

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
Granting Institution of *Inter Partes* Review
35 U.S.C. § 314

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. Resonant Systems, Inc., Patent Owner, filed a Preliminary Response (Paper 6, “Prelim. Resp.”).

The standard for instituting an *inter partes* review is set forth in 35 U.S.C. § 314(a), which provides that an *inter partes* review may not be instituted unless the information presented in the Petition and any preliminary response shows that “there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition.”

For the reasons explained below, we determine that Petitioner has established a reasonable likelihood that it would prevail with respect to at least one challenged claim. Accordingly, we institute an *inter partes* review as to challenged claims 1–6, 10, 17, 19, and 20 and the grounds raised in the Petition.

II. BACKGROUND

A. *Real Parties in Interest*

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

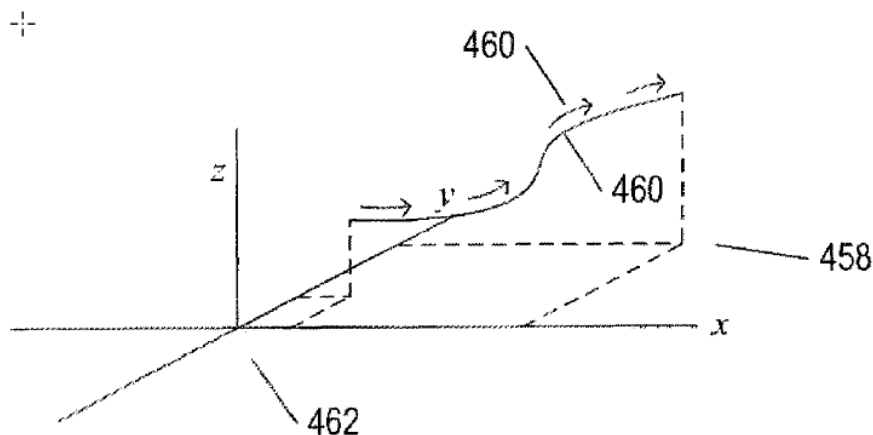
B. *Related Matters*

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, and IPR2024-00808.

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:

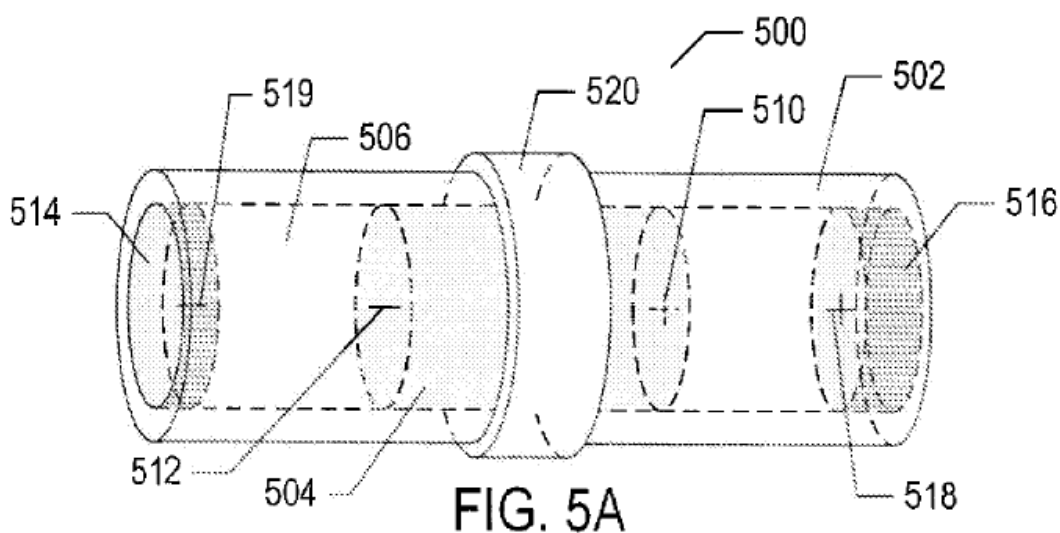


Figure 5A depicts cylindrical housing 502 forming cylindrical chamber 506, disk-like magnets 514 (left) and 516 (right) with negative and positive polarity, respectively, and conductive coil 520 encircling tube 502.

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.

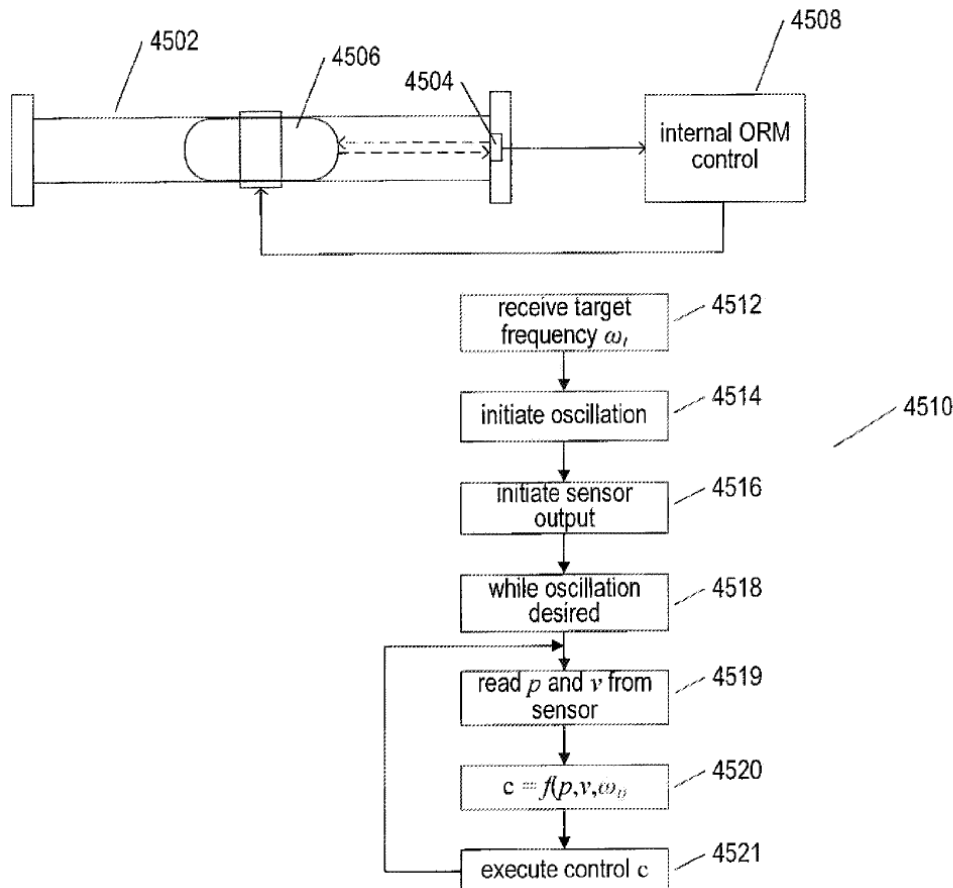


FIG. 45

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 31:44–48.¹

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. [pre] 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;

¹ It is not clear on this preliminary record if the specification describes a specific function or how to calculate values in the table.

- [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 (bracketed annotations by Petitioner).

E. Asserted Grounds of Unpatentability

Petitioner contends that claims 1–6, 10, 17, 19, and 20 are unpatentable as follows:²

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

² 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.

³ Alexander, US 2013/0237751 A1, published Sep. 12, 2013. Ex. 1005.

⁴ Cosper et al., US 2008/0246532 A1, published Oct. 9, 2008. Ex. 1006.

⁵ Gregorio et al., US 7,843,277 B2, issued Nov. 30, 2010. Ex. 1007.

⁶ Ramsay et al., US 2008/0294984 A1, published Nov. 27, 2008. Ex. 1010.

⁷ Muramatsu, US 5,952,806, issued Sep. 14, 1999. Ex. 1009.

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
3–6	103	Gregorio, Ramsay, Muramatsu
1–5, 10, 17, 19, 20	103	Gregorio, Fuller ⁸
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 Petition with a Declaration of Dr. Blake Hannaford. Ex. 1003.

III. DISCRETIONARY DENIAL UNDER 35 U.S.C. § 314(a)

Patent Owner contends that we should exercise our discretion to deny institution under 35 U.S.C. § 314(a) in light of the Apple Litigation. Prelim. Resp. 7–16. Patent Owner contends that the factors identified in *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 (PTAB Mar. 20, 2020) (precedential) (“*Fintiv*”), weigh in favor of exercising discretion to deny institution. *Id.*

On June 21, 2022, the Director of the U.S. Patent and Trademark Office (“USPTO”) issued a Memorandum titled “Interim Procedure for Discretionary Denials in AIA Post-Grant Proceedings With Parallel District Court Litigation” (“Memorandum”),⁹ which states, among other things, that “the PTAB will not discretionarily deny institution in view of parallel

⁸ Fuller et al., US 2008/0001484 A1, published Jan. 3, 2008. Ex. 1008.

⁹ The Memorandum is *available at* https://www.uspto.gov/sites/default/files/documents/interim_proc_discretionary_denials_aia_parallel_district_court_litigation_memo_20220621_.pdf.

district court litigation where a petitioner presents a stipulation not to pursue in a parallel proceeding the same grounds or any grounds that could have reasonably been raised before the PTAB.” Memorandum 3 (citing *Sotera Wireless, Inc. v. Masimo Corp.*, IPR2020-01019, Paper 12 (PTAB Dec. 1, 2020) (precedential as to § II.A)).

In a September 18, 2024 letter, Petitioner has stated that “Apple hereby stipulates that if the PTAB authorizes petitioner to enter this stipulation into evidence in IPR2024-00983 and institutes the proceeding, Apple will not pursue in the above-captioned litigation the same invalidity grounds raised (or any grounds that could have been raised) in IPR2024-00983 for any claim of the patent.” Ex. 1017 (citing *Sotera*, IPR2020-01019, Paper 12).

Applying the guidance provided in the Memorandum, we decline to exercise our discretion to deny institution in this proceeding under *Fintiv* because Petitioner submitted a *Sotera* stipulation.

IV. ANALYSIS OF PETITIONER’S CHALLENGES

A. *The Obviousness Standard*

Pursuant to the AIA, a patent claim is unpatentable under 35 U.S.C. § 103 if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. 35 U.S.C. § 103. The obviousness question involves resolving 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 when presented (not so here), (4) objective evidence of non-obviousness. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

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.” Prelim. Resp. 3.

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. 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; Prelim. Resp. 5–6. On the one hand, 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. Likewise, Patent Owner states that it “does not believe it is necessary to construe ‘control component’ to decide whether to institute this IPR.” Prelim. Resp. 6.

However, in the Apple Litigation, both parties have asserted 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); Prelim. Resp. 5. 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 Texas 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. Prisma 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.

2. *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 Texas 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).¹⁰

¹⁰ 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.

For purposes of this decision, 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.

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.

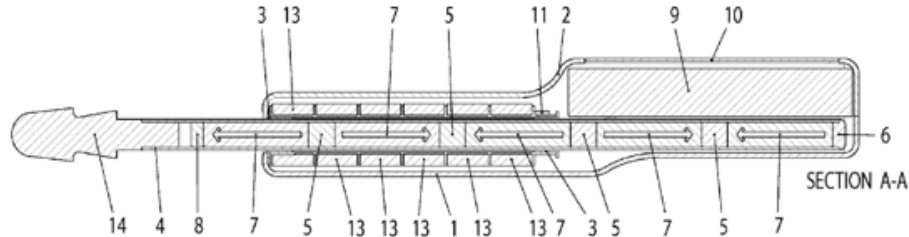


Figure 1A

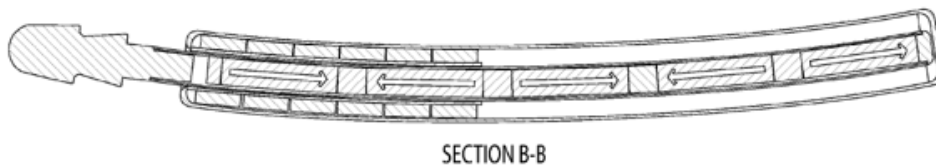


Figure 7A

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.

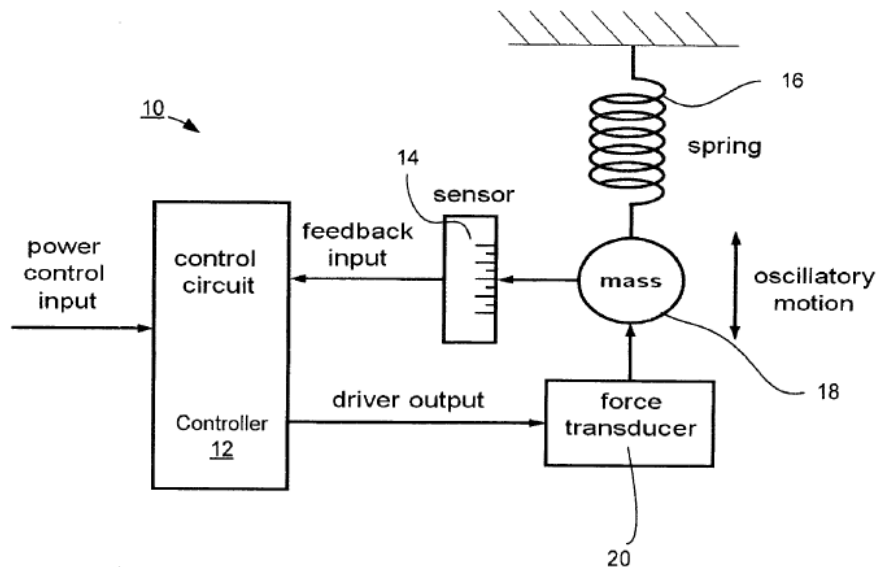


FIG. 1

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, electro-magnetic, 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*

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.

At this stage, we are persuaded by Petitioner’s expert’s testimony that one of ordinary skill would have been motivated to combine Alexander and Cosper in the manner proposed. Accordingly, for purposes of this decision, we determine that Petitioner has provided sufficiently articulated reasoning with rational underpinnings for the proffered combined teachings of Alexander and Cosper.

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).¹¹

For claim requirement 1a regarding a “space curve” “oscillation path,”¹² 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).

For claim requirement 1b 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).

¹¹ Based on the present record, we make no determination at this stage of the proceeding that the preamble of independent claim 1 (or of independent claim 10) is limiting. We note, however, that the parties in the Texas Litigation agreed that the preambles are limiting. Ex. 2002, 10.

¹² For economy of presentation, we refer to the portions of claim 1 using the added numbering (1a, 1b, 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 1c 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 1d 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).

At this stage of the proceeding, Patent Owner does not provide arguments regarding claims 1 or 10. *See generally* Prelim. Resp. Based on the evidence of record, we determine that Petitioner has demonstrated a reasonable likelihood that claims 1 and 10 are unpatentable 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).

At this stage of the proceeding, Patent Owner does not provide arguments regarding claims 2–6, 17, 19, or 20. *See generally* Prelim. Resp. Based on the evidence of record, we determine that Petitioner has demonstrated a reasonable likelihood that claims 2–6, 17, 19, and 20 are unpatentable 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. 55–58.¹³

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.

¹³ 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, for purposes of this decision, 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.

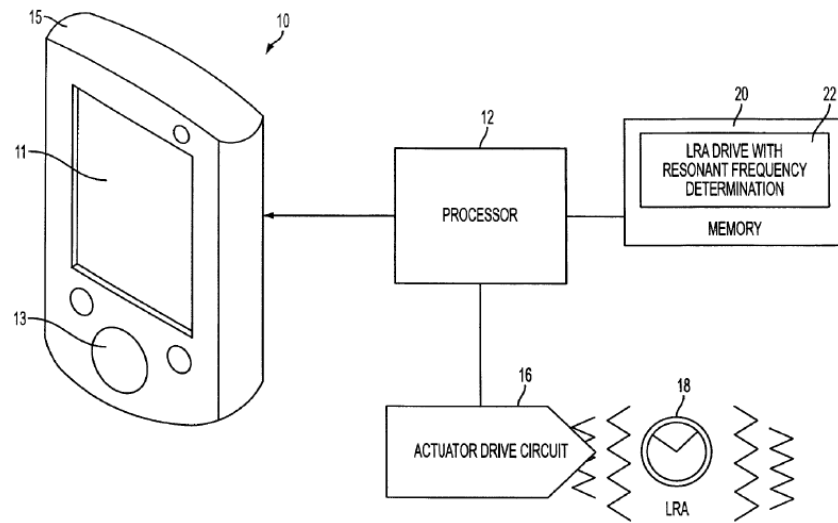


FIG. 1

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 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.

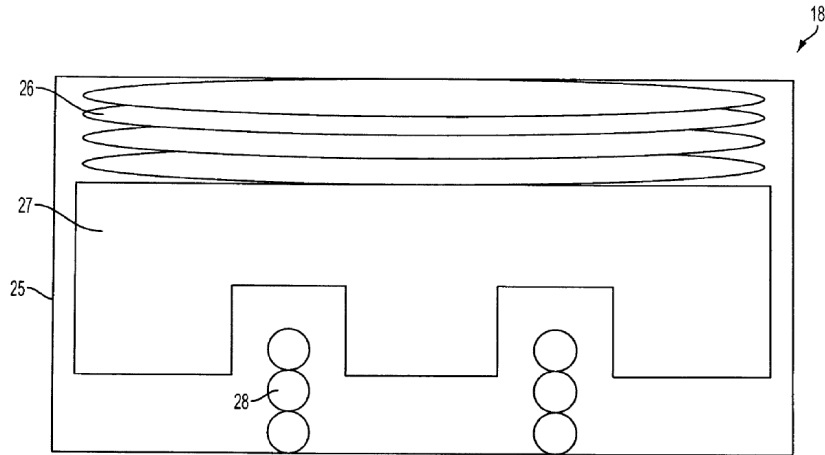


FIG. 2

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 and calculated velocity is used to maintain the LRA at a resonant frequency. *Id.* at 2:1–9, 2:46–50, 4:15–65. Driving the LRA at its resonant frequency ensures that “the haptic effects can be most effective and efficient.” *Id.* at 1:32–35.

2. Fuller

Fuller is directed to a 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. *Id.* at 56–58 (citing Ex. 1007, Abstr., 1:6–8, 1:39–65; Ex. 1008 ¶ 5, 12, 33, 38, 42, 51; Ex. 1003 ¶¶ 199–205).

At this stage, 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. Accordingly, for purposes of this decision, we determine that Petitioner has provided sufficiently articulated reasoning with rational underpinnings for the proffered combined teachings of Gregorio and Fuller.

4. *Independent Claims 1 and 10*

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 1a 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 1b 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 1c 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 1d 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 demonstrates 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).

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).

At this stage of the proceeding, Patent Owner does not provide arguments regarding claims 1 or 10. *See generally* Prelim. Resp. Based on the evidence of record, we determine that Petitioner has demonstrated a reasonable likelihood that claims 1 and 10 are unpatentable over the combination of Gregorio and Fuller.

5. *Claims 2–5, 17, 19, and 20*

Claims 2–5, 17, 19, and 20 are quoted above at Section IV.D.5.

For claim 2, Petitioner relies on the disclosure in Gregorio of sensors, such as Hall sensors. Pet. 50, 59 (citing Ex. 1007, 4:7–13; Ex. 1003 ¶¶ 182, 213).

For claims 3–5, Petitioner relies on the disclosure in Gregorio 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. 50–51, 59 (citing Ex. 1007, Abstr., 2:36–53, 4:10–14, 4:37–65, cls. 1–2, 11; Ex. 1003 ¶¶ 183–185, 213).

For claims 17 and 19, Petitioner relies on the disclosure in Gregorio of a touch surface and associated components for providing control parameters to the control component. Pet. 53–54, 59 (citing Ex. 1007, 2:10–17, 2:54–67, 3:1–11; Ex. 1003 ¶¶ 193–195, 213).

For claim 20, Petitioner relies on the disclosure in Gregorio of the controller causing the oscillating resonant module to produce a resonant-frequency vibration mode in the physical device. Pet. 54–55, 59 (citing Ex. 1007, 2:54–67, 3:1–11; Ex. 1003 ¶¶ 196, 213).

At this stage of the proceeding, Patent Owner does not provide arguments regarding claims 2–5, 17, 19, or 20. *See generally* Prelim. Resp. Based on the evidence of record, we determine that Petitioner has demonstrated a reasonable likelihood that claims 2–5, 17, 19, and 20 are unpatentable over the combination of Gregorio and Fuller.

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

Petitioner contends that claims 3–6 would have been obvious over the combined teachings of Gregorio, Fuller, and Muramatsu. Pet. 65–71.¹⁴ Muramatsu discloses a force sense controller that includes an actuator that drives a plunger and 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 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 Gregorio/Fuller combination 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.,

¹⁴ Petitioner also challenges claims 3–6 over the combination of Gregorio and Muramatsu, over the combination of Gregorio, Ramsay, and Muramatsu, and over the combination of Gregorio, Fuller, Ramsay, and Muramatsu. Pet. 65–71. However, for purposes of this decision, it is not necessary to consider those alternative grounds.

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 combination of Gregorio, Fuller, and Muramatsu as an alternative challenge to claims 3–6, including 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, 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).

At this stage of the proceeding, Patent Owner does not provide arguments regarding claims 3–6. *See generally* Prelim. Resp. Based on the evidence of record, we determine that Petitioner has demonstrated a reasonable likelihood that claims 3–6 are unpatentable over the combination of Gregorio, Fuller, and Muramatsu.

V. CONCLUSION

After considering the evidence and arguments presented in the Petition and the Preliminary Response, we determine that Petitioner has demonstrated a reasonable likelihood of prevailing on its assertion that at least one claim of the ’882 patent is unpatentable. Accordingly, we institute an *inter partes* review of claims 1–6, 10, 17, 19, and 20 and all of the grounds presented in the Petition. *See* 37 C.F.R. § 42.108(a); *SAS Inst., Inc. v. Iancu*, 138 S. Ct. 1348, 1359–60 (2018); *AC Techs. S.A. v. Amazon.com, Inc.*, 912 F.3d 1358, 1364 (Fed. Cir. 2019) (“[I]f the Board institutes an IPR, it must . . . address all grounds of unpatentability raised by the petitioner.”). At this stage of the proceeding, we have not made a final determination as to the patentability of these challenged claims.”

VI. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that pursuant to 35 U.S.C. § 314, *inter partes* review is instituted as to challenged claims 1–6, 10, 17, 19, and 20 of the '882 patent with respect to all grounds of unpatentability presented in the Petition; and

FURTHER ORDERED that *inter partes* review is commenced on the entry date of this Order, and pursuant to 35 U.S.C. § 314(c) and 37 C.F.R. § 42.4, notice is hereby given of the institution of a trial.

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Patent 11,152,882 B2

PETITIONER:

W. Karl Renner
Craig A. Deutsch
Joel A. Henry
FISH & RICHARDSON P.C.
axf-ptab@fr.com
deutsch@fr.com
jhenry@fr.com

PATENT OWNER:

Reza Mirzaie
Qi (Peter) Tong
Kristopher Davis
Neil A. Rubin
RUSS AUGUST & KABAT
rmirzaie@raklaw.com
ptong@raklaw.com
kdavis@raklaw.com
nrubin@raklaw.com