

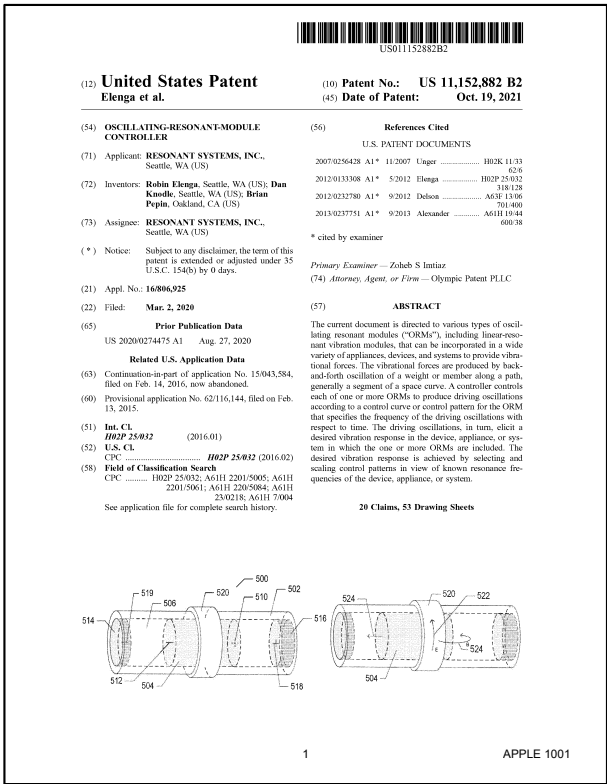
IPR2024-00983

*Apple Inc. v.
Resonant Systems, Inc.*

U.S. Patent No. 11,152,882

Patent Owner's Demonstratives

Challenged Claims

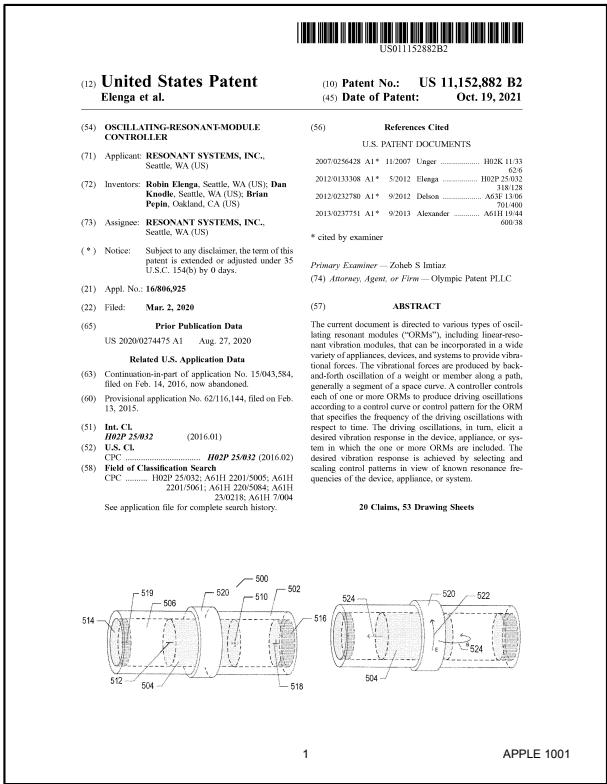


Ex. 1001

'882 Patent, cl. 1:

1. An oscillating resonant module comprising:
an oscillation path, which represents a segment of a space curve, along which a point within a mass moves;
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;
one or more sensors that output indications of the positions of the mass within the oscillation path at specific points in time; and

Challenged Claims



Ex. 1001

'882 Patent, cl. 1 (cont'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.

Claim Construction

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

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Board's Constructions from Institution Decision

Term	Boards's Construction
"control component"	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. Corresponding 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.
"a segment of a space curve"	(Not construed)

Reply did not address claim construction at all.

ID 11-15; POR 6-9

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

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Not Analogous Art / No Motivation to Combine (Ground 1)

Not Analogous Art / No Motivation to Combine (Ground 1)

'882 Patent:

(12) **United States Patent**
Elenga et al.

(54) **OSCILLATING-RESONANT-MODULE
CONTROLLER**

(71) Applicant: **RESONANT SYSTEMS, INC.**,
Seattle, WA (US)

(72) Inventors: **Robin Elenga**, Seattle, WA (US); **Dan
Knodle**, Seattle, WA (US); **Brian
Pepin**, Oakland, CA (US)

(73) Assignee: **RESONANT SYSTEMS, INC.**,
Seattle, WA (US)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 0 days.

(21) Appl. No.: **16/806,925**

(22) Filed: **Mar. 2, 2020**

1. An oscillating resonant module comprising:
an oscillation path, which represents a segment of a space
curve, along which a point within a mass moves;
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;
one or more sensors that output indications of the posi-
tions of the mass within the oscillation path at specific
points in time; and

Ex. 1001

Not Analogous Art / No Motivation to Combine (Ground 1)

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(71) Applicant: **RESONANT SYSTEMS, INC.**,
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The current document is directed to various types of oscillating resonant modules (“ORMs”), including linear-resonant vibration modules, that can be incorporated in a wide

Ex. 1001

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

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Not Analogous Art / No Motivation to Combine (Ground 1)

Conceptual resonant design

(12) **United States Patent**
Elenga et al.

(54) **OSCILLATING-RESONANT-MODULE**
CONTROLLER

(71) Applicant: **RESONANT SYSTEMS, INC.**,
Seattle, WA (US)

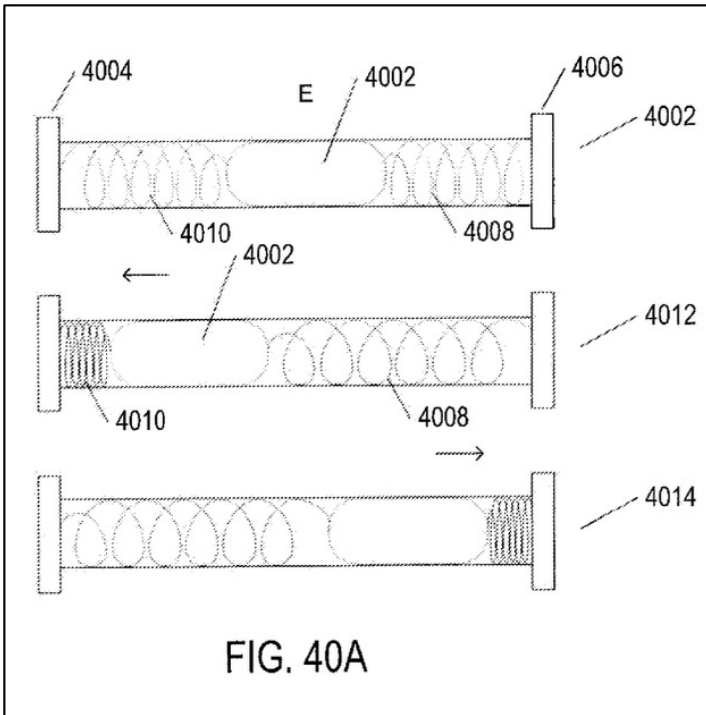
(72) Inventors: **Robin Elenga**, Seattle, WA (US); **Dan Knodle**, Seattle, WA (US); **Brian Pepin**, Oakland, CA (US)

(73) Assignee: **RESONANT SYSTEMS, INC.**,
Seattle, WA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **16/806,925**

(22) Filed: **Mar. 2, 2020**



Ex. 1001; POR 23

Not Analogous Art / No Motivation to Combine (Ground 1)



Prof. Blake Hannaford
Petitioner's Expert

Resonance is a very general phenomenon of systems that can -- that have components which store and release energy.· So a very typical example is a mass connected to a spring.· Both the mass and the spring store energy but in different ways.

Another one is electrical resonance where a circuit is tuned to a frequency with an inductor and a capacitor, and then the mathematics associated with those circuits have very similar properties, which, in many case, cause the system to oscillate.

Ex. 2013 at 11:2–11; Reply 9-10

Not Analogous Art / No Motivation to Combine (Ground 1)



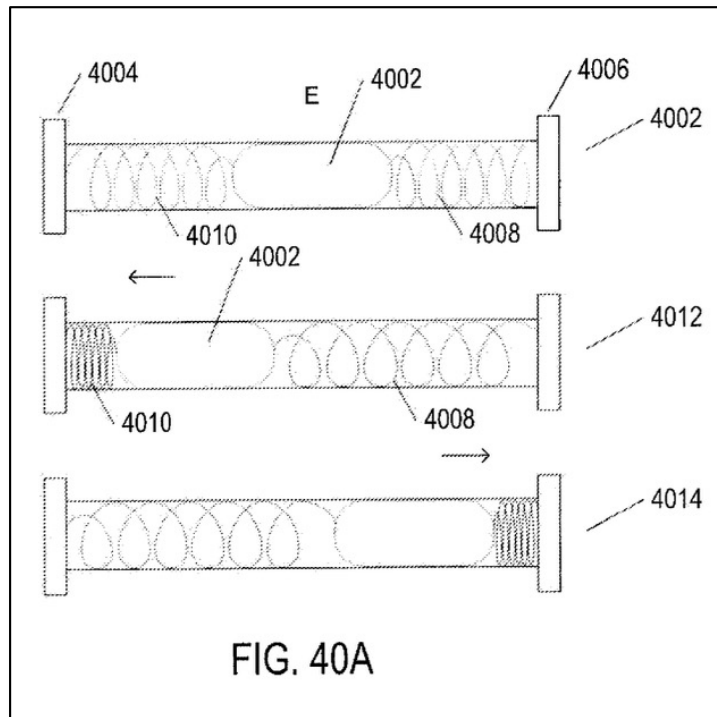
Prof. Keith Goossen
Patent Owner's Expert

63. I agree at a high level with Dr. Hannaford's explanation of resonance. A system cannot be resonant unless it can store and transfer energy between two or more different forms. A mass on a spring is a typical example. Extending or contracting the spring from its resting position requires energy. Some of that energy is lost, for example due to friction; the loss is called damping. But other than damping, the energy is not lost but rather stored in a different form. For example, the compressed spring will tend to return to a relaxed state, and will move the mass back towards the center, converting the stored energy into kinetic energy.

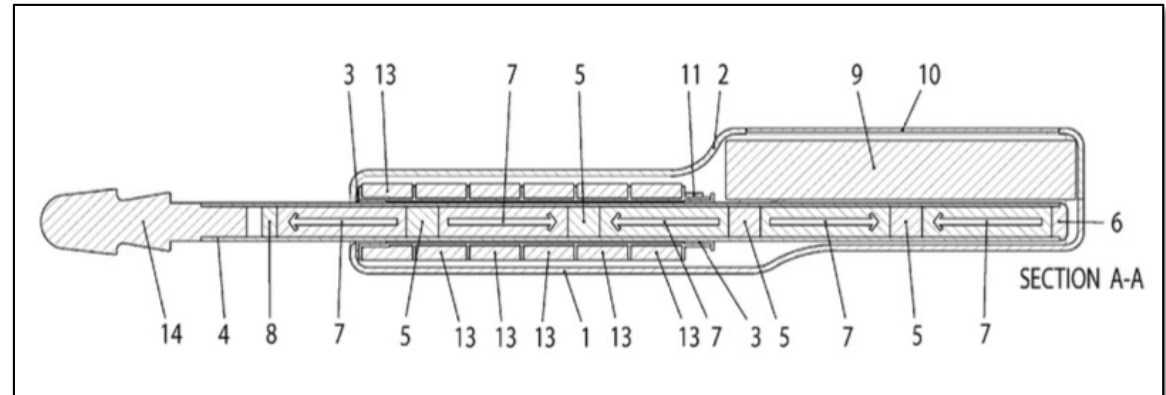
Ex. 2009, ¶ 63; POR 10

Not Analogous Art / No Motivation to Combine (Ground 1)

'882 and Alexander



Ex. 1001; POR 23



Ex. 1005; POR 11

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

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Not Analogous Art / No Motivation to Combine (Ground 1)



Prof. Blake Hannaford
Petitioner's Expert

- Q. And you don't offer any opinions in this declaration that Alexander discloses a resonant motor; correct?
- A. Well, I — I — I still have the opinion that they — that Alexander — that they don't accurately summarize Alexander in Cosper or how a POSITA would interpret those references, but I don't recall a statement anywhere in my declaration that Alexander discloses resonant motors.
- Q. Did you offer any opinion in your declaration that Alexander discloses anything about resonance at all?
- A. Not that I recall, sitting here today, other than a system that can be adapted to have resonance.

Ex. 2020 at 8:13-9:2; Sur-Reply 6

Not Analogous Art / No Motivation to Combine (Ground 1)



Prof. Keith Goossen
Patent Owner's Expert

85. The resonant frequency can be calculated as $f = \frac{1}{2\pi} \sqrt{\frac{k}{m}}$. Assuming the mass m is in the range of a tenth of a kilogram, the spring constant must be approximately 4 N/m, or 0.023 lbf/in to achieve a resonant frequency of 1 Hz. This would be a very weak spring. At a displacement of three inches (half of the six-inch stroke), the maximum restoring force would be approximately 0.3 N, which is approximately the same as the force of gravity on a 31 gram object. Dr. Hannaford does not and cannot show that a bias member could provide any plausible benefit for resonant operation in the 1 Hz range, as taught by Alexander.

Ex. 2009, ¶ 85; POR 21; Sur-Reply 9

Not Analogous Art / No Motivation to Combine (Ground 1)



Prof. Blake Hannaford
Petitioner's Expert

25. Based on my knowledge and experience in the field and my review of Alexander and Cosper, a POSITA would have readily implemented Cosper's teachings in Alexander according to parameters desired for a particular application. As one example, a POSITA would have readily configured the combined system to provide resonant operation at a stroke length near the middle of a maximum stroke length. *Id.* Alexander was not limited to a stroke length of six inches. In the combined system, a POSITA would have readily implemented other stroke lengths, including shorter stroke lengths. Thus, in an example implementation, a

Ex. 1018; Sur-Reply 8a

Not Analogous Art / No Motivation to Combine (Ground 1)



Prof. Keith Goossen
Patent Owner's Expert

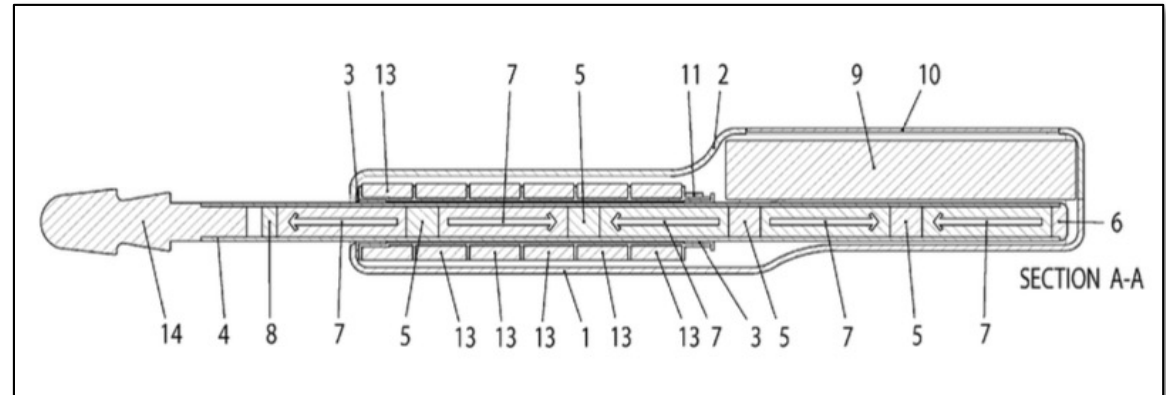
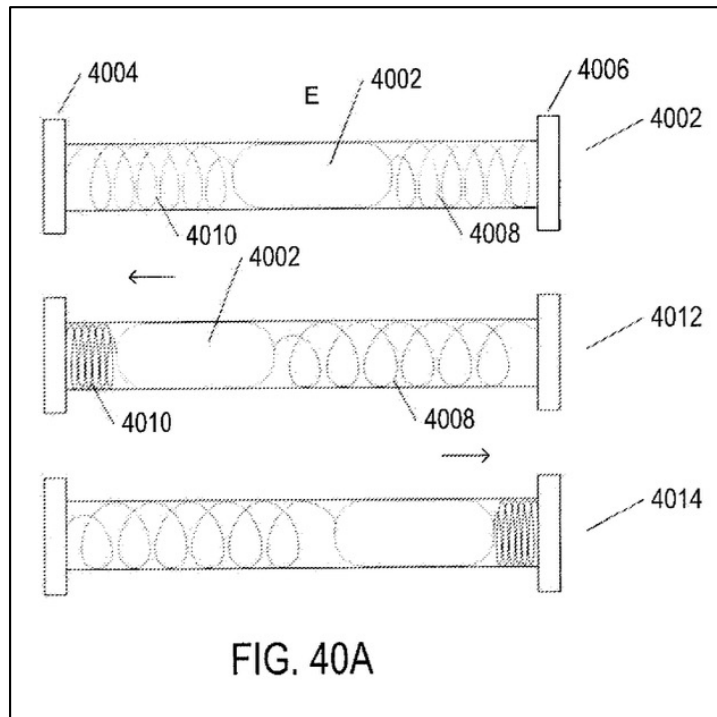
88. And Dr. Hannaford does not and cannot show that a POSITA would have been able to select a bias member with a working or linear range large enough to cover the full stroke length of Alexander's embodiment that would be physically compatible with the overall system. Put simply, there needs to be a place to put the spring or elastomeric member. Typically springs would be placed at the end of the movable component, as in the '882 Patent's Fig. 40A:

89. There is not space in Alexander's embodiment for such a spring, particularly in the "double-ended" embodiment.⁴⁰

Ex. 2009, ¶¶ 88-89; POR 22-24; Sur-Reply 10

Not Analogous Art / No Motivation to Combine (Ground 1)

'882 and Alexander

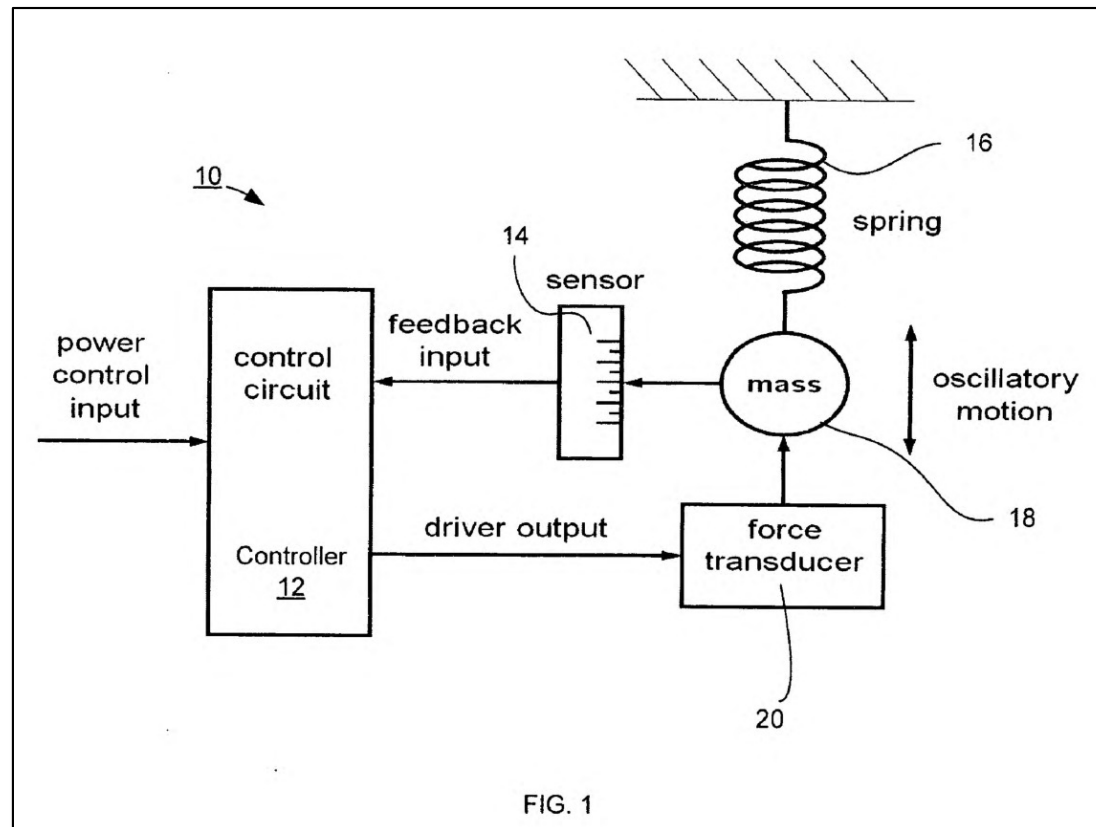


Ex. 2009, ¶¶ 88-89; POR 22-24; Sur-Reply 10

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

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Not Analogous Art / No Motivation to Combine (Ground 1)



Ex. 1006 (Casper)

Not Analogous Art / No Motivation to Combine (Ground 1)

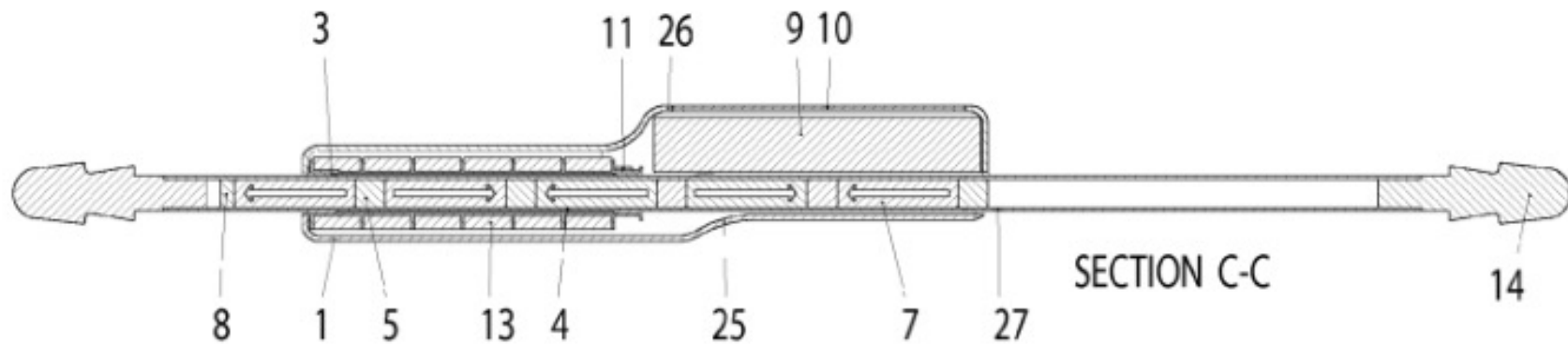


Figure 9B

Ex. 1005 (Alexander); POR 24

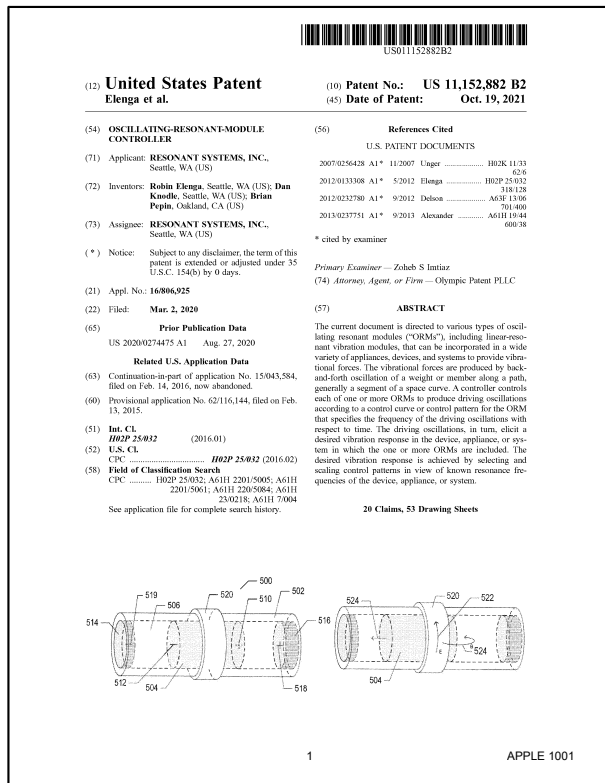
DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

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Failure to satisfy
steps 4519 and 4520 of “control
component”
(Grounds 2A-2H)

Steps 4519 and 4520 of “control component” (Grounds 2A-2H)

Under § 112(f) construction:



Ex. 1001

Ex. 1001 at 31:35-40

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

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sensor output. Then, in the while-loop of steps 4518-4521, the control logic continuously receives position and velocity data from the sensor and executes immediate control based on that position and velocity data. In step 4519, the control logic reads the position and velocity data from the sensor. This may involve a certain amount of computation, such as computing the difference and position with time over several readings, but because of the direct nature of the position sensing, is generally far less inferential and computationally intensive than in the case of indirect sensing. Then, in step

Steps 4519 and 4520 of “control component” (Grounds 2A-2H)

Gregorio’s algorithm uses back EMF (velocity) and its derivative (acceleration) — not position

At 304, during each drive cycle, after the end of the last drive pulse (i.e., during the monitoring portion of the drive cycle), the LRA vibration amplitude is measured based on the derivative of the speed of the mass (“dv/dt”), which is based on the back EMF. The derivative of the speed of the mass provides a measurement of how far the mass will rise above the zero crossing.

Ex. 1007 at 4:44-48; POR 26

Steps 4519 and 4520 of “control component” (Grounds 2A-2H)

Gregorio’s algorithm uses back EMF (velocity) and its derivative (acceleration) — not position



Prof. Blake Hannaford
Petitioner’s Expert

- Q. Okay. So would you agree that Gregorio’s back EMF measurement would not provide a measurement of the position of the magnet?
- A. Very generally, back EMF is caused by a magnet’s velocity, and the voltage of a back EMF-based sensor is proportional to the velocity of the magnet relative to a coil. Velocity—a POSITA would have several means to convert a velocity measurement to a position measurement.

Ex. 2013 at 34:5-35:6; POR 25

Steps 4519 and 4520 of “control component” (Grounds 2A-2H)

Gregorio’s algorithm uses back EMF (velocity) and its derivative (acceleration) — not position



Prof. Blake Hannaford
Petitioner's Expert

- Q. Suppose that the only piece of information you had was the back EMF voltage measurement from Gregorio’s system at a single point in time. Would a POSITA have a way of deducing from that single value the position of the mass—or magnet of Gregorio?
- A. I—I don’t recall that this is anything that I formed an opinion on in my report. Answering your question in the abstract, in a digital system, probably not. An analog circuit could convert, as I said before, by a process known as integration. It could convert the velocity signal to a position, and that could be sampled at a single point in time.

Ex. 2013 at 34:5-35:6; POR 25

Steps 4519 and 4520 of “control component” (Grounds 2A-2H)



Prof. Keith Goossen
Patent Owner's Expert

93. While it may be possible to deduce position from integrating velocity measurements over a period of time, Gregorio does not describe doing so. Rather, Gregorio provides a detailed description of control utilizing the back EMF signal alone.⁴⁷ In particular, “the LRA vibration amplitude is measured based upon the derivative of the speed of the mass (dv/dt), which is based on the back EMF.”⁴⁸ No similar description is provided for how control would be achieved if a position sensor such as a Hall sensor was used, but a POSITA desiring to measure amplitude using a position sensor would do so by comparing position measurements directly, rather than by deriving velocity from position measurements and then taking a derivative of the derived velocity.

Ex. 2009, ¶ 93; POR 27

Steps 4519 and 4520 of “control component” (Grounds 2A-2H)

Petitioner’s rationale for deriving velocity from position is “oscillat[ion] at a resonant frequency.”

Even beyond the known benefits discussed above, a POSITA would have recognized derivation of velocity and acceleration as a “suitable” option to effectuate Gregorio’s objective to oscillate at a resonant frequency. *Intel Corporation v. PACT XPP Schweiz AG*, 61 F.4th 1373, 1381 (Fed. Cir. March 13, 2023) (reversing Board and finding Petitioner just had to show feature was a “suitable” option). That is enough and provides an independent reason why Gregorio renders obvious steps 4519 and 4520.

Reply at 19

Steps 4519 and 4520 of “control component” (Grounds 2A-2H)



“[I]f there's a known technique **to address a known problem** using ‘prior art elements **according to their established functions**,’ then there is a motivation to combine. And we specify **address a known problem** because ‘[i]t's not necessary to show that a combination is the best option, only that it be a suitable option.’”

Intel Corporation v. PACT XPP Schweiz AG, 61 F.4th 1373, 1380 (Fed. Cir. 2023)

“obviousness concerns whether a skilled artisan **not only could have made but would have been motivated** to make the combinations or modifications of prior art to arrive at the claimed invention.”

Belden Inc. v. Berk-Tek LLC, 805 F.3d 1064, 1073 (Fed. Cir. 2015)

Sur-Reply at 11-12

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

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Steps 4519 and 4520 of “control component” (Grounds 2A-2H)

Deriving velocity from position provides no additional information regarding oscillation at a resonant frequency.



Prof. Blake Hannaford
Petitioner's Expert

Q. Would you agree that for a device operating at or near resonance, each of the graphs of position versus time, velocity versus time, and acceleration versus time will be approximately sinusoids?

A. Yeah, in the — sorry. In the abstract, mathematically speaking, yes, I agree with that.

Q. Would you agree that for a given frequency, each of those graphs of position, velocity, acceleration will have the same period?

A. All waves that have the same frequency also have the same period, so yes.

Ex. 2020 at 12:17–13:7; Sur-Reply 13

Steps 4519 and 4520 of “control component” (Grounds 2A-2H)

Deriving velocity from position provides no additional information regarding oscillation at a resonant frequency.



Prof. Blake Hannaford
Petitioner's Expert

$$x = A \sin \omega t$$

$$v = A\omega \cos \omega t$$

Ex. 2020 at 14:3–7; Sur-Reply 13

Steps 4519 and 4520 of “control component” (Grounds 2A-2H)

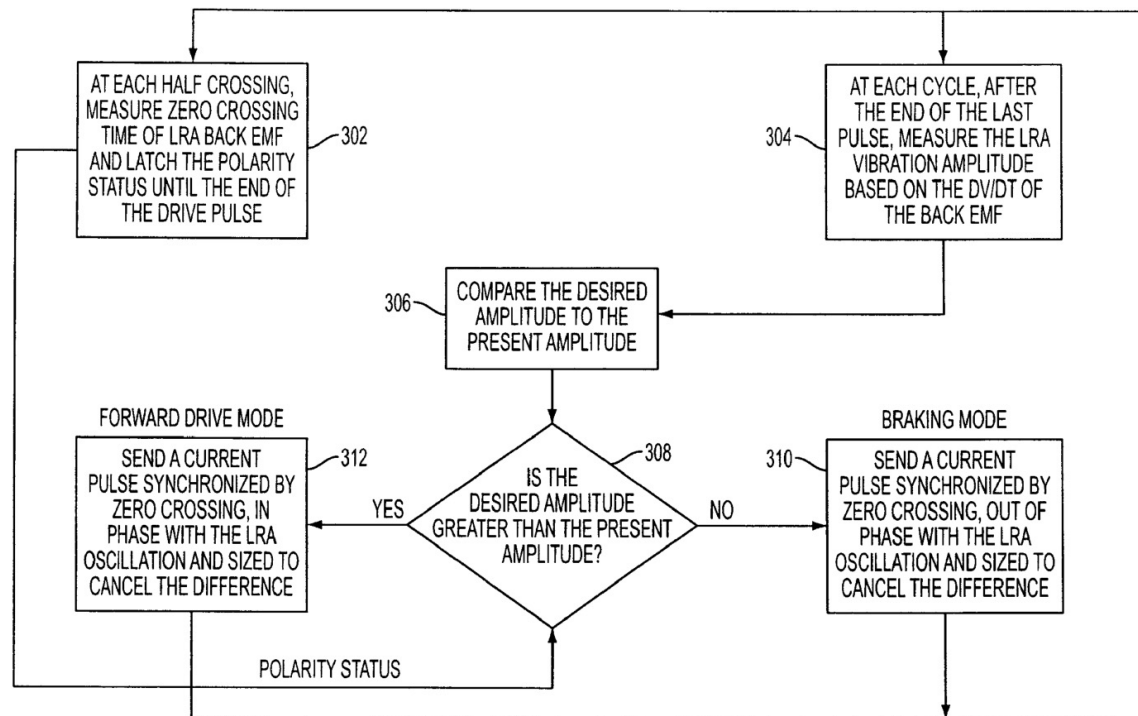


FIG. 3

Ex. 1007 (Gregorio)

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

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Steps 4519 and 4520 of “control component” (Grounds 2A-2H)

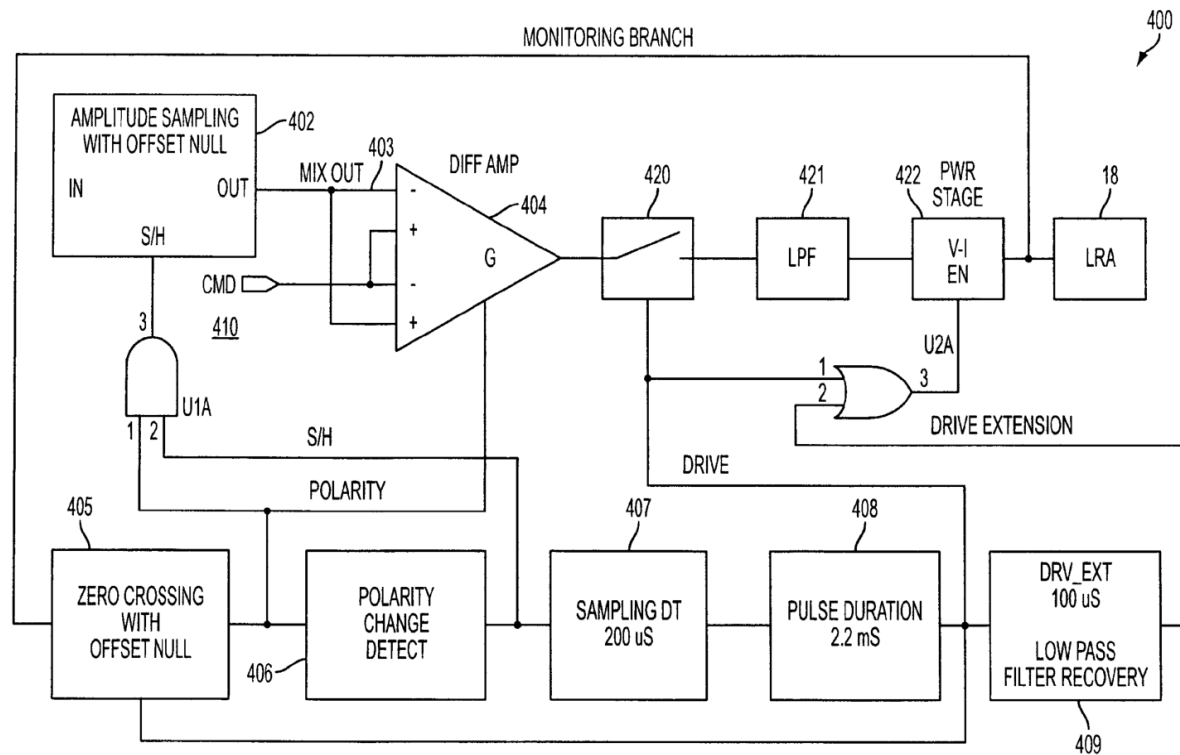


FIG. 4

Ex. 1007 (Gregorio)

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Resonant Systems | IIPR2024-00983 | SLIDE 31

Steps 4519 and 4520 of “control component” (Grounds 2A-2H)

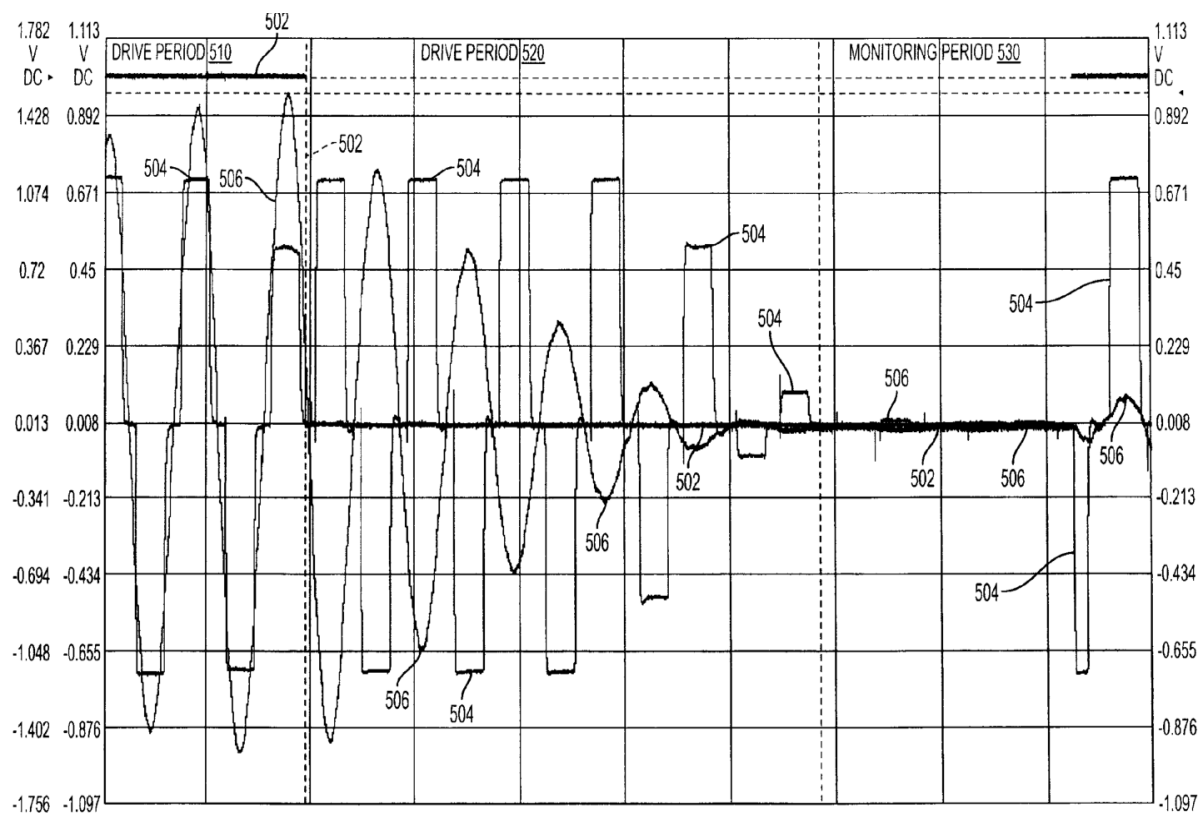


FIG. 5
Ex. 1007 (Gregorio)

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

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Steps 4519 and 4520 of “control component” (Grounds 2A-2H)

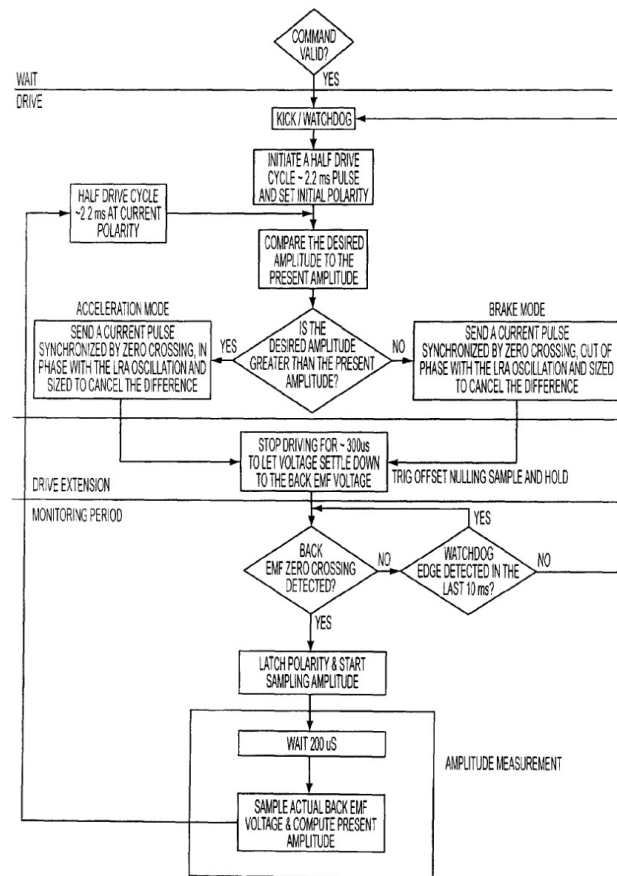
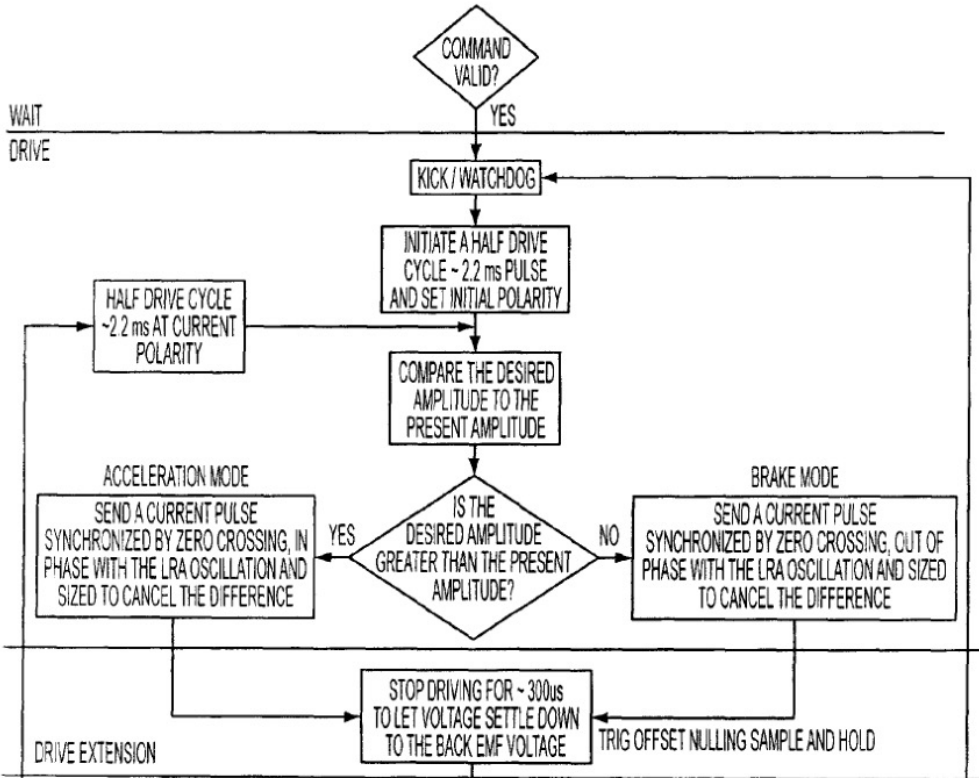


FIG. 6

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Ex. 1007 (Gregorio)

Steps 4519 and 4520 of “control component” (Grounds 2A-2H)



Ex. 1007 (Gregorio)

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

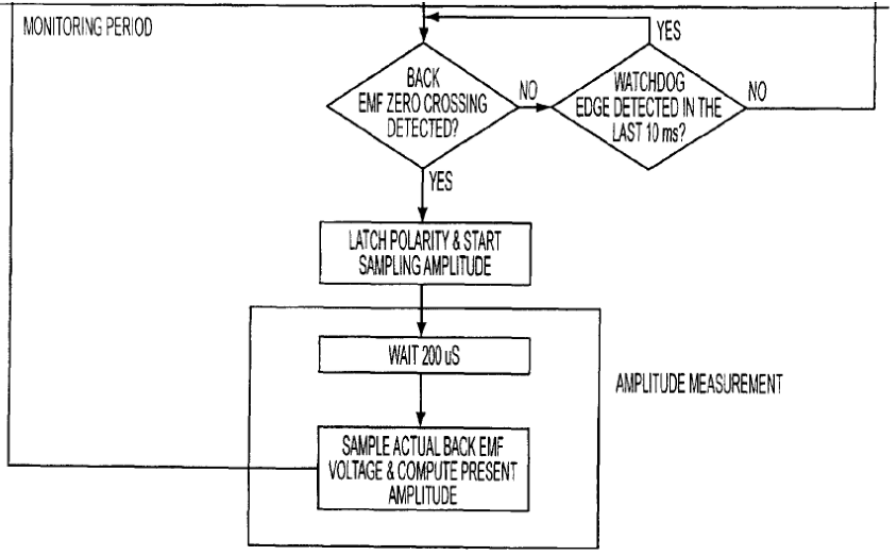
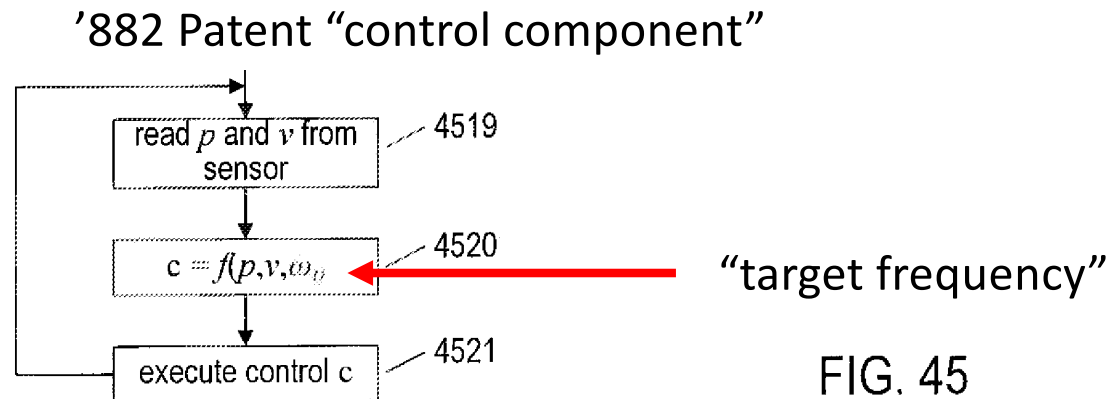


FIG. 6

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Muramatsu - step 4520 of “control component” (Grounds 2E-2H)



- No target frequency in Muramatsu
- No resonance in Muramatsu
- No analysis of this limitation in petition or reply for these grounds
- No explanation of how Muramatsu remedies deficiencies of grounds 2A-2D

Ex. 1001, Fig. 45; Response at 29-30; Sur-Reply 15-16

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

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