

Petitioner's Oral Hearing Demonstratives

Apple Inc.
(Petitioner)
v.
Resonant Systems, Inc.
(Patent Owner)

Case Nos. IPR2024-00983
U.S. Patent No. 11,152,882

Before Hon. Norman H. Beamer, Karl D. Easthom, Brian D. Range

Instituted Grounds

Ground	'882 Patent Claims	§103 Basis
1	1-6, 10, 17, 19, 20	Alexander-Cosper
2A	1-5, 10, 17, 19, 20	Gregorio
2C	1-5, 10, 17, 19, 20	Gregorio-Ramsay
2E	3-6	Gregorio-Muramatsu
2G	3-6	Gregorio-Ramsay-Muramatsu
2B	1-5, 10, 17, 19, 20	Gregorio-Fuller
2D	1-5, 10, 17, 19, 20	Gregorio-Fuller-Ramsay
2F	3-6	Gregorio-Fuller-Muramatsu
2H	3-6	Gregorio-Fuller-Ramsay-Muramatsu

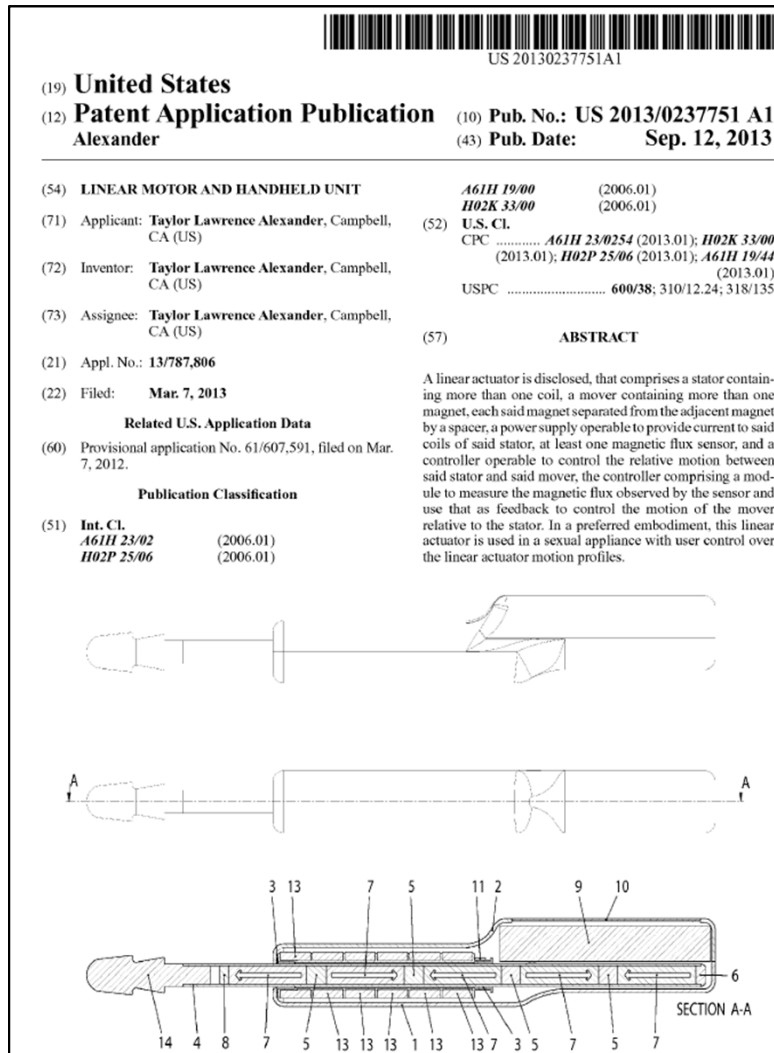
Petition (Pet.), 1

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A POSITA would have been motivated to combine Alexander and Cosper

Alexander:



[0022] One objective of the present invention is to provide a linear motor with attributes that may include: precise motion control and/or relatively low cost, among other possible attributes. For the purposes of this disclosure, the terms “motor” and “actuator” may be used interchangeably. In addition, the term “linear” may mean at least some extent of linear motion, and may optionally include rotary motion in addition to linear motion. Or, alternatively, it may be curvilinear motion.

1. A linear actuator, comprising:

a stator containing more than one coil, wherein said more than one coils are arranged longitudinally along the long axis of said stator,

a mover containing more than one magnet, each said magnet separated from the adjacent magnet by a spacer,

...

a power supply operable to provide current to said coils of said stator,

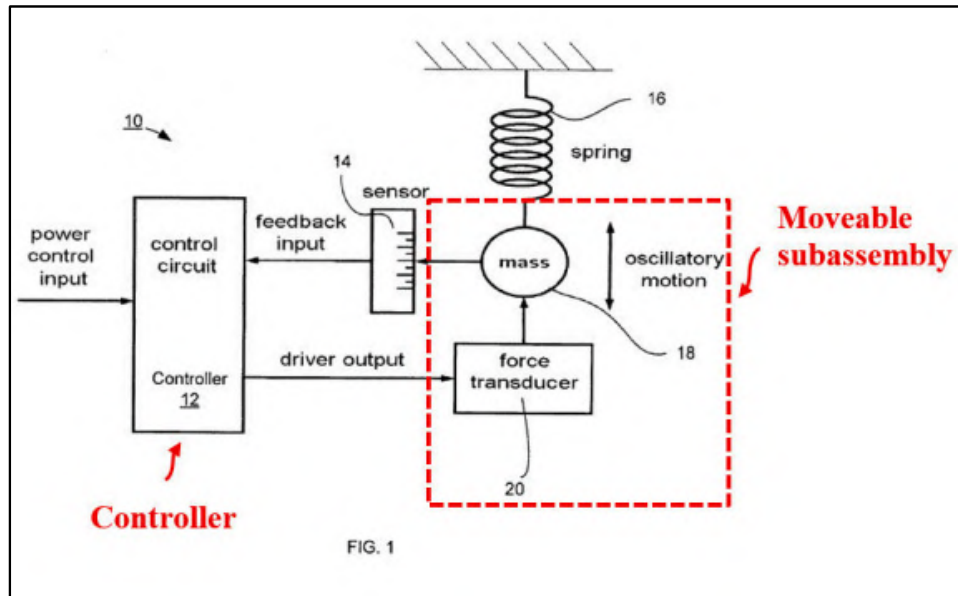
at least one position sensor; and

a controller operable to control the relative motion between said stator and said mover, the controller comprising a module to measure the mover position observed by said position sensor and a module to meter the current sent from said power supply to said coils in response to the position measured by said position sensor.

A POSITA would have been motivated to combine Alexander and Cosper

Cosper:

the motion of the subassembly may be derived). For example, one or more sensors 14 may detect position, velocity, acceleration, etc. for the subassembly (e.g., of bias 16 and/or mass 18). In some variations, a sensor 14 is connected to a driver



[0049] FIG. 1 illustrates schematically an exemplary control system 10 for use with a mechanical resonant subassembly system. In general, the control system 10 described herein includes control logic (e.g., hardware, software, firmware, or combinations thereof) included with a controller or control circuit 12), a sensor 14 for determining a parameter from the moveable subassembly (e.g., including a bias 16 and mass 18), a sensor input for inputting the parameter into the control logic of control circuit 12, and a control output from the control logic to drive the moveable subassembly at or near resonance via force transducer 20.

[0056] Implementation of the described methods and operations may be carried out via software, hardware, firmware, or any suitable combination thereof. Further, one of ordinary skill in the art will recognize that various algorithms for analyzing feedback signals and driving the resonant subassembly as described are contemplated.

The power converter system is controlled by a microprocessor system. The microprocessor system provides an integrated closed loop control and the PWM generation for the converter systems, in addition to the control of the white light generated by the LED luminary. This approach pro-

EX1009, [0049], [0056]; EX1043, 2:19-43; Pet., 18

A POSITA would have been motivated to combine Alexander and Cospers

Petition - Alexander-Cosper Combination:

A POSITA would have been motivated to utilize feedback control to facilitate oscillation at a resonant frequency, as suggested by Cosper, when implementing a handheld device consistent with Alexander's teachings, to achieve known benefits. APPLE-1006, [0010], [0049]-[0050]; APPLE-1003, ¶65. One or more bias members, such as a spring or elastomeric member, are positioned to act on the mover, based on Cosper's suggestions, and, in at least one operating scenario, the feedback control system maintains oscillation at a resonant frequency.

Relatedly, a POSITA would have found it obvious to implement a feedback control system that utilizes "one or more sensors" that directly detect "position, velocity, acceleration, etc.," as suggested by Cosper and Alexander. APPLE-1006, [0050]; APPLE-1003, ¶69. Alexander describes "a sensor for sensing the motion of the mover," including by direct position sensing. APPLE-1005, [0005]; [0034] ("a variety of different position sensors may be used"); [0035]-[0036]; [0040]. Cosper further details options for effectively implementing sensors that detect position, etc., in a feedback control system, implemented as alternatives or additions to existing sensor(s), such as those of Alexander, for example. *Id.*; see APPLE-1006, [0009], [0010], [0049]-[0050], [0069].

A POSITA would have been motivated to combine Alexander and Cosper

Dr. Hannaford:

sensor “mounted to the mover”). APPLE-1005, [0036]. Alexander also expresses objectives of improving precision of oscillation output by implementing effective position sensing for feedback control. APPLE-1005, [0003], [0004]. A POSITA would have recognized Cosper, including based on its teachings of “one or more sensors” that detect “position, velocity, acceleration” as providing suitable design details and alternatives. *Id.*, [0053]. A POSITA would have effectively implemented position sensors for feedback control, based on Cosper’s teachings and advancing Alexander’s stated objectives of improving precision of oscillation output. APPLE-1005, [0003], [0004].

Pet. 14-15; APPLE-1003, ¶72

A POSITA would have been motivated to combine Alexander and Cosper

Dr. Hannaford:

71. As a first reason, a POSITA would have been motivated to combine the teachings of Alexander with the teachings of Cosper to provide the option of oscillation at or near a resonant frequency. APPLE-1006, Abstract, [0005]-[0008], [0009]-[0011], [0053]-[0055], [0056], [0106] (“user control”). Based on my knowledge and experience in the field and my review of Alexander and Cosper, a POSITA would have recognized from Cosper’s description the advantage of facilitating increased system movement for a reduced or minimal amount of energy, in at least some operating scenarios (e.g., when oscillating over at least a portion of the available stroke). APPLE-1008, [0036]. For example, Cosper

Cosper:

[0005] Mechanical systems typically have a resonant frequency, a natural frequency at which the system tends to move or oscillate when an impulse is applied. Moving the system at non-resonant frequencies may require significantly more energy. Accordingly, it may be desirable to move and control a mechanical system at or near its resonant frequency to achieve the maximum system movement for a reduced or minimal amount of energy.

Pet. 13-14; APPLE-1006, [0005]; APPLE-1003, ¶71

A POSITA would have been motivated to combine Alexander and Cosper

Dr. Hannaford:

76. Indeed, the combination is predictable, in part, because elements of the combined system would each perform similar functions they had been known to perform prior to the combination. Alexander's actuator would still perform the same back-and-forth oscillation of its mover/mass as it did prior to the combination with Cosper, with updates to account for control logic and exemplary sensors for position sensing (e.g., electromagnetic and induction sensors), in accordance with Cosper's suggestions. APPLE-1006, [0054], [0010].

EX1003, ¶76; Pet., 16

A POSITA would have been motivated to combine Alexander and Cosper

Dr. Hannaford:

so would have predictably facilitated efficient operation of Alexander's device, facilitating increased amplitude/velocity for a given input when operating at such frequencies, and relatedly promote efficient power usage (e.g., from the battery) in obtaining this output. A POSITA would have recognized the benefits of obtaining a given amplitude or velocity output while facilitating a more lightweight and/or compact design. For example, generating a given amplitude or velocity when operating in resonant condition would have been predictably achieved with relatively less current. Relatedly, a POSITA would have recognized that a resonant system can facilitate reduced weight and/or volume compared to non-resonant systems. I note that a POSITA likewise would have recognized that such a configuration would thus enhance user satisfaction and the user's perception of the device. Pet., 13-14; APPLE-1003, ¶¶70-71.

A POSITA would have been motivated to combine Alexander and Cosper

Dr. Hannaford:

lengths above and below a resonant operating condition. Such configurations would have predictably achieved the benefits of enhanced output and power-efficient operation. A POSITA would have recognized this would have especially been the case in a scenario in which the device is operated at resonance for a meaningful duration. Moreover, such a configuration would avail the user of an additional motion profile to choose from. Indeed, a POSITA would have recognized this overall effective operation in greater amplitude/velocity configurations, even if some frequencies, stroke lengths, etc., might require additional power.

Reply, 13-14; APPLE-1018, ¶25

A POSITA would have been motivated to combine Alexander and Cosper

Patent Owner: Alexander is directed to a device that “penetrates and thrusts into the human body.” Sur-Reply, 7

Alexander:

(54) **LINEAR MOTOR AND HANDHELD UNIT**

(57) **ABSTRACT**

A linear actuator is disclosed, that comprises a stator containing more than one coil, a mover containing more than one

1. A linear actuator, comprising:

a stator containing more than one coil, wherein said more than one coils are arranged longitudinally along the long

a [0022] One objective of the present invention is to provide a linear motor with attributes that may include: precise motion control and/or relatively low cost, among other possible attributes. For the purposes of this disclosure, the terms

EX1005, Title, Abstract, cl. 1, [0022]

A POSITA would have been motivated to combine Alexander and Cosper

Patent Owner: Alexander is directed to a device that “penetrates and thrusts into the human body,” and “The record does not suggest any reason to believe that Dr. Hannaford’s ‘knowledge and experience in the field’ (Ex. 1018, ¶ 25) provide the basis for useful opinions on desirable behavior for a product of the type described in Alexander.” Sur-Reply, 8

Dr. Goossen:

And, in terms of how a user selects the stroke length, that is not something that is part of my expert profile.

EX1019, 41:10-21; see Reply, 13

A POSITA would have been motivated to combine Alexander and Cosper

Alexander:

The motor mover can include a housing tube 4, which contains at least one magnet 7 inside of the housing tube 4. Note that the arrows on the magnets in FIG. 1A indicate one possible orientation of polarity of the magnets. If more than one magnet 7 is used, they may be separated from each other by spacers 5. These spacers can be made of a variety of materials,

[0025] The spacing and orientations of the magnets may vary based on the design. For example, a series of single

Dr. Hannaford:

three magnet phases are provided to facilitate a six-inch stroke. A POSITA would have recognized from Alexander's description that, where only "one magnet" is used (APPLE-1005, [0023]), the stroke length would be shorter. For example, a POSITA would have recognized length to be as short as an inch or less, scaling down from the number of magnets in the six-inch stroke example. I note that the Patent Owner Response does not address configurations that use just "one magnet," for example. POR, 18-21.

EX1018, ¶124; Reply,
13; EX1005, [0023],
[0025]

A POSITA would have been motivated to combine Alexander and Cosper

Patent Owner:

While the stroke length, frequency, or pattern in particular embodiments of Alexander may be illustrative or non-limiting, common sense suggests that there are limits to the types of movements that would be desirable for a sex toy of the type taught in Alexander.

Sur-Reply, 8

A POSITA would have been motivated to combine Alexander and Cosper

Dr. Goossen:

20 Q. And so, for example, you didn't
21 consider a configuration of Alexander that used a
22 single magnet, for example?

1 A. It was not necessary for my
2 analysis.

Alexander:

The motor mover can include a housing tube 4, which contains at least one magnet 7 inside of the housing tube 4. Note that the arrows on the magnets in FIG. 1A indicate one possible orientation of polarity of the magnets. If more than one magnet 7 is used, they may be separated from each other by spacers 5. These spacers can be made of a variety of materials,

[0025] The spacing and orientations of the magnets may vary based on the design. For example, a series of single

A POSITA would have been motivated to combine Alexander and Cosper

Dr. Goossen:

If one phase is one inch long and the stroke is four inches long, then there would be four different phases the rod could be in.

A. My analysis of this art was specific to whether it is a resonant system, and my opinion is that it is not a resonant system. And any other analysis is outside this scope of my report.

Q. Well so I'm just trying to understand the construction that Alexander is describing in Paragraph 40.

And so, my question is, if one phase is two inches long and the rod stroke is four inches, there would just be two different phases the rod could be in. Correct?

A. I mean again, my report contains analysis that it is my opinion that this is not showing a resonant system, and any other analysis like the phases of the stroke are not part of my analysis.

Q. Just to clarify, I'm talking about the, at partway through Paragraph 40 where it says, "The magnetic field sensors return a repeating wave pattern that can be used to calculate the rod's position within one phase of the magnets (a magnet-spacer-magnet-spacer set)."

A. That was not part of my analysis.

Q. Did you consider how many magnets could be in each respective phase?

A. I did not need that for my analysis.

Q. Okay. How about, how many phases of magnets would be present in the device?

A. Again, that was not necessary for, to perform an analysis to support my opinion that this is not a resonant system.

Q. And so, for example, you didn't consider a configuration of Alexander that used a single magnet, for example?

A. It was not necessary for my analysis.

A POSITA would have been motivated to combine Alexander and Cosper

Dr. Hannaford:

lengths, including shorter stroke lengths. Thus, in an example implementation, a POSITA would have predictably implemented the combination to have a stroke length of 1 in. for example. Relatedly, a POSITA would have recognized a range of frequencies, especially based on Alexander's express teachings of "fast" and motion profiles. *See*, APPLE-1005, [0055]. Moreover, a POSITA would have recognized the variety of motion patterns (e.g., "sinusoidal") that were desirable in Alexander's device. And, a POSITA would have readily configured the bias member to provide resonance at a particular combination of such parameters, such as at a midpoint of the maximum stroke length, facilitating selection of stroke lengths above and below a resonant operating condition. Such configurations

EX1018, ¶25; Reply, 13

A POSITA would have been motivated to combine Alexander and Cosper

Dr. Hannaford:

Alexander's device. And, a POSITA would have readily configured the bias member to provide resonance at a particular combination of such parameters, such as at a midpoint of the maximum stroke length, facilitating selection of stroke lengths above and below a resonant operating condition. Such configurations would have predictably achieved the benefits of enhanced output and power-efficient operation. A POSITA would have recognized this would have especially been the case in a scenario in which the device is operated at resonance for a meaningful duration. Moreover, such a configuration would avail the user of an additional motion profile to choose from. Indeed, a POSITA would have recognized this overall effective operation in greater amplitude/velocity configurations, even if some frequencies, stroke lengths, etc., might require additional power.

A POSITA would have been motivated to combine Alexander and Cosper

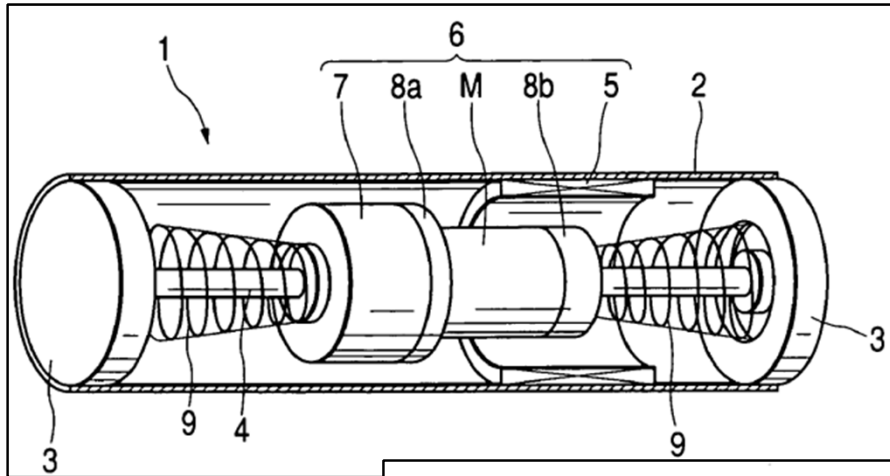
Dr. Hannaford:

77. I further note, based on my knowledge and experience in the field and my review of Alexander and Cosper, a POSITA would have included a bias member to facilitate resonant operation, and corresponding control, to be **a matter of design choice implemented with a reasonable expectation of success**. Such configurations were **conventional** in the timeframe prior to the '882 patent, and Alexander confirms such design choices were within the purview of a POSITA's knowledge. *See, e.g.*, APPLE-1007, 3:12-28, FIG. 2; APPLE-1008, [0007], [0025], [0048]-[0050], FIGS. 8-9; APPLE-1014, 2:29-54, 3:64-4:5, 5:25-50, 7:26-30, FIGS. 1A-1B; *see also* APPLE-1005, [0025] ("The spacing and orientations of the magnets may vary based on the design"); [0060].

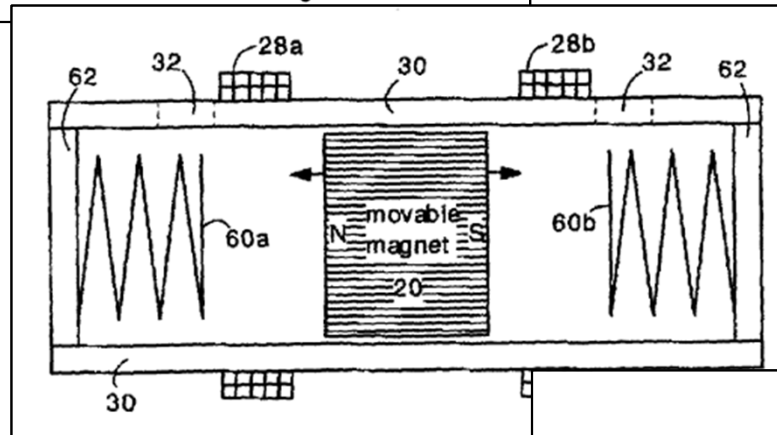
EX1003, ¶177; Pet., 16

A POSITA would have been motivated to combine Alexander and Cosper

Wakuda:



Fuller:



Gregorio:

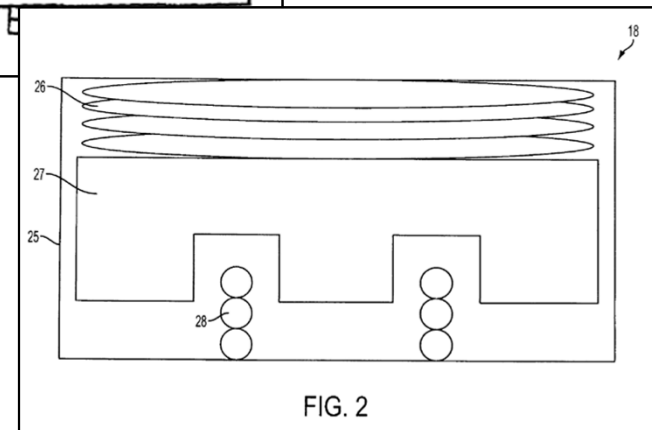


FIG. 2

EX1007, FIG. 2; EX1008, FIG. 8; EX1014, FIG. 1A; EX1003, ¶ 77

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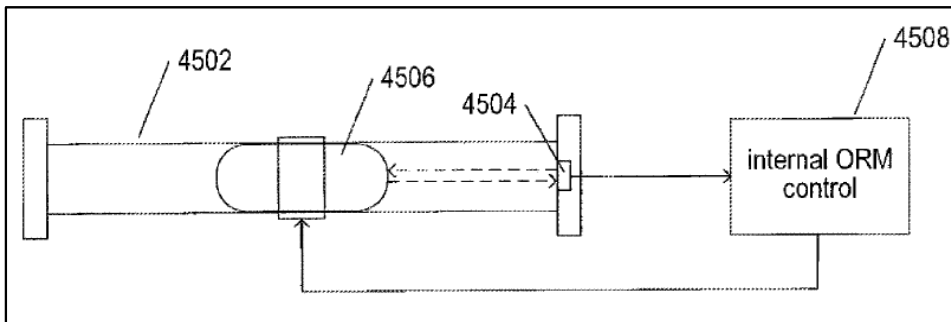
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Issue 4: Gregorio in view of Muramatsu renders obvious steps 4519 and 4520 (Grounds 2E-2H)	42

Alexander and Cosper are analogous art to the '882 Patent

'882 Patent:

TECHNICAL FIELD

The current document is 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.



Alexander:

[0022] One objective of the present invention is to provide a linear motor with attributes that may include: precise motion control and/or relatively low cost, among other possible attributes. For the purposes of this disclosure, the terms

1. A linear actuator, comprising:

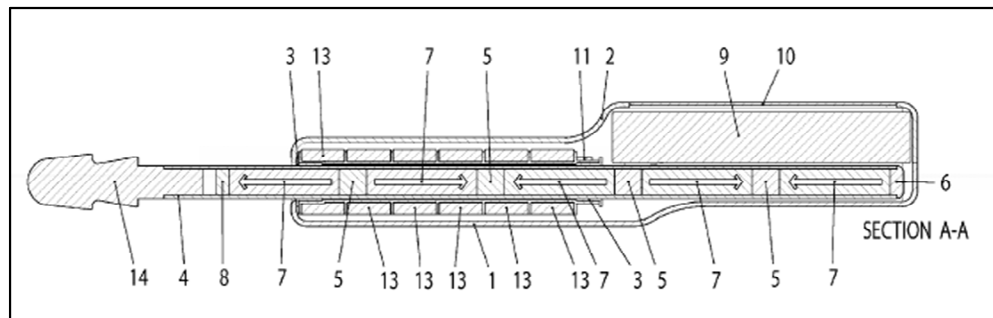
a stator containing more than one coil, wherein said more than one coils are arranged longitudinally along the long axis of said stator,

a mover containing more than one magnet, each said magnet separated from the adjacent magnet by a spacer, wherein said magnets are placed longitudinally along the long axis of said mover, wherein the long axis of said mover is substantially collinear with the long axis of said stator, such that said stator and said mover can move linearly with respect to each other along their long axes,

a power supply operable to provide current to said coils of said stator,

at least one position sensor; and

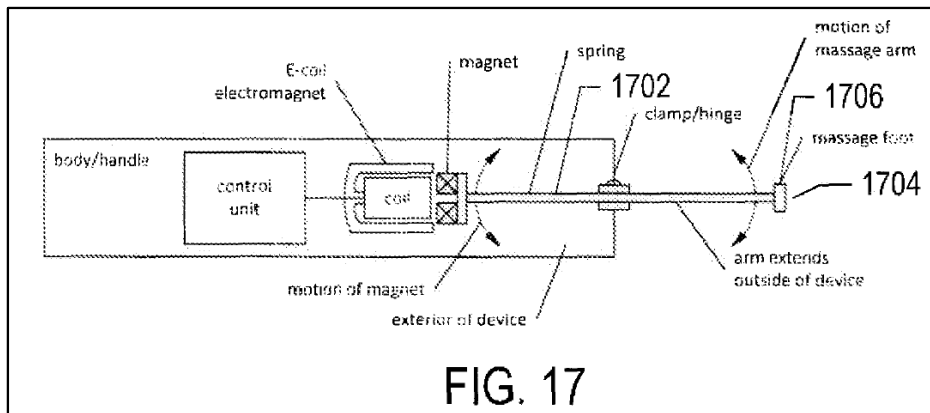
a controller operable to control the relative motion between said stator and said mover, the controller comprising a



Alexander and Cosper are analogous art to the '882 Patent

'882 Patent:

FIG. 17 shows another ORM similar to the ORM shown in FIG. 16. In this ORM, the spring member 1702 is extended to provide an external massage arm 1704 that extends out from the housing to provide a linearly oscillating massage-foot member 1706 for massaging human skin or some other substrate, depending on the application.



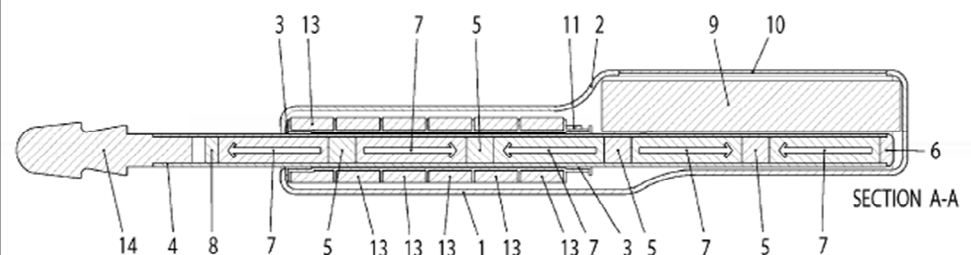
Alexander:

(54) LINEAR MOTOR AND HANDHELD UNIT

(57)

ABSTRACT

A linear actuator is disclosed, that comprises a stator containing more than one coil, a mover containing more than one magnet, each said magnet separated from the adjacent magnet by a spacer, a power supply operable to provide current to said coils of said stator, at least one magnetic flux sensor, and a controller operable to control the relative motion between said stator and said mover, the controller comprising a module to measure the magnetic flux observed by the sensor and use that as feedback to control the motion of the mover relative to the stator. In a preferred embodiment, this linear actuator is used in a sexual appliance with user control over the linear actuator motion profiles.



Alexander and Cosper are analogous art to the '882 Patent

Alexander:

(56)

References Cited

U.S. PATENT DOCUMENTS

2007/0256428	A1 *	11/2007	Unger		H02K 11/33 62/6
2012/0133308	A1 *	5/2012	Elenga		H02P 25/032 318/128
2012/0232780	A1 *	9/2012	Delson		A63F 13/06 701/400
2013/0237751	A1 *	9/2013	Alexander		A61H 19/44 600/38

* cited by examiner

Dr. Hannaford:

145-179. The application of Alexander by the Examiner during prosecution of the application leading to the '882 Patent demonstrates that a POSITA would have found Alexander's teachings reasonably pertinent to the problems of the '882 patent, as the Patent Office itself found Alexander worthy of consideration when evaluating the '882 Patent. A POSITA would have found Alexander's teachings pertinent to the objectives of producing predetermined vibration responses in vibration modules, and to shortcomings of unbalanced electric motors, that the '882 Patent recites. Like the '882 patent, Alexander generates motion profiles in

Alexander and Cosper are analogous art to the '882 Patent

Patent Owner: “Apple’s focus on out-of-context portions of the specification—to the exclusion of the claims—to determine analogousness is contrary to law, as confirmed by the cases Apple itself cites.” Sur-Reply, 2

Federal Circuit: “[D]etermine 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 1320, 1325-1326.

Alexander and Cosper are analogous art to the '882 Patent

'882 Patent:

Because of the above-discussed disadvantages with the commonly employed unbalanced-electric-motor vibration-generation units, designers, manufacturers, and, ultimately, users of a wide variety of different vibration-based devices, appliances, and systems continue to seek more efficient and capable vibration-generating units for incorporation into many consumer appliances, devices, and systems.

harnessed for various applications, but also produces destructive, unbalanced forces within the motor that contribute to rapid deterioration of motor parts. Enormous care

use. Unbalanced electric motors, as discussed above, oscillating motion back and forth along a predefined-path, or space curve, cannot generally be produced by unbalanced electric motors. Unbalanced electric motors generate vibra-

electric motors. Unbalanced electric motors generate vibrations in only a very limited portion of the total vibrational-force/frequency space. FIG. 3 shows a graph of vibrational

transfer to the coil 726. The CPU receives input 730 from one or more electromechanical sensors 732 that generate a signal corresponding to the strength of vibration currently being produced by the linearly oscillating mass 734. Sensors may include one or more of accelerometers, piezoelectric devices, pressure-sensing devices, or other types of sensors that can generate signals corresponding to the strength of desired vibrational forces.

Alexander:

[0034] A feedback control system is used to control the position and motion of the mover. In this system, a position sensor measures the position of the tube and reports the position of the tube to the main drive and control electronics. Those control electronics control the current that is driven through the coils, creating a feedback system that allows precise control of the position of the tube. A plastic, or other suitable material, linear bearing at each end of the coil assem-

[0037] Using feedback control of the mover position, a variety of position and motion parameters of the linear motor can be controlled by the control system, including: mover stroke, mover speed, and mover acceleration. In addition, various profiles are possible, including nonlinear motion profiles, such as sine wave motion. With the precise control of

Alexander and Cosper are analogous art to the '882 Patent

'882 Patent:

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

In many cases, the position and velocity data is more accurate and far more timely provided than position and velocity data derived from indirect sensing and inference.

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

Alexander:

[0034] A feedback control system is used to control the position and motion of the mover. In this system, a position sensor measures the position of the tube and reports the position of the tube to the main drive and control electronics. Those control electronics control the current that is driven through the coils, creating a feedback system that allows precise control of the position of the tube. A plastic, or other suitable material, linear bearing at each end of the coil assem-

Alexander and Cosper are analogous art to the '882 Patent

'882 Patent:

The desired vibration response of the ORM is a sine-wave-like 3702 oscillation that is plotted, in FIG. 37A, on an amplitude versus time coordinate system 3704. FIG. 37B

form. As shown in FIG. 37D, many more voltage pulses are used in order to achieve the sine-wave-like vibration response of the ORM. For example, in the constant-width-

Alexander:

stroke, mover speed, and mover acceleration. In addition, various profiles are possible, including nonlinear motion profiles, such as sine wave motion. With the precise control of this system, it may also be possible to have smaller order motion, within the larger bulk motion. For example, one embodiment may vibrate the mover back and forth during its stroke inwards or outwards.

different parameter settings. For example, Profile 1 may be a slow, short stroke, while Profile 2 may be a fast sinusoidal stroke. Another profile may have fast extension of the mover,

Alexander and Cosper are analogous art to the '882 Patent

'882 Patent:

TECHNICAL FIELD

The current document is 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.

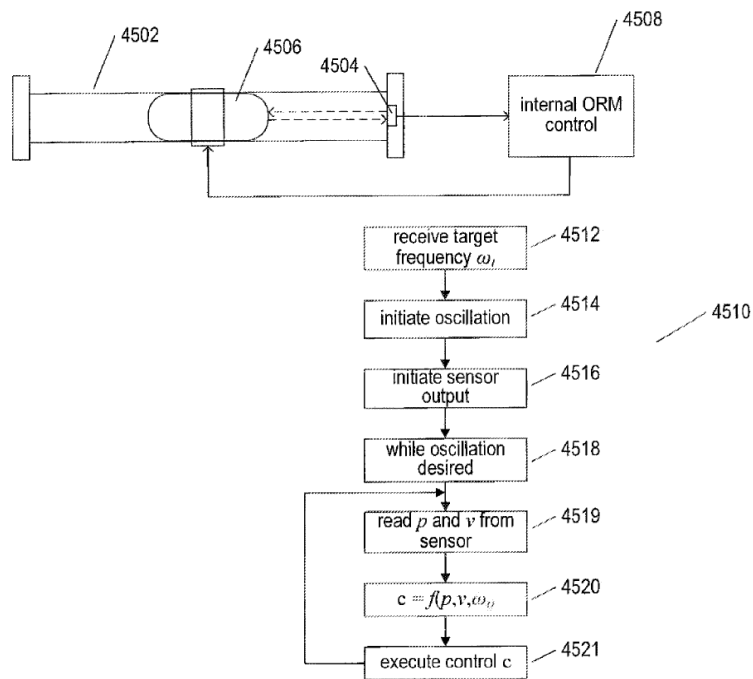


FIG. 45

Cosper:

[0003] This application generally relates to systems and methods for control of a mass and bias (e.g., “elastomeric members”) subassembly, including oscillating mechanical systems, that operate in an oscillatory mode at or near their mechanical resonant frequency. In one example, the systems are described for use with illumination systems including an oscillating resonant engine.

[0012] Any appropriate subassembly may be used with the systems and methods described herein. For example, a controller (including a control circuit) as described herein may be

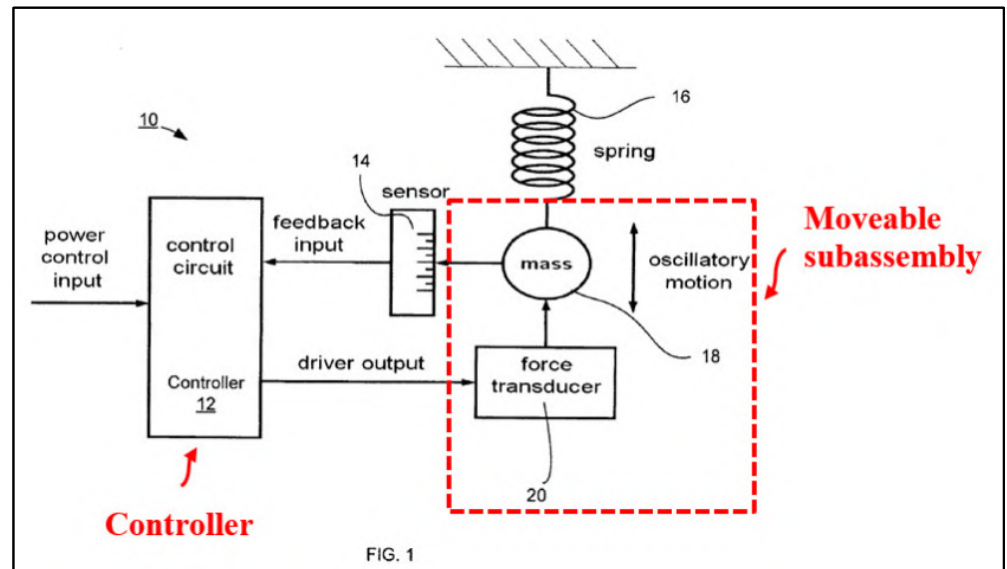


FIG. 1

Alexander and Cosper are analogous art to the '882 Patent

'882 Patent:

Because of the above-discussed disadvantages with the commonly employed unbalanced-electric-motor vibration-generation units, designers, manufacturers, and, ultimately, users of a wide variety of different vibration-based devices, appliances, and systems continue to seek more efficient and capable vibration-generating units for incorporation into many consumer appliances, devices, and systems.

cations discussed above. Unbalancing the shaft of an electric motor not only produces useful vibrations that can be harnessed for various applications, but also produces destructive, unbalanced forces within the motor that contribute to rapid deterioration of motor parts. Enormous care

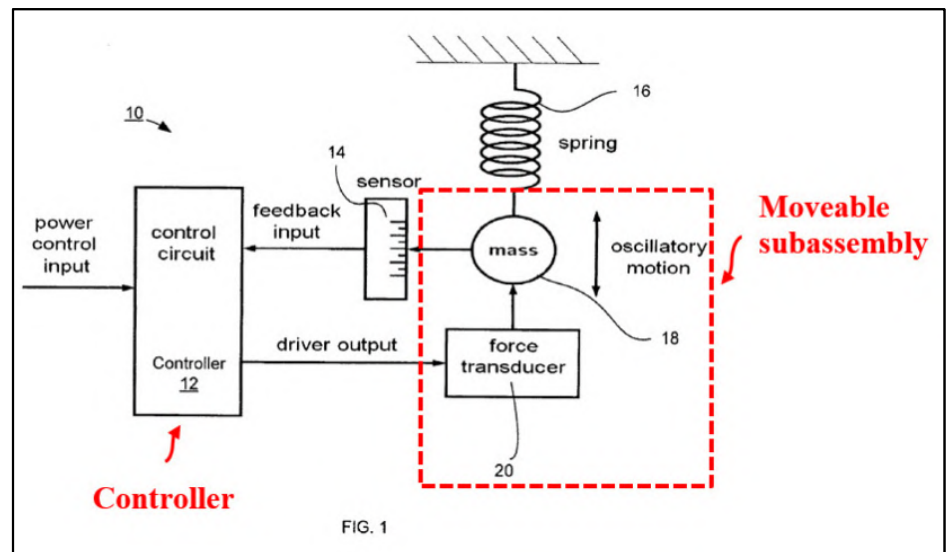
the electric motor and other parts deteriorate. Unbalanced electric motors are relatively inefficient at producing vibrational motion. A far greater amount of power is consumed by

use. Unbalanced electric motors, as discussed above, oscillating motion back and forth along a predefined-path, or space curve, cannot generally be produced by unbalanced electric motors. Unbalanced electric motors generate vibra-

electric motors. Unbalanced electric motors generate vibrations in only a very limited portion of the total vibrational-force/frequency space. FIG. 3 shows a graph of vibrational

Cosper:

[0009] The present invention discloses systems and methods for automatically driving (e.g., controlling energy applied) and maintaining oscillation of an assembly including a mass and a bias member (which may also be referred to as a spring or elastomeric member) at a resonant frequency. In one example, apparatus for maintaining oscillation of a moveable subassembly including a mass and bias comprises a controller operable to receive a signal from a sensor associated with a position or motion of the subassembly, and generate a drive signal for driving the subassembly in response to the received signal from the sensor. In this manner, the controller may monitor the motion of the subassembly and adjust or modulate the driving force over time to



Alexander and Cosper are analogous art to the '882 Patent

“A petitioner is not required to anticipate and raise analogous art arguments in its petition; instead a petitioner can use its reply to ‘respond to arguments raised in the corresponding opposition, patent owner preliminary response, patent owner response, or decision on institution.”

Sanofi-Aventis Deutschland GmbH v. Mylan Pharms. Inc., 66 F.4th 1373, 1379.82:

“It is not always necessary for a petition to expressly address analogousness. For instance, it may be clear from the petition's description of the references and the challenged claims that prior art is in the same field of endeavor as the challenged patent, or the pertinence of the prior art to the problem solved by the invention may be implicit in the petition's discussion of the challenged claims and why a person of ordinary skill would be motivated to combine the prior art references with a reasonable expectation of success.

Corephotonics, Ltd. v. Apple Inc., 84 F.4th 990, 1004, 2023 U.S. App. LEXIS 27372, *18, 2023 U.S.P.Q.2D (BNA) 1202

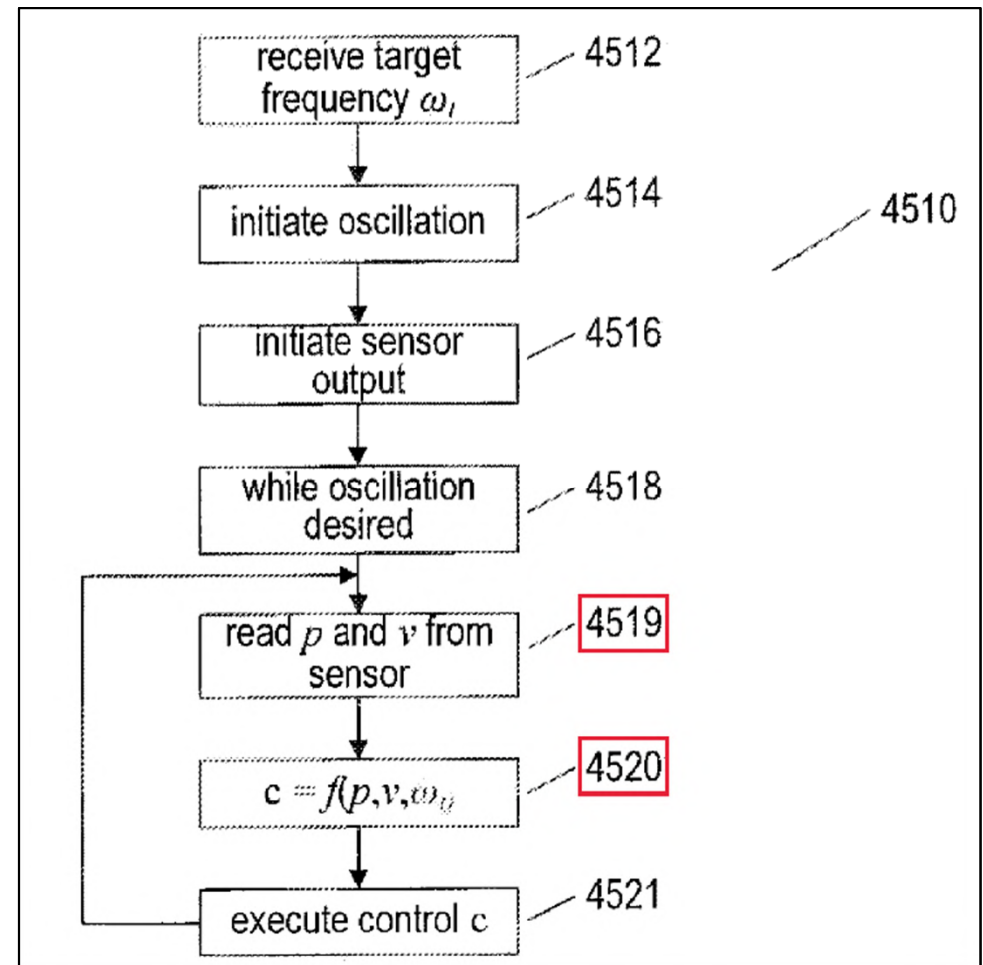
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The Gregorio Grounds render obvious steps 4519 and 4520

'882 Patent – Claim 1:

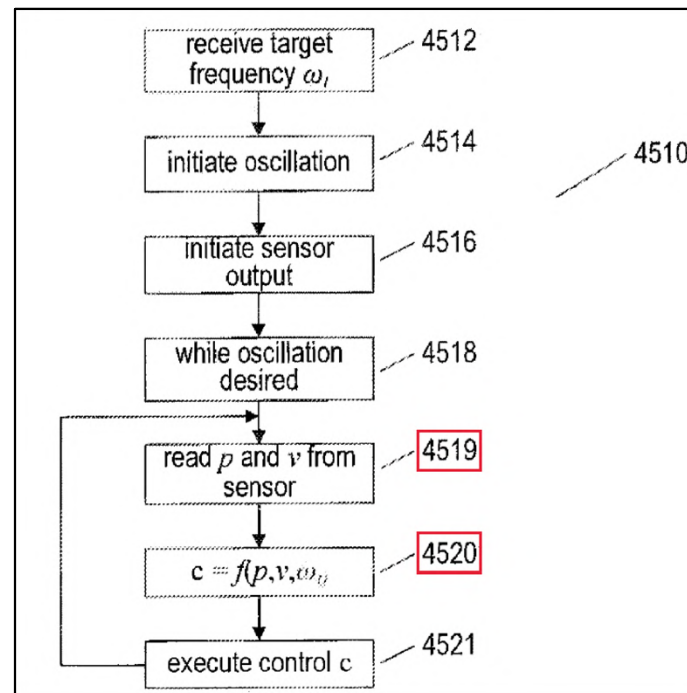
1. An oscillating resonant module comprising:
an oscillation path, which represents a segment of a space curve, along which a point within a mass moves;
a mass that is driven by energy supplied to the oscillating resonant module to oscillate back and forth along the oscillation path that represents a 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
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.



The Gregorio Grounds render obvious steps 4519 and 4520

'882 Patent:

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



The Gregorio Grounds render obvious steps 4519 and 4520

Gregorio:

haptic effect. 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. In this embodiment, 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 generated by the mass and drive coil of the LRA itself.

One embodiment is a system that drives an LRA to generate vibrotactile haptic feedback on a user interface or other area of a device. The system drives the LRA so that the resonant frequency of the LRA can be determined during a drive period and the drive signal can be adjusted to maximize the haptic feedback based on the determined resonant frequency

Dr. Hannaford:

4518). As I mentioned above, Gregorio's resonant actuator includes at least one "sensing device" for "detecting the position of mass," and the sensing devices "provide a sensed position signal that can be used as the monitoring signal to provide information about the position[s] of the mass." APPLE-1007, 4:7-13.

Gregorio's control component receives outputs from the one or more sensors when Gregorio's sensed position signals are received by its control component as outputs of its sensing devices (e.g., a Hall sensor). In particular, Gregorio's control component reads position data and reads (or derives) velocity data from the sensor(s) (step 4519).

moving mass (step 4520). Pet., 46-49. I note that Gregorio expressly indicates the drive signal is "adjusted to maximize the haptic feedback based on the determined resonant frequency," which would have further highlighted to a POSITA that appropriate control is computed based on the target frequency ω_t . APPLE-1007, 2:3-9 (emphasis added).

The Gregorio Grounds render obvious steps 4519 and 4520

Dr. Goossen Declaration:

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.

Dr. Goossen Deposition:

Q. So, what would be a disadvantage of not using V and only using P?

A. Well, I mean in, in, I mean in my envisioning of the system, I mean like I say if you only had P and you updated it according to the target but you didn't update V the slope, right, then, I mean, the thing would be going off in the wrong direction, so to speak, kind of, right, in the next step.

So, it definitely tracks better if you do both. Because V is the slope of the waveform.

The Gregorio Grounds render obvious steps 4519 and 4520

Dr. Hannaford:

178. Based on my knowledge and experience in the field and my review of Gregorio, a POSITA would have recognized from Gregorio's description, and found obvious, to determine velocity from the available position data. *Id.* Computation of velocity based on the change in position over time, such as comparing a difference in current and previous positions over a time, is a fundamental principal recognized by a POSITA. Such a value is readily computed based on position information available from the position sensors. A POSITA would have been led to utilize this basic computation when using a position sensor in accordance with Gregorio's description. Moreover, a POSITA would have recognized that computing velocity in this manner would have beneficially provided the controller with additional information relevant to the current motion of the movable mass, providing an alternative source of velocity information,

Pet., 48; EX1003, ¶178

The Gregorio Grounds render obvious steps 4519 and 4520

Dr. Hannaford:

34. For example, velocity information would have facilitated enhanced characterization of the movement of the mass accurately and in real-time by detecting the change in position over time, furthering Gregorio's objective of detecting and controlling to achieve oscillation at a resonant frequency. Pet., 48-

35. A POSITA would have also recognized the signal processing advantages associated with derivation of velocity, including the sharper peak associated with velocity or acceleration (dv/dt). Relatedly, a POSITA would have recognized, in effectuating Gregorio's objective of determining resonant frequency, that conventional tracking methods would have benefited from the use of velocity, for example as inputs to a band-pass filter or Kalman filter. A POSITA would have likewise recognized the benefits of using a derivative of the speed of the mass as an indicator of "how far the mass will rise above the zero crossing," which can be determined at various points, separate from a measurement of a particular max position. APPLE-1007, 4:42-48.

The Gregorio Grounds render obvious steps 4519 and 4520

Dr. Hannaford:

33. For example, a POSITA would have found obvious that computing velocity from position **beneficially provided the controller with information relevant to the current motion of the movable mass, and further facilitated determination of acceleration (dv/dt)**. Pet., 48. Determining velocity and acceleration from position was **ubiquitous and common** in such applications. And, a POSITA would have especially recognized benefits of doing so in view of Gregorio's description of determining the "derivative of the speed of the mass (dv/dt).” APPLE-1007, 4:42-48.

The Gregorio Grounds render obvious steps 4519 and 4520

Dr. Hannaford:

26-27. As I noted above, even if Patent Owner's proposal were viable, the technique of calculating dv/dt was conventional. Moreover, unlike Patent Owner's proposal, calculating dv/dt is expressly mentioned by Gregorio to calculating "how far the mass will rise above the zero crossing" in determining the resonant frequency. APPLE-1007, 4:42-48. Such calculating was a known effective option for effectuating Gregorio's objective.

"And contrary to the Board's suggestion, [Petitioner] never had to show that replacing [Reference A's] secondary cache with [Reference B's] secondary cache was an 'improvement' in a categorical sense."

Intel Corporation v. PACT XPP Schweiz AG, 61 F.4th 1373, 1381 (Fed. Cir. March 13, 2023).

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The Gregorio Grounds render obvious steps 4519 and 4520

Dr. Hannaford:

242. Based on my knowledge and experience in the field and my review of Gregorio and Fuller, a POSITA would have been motivated to implement the Gregorio and Gregorio-Fuller systems **in accordance with Muramatsu's suggestions computing control outputs from position and/or velocity** of a moving object, and using pre-computed values in lookup tables. APPLE-1009, 4:41-50,

243. **In the combined system**, Gregorio's processor/logic circuitry **determines the velocity of the moveable component** (e.g., "magnet 27) based on current and previously measured positions of the movable magnet. APPLE-1009, 6:23-27. Additionally, the processor/logic circuitry "includes data tables storing

The Gregorio Grounds render obvious steps 4519 and 4520

Dr. Hannaford:

simply based on current and previous positions. Even if not apparent from Gregorio alone, a POSITA would have predictably looked to other teachings, such as Muramatsu to implement and further Gregorio's feedback control objectives—Muramatsu expressly demonstrates the POSITA's knowledge of a controller that "calculates a current velocity X' on the basis of the current position X and the previous position." APPLE-1009, 6:23-27. Utilization of position measurements at multiple (e.g., two) points would have been recognized as a conventional and reliable technique for determining velocity, and facilitating effective characterization of the motion of Gregorio's moveable magnet(s) for use in the feedback control system. APPLE-1005, [0038].

The Gregorio Grounds render obvious steps 4519 and 4520

Patent Owner: “The Petition’s discussion of Grounds 2E–2H does not mention the ‘target frequency’ or step 4520 of the control component algorithm that computes control outputs based upon this target frequency.” Sur-Reply, 15

Dr. Hannaford:

249. A POSITA would have readily recognized the applicability of such techniques to Gregorio’s system. Moreover, a POSITA would have had a reasonable expectation of success. The control scheme of the combined systems operates consistent with Gregorio, and the modifications to implement Muramatsu’s techniques for determining velocity and use of data tables, for example, would have been primarily software based. Moreover, each of Gregorio, Fuller, and Muramatsu relates to systems that include sensors for detecting motion of a moving component, and processing the sensor data for control.

Pet., 68;
EX1003, ¶249