# Petitioner's Oral Hearing Demonstratives

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

Case No. IPR2024-00807
U.S. Patent No. 8,860,337

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

FISH.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

APPLE 1056
Apple Inc. v. Resonant Systems, Inc.
IPR2024-00807

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# The Challenged Patent



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# The ’337 Patent


US008860337B2

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

(10) **Patent No.: US 8,860,337 B2**
(45) **Date of Patent: Oct. 14, 2014**

(54) **LINEAR VIBRATION MODULES AND LINEAR-RESONANT VIBRATION MODULES**

(75) Inventors: **Robin Elenga**, Seattle, WA (US); **Brian Marc Pepin**, Oakland, CA (US); **Glen Tompkins**, Woodinville, WA (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 322 days.

(21) Appl. No.: **13/345,607**

(22) Filed: **Jan. 6, 2012**

(65) **Prior Publication Data**

US 2012/0133308 A1 May 31, 2012

**Related U.S. Application Data**

(63) Continuation-in-part of application No. 12/782,697, filed on May 18, 2010, now Pat. No. 8,093,767.

(60) Provisional application No. 61/179,109, filed on May 18, 2009.

(51) **Int. Cl.**
***H02K 33/00*** (2006.01)
***H02K 33/16*** (2006.01)

(52) **U.S. Cl.**
CPC ..... ***H02K 33/16*** (2013.01)
USPC ..... **318/128**; 318/129; 318/114

(58) **Field of Classification Search**
USPC ..... 318/128, 129, 114; 310/19, 36, 254, 17; 340/407.1
See application file for complete search history.

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(Continued)

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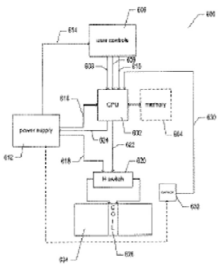
EP 1 376 833 A1 1/2004

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(57) **ABSTRACT**

The current application is directed to various types of linear vibrational modules, including linear-resonant vibration modules, that can be incorporated in a wide variety of appliances, devices, and systems to provide vibrational forces. The vibrational forces are produced by linear oscillation of a weight or member, in turn produced by rapidly alternating the polarity of one or more driving electromagnets. Feedback control is used to maintain the vibrational frequency of linear-resonant vibration module at or near the resonant frequency for the linear-resonant vibration module. Both linear vibration modules and linear-resonant vibration modules can be designed to produce vibrational amplitude/frequency combinations throughout a large region of amplitude/frequency space.

**5 Claims, 20 Drawing Sheets**



EX1001 (‘337 patent), page 1

(57) **ABSTRACT**

The current application is directed to various types of linear vibrational modules, including linear-resonant vibration modules, that can be incorporated in a wide variety of appliances, devices, and systems to provide vibrational forces. The vibrational forces are produced by linear oscillation of a weight or member, in turn produced by rapidly alternating the polarity of one or more driving electromagnets. Feedback control is used to maintain the vibrational frequency of linear-resonant vibration module at or near the resonant frequency for the linear-resonant vibration module. Both linear vibration modules and linear-resonant vibration modules can be designed to produce vibrational amplitude/frequency combinations throughout a large region of amplitude/frequency space.

EX1001 (‘337 patent), page 1

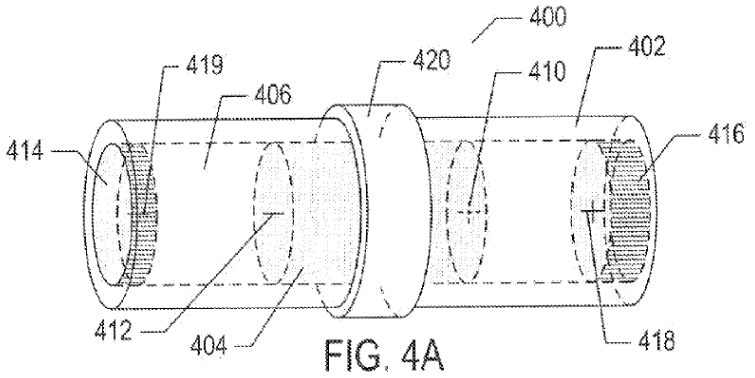


FIG. 4A

EX1001 (‘337 patent), page 6 (FIG. 4A)



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# The ’337 Patent – Independent Claim 2

[2pre] A linear vibration module comprising:

[2a] a housing;

[2b] a moveable component;

[2c] a power supply;

[2d] user-input features;

[2e] a driving component that drives the moveable component in each of two opposite directions within the housing; and

[2f] a control component that controls supply of power from the power supply to the driving component to cause the moveable component to oscillate at a frequency and an amplitude specified by user input received from the user-input features,

[2g] wherein the control component drives simultaneous oscillation of the moveable component at two or more frequencies to generate complex vibration modes.

EX-1001, 16:1-16



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# Highlights from Asserted Prior Art



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# IPR Instituted Grounds

| Ground | Claim(s) Challenged |
|---|---|
| Wakuda, Ramsay | *2*, 3 |
| Wakuda, Ramsay, Rossi, Aldrich | *2*, 3 |
| Gregorio, Ramsay, Wakuda | *2* |
| Gregorio, Ramsay, Tierling | *2*, 3 |
| Gregorio, Ramsay, Wakuda, Rossi, Aldrich | *2* |
| Gregorio, Ramsay, Tierling, Rossi, Aldrich | *2*, 3 |

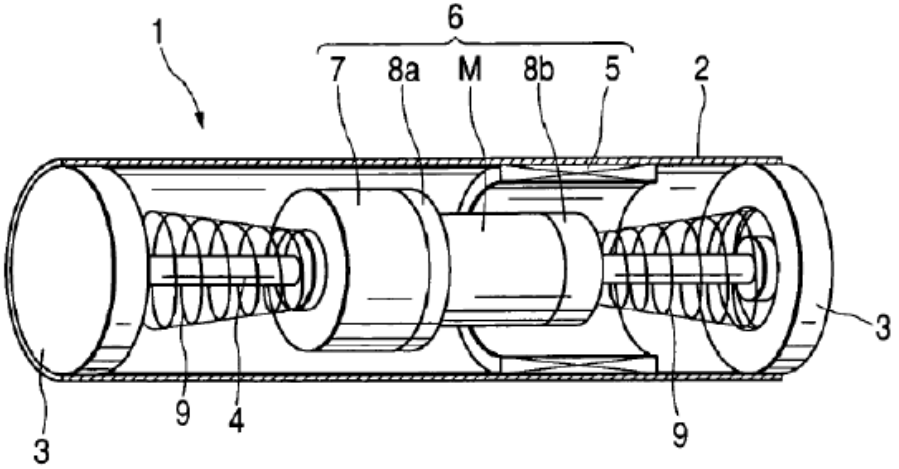
* Independent claim noted in ***green***

Institution Decision (ID), 7

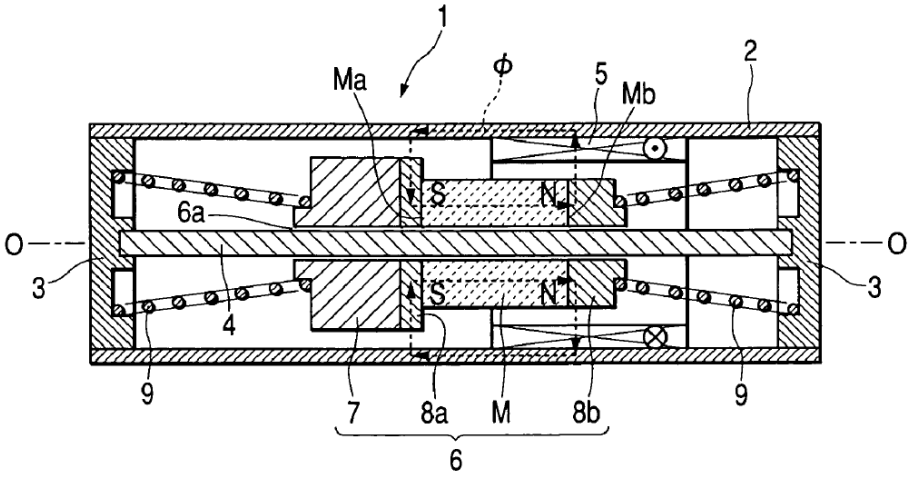


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# Overview of Wakuda




Wakuda (APPLE-1005), FIG. 1A; Pet., 26)




Wakuda (APPLE-1005), FIG. 1B; Pet., 30)

A vibration generator system according to the invention comprises vibration generating means **1** shown in FIG. **1** and control means shown in FIG. **3**.

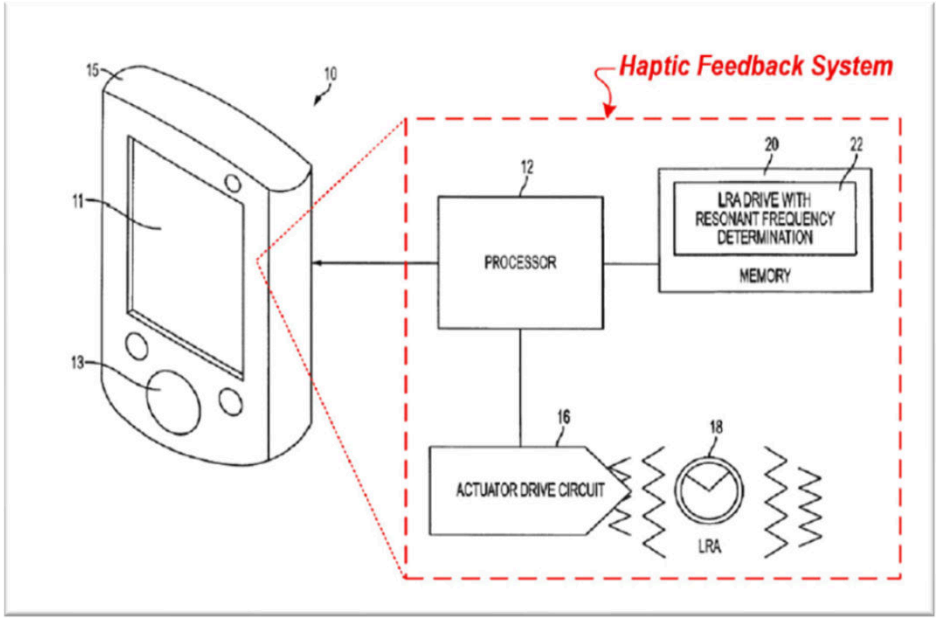
The vibration generating means **1** shown in FIG. **1** comprises a cylindrical-shaped casing **2** made of a magnetic substance as a support, and covers **3**, **3** made of a non-magnetic substance and being mountable on both ends of the casing. A shaft **4** made of a non-magnetic substance is supported on inner surfaces of the covers **3**, **3**, the shaft **4** being in agreement with an imaginary center line O—O, which extends centrally of the casing **2** and the covers **3**, **3**.

A coil **5** is fixed to an inner wall of the casing **2**. The coil **5** is formed by winding a length of covered copper wire, such as enameled wire or the like, in a cylindrical shape, and is fixed in a position somewhat to one (a X1 side in FIG. **1**) of the covers **3** from a center of a length of the casing **2** in a direction X shown.

A movable body **6** is provided inside the casing **2**. The movable body **6** is provided at one end thereof (a X2 side) with a weight **7** made of a non-magnetic substance and at the other end thereof (a X1 side) with a magnet M. Also, the magnet M is provided on both end surfaces thereof with yoke members **8***a*, **8***b*, which are formed from a magnetic material. The weight **7**, yoke member **8***a*, magnet M, and the yoke member **8***b* are column- or disk-shaped, and all outer peripheral surfaces thereof are positioned in circles concentric with a center of the shaft **4**.


DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# Overview of Gregorio




Pet., 9 (reproducing and annotating Gregorio (APPLE-1004), FIG. 1)

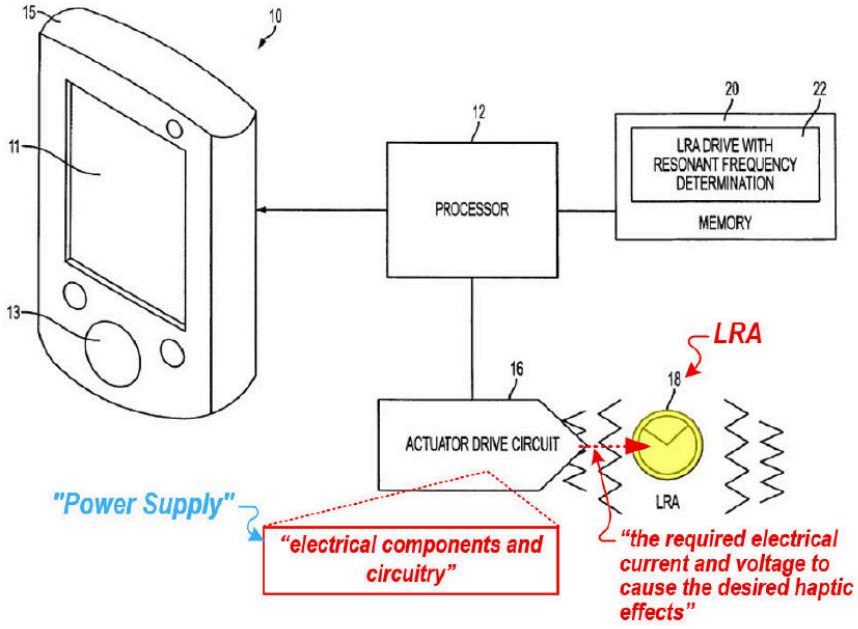
FIG. **1** is a block diagram of a haptically-enabled system **10** in accordance with one embodiment. System **10** includes a touch sensitive surface **11** or other type of user interface mounted within a housing **15**, and may include mechanical keys/buttons **13**. Internal to system **10** is a haptic feedback system that generates vibrations on system **10**. In one embodiment, the vibrations are generated on touch surface **11**.

The haptic feedback system includes a processor **12**. Coupled to processor **12** is a memory **20** and an actuator drive circuit **16**, which is coupled to an LRA actuator **18**. Processor **12** may be any type of general

Gregorio (APPLE-1004), 2:10-20; Pet., 8-11


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# Overview of Gregorio



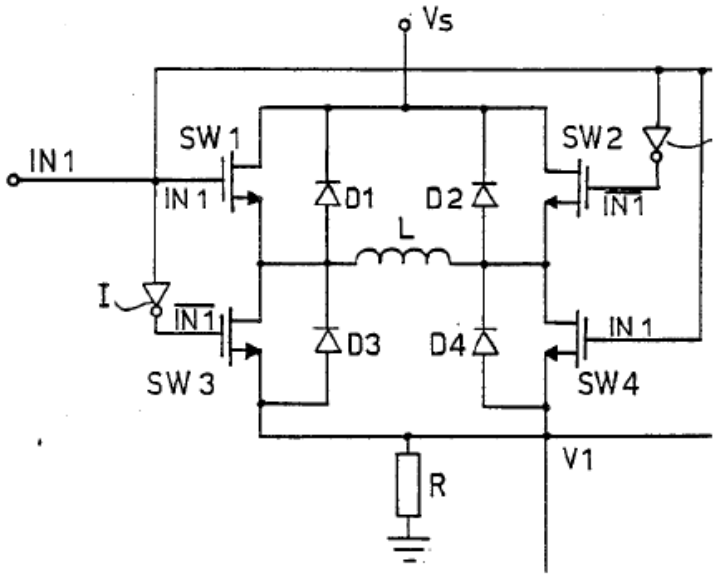

Pet., 14 (reproducing and annotating Gregorio (APPLE-1004), FIG. 1)

Processor **12** outputs the 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. System **10** may include more than one LRA **18**, and each LRA may include a separate drive circuit **16**, all coupled to a common processor **12**. Memory device **20** can be any type of storage device or computer-readable medium, such as random access memory ("RAM") or read-only memory ("ROM"). Memory **20** stores instructions executed by processor **12**. Among the instructions, memory **20** includes an LRA Drive with Resonant Frequency Determination module **22** which are instructions that, when executed by processor **12**, generate drive signals for LRA **18** while also determining the resonant frequency of LRA **18** and adjusting the drive signals accordingly. The functionality of module **22** is discussed in more detail below. Memory **20** may also be located internal to processor **12**, or any combination of internal and external memory.

Gregorio (APPLE-1004), 2:36-53; Pet., 8-11


DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# Overview of Rossi




APPLE-1020, Figure 6 (partial)

Rossi (APPLE-1020), FIG. 6 (partial) (cited in Pet. 31)

## *Petition's Construction*

Rossi's H-bridge switching circuit includes "two pairs of analog switches arranged in a bridge configuration." APPLE-1020, Abstract; 1:65-3:55, Figures 4, 6, cls. 1, 3, 4. The H-bridge circuit includes a "driving signal IN1" input, which is split and a portion passed through an "inverter I" to generate an internal "driving signal IN1" and an "inverted signal thereof $\overline{\text{IN1}}$." *Id.*; APPLE-1003, [74]-[79].

Pet. 31



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# Wakuda Combination



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# Topics For Discussion

## Wakuda Combination

1. **The Combination renders obvious the Power Supply ([2c])**
2. The Combination renders obvious the Control Component ([2f])


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# The ’337 Patent – Independent Claim 2

[2pre] A linear vibration module comprising:

[2a] a housing;

[2b] a moveable component;

[2c] a power supply;

[2d] user-input features;

[2e] a driving component that drives the moveable component in each of two opposite directions within the housing; and

[2f] a control component that controls supply of power from the power supply to the driving component to cause the moveable component to oscillate at a frequency and an amplitude specified by user input received from the user-input features,

[2g] wherein the control component drives simultaneous oscillation of the moveable component at two or more frequencies to generate complex vibration modes.

EX-1001, 16:1-16



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# Wakuda's Express Disclosure of the Power Supply

Pet., 17-19; Pet. Rep., 2-4

*Wakuda*

The drive means 13 is provided with two output parts, one of which is connected to one of the terminals Ta1 of the coil 5 and the other of which is connected to the other of the terminals Ta2 of the coil 5.

The signal generation means 12 generates a drive signal S1 on the basis of a command from the vibration control means 14 to output the same to the drive means 13, and a drive current having a predetermined waveform is given to the terminal Ta1 and the terminal Ta2 of the coil 5 from the drive means 13. The signal generation means 12 stores the drive signals S1 having a plurality of patterns, and a drive signal S1 having a certain pattern is selected on the basis of a command from the vibration control means 14 to be given to the drive means 13.

Wakuda (APPLE-1005), 6:26-39 (cited in Pet., 17-18)



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# Wakuda's Express Disclosure of the Power Supply

Pet., 17-19; Pet. Rep., 2-4

**Petition (at 17)**

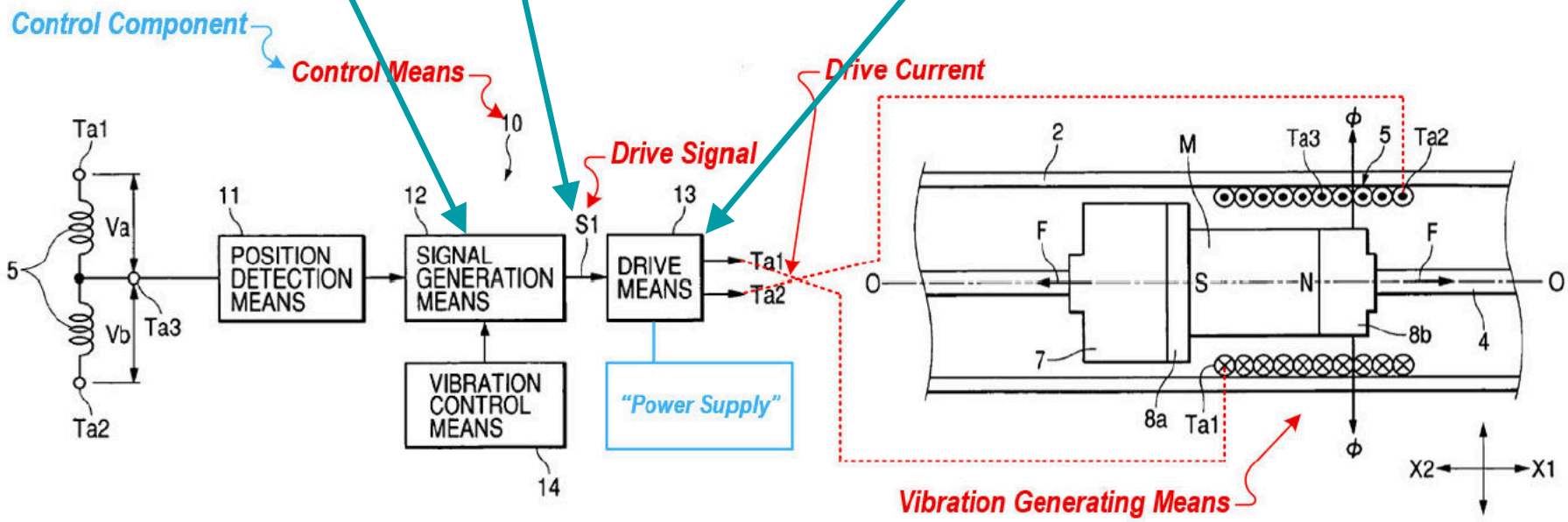
***Wakuda's control means includes "signal generation means 12" that "generates a drive signal S1*** on the basis of a command from the vibration control means 14 to output the same to the drive means 13. APPLE-1005, 6:23-39."

**Petition (at 17)**

***According to the drive signal S1, the drive means 13 provides "a drive current having a predetermined waveform*** ... to the terminal Ta1 and the terminal Ta2 of the coil 5." *Id.*

**Petition (at 17-18)**

***Because the drive means supplies the drive current to the coil of the vibration generating means, a POSITA would have readily understood and found obvious that the drive means includes, or is coupled to, the power supply ([1c]),*** and that the control means (control component) controls, via the drive signal, the supply of current (supply of power) from the power supply, which is included in or coupled to the drive means, to the coil (moveable component ([1b])). APPLE-1003, [110]; APPLE-1005, Figures 3-4 (below).




Wakuda (APPLE-1005), FIGS. 3 and 4 (cited and annotated in Pet., 18)

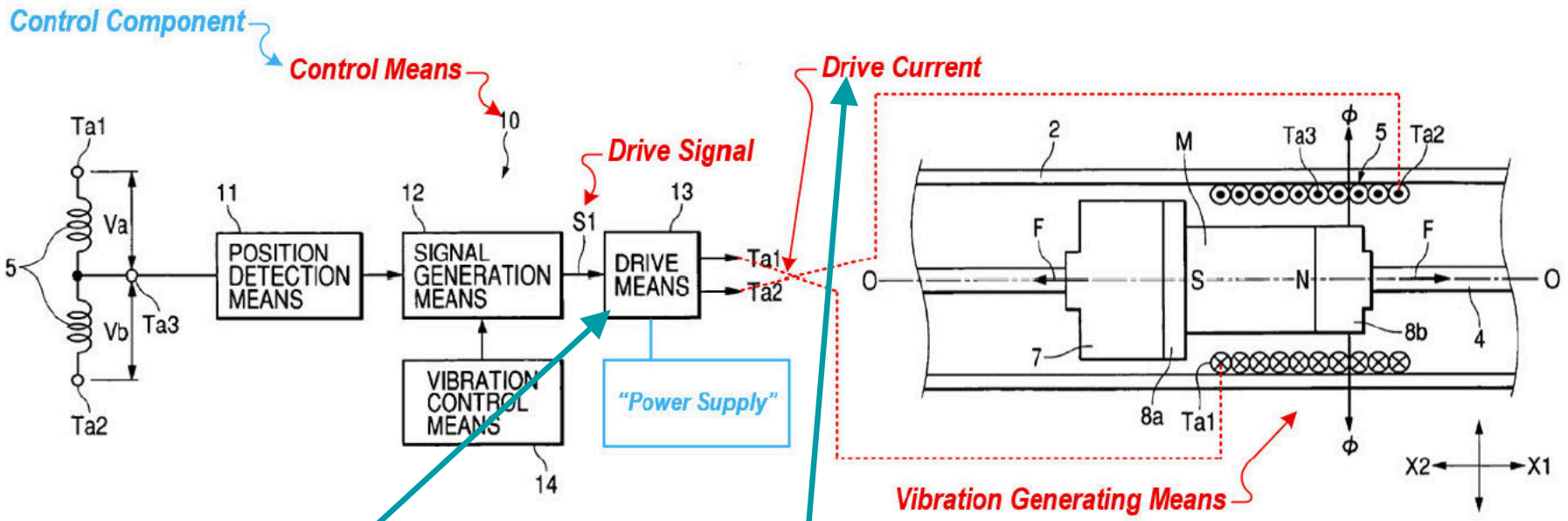


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# Wakuda's Express Disclosure of the Power Supply

Pet., 17-19; Pet. Rep., 2-4




Wakuda (APPLE-1005), FIGS. 3 and 4 (cited and annotated in Pet., 18)

## Petitioner Reply

The drive means qualifies as a power supply because a POSITA would have understood and found it obvious that electric current is supplied with voltage, and electric power is defined by current and voltage.

Pet. Rep. 3

## Goosen's Testimony

Q. Would you agree that if you supply current and voltage, that you are supplying power?

***A.*** ***Yes***. But, he doesn't explain how.

---

Q. But, current power -- current/power necessarily comes from [a] power supply, correct?

A. Yes. What I am saying there is that a single signal controls everything.").

APPLE-1055 (Goossen Decl. Tr.), 76:11-14, 138:17-20 (cited in Pet. Rep., 3)



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# Plain and Ordinary Meaning of "Power Supply" Supports Wakuda's Express Disclosure

Pet. Rep., 4-5

## *Hannaford Testimony*

"A POSITA would have understood and found obvious that Wakuda's drive means corresponds to the power supply, given the plain and ordinary meaning of the term "power supply."

APPLE-1049, [5] (citing APPLE-1050, 1, APPLE-1051, APPLE-1052, APPLE-1053, ID (Paper 10), 30)

WIKIPEDIA
The Free Encyclopedia

**Power supply**

A **power supply** is an electrical device that supplies electric power to an electrical load. The main purpose of a power

APPLE-1050, 1 (cited in Pet. Rep., 4)

SECOND EDITION COMPREHENSIVE DICTIONARY OF ELECTRICAL ENGINEERING

**power supply** an electronic module that converts power from some power source to a form which is needed by the equipment to which power is being supplied.

APPLE-1051 (cited in Pet. Rep., 4)

Illustrated DICTIONARY of ELECTRICAL ENGINEERING

■ **power supply**

a separate unit or part of a circuit that supplies power to the rest of the circuit or to a system.

APPLE-1052 (cited in Pet. Rep., 4)

**power supply** *noun* ELEC **1.** an electrical circuit that provides certain direct current voltage and current levels from an alternating current source for use in other electrical circuits ○ *If the power supply from the amplifier to the gauge fails, the needle slowly falls to zero.* **2.** sa
**power supply unit**

DICTIONARY OF SCIENCE AND TECHNOLOGY

APPLE-1053 (cited in Pet. Rep., 4)



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# The Board Discussed the Power Supply was Well-Known

Pet. Rep., 4-5

| *Institution Decision* |
| --- |
| "Moreover, the '337 patent does not disclose any detail or structure for the controllable power supply, indicating that such a controllable power supply was well-known." |

ID (Paper 10), 30 (cited in Pet. Rep., 5)



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DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# Topics For Discussion

## Wakuda Combination

1. The Combination renders obvious the Power Supply ([2c])
2. **The Combination renders obvious the Control Component ([2f])**



DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# The ’337 Patent – Independent Claim 2

[2pre] A linear vibration module comprising:

[2a] a housing;

[2b] a moveable component;

[2c] a power supply;

[2d] user-input features;

[2e] a driving component that drives the moveable component in each of two opposite directions within the housing; and

[2f] a control component that controls supply of power from the power supply to the driving component to cause the moveable component to oscillate at a frequency and an amplitude specified by user input received from the user-input features,

[2g] wherein the control component drives simultaneous oscillation of the moveable component at two or more frequencies to generate complex vibration modes.

EX-1001, 16:1-16



DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# The Combination renders obvious the Control Component ([2f])

2. The Combination renders obvious the Control Component ([2f])

   a. **Means-Plus-Function Construction of "Control Component"**

   b. The Combination renders obvious the Recited Amplitude ("output p")

   c. The Combination renders obvious the Recited Frequency ("output d")



DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# Both Parties' Means-Plus-Function Constructions

POR, 7-15

| *Petition's Construction* |
| --- |
| "This Petition treats 'control component' in claim 2 as including one of the switches shown in Figures 5A-6 and described at 5:45-65, 6:2-8 and the processor (also referred to as microprocessor, microcontroller, or CPU) that performs the algorithm shown in Figures 7A-7C and described at 6:43-8:30 and 13:3-41, and equivalents of this structure." |

Pet. 4

| *Resonant's Construction in Parallel Proceeding* |
| --- |
| **Structure**: microcontroller with internal or external memory; processor; CPU; microprocessor; and equivalents thereof<br><br>[if an algorithm is required] Where the corresponding structure is a processor, CPU, or microprocessor, the processor / CPU / microprocessor is programmed with an algorithm comprising the following steps: (a) set the mode and strength to values representing selections made by user input to the user input features; (b) provide a corresponding output to the power supply so that the power supply provides a corresponding output to the driving component; and (c) drive simultaneous oscillation of the moveable component at two or more frequencies. |

Ex. 2002, (Markman Order), 5-6



DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# Means-Plus-Function Construction of "Control Component" in Institution Decision

POR, 7-15

*Institution Decision*

"In summary, the corresponding structure of the "control component" under a means-plus-function interpretation that relies upon a microprocessor (and memory) as corresponding structure further requires algorithmic structure at least for 1) operating a timer or its equivalent to flip the polarity of a control value periodically corresponding to a user-selected frequency and input the control value to an H-bridge switch circuit to change the direction of the current through the coil as supplied by the power supply, and 2) computing an output value corresponding to a user-selected amplitude of oscillation and outputting the value to the claimed power supply so that the power supply outputs an appropriate current amplitude to a coil."

ID, 20



DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# The Combination renders obvious the Control Component ([2f])

2. The Combination renders obvious the Control Component ([2f])

a. Means-Plus-Function Construction of “Control Component”

**b. The Combination renders obvious the Recited Amplitude (“output p”)**

c. The Combination renders obvious the Recited Frequency (“output d”)



DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# Resonant's Argument

Pet. Rep., 1-8

***While acknowledging that Wakuda discloses a direction output "d," Resonant alleges that Wakuda does not disclose a separate output "p" to the power supply.***

| *Resonant's POR* |
| --- |
| "[Wakuda] does not show an "output value p corresponding to the currently selected strength" or an "output p to the power supply," one or both of which is required under the proper means-plus-function construction." |

POR, 16



DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# Resonant's Argument

Pet. Rep., 1-8

***Cont'd***

*Resonant's POR*

A POSITA reading Wakuda would readily understand Wakuda's teaching to use a single drive signal to control both the frequency and amplitude of the vibration of the vibration generating means, by controlling whether the drive signal is in-phase ("accumulation signal") or out-of-phase ("damping signal") with the vibrational waveform. (*Id.*) This is illustrated, for example, in Wakuda's figures 4 and 5, shown below (Ex. 1005 Figs. 4 and 5.):

…

Based on this, a POSITA would similarly recognize that Wakuda does not disclose, and does not require, a separate signal d ***[sic]*** from the control component to the power supply, either directly or indirectly. (Ex. 2009, ¶ 150.) This is in contrast to the teaching of the '337 Patent, and the requirement under the correct means-plus-function construction, of both a directional output d (corresponding to Wakuda's drive signal) and a separate output p to the power supply (which has no counterpart in Wakuda). (*Id.*)

POR, 16-19



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# Resonant's Limited Reading of Wakuda's "Drive Means" Is Erroneous

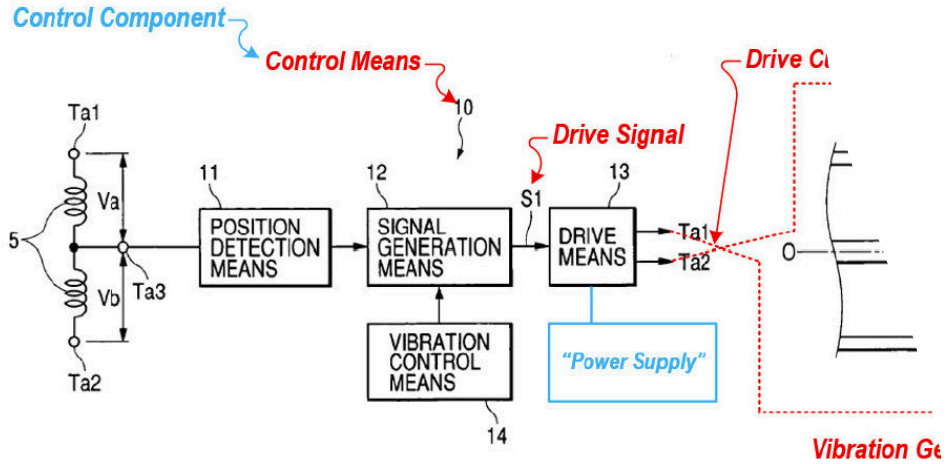
Pet. Rep., 1-8

***Wakuda's "drive signal" is for controlling the amount of current being supplied by the drive means 13 (the power supply), as well as the direction of current being supplied by the drive means 13 (i.e., Resonant's "conduit of power" part)***

## *Petitioner Reply*

The assumption by Patent Owner and Dr. Goossen—Wakuda's drive signal S1 is only to change the direction of constant current—is wrong. APPLE-1049, [7]. Nowhere does Wakuda limit its drive means 13 to only a switch that changes the direction of current. Id. In fact, Wakuda offers numerous teachings otherwise, namely a drive signal S1 having variable current.

Pet. Rep. 6-7 (citing Wakuda (APPLE-1005), 6:63-66, 7:61-63, 9:40-48, 8:7-14)




Wakuda (APPLE-1005), FIGS. 3 and 4 (cited and annotated in Pet., 18)



DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# Resonant's Limited Reading of Wakuda's "Drive Means" Is Erroneous

Pet. Rep., 1-8

***Wakuda's drive signal S1 varies in current level:***

| *Wakuda* |
| --- |
| FIG. 4 shows a waveform of a drive signal S1. In the embodiment, while the drive signal S1 is given to the coil 5 as a rectangular wave, the drive signal S1 may have a waveform such as a ***triangular wave*** or the like. |

Gregorio (APPLE-1005), 6:63-66 (cited in Pet. Rep. 6-7)

| *Wakuda* |
| --- |
| In addition, it is not necessarily required that the accumulation signal S1 a include the excitation signal A and the reverse excitation signal B, and so vibrations can be generated in the movable body 6 and increased in amplitude only with the excitation signal A or the reverse excitation signal B. In this case, amplitude can be abruptly increased by increasing the excitation signal A or the reverse excitation signal B ***in current quantity***. |

Gregorio (APPLE-1005), 7:56-63 (cited in Pet. Rep. 6-7)



DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# Resonant's Limited Reading of Wakuda's "Drive Means" Is Erroneous

Pet. Rep., 1-8

***Wakuda's drive signal S1 varies in current level:***

| *Wakuda* |
| --- |
| Also, the envelope E that can be bodily sensed by humans can be freely changed in frequency and cycle by changing a repeating cycle period of a set of the accumulation signal S1 a and the damping signal S1 b in the drive signal S1. Also, the envelope E can be changed in amplitude by changing the number of and a ***current quantity*** of the excitation signal A and the reverse excitation signal B and changing the number of and a ***current quantity*** of the inhibition signals C and the reverse inhibition signals D. |

Gregorio (APPLE-1005), 6:40-48 (cited in Pet. Rep. 6-7)

| *Wakuda* |
| --- |
| Methods of controlling an increasing rate (decreasing rate) of amplitude include a method of varying an input energy, and a method of staggering a drive signal S1. The former method of varying an input energy includes control through amplitude variation, in which ***a drive current (or a drive voltage) given to the coil 5 is varied in quantity***, and PWM (Pulse Width Modulation) control, in which a drive current (or a drive voltage) is varied in energization time. Also, the latter method of staggering a drive signal S1 includes one, in which phase is shifted, and one, in which frequency is shifted. |

Gregorio (APPLE-1005), 9:40-48 (cited in Pet. Rep. 6-7)



DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# The Combination renders obvious the Control Component ([2f])

2. The Combination renders obvious the Control Component ([2f])

a. Means-Plus-Function Construction of “Control Component”

b. The Combination renders obvious the Recited Amplitude (“output p”)

**c. The Combination renders obvious the Recited Frequency (“output d”)**



DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

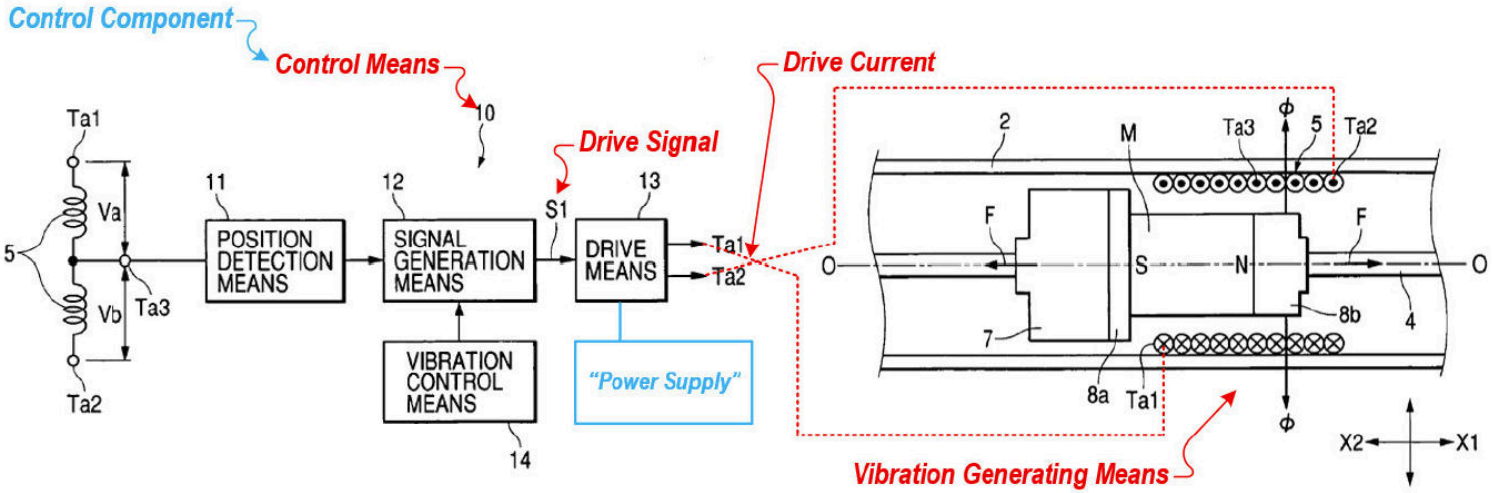
# Wakuda's Disclosure of Directional Output "d"

Pet. Rep., 1-10

## *Wakuda*

The position detection means 11 detects that the movable body 6 has reached the neutral position shown in FIGS. 1 and 2, that is, a middle point in the reciprocation stroke. When a detection signal of the middle point detected by the position detection means 11 is given to the signal generation means 12, the signal generation means 12 performs control, such as ***switching of current direction of the drive signal S1*** or the like, with the detection signal as a standard.

Wakuda (APPLE-1005), 6:40-47 (cited in Pet., 18)




Wakuda (APPLE-1005), FIGS. 3 and 4 (cited and annotated in Pet., 18)



DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# Directional Output "d" in Wakuda-Ramsay-Rossi Comb

Pet. Rep., 8-10

***Rossi's H-bridge specifically implements the directional control part of Wakuda' drive means 13, while preserving the current amount control part of the drive means 13***

*Petitioner Reply*

In the Wakuda-Ramsay-Rossi combination, Rossi's H-bridge is implemented as ***part*** of Wakuda's drive means 13 to switch the direction/polarity of drive signals to the coil of the vibration generating means, thereby adjusting the frequency of haptic effect. **Pet., 32**; APPLE-1003, [135]-[144]; APPLE-1049, [11]. Contrary to Patent Owner's conclusory arguments, Rossi's H-bridge does not replace the entirety of Wakuda's drive means 13. Instead, it provides an example of how to implement the frequency control part (e.g., directional signal control part) of Wakuda's drive means 13. *Id.* Accordingly, Wakuda's drive means 13 preserves the capability to adjust the amplitude of current being applied to the coil in order to adjust the strength/magnitude of the haptic vibration. Id.; *see generally* **Pet., 32-34, 39-40**; APPLE-1003, [135]-[144], [160].

Pet. Rep. 9 (citing Pet., 32-34, 39-40

FISH.



DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# Resonant Appreciates Wakuda's Directional Output "d"

Pet. Rep., 1-10

***Resonant acknowledged that Wakuda discloses a direction output "d" to the drive means (the power supply).***

| *Resonant's POR* |
| --- |
| Based on this, a POSITA would similarly recognize that Wakuda does not disclose, and does not require, a separate signal d ***[sic]*** from the control component to the power supply, either directly or indirectly. (Ex. 2009, ¶ 150.) This is in contrast to the teaching of the '337 Patent, and the requirement under the correct means-plus-function construction, of both ***a directional output d (corresponding to Wakuda's drive signal)*** and a separate output p to the power supply (which has no counterpart in Wakuda). (*Id.*) |

POR, 19

| *Resonant's POR* |
| --- |
| Wakuda teaches a drive signal to the drive means to switch the direction of the current supplied by the power supply to the coil, which is sufficient, in the context of the purported obviousness combination, to control the haptic effects. (*Id.*) |

POR, 19-20



DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# All limitations are met under Patent Owner's Untimely Construtction

Pet. Rep., 1-10

## *Resonant's POR*

This is in contrast to the teaching of the '337 Patent, and the requirement under the correct means-plus-function construction, of both ***a directional output d*** (corresponding to Wakuda's drive signal) and ***a separate output p to the power supply*** (which has no counterpart in Wakuda). (*Id.*)

…

This is consistent with, and supports, Dr. Goossen's opinion that Wakuda teaches a single drive signal S1 to drive means 13 to control both direction and current/ power, and ***not a second signal p to the power supply*** as taught and required by the '337 patent. (Ex. 2009, ¶ 151.)

POR, 19

## *Resonant's Sur-Reply*

At most, Wakuda's disclosures concerning drive signal S1 teach a single step of outputting a signal. Nowhere does it teach ***separately outputting d and p signals at separate steps*** of the algorithm as required by the means-plus-function corresponding structures proposed by Apple and adopted in the Board's Institution Decision.

Sur-reply, 6



DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# Gregorio Combination



DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# Topics For Discussion

## Gregorio Combination

1. **The Combination renders obvious the Power Supply ([2c])**
2. The Combination renders obvious the Control Component ([2f])


DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# The ’337 Patent – Independent Claim 2

[2pre] A linear vibration module comprising:

[2a] a housing;

[2b] a moveable component;

[2c] a power supply;

[2d] user-input features;

[2e] a driving component that drives the moveable component in each of two opposite directions within the housing; and

[2f] a control component that controls supply of power from the power supply to the driving component to cause the moveable component to oscillate at a frequency and an amplitude specified by user input received from the user-input features,

[2g] wherein the control component drives simultaneous oscillation of the moveable component at two or more frequencies to generate complex vibration modes.

EX-1001, 16:1-16



FISH.

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# Gregorio's Express Disclosure of the Power Supply

Pet., 50-51, 62-63; Pet. Rep., 10-11

| *Gregorio* |
| --- |
| "Processor 12 outputs the 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." |

Gregorio (APPLE-1004), 2:36-39 (cited in Pet., 50-51, 62-63)

FISH.



DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# Plain and Ordinary Meaning of "Power Supply" Supports Gregorio's Express Disclosure

Pet. Rep., 12-13

## *Hannaford Testimony*

"A POSITA would have understood and found obvious that Gregorio's actuator drive circuit corresponds to the power supply, given the plain and ordinary meaning of the term "power supply."

APPLE-1049, [17] (citing APPLE-1050, 1, APPLE-1051, APPLE-1052, APPLE-1053, ID (Paper 10),44)

WIKIPEDIA
The Free Encyclopedia

**Power supply**

A **power supply** is an electrical device that supplies electric power to an electrical load. The main purpose of a power

APPLE-1050, 1 (cited in Pet. Rep., 12)

SECOND EDITION COMPREHENSIVE DICTIONARY OF ELECTRICAL ENGINEERING

**power supply** an electronic module that converts power from some power source to a form which is needed by the equipment to which power is being supplied.

APPLE-1051 (cited in Pet. Rep., 12)

Illustrated DICTIONARY of ELECTRICAL ENGINEERING

■ **power supply**

a separate unit or part of a circuit that supplies power to the rest of the circuit or to a system.

APPLE-1052 (cited in Pet. Rep., 12)

**power supply** *noun* ELEC **1.** an electrical circuit that provides certain direct current voltage and current levels from an alternating current source for use in other electrical circuits ○ *If the power supply from the amplifier to the gauge fails, the needle slowly falls to zero.* **2.** sa
**power supply unit**

DICTIONARY OF SCIENCE AND TECHNOLOGY

APPLE-1053 (cited in Pet. Rep., 12)



DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# Resonant's Own Expert Acknowledges Gregorio's Disclosure of the Power Supply

Pet. Rep., 3

| *Goosen's Testimony* |
| --- |
| Q. Would you agree that if you supply current and voltage, that you are supplying power?<br><br>A. ***Yes***. But, he doesn't explain how. |

APPLE-1055 (Goossen Decl. Tr.), 76:11-14 (cited in Pet. Rep., 12)



DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# Gregorio's Express Disclosure of the Power Supply

Pet., 50-51, 62-63; Pet. Rep., 10-11

| *Gregorio* |
| --- |
| "Processor 12 outputs the 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." |

Gregorio (APPLE-1004), 2:36-39 (cited in Pet., 50-51, 62-63)

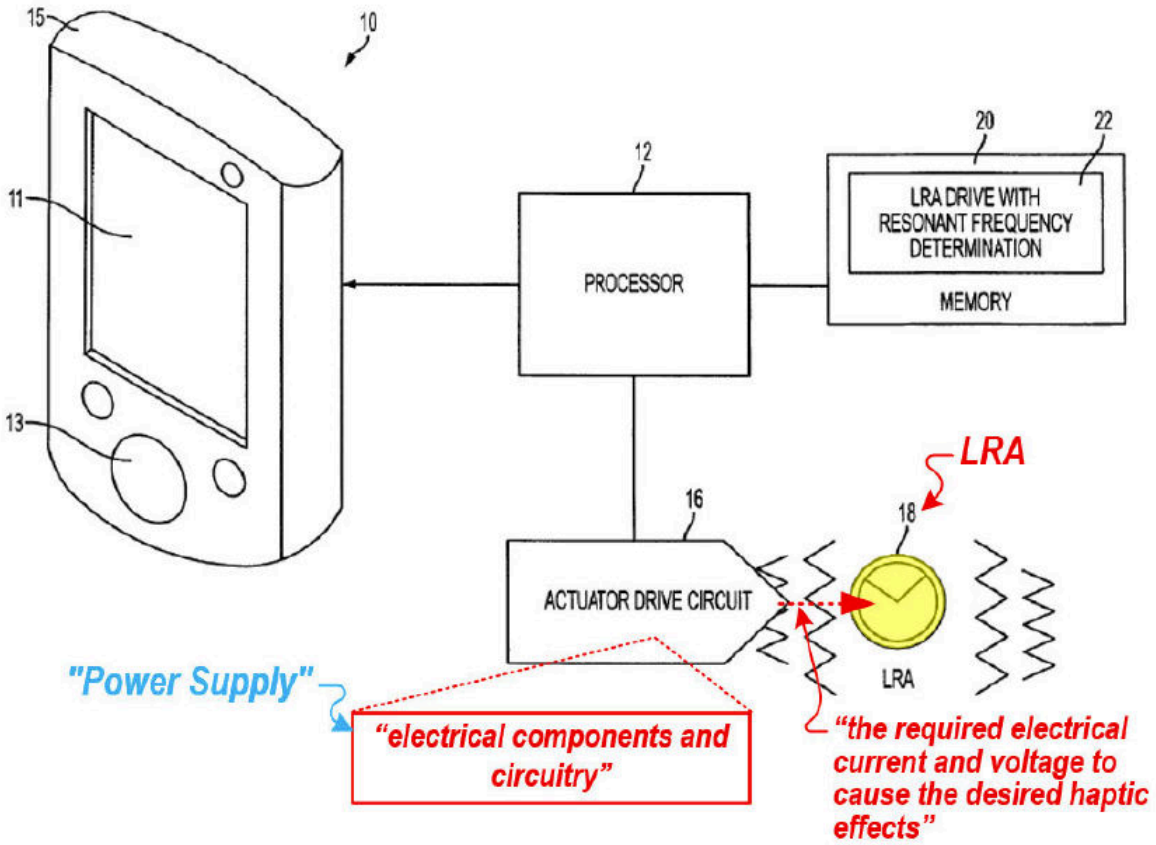
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DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# Gregorio's Express Disclosure of the Power Supply

Pet., 62-63; Pet. Rep., 10-11




Gregorio (APPLE-1004), FIG. 1 (annotated in Pet. 63)



DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# The Board Discussed the Power Supply was Well-Known

ID, 44

*Institution Decision*

"Moreover, the '337 patent does not disclose any detail or structure for the controllable power supply, indicating that such a controllable power supply was well-known."

ID (Paper 10), 44 (cited in Pet. Rep., 12-13)



DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# Topics For Discussion

## Gregorio Combination

1. The Combination renders obvious the Power Supply ([2c])
2. **The Combination renders obvious the Control Component ([2f])**



DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# The ’337 Patent – Independent Claim 2

[2pre] A linear vibration module comprising:

[2a] a housing;

[2b] a moveable component;

[2c] a power supply;

[2d] user-input features;

[2e] a driving component that drives the moveable component in each of two opposite directions within the housing; and

[2f] a control component that controls supply of power from the power supply to the driving component to cause the moveable component to oscillate at a frequency and an amplitude specified by user input received from the user-input features,

[2g] wherein the control component drives simultaneous oscillation of the moveable component at two or more frequencies to generate complex vibration modes.

EX-1001, 16:1-16



DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# The Combination renders obvious the Control Component ([2f])

2. The Combination renders obvious the Control Component ([2f])

a. **Means-Plus-Function Construction of "Control Component"**

b. The Combination renders obvious the Recited Amplitude ("output p")

c. The Combination renders obvious the Recited Frequency ("output d")

d. All limitations are met under Patent Owner's untimely construction



DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# Both Parties' Means-Plus-Function Constructions

POR, 7-15

| *Petition's Construction* |
| --- |
| "This Petition treats 'control component' in claim 2 as including one of the switches shown in Figures 5A-6 and described at 5:45-65, 6:2-8 and the processor (also referred to as microprocessor, microcontroller, or CPU) that performs the algorithm shown in Figures 7A-7C and described at 6:43-8:30 and 13:3-41, and equivalents of this structure." |

Pet. 4

| *Resonant's Construction in Parallel Proceeding* |
| --- |
| **Structure**: microcontroller with internal or external memory; processor; CPU; microprocessor; and equivalents thereof<br><br>[if an algorithm is required] Where the corresponding structure is a processor, CPU, or microprocessor, the processor / CPU / microprocessor is programmed with an algorithm comprising the following steps: (a) set the mode and strength to values representing selections made by user input to the user input features; (b) provide a corresponding output to the power supply so that the power supply provides a corresponding output to the driving component; and (c) drive simultaneous oscillation of the moveable component at two or more frequencies. |

Ex. 2002, (Markman Order), 5-6



DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# Means-Plus-Function Construction of "Control Component" in Institution Decision

POR, 7-15

*Institution Decision*

"In summary, the corresponding structure of the "control component" under a means-plus-function interpretation that relies upon a microprocessor (and memory) as corresponding structure further requires algorithmic structure at least for 1) operating a timer or its equivalent to flip the polarity of a control value periodically corresponding to a user-selected frequency and input the control value to an H-bridge switch circuit to change the direction of the current through the coil as supplied by the power supply, and 2) computing an output value corresponding to a user-selected amplitude of oscillation and outputting the value to the claimed power supply so that the power supply outputs an appropriate current amplitude to a coil."

ID, 20



DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# Resonant's Argument

Pet. Rep., 10-15

*Resonant's POR*

Also, the means-plus-function construction requires at least two outputs from the control component, namely ***the output 'd,' corresponding to the desired direction***, as produced by the frequency timer, and ***the output 'p'*** to the power supply. (Ex. 2009, ¶ 123.) The petition does not and cannot show both of these outputs."

POR, 27

FISH.



DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# The Combination renders obvious the Control Component ([2f])

2. The Combination renders obvious the Control Component ([2f])

a. Means-Plus-Function Construction of "Control Component"

**b. The Combination renders obvious the Recited Amplitude ("output p")**

**c. The Combination renders obvious the Recited Frequency ("output d")**

d. All limitations are met under Patent Owner's untimely construction



DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# Resonant's Argument

Pet. Rep., 10-15

*Resonant's POR*

"The petition does not contend that Gregorio discloses any processor or algorithm that provides an 'output value p corresponding to the currently selected strength' or ***an 'output p to the power supply,'*** …

POR, 27



DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# Gregorio's "Control Signals" for Amount of Current

Pet., 62-64

***The Petition discussed that Gregorio controls the actuator drive circuit 16 (the power supply) to change both the frequency and the amplitude of the oscillation***

| *Petition* |
| --- |
| Gregorio-Ramsay-Wakuda's vibration module includes a control component (combination of "processor," "memory," and either "LRA Drive with Resonant Frequency Determination module" or circuit 400) that controls the supply of power from the power supply ("actuator drive circuit") to the driving component ("coil") to cause the moveable component ("movement/oscillation of magnet") to oscillate at a frequency (high-level frequency, assumed resonance frequency, or determined resonance frequency) and an amplitude (high level "magnitude," "desired amplitude," or "present amplitude") specified by user input received from the user-input features (Gregorio-Ramsay's on-device user interface allowing the user to separately input frequency and amplitude). APPLE-1006, [0005], [0015]; APPLE-1003, [225]-[231]. |

Pet., 62 (Element [1f]); 65 (Element [2f])



DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# Resonant's Limited Reading of Gregorio's "Actuator Drive Circuit" Is Erroneous

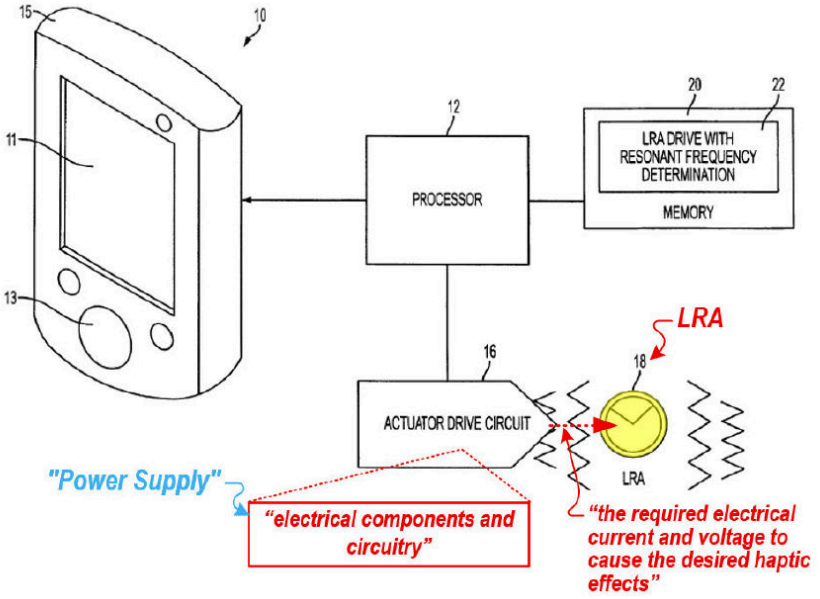
Pet. Rep., 10-15; Pet. 62-64

***Gregorio's "control signals" are for controlling the amount of current being supplied by the drive circuit 16 (the power supply), as well as the direction of current being supplied by the drive circuit 16 (i.e., Resonant's "conduit of power" part)***

## *Petitioner Reply*

Gregorio's processor 12 "decide[s] what haptic effects are to be played and the order in which the effects are played based on ***high level parameters***," such as "***magnitude, frequency*** and duration," which can dynamically vary "based on a user's interaction."

Pet. Rep. 14 (citing Gregorio (APPLE-1004), 2:25-30)




Gregorio (APPLE-1004), FIG. 1 (annotated in Pet. 63)



DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# Gregorio's "Control Signals" for Both Direction and Amount of Current

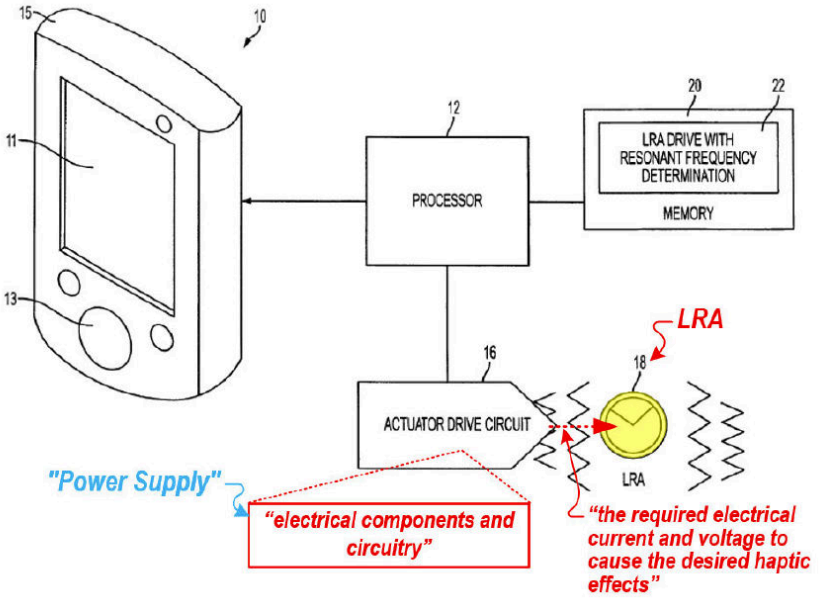
Pet. Rep., 13-15; Pet. 62-64

***Cont'd***

**Hannaford Testimony**

Therefore, a POSITA, reading Gregorio's disclosure, would have naturally understood and found it obvious that the "control signals" from the processor 12 to the actuator drive circuit 16 include information that controls the drive circuit 16 to "supply LRA 18 with the required electrical current and voltage" that correspond to the ***"high level parameters"*** (i.e., "magnitude, frequency and duration") for the selected haptic effect. That is, the ***"control signals"*** from the processor 12 to the drive circuit 16 determine the attributes (e.g., amplitude, direction, etc.) of the current supplied by the actuator drive circuit 16 (the claimed power supply) to the LRA 18.

APPLE-1049, [20]; Pet. Rep., 14




Gregorio (APPLE-1004), FIG. 1 (annotated in Pet. 60)



DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# The Combination renders obvious the Control Component ([2f])

2. The Combination renders obvious the Control Component ([2f])

a. Means-Plus-Function Construction of "Control Component"

b. The Combination renders obvious the Recited Amplitude ("output p")

**c. The Combination renders obvious the Recited Frequency ("output d")**

d. All limitations are met under Patent Owner's untimely construction



DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# Means-Plus-Function Construction of "Control Component" in Institution Decision

*Institution Decision*

"In summary, the corresponding structure of the "control component" under a means plus function interpretation that relies upon a microprocessor (and memory) as corresponding structure further requires algorithmic structure at least for 1) operating a timer or its equivalent to flip the polarity of a control value periodically corresponding to a user-selected frequency and input the control value to an H-bridge switch circuit to change the direction of the current through the coil as supplied by the power supply, and 2) computing an output value corresponding to a user-selected amplitude of oscillation and outputting the value to the claimed power supply so that the power supply outputs an appropriate current amplitude to a coil."

ID (Paper 11), 20



DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

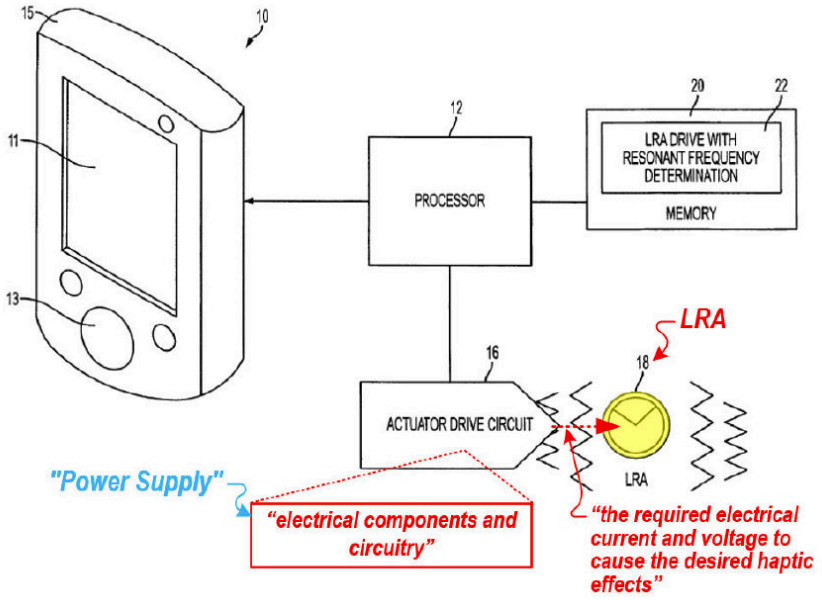
# Resonant's Limited Reading of Gregorio's "Actuator Drive Circuit" Is Erroneous

Pet. Rep., 10-15; Pet. 62-64

## *Petitioner Reply*

Gregorio's processor 12 "decide[s] what haptic effects are to be played and the order in which the effects are played based on ***high level parameters***," such as "***magnitude, frequency*** and duration," which can dynamically vary "based on a user's interaction."

Pet. Rep. 14 (citing Gregorio (APPLE-1004), 2:25-30)




Gregorio (APPLE-1004), FIG. 1 (annotated in Pet. 63)



DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# Gregorio's "Control Signals" for Both Direction and Amount of Current in Gregorio-Ramsay-Rossi Combo

Pet. Rep., 15-18

***Rossi's H-bridge specifically implements the directional control part of Gregorio's actuator drive circuit 16, while preserving the current amount control part of the actuator drive circuit 16***

| *Petitioner Reply* |
| --- |
| In the Gregorio-Ramsay-Rossi combination, Rossi's H-bridge is implemented as ***part*** of Gregorio's actuator driver circuit 16 to switch the direction/polarity of drive signals to the LRA, thereby adjusting the frequency of haptic effect. APPLE-1049, [25]; **Pet., 75-76**; APPLE-1003, [263]-[272].<br>Contrary to Patent Owner's conclusory arguments, Rossi's H-bridge does not replace the entirety of Gregorio's drive circuit 16. APPLE-1049, [26]. Instead, it provides an example of how to implement the frequency control part (e.g., directional signal control part) of Gregorio's actuator drive circuit 16. *Id.* Accordingly, Gregorio's drive circuit 16 preserves the capability to adjust the amplitude of current applied to LRA to adjust the strength/magnitude of the haptic effect. *Id.*; *see generally* **Pet., 75-76, 79-80**; APPLE-1003, [265]-[272], [289]-[292], [323]. |

Pet. Rep. 17 (citing Pet., 75-76-79-80)

FISH.



DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# Gregorio's "Control Signals" for Both Direction and Amount of Current

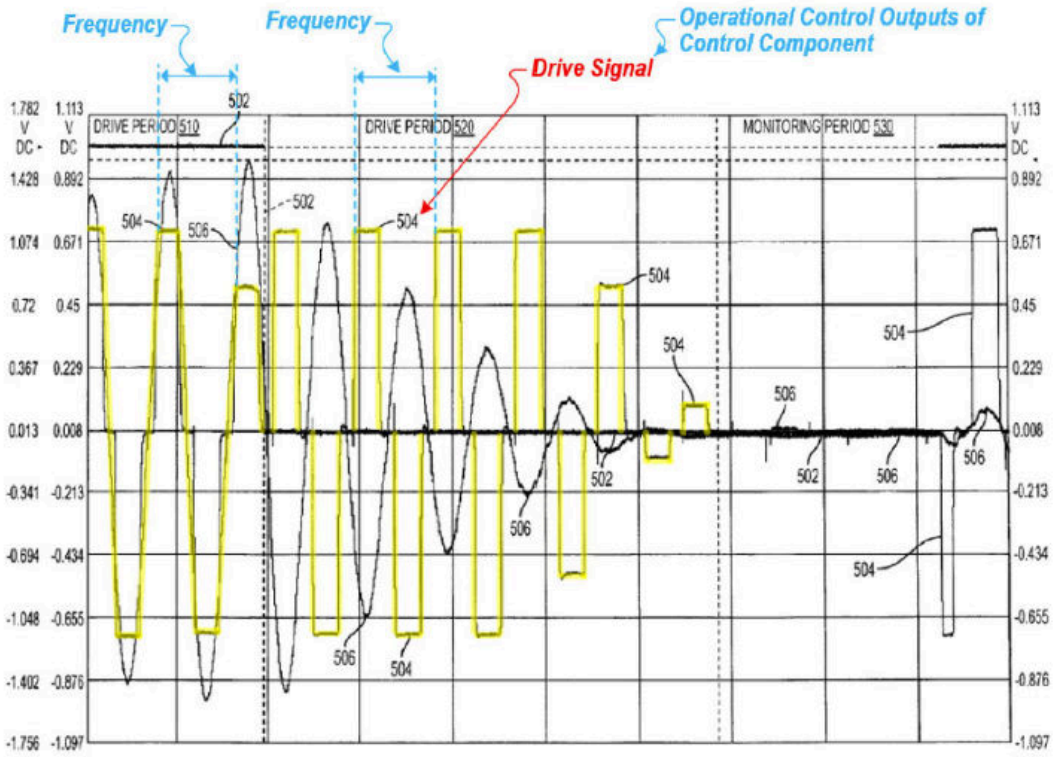
Pet. Rep., 10-15

***Gregorio's drive signal (also referred to as "drive signal pulses" or "drive pulses"), resulting from the "control signals," determine both the amount and the direction of the current being supplied to LRA.***

**Hannaford Testimony**

In fact, Gregorio's drive signal 504, which is applied to LRA 18 to generate a desired haptic effect, has a varying magnitude, which is adjusted by varying the amplitude of current or the level of power.

APPLE-1049, [21] (citing APPLE-1004, 4:1-2, 4:5-7, 5:60-61, FIG. 5, cl. 2); Pet. Rep., 14-15




Gregorio (APPLE-1004), FIG. 5 (annotated in Pet. Rep., 14-15)



DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# The Combination renders obvious the Control Component ([2f])

2. The Combination renders obvious the Control Component ([2f])

a. Means-Plus-Function Construction of "Control Component"

b. The Combination renders obvious the Recited Amplitude ("output p")

c. The Combination renders obvious the Recited Frequency ("output d")

**d. All limitations are met under Patent Owner's untimely construction**



DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# All limitations are met under Patent Owner's untimely construction

Pet. Rep., 15-18

## *Resonant's POR*

"The petition does not contend that Gregorio discloses any processor or algorithm that provides an 'output value p corresponding to the currently selected strength' or ***an 'output p to the power supply,'*** …

Also, the means-plus-function construction requires at least two outputs from the control component, namely ***the output 'd,' corresponding to the desired direction***, as produced by the frequency timer, and ***the output 'p'*** to the power supply. (Ex. 2009, ¶ 123.) The petition does not and cannot show both of these outputs."

POR, 27

## *Resonant's Sur-Reply*

"In particular, ***[the Petition] fails to show that the "output d" and "output p" occur separately***, on different iterations of the Figure 7A loop, as required by the algorithm of the Board's construction."

"Nowhere does Gregario teach ***separately outputting d and p signals at separate steps*** of the algorithm as required by the means-plus-function corresponding structures proposed by Apple and adopted in the Board's Institution Decision."

Sur-reply, 1, 10



DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

# The zero crossing time of the LRA is measured and the polarity status is latched until the end of the drive pulse

Gregorio (APPLE-1004),4:37-42, which is cited in Pet. 78

wave.

At **302**, at each half crossing of the drive pulse (i.e., when the square wave pulse goes from positive to negative and vice versa), the zero crossing time of the LRA back EMF is measured and the polarity status is latched until the end of the drive pulse.

At **304**, during each drive cycle, after the end of the last

DEMONSTRATIVE EXHIBIT - NOT EVIDENCE

# Gregario describes the "generation or variation" of these parameters "based on a user's interaction"

Gregorio (APPLE-1004),2:18-35, which is cited in Pet. 59)

The haptic feedback system includes a processor **12**. Coupled to processor **12** is a memory **20** and an actuator drive circuit **16**, which is coupled to an LRA actuator **18**. Processor **12** may be any type of general purpose processor, or could be a processor specifically designed to provide haptic effects, such as an application-specific integrated circuit ("ASIC"). Processor **12** may be the same processor that operates the entire system **10**, or may be a separate processor. Processor **12** can decide what haptic effects are to be played and the order in which the effects are played based on high level parameters. In general, the high level parameters that define a particular haptic effect include magnitude, frequency and duration. Low level parameters such as streaming motor commands could also be used to determine a particular haptic effect. A haptic effect may be considered "dynamic" if it includes some variation of these parameters when the haptic effect is generated or a variation of these parameters based on a user's interaction.

Processor **12** outputs the control signals to drive circuit **16**

DEMONSTRATIVE EXHIBIT - NOT EVIDENCE