaching of one prior art reference over the other without the exercise of independent judgment. *See Lear Siegler, Inc. v. Aeroquip Corp.*, 733 F.2d 881, 889 (Fed. Cir. 1984). An obviousness analysis "need not seek out precise teachings directed to the specific subject matter of the challenged claim, for a court can take account of the inferences and creative steps that a person of ordinary skill in the art would employ." *KSR Int'l Co.*, 550 U.S. at 418.

Here, Patent Owner's arguments are premised on the assumption that one of ordinary skill would be dissuaded from the combination because of

problems arising from applying the resonance teachings of Cosper to the sex toy application of Alexander. But one of ordinary skill would not have been so constrained, and the record shows that the broad disclosures of the references would have been readily combined. “A person of ordinary skill is also a person of ordinary creativity, not an automaton.” *KSR Int’l Co.*, 550 U.S. at 421. The preponderance of the evidence supports, for example, Petitioner’s position that Cosper’s teachings would enhance the Alexander device by improving precision of oscillation output by implementing effective position sensing for feedback control and facilitating maximum magnitude with reduced input, yielding lighter weight, more compact design, and energy savings. Reply 10–11 (citing 1018 ¶¶ 20–22). Accordingly, we determine that Petitioner has proved by a preponderance of the evidence that that one of ordinary skill would have been motivated to combine Alexander and Cosper in the manner proposed.

4. *Independent Claims 1 and 10*

For the “oscillating resonant module” preamble of independent claim 1, Petitioner generally relies on the actuator disclosure of Alexander. Pet. 17 (citing Ex. 1005, Figs. 1A, 7A, 9A, ¶¶ 5, 23, 39; Ex. 1003 ¶¶ 78–79).

For claim requirement 1[a] regarding a “space curve” “oscillation path,”¹¹ Petitioner relies on the disclosure in Alexander of an actuator embodiment that follows a curvilinear path. Pet. 17–19 (citing Ex. 1005, Fig. 7A, ¶¶ 22, 50, cl. 18; Ex. 1003 ¶¶ 81–83).

¹¹ For economy of presentation, we refer to the portions of claim 1 using the added numbering (1[a], 1[b], etc.) shown in Section II.D above, and paraphrase the referenced claim requirement, although the complete language of each claim requirement is the subject of our analysis.

For claim requirement 1[b] regarding a “mass ... oscillating ... along ... a space curve,” Petitioner relies on the disclosure in Alexander of magnets 7 that oscillate back and forth along a curvilinear path. Pet. 19–20 (citing Ex. 1005, Fig. 7A, ¶¶ 5, 23, 34, 36, 50; Ex. 1003 ¶¶ 85–90).

For claim requirement 1[c] regarding “sensors,” Petitioner relies on the disclosure in Alexander of position sensors such as a flux sensor, and on sensors that directly measure position and velocity in the Alexander/Cosper combination. Pet. 20–22 (citing Ex. 1005 ¶¶ 5, 34–36, 38–40; Ex. 1006 ¶¶ 35, 50, 53; Ex. 1003 ¶¶ 91–97).

For claim requirement 1[d] regarding a “control component,” Petitioner relies on the disclosure in the Alexander/Cosper combination of a feedback controller. Pet. 22–24 (citing Ex. 1005, Abstr., ¶¶ 5, 25, 34–35, 37, 40, cls. 10–11; Ex. 1006 ¶ 10; Ex. 1003 ¶¶ 99–105). Petitioner demonstrates that the feedback controller of the Alexander/Cosper combination performs the algorithm of Figure 45 of the ’882 patent in accord with 35 U.S.C. §112(f). *Id.* at 24–30 (citing Ex. 1005, Abstr., ¶¶ 5, 34, 37–40, 47, 52, 55, 59, cls. 10, 16; Ex. 1006 ¶¶ 10, 50, 52, 106; Ex. 1003 ¶¶ 106–122).

Independent claim 10 includes requirements commensurate with claim 1 and additionally requires a “physical device” with one or more “oscillating resonant modules,” and a “controller.” Ex. 1001, 33:39–34:2. Petitioner relies on its analysis for claim 1, with the additional reliance on the disclosure in Alexander of a user interface as the “controller” (distinct from the “control component”). Pet. 36–38 (citing Ex. 1005, Abstr., ¶¶ 37–38, 52, 55; Ex. 1006 ¶ 10; Ex. 1003 ¶¶ 139–149).

Other than arguing against the combination of Alexander and Cosper generally, which argument, as discussed above, we do not agree with, Patent Owner does not specifically dispute Petitioner's arguments that combination teaches the requirements of claims 1 and 10. *See generally* PO Resp. Accordingly, having considered and weighed the entirety of the evidence, we determine that Petitioner has proved by a preponderance of the evidence that claims 1 and 10 are unpatentable under 35 U.S.C. § 103(a) over the combination of Alexander and Cosper.

5. *Claims 2–6, 17, 19, and 20*

Claim 2 depends from claim 1 and additionally requires, “the one or more sensors are selected from among one or more: mechanical sensors; electromagnetic sensors; and optical sensors.” Ex. 1001, 33:4–8. For claim 2, Petitioner relies on the disclosure in Alexander of magnetic flux sensors, and the disclosure in Cosper of “optical sensors, mechanical sensors, [and] electromagnetic sensors.” Pet. 31 (citing Ex. 1005 ¶¶ 35, 40; Ex. 1006 ¶¶ 125, 127; Ex. 1003 ¶¶ 124–125).

Claim 3 depends from claim 1 and additionally requires, “the control component determines, from the received sensor outputs, the velocity of the mass from the positions of the mass at two or more points in time.” Ex. 1001, 33:9–12. Claims 4 and 5 depend from claim 3 and additionally require:

the control outputs, output by the control component to the actuator, are computed as the output value of a function that takes, as input,

[claim 4] the current position of the mass

[claim 5] the current position of the mass and the current velocity of the mass.

Ex. 1001, 33:13–21. For claims 3–5, Petitioner relies on the disclosures in Alexander and Cosper of sensors that measure position, which measurements are used to calculate velocity, and the disclosures of the use of position and velocity by control components to drive oscillation. Pet. 31–34 (citing Ex. 1005, Abstr., ¶¶ 35–40, 47; Ex. 1006 ¶¶ 10, 39; Ex. 1003 ¶¶ 126–132).

Claim 6 depends from claim 3 and additionally requires:

the control outputs, output by the control component to the actuator, are computed from pre-computed values indexed by the current position of the mass and the current velocity of the mass.

Ex. 1001, 33:22–26. For claim 6, Petitioner relies on the disclosure in Alexander of motion profiles stored in a lookup table and used to control outputs that generate the required force. Pet. 34–36 (citing Ex. 1005 ¶¶ 37–39, 46–47, cl. 11; Ex. 1003 ¶¶ 133–138). Petitioner’s expert testifies that a person skilled in the art would have recognized lookup tables, as described by Alexander, as facilitating efficient and repeatably determination of a control output when indexed based on current position and velocity, to effectuate Alexander and Cosper’s feedback control objectives. Ex. 1003 ¶¶ 135–136.

Claim 17 depends from claim 1 and additionally requires:

a controller, within the physical device, that receives control signals input to the physical device, and outputs control signals to one or more of the one or more oscillating resonant modules to controls [*sic*] the vibration response produced by the one or more oscillating resonant modules.

Ex. 1001, 34:39–46. Claim 19 depends from claim 17 and additionally requires, “the controller passes at least a portion of the received control signals input to the physical device to one or more of the one or more

oscillating resonant module [*sic*].” Ex. 1001, 34:52–55. For claims 17 and 19, Petitioner relies on the disclosure in Alexander of a user interface for providing control parameters to the control component. Pet. 38–39 (citing Ex. 1005 ¶¶ 5, 39, 52, 55, cls. 16–17; Ex. 1003 ¶¶ 150–153).

Claim 20 depends from claim 17 and additionally requires:

the controller controls the one or more oscillating resonant modules to each produce a vibration response, the vibration responses produced by the oscillating resonant modules together producing a resonant-frequency vibration mode in the physical device.

Ex. 1001, 34:56–61. For claim 20, Petitioner relies on the disclosure in Alexander/Cosper combination of the controller causing the oscillating resonant module to produce a resonant-frequency vibration mode in the physical device. Pet. 39–40 (citing Ex. 1003 ¶¶ 154–155).

Other than the above-discussed arguments challenging the combination of Alexander and Cosper, Patent Owner does not provide specific arguments regarding claims 2–6, 17, 19, or 20. *See generally* PO Resp. Based on the evidence of record, we determine that Petitioner has proved by a preponderance of the evidence that claims 2–6, 17, 19, and 20 are unpatentable under 35 U.S.C. § 103(a) over the combination of Alexander and Cosper.

E. Alleged Obviousness of Claims 1–5, 10, 17, 19, and 20 over Gregorio and Fuller

Petitioner contends that claims 1–5, 10, 17, 19, and 20 would have been obvious over the combined teachings of Gregorio and Fuller.

Pet. 55–58.¹²

1. Gregorio

Gregorio discloses a device with an “LRA [Linear Resonant Actuator] to generate vibrotactile haptic feedback on a user interface.” Ex. 1007, 2:3–5. Figure 1 is reproduced below.

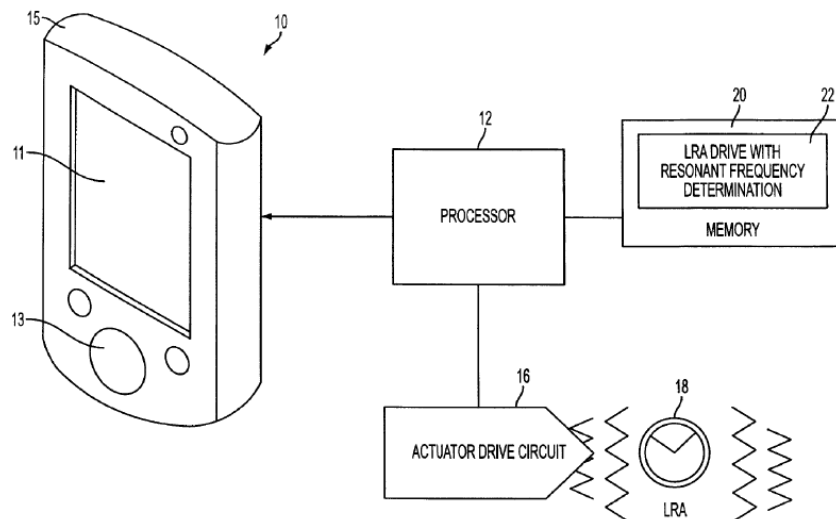


FIG. 1

Figure 1 is a block diagram of a haptically-enabled system 10, such as a cellular telephone, PDA, or computer tablet, which includes a touch surface

¹² Petitioner also challenges claims 1–5, 10, 17, 19, and 20 over Gregorio alone, over the combination of Gregorio and Ramsay, and over the combination of Gregorio, Fuller and Ramsay. Pet. 40–55, 59–65. However, as explained further below, it is not necessary to consider those alternative grounds, except to the extent that Petitioner incorporates portions of its Gregorio discussion by reference in its analysis of the Gregorio/Fuller combination.

11, keys or buttons 13, and an internal haptic feedback mechanism that generates vibrations on the system. Ex. 1007, 2:10–15, 3:1–2. The internal system (shown to the right of the device) includes processor 12, memory 20, actuator drive circuit 16, and LRA actuator 18. *Id.* at 2:18–20. Processor 12 controls the haptic effects based on high level parameters including magnitude, frequency and duration. *Id.* at 2:25–30. Processor 12 outputs control signals to drive circuit 16, which includes electronic components and circuitry used to supply LRA 18 with the required electrical current and voltage to cause the desired haptic effects. *Id.* at 2:36–39. Memory 20 includes LRA Drive with Resonant Frequency Determination module 22 which are instructions executed by processor 12 to generate drive signals for LRA 18. *Id.* at 2:46–49.

Figure 2 is reproduced below.

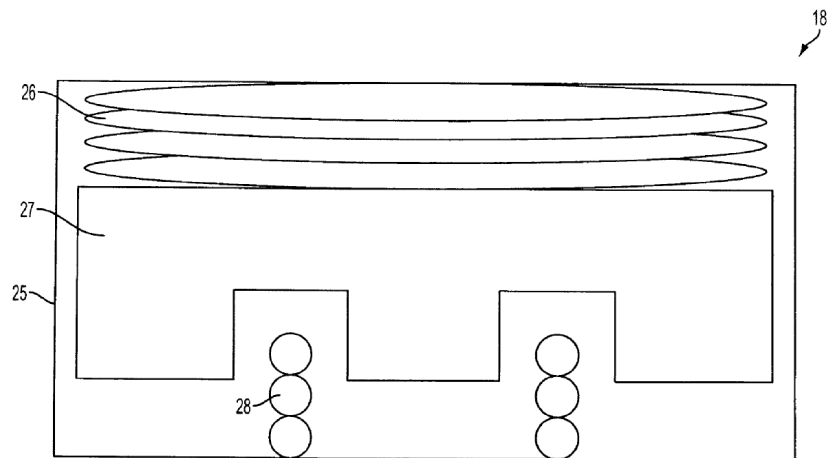


FIG. 2

Figure 2 is a cut-away side view of LRA 18 including casing 25, magnet/mass 27, linear spring 26, and electric coil 28. Ex. 1007, 3:12–14. When current flows thru coil 28 a magnetic field forms around the coil to interact with the magnetic field of magnet 27, and depending on the

direction of the current flow, pushes or pulls on the magnet to compress or decompress the spring. *Id.* at 3:17–24.

In one embodiment, LRA 18 includes a sensing coil, Hall sensor, optical sensor or other type of sensing device that is located in proximity to mass 27 for detecting the position of mass 27. Ex. 1007, 4:7–10. The position information is used to maintain the LRA at a resonant frequency. *Id.* at Abstr., 2:1–9, 2:46–50, 4:10–14. Driving the LRA at its resonant frequency ensures that “the haptic effects can be most effective and efficient.” *Id.* at 1:35–36.

2. *Fuller*

Fuller is directed to an electromagnetic vibrator with a moveable magnet with electromagnetic coils that can drive the magnet along a “curved axial pathway.” Ex. 1008, Fig. 10, ¶¶ 6, 51, cl. 9. The coils are used in a feedback circuit to resonantly control the motion of the movable magnet. *Id.* at ¶ 12.

3. *The Combination of Gregorio and Fuller*

Petitioner argues that it would have been obvious to modify Gregorio to have a curved oscillation path as disclosed in Fuller. Pet. 56 (citing Ex. 1003 ¶¶ 197–205. Petitioner’s expert testifies that the combination would have been motivated because a curved oscillation path facilitates generation of vibration output in multiple directions, and that the combination involved combining prior art elements according to known methods to yield predictable results. *See* Ex. 1003 ¶¶ 199–205; Pet. 56–58 (citing Ex. 1007, Abstr., 1:6–8, 1:39–65; Ex. 1008 ¶ 5, 12, 33, 38, 42, 51; Ex. 1003 ¶¶ 199–205).

Patent Owner does not address the motivation to combine Gregorio and Fuller. *See generally* PO Resp. We are persuaded by Petitioner’s expert’s testimony that one of ordinary skill would have been motivated to combine Gregorio and Fuller in the manner proposed. We determine that Petitioner has proved by a preponderance of the evidence that that one of ordinary skill would have been motivated to combine Gregorio and Fuller in the manner proposed.

4. *Claims 1–5, 10, 17, 19, and 20*

a) Petitioner’s Argument

For the “oscillating resonant module” preamble of independent claim 1, Petitioner generally relies on the resonant actuator. with a movable magnet, disclosed in Gregorio. Pet. 42, 58 (citing Ex. 1007, Abstr., 2:10–20; 3:12–28; 3:44–64, cl. 16; Ex. 1003 ¶¶ 157, 206–207).

For claim requirement 1[a] regarding a “space curve” “oscillation path,” Petitioner relies on the disclosure in the Gregorio/Fuller combination of an actuator embodiment that follows a curvilinear path. Pet. 42, 58–59 (citing Ex. 1007, 3:12–22; Ex. 1008, Fig. 10, ¶ 5; Ex. 1003 ¶¶ 208–209).

For claim requirement 1[b] regarding a “mass ... oscillating ... along ... a space curve,” Petitioner relies on the disclosure in the Gregorio/Fuller combination of magnet 27 that oscillates back and forth along a curved path. Pet. 42–43, 59 (citing Ex. 1007, 1:29–30, 2:10, 2:36–39, 3:1–2, 3:12–21; Ex. 1008 ¶ 5; Ex. 1003 ¶¶ 210–212).

For claim requirement 1[c] regarding “sensors,” Petitioner relies on the disclosure in Gregorio of position sensors such as Hall sensors that directly measure position. Pet. 43–44, 59 (citing Ex. 1007, 4:7–10, 4:10–13; Ex. 1003 ¶¶ 162–164, 213). Petitioner’s expert testifies that it would have

been obvious that velocity is derived from successive position measurements. Ex. 1003 ¶¶ 163–164, 178.

For claim requirement 1[d] regarding a “control component,” Petitioner relies on the disclosure in Gregorio of processor 12 that generates control outputs based on control signals, together with actuator drive circuit 16. Pet. 44–46, 59 (citing Ex. 1007, Abstr., Fig. 1, 1:24–46, 2:18–63, 4:5–36, 4:41–48, 6:5–9, 6:55–58, cl. 11; Ex. 1003 ¶¶ 165–169, 213). Petitioner argues that the control component of the Gregorio/Fuller combination performs the algorithm of Figure 45 of the ’882 patent in accord with 35 U.S.C. §112(f). *Id.* at 46–49 (citing Ex. 1007, 1:43–46, 2:3–9, 2:45–53, 4:7–13, 4:42–48, 6:55–58, cl. 11; Ex. 1003 ¶¶ 170–179). In particular, for step 4519 of the Figure 45 algorithm, Petitioner states that “[t]he processor/logic circuitry [of Gregorio] reads position and velocity (speed) data from the sensor (step 4519) while oscillation is desired (step 4518).” *Id.* at 47 (citing Ex. 1003 ¶ 177). Petitioner relies on the explicit disclosure of a position sensor, such as a Hall sensor, to measure position, and argues that it would have been obvious to also derive velocity data from the position data. *Id.* at 48 (citing Ex. 1003 ¶¶ 177–178). For the required position (p) and velocity (v) inputs of step 4520 of the Figure 45 algorithm, Petitioner argues:

Gregorio’s control component “receive[s] a signal that comprises **a position of the mass from the resonant actuator.**” APPLE-1007, Abstract, 6:55-58, 1:43-46, cl. 11. Gregorio’s control component obtains a “derivative of the **speed** of the mass (“dv/dt”)” corresponding to vibration amplitude. *Id.*, 4:42-48; APPLE-1003, ¶179. And Gregorio’s control component uses the vibration amplitude, which is a function of the speed, to compute the appropriate control signal. *Id.*

Pet. 48–49.

Independent claim 10 includes requirements commensurate with claim 1, and additionally requires a “physical device” with one or more “oscillating resonant modules,” and a “controller.” Ex. 1001, 33:39–34:2. Petitioner relies on its analysis for claim 1, with the additional reliance on the disclosure in Gregorio of a touch surface and associated components as the “controller” (distinct from the “control component”). Pet. 51–53, 59 (citing Ex. 1007, 2:10–67, 3:1–11; Ex. 1003 ¶¶ 186–192, 213).

b) Patent Owner’s Response

In response to Petitioner’s challenges to independent claims 1 and 10 over Gregorio and Fuller, Patent Owner argues that Petitioner has not shown that Gregorio, whether alone or in combination with Fuller, teaches or suggests the control component requirement of the claims. PO Resp. 24–29. In particular, Patent Owner focuses on the applicable means-plus-function claim construction (*see* Section III.C.2 above), arguing that Petitioner has not shown that Gregorio discloses Figure 45 algorithm step 4519 (“read p and v from sensor”) and step 4520 (computing oscillation control c as a function of target frequency ω_t and current position p and velocity v of the moving mass). *Id.* at 27–29.

Patent Owner points out that Petitioner relies on an embodiment disclosed in Gregorio in which oscillation control is determined by the position of the moving mass as measured by a Hall sensor, optical sensor or other type of sensing device. *Id.* at 24–25 (citing Pet. 43, 53; Ex. 1007, 4:7–13). However, argues Patent Owner, there is no disclosure in Gregorio that this position sensor embodiment also measures and uses velocity in controlling oscillation. *Id.* at 27–29 (citing Ex. 2009 ¶¶ 94–97). Patent

Owner challenges, as conclusory and unsupported, Petitioner’s argument that it would have been obvious to derive velocity from the position measurements. *Id.* at 27. Patent Owner submits that there would be no reason to derive the velocity, because the position measurements already directly provide the required amplitude information, and no enhanced redundancy or reliability benefit in doing so because a velocity value derived from position is no more accurate than the position data and in no sense an alternative source of data. *Id.* (citing Ex. 2009 ¶ 94).

Patent Owner notes that Gregorio discloses an alternative embodiment in which oscillation control is determined by the velocity, but not the position, of the moving mass as measured by back EMF. PO Resp. 25–26 (citing Ex. 1007, 3:65–4:7, 4:26–27, 4:44–46; Ex. 2009 ¶ 92). But, argues Patent Owner, Gregorio specifies that the back EMF embodiment is an alternative to the position sensor embodiment. *Id.* at 25, 28 (citing Ex. 1007, 4:10–14 (“the sensing device will provide a sensed position signal that can be used as the monitoring signal to provide information about the position of the mass 27 ***instead of*** the back EMF signal” (emphasis added))); Ex. 2009 ¶ 95). Patent Owner argues that because Petitioner relies on the position sensor disclosure as satisfying claim requirement 1[c] (“one or more sensors . . . that output indications . . . of the positions of the mass within the oscillation path at specific points in time”), the back EMF disclosure cannot be relied on to satisfy the velocity aspect of algorithm steps 4519 or 4520 for purposes of the means-plus-function analysis. *Id.* at 24–25, 28 (citing Pet. 43, 53).

Patent Owner does not address any other issues with respect to Petitioner's challenges to claims 1–5, 10, 17, 19, and 20 as obvious over Gregorio and Fuller. *See generally* PO Resp.

c) Petitioner's Reply

In reply, Petitioner repeats its assertion that “Gregorio’s control component reads/derives position and velocity data from the sensor(s) (step 4519).” Reply 17 (citing Pet., 48; Ex. 1018 ¶ 30). Petitioner argues that computing velocity from position would provide additional information regarding the motion of the moveable mass — such as changes in direction, transitions in velocity, and acceleration — in order to accurately control resonant oscillation. *Id.* at 17–18 (citing Ex. 1018 ¶¶ 33–35; Ex. 1019, 29:4–15). Petitioner argues that, even if using a position sensor by itself were sufficient to measure amplitude, the conventional technique of calculating dv/dt was an equally viable alternative. *Id.* at 19 (citing Ex. 1007, 4:42–48; Ex. 1018 ¶ 36). Petitioner also denies that it is relying on both position sensing and back EMF sensing in the same system. *Id.* at 20.

d) Patent Owner's Sur-Reply

Patent Owner responds that, although it would have been possible to derive velocity (and acceleration) from the position measurements in Gregorio, there is no disclosure or suggestion of doing so in that reference, and Petitioner has not established that one of ordinary skill would have been motivated to do so. Sur-Reply 11–12. Patent Owner reiterates its point that calculating velocity from position data does not provide any additional details that would be useful in monitoring the amplitude of the moving mass or controlling its resonant frequency. *Id.* at 12–14. Patent Owner argues: “a

POSITA that had a Hall sensor available would use its position values directly to determine amplitude and would not be motivated to use them in combination with velocity and acceleration values that are derived from the position measurements.” *Id.* at 15 (citing Ex. 2009 ¶ 93).

e) Analysis

We agree with Patent Owner that Gregorio, whether taken alone or in combination with Fuller (or Ramsey), does not teach or suggest the control component requirement of the claims as interpreted under 35 U.S.C. § 112(f), because it does not teach or suggest using velocity as specified in Figure 45 algorithm steps 4519 and 4520 of the ’882 patent. The Gregorio position sensor embodiment, discussed above, measures position to determine the amplitude of the moving mass, for purposes of controlling resonant behavior. Ex. 1007, Abstr., 1:43–46, 4:7–14. That is the embodiment that Petitioner relies on for its obviousness challenges. In Gregorio’s disclosure of the position sensor embodiment, there is no suggestion that velocity is used in addition to position to control resonant behavior. As discussed, the back EMF embodiment does use velocity for controlling resonant behavior, but does not use position, and in any event is not relied on by Petitioner.

Petitioner’s reliance on expert testimony to fill in the gap by arguing that it would have been obvious to modify the position sensor embodiment to additionally calculate velocity from the position data is unpersuasive. As Patent Owner argues, there would be no reason to do so — any velocity value calculated from position adds nothing to the accuracy of the data and provides no additional information useful to controlling resonant behavior. Expert testimony offered to supply a limitation missing from the prior art is “particularly problematic.” *Xerox Corp. v. Bytemark, Inc.*, IPR2022-00624,

Paper 9, 16 (PTAB Aug. 24, 2022); *see also Arendi S.A.R.L. v. Apply, Inc.*, 832 F.3d 1355, 1361–62 (Fed. Cir. 2016) (non-prior-art evidence is “typically invoked to provide a known motivation to combine, not to supply a missing claim limitation”); Memorandum, *Enforcement And Non-Waiver Of 37 C.F.R. § 42.104(B)(4) And Permissible Uses Of General Knowledge In Inter Partes Reviews* (7/31/25) (“[E]xpert testimony . . . that is not ‘prior art consisting of patents or printed publications’ . . . may not be used to supply a missing claim limitation”). Likewise:

Expert testimony . . . cannot take the place of a disclosure in a prior art reference, when that disclosure is required as part of the unpatentability analysis [B]ecause an *inter partes* review may only be requested “on the basis of prior art consisting of patents or printed publications,” 35 U.S.C. § 311(b), expert testimony cannot take the place of disclosure from patents or printed publications.

Consolidated Trial Practice Guide, 36.¹³

Accordingly, having considered and weighed the entirety of the evidence, we determine that Petitioner has not proved by a preponderance of the evidence that independent claims 1 and 10 are unpatentable under 35 U.S.C. § 103(a) over the combination of Gregorio and Fuller. We also determine that Petitioner has not proved by a preponderance of the evidence that claims 2–5, 17, 19, and 20 are unpatentable under 35 U.S.C. § 103(a) over the combination of Gregorio and Fuller, because they depend from claim 1 or 20.¹⁴

¹³ <https://www.uspto.gov/patents/ptab/resources#TPG-NOV2019-web>.

¹⁴ The same analysis as discussed for Petitioner’s challenges based on the combination of Gregorio and Fuller also applies to Petitioner’s challenges to claims 1–5, 10, 17, 19, and 20 over Gregorio alone, over the combination of

F. Alleged Obviousness of Claims 3–6 over Gregorio and Muramatsu, over Gregorio, Ramsay, and Muramatsu, over Gregorio, Fuller, and Muramatsu, and over Gregorio, Fuller, Ramsay, and Muramatsu

Petitioner contends that claims 3–6 would have been obvious over various combinations of the above-discussed references with Muramatsu. Pet. 65–71. Muramatsu discloses a force sense controller that includes an actuator that drives a plunger, a sensor for producing a detecting signal indicative of current position of the plunger, and a controlling unit connected to the actuator and the sensor. Ex. 1009, Abstr. The controlling unit calculates a current velocity from the position data so as to determine the direction of motion of the plunger, and selects a data table assigned to the direction of the motion for reading out a target reaction force. *Id.*

Petitioner argues that one of ordinary skill in the art would have been motivated to modify the combinations to utilize the conventional techniques disclosed in Muramatsu of computing control outputs from position and/or velocity of a moving object, and using pre-computed values in lookup tables. Pet. 65–68 (citing Ex. 1007, Abstr., 5:58–61; Ex. 1009, Fig. 1, 4:40–60, 5:21–28, 6:23–27, 9:57–10:2; Ex. 1003 ¶¶ 241–249).

Petitioner relies on the combinations with Muramatsu to challenge claims 3–6, relying on the disclosures in Muramatsu of calculating velocity from position measurements and using that information with look-up tables to generate control outputs for that actuator. Pet. 68–71 (citing Ex. 1007,

Gregorio and Ramsay, and over the combination of Gregorio, Fuller and Ramsay. Pet. 40–55, 59–65. Ramsey is not relied on for any teaching or suggestion of the Figure 45 algorithm steps 4519 and 4520 of the '882 patent under the means plus function analysis. Pet. 59–65.

Abstr., 1:24–46, 2:36–53, 4:10–12, 4:42–65, cls. 1–2, 11; Ex. 1009, 4:40–60, 5:21–28, 6:23–27, 8:5–15, 8:66–9:15; Ex. 1003 ¶¶ 250–258).

Patent Owner argues that Petitioner does not rely on Muramatsu for its challenges to the independent claims, including the requirements to satisfy the Figure 45 algorithm steps 4519 and 4520 of the '882 patent under the means plus function analysis. PO Resp. 29. Patent Owner also argues that Muramatsu does not relate to a system that oscillates or exhibits resonance, and Petitioner does not offer any argument that would provide additional motivation to modify Gregorio to include the use of velocity in its position sensor embodiment. *Id.* at 30; *see also* Sur-Reply 15–16.

Petitioner replies that Muramatsu confirms that computing control outputs from position and/or velocity of a moving object was a conventional technique. Reply 20. However, Petitioner's reliance on Muramatsu at most confirms that one of ordinary skill ***could*** have derived velocity from the position measurements of Gregorio. But Muramatsu does not provide any additional support for Petitioner's argument that one of ordinary skill ***would*** have been motivated to modify Gregorio to include velocity as an input to controlling oscillation.

Accordingly, having considered and weighed the entirety of the evidence, we determine that Petitioner has not proved by a preponderance of the evidence that claims 3–6 are unpatentable under 35 U.S.C. § 103(a) over the combination of Gregorio and Muramatsu, of Gregorio, Ramsay, and Muramatsu, of Gregorio, Fuller, and Muramatsu, or of Gregorio, Fuller, Ramsay, and Muramatsu.

IV. CONCLUSION¹⁵

For the foregoing reasons, we are persuaded that Petitioner establishes by a preponderance of the evidence that claims 1–6, 10, 17, 19, and 20 of the '882 patent have been shown to be unpatentable.

In summary:

Claims	35 U.S.C. §	References/ Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1–6, 10, 17, 19, 20	103	Alexander, Cospers	1–6, 10, 17, 19, 20	
1–5, 10, 17, 19, 20	103	Gregorio		1–5, 10, 17, 19, 20
1–5, 10, 17, 19, 20	103	Gregorio, Ramsay		1–5, 10, 17, 19, 20
3–6	103	Gregorio, Muramatsu		3–6
3–6	103	Gregorio, Ramsay, Muramatsu		3–6
1–5, 10, 17, 19, 20	103	Gregorio, Fuller		1–5, 10, 17, 19, 20
1–5, 10, 17, 19, 20	103	Gregorio, Fuller, Ramsay		1–5, 10, 17, 19, 20

¹⁵ Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner's attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. See 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. See 37 C.F.R. §§ 42.8(a)(3), (b)(2).

Claims	35 U.S.C. §	References/ Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
3–6	103	Gregorio, Fuller, Muramatsu		3–6
3–6	103	Gregorio, Fuller, Ramsay, Muramatsu		3–6
Overall Outcome			1–6, 10, 17, 19, 20	

V. ORDER

In consideration of the foregoing, it is hereby

ORDERED that claims 1–6, 10, 17, 19, and 20 of U.S. Patent No. 11,152,882 B2 have been shown to be unpatentable under 35 U.S.C. § 103; and

FURTHER ORDERED that, because this is a final written decision, parties to this proceeding seeking judicial review of our Decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

IPR2024-00983
Patent 11,152,882 B2

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