

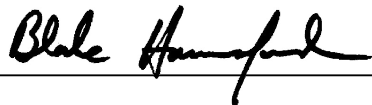
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent of: Elenga et al.
U.S. Patent No.: 9,941,830 Attorney Docket No. 50095-0179IP1
Issue Date: April 10, 2018
Appl. Serial No.: 15/181,249
Filing Date: June 13, 2016
Title: LINEAR VIBRATION MODULES AND LINEAR-RESONANT
VIBRATION MODULES

SUPPLEMENTAL DECLARATION OF DR. BLAKE HANNAFORD

I hereby declare that all statements made of my own knowledge are true and that all statements made on information and belief are believed to be true. I further declare that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of the Title 18 of the United States Code.

Dated: 29-May-2025

By: 

Blake Hannaford, Ph.D.

This Declaration expands on the conclusions that I have formed based on the analysis provided in my first declaration (APPLE-1003, incorporated herein by reference in its entirety; “Original Declaration”). Consistent with my findings provided in my Original Declaration and based upon my knowledge and experience and my review of the prior art publications listed in my first and current declarations, a POSITA would have found that claims 1-8, 14-17, 19, and 20 (“the Challenged Claims”) of the ’830 patent are rendered obvious by at least the combinations of references set forth in my Original Declaration.

I. GROUNDS 2A RENDERS THE CHALLENGED CLAIMS OBVIOUS UNDER MEANS-PLUS-FUNCTION CONSTRUCTIONS

1. As I already discussed in the Original Declaration, Gregorio expressly describes its “actuator drive circuit” as the claimed power supply and teaches that its processor outputs the value (“control signals”) to the actuator drive circuit, thereby satisfying step 762 of FIG. 7C. APPLE-1003, [60]-[66], [97]-[99], [103]-[110], [230]-[233], [259]-[261].

2. The POR argues that the Petition fails to demonstrate that the processor “computes an output value p” and “outputs the value p to the power supply.” POR, 19-20. This assertion, however, simply disregards Gregorio’s explicit disclosure of the claimed power supply (e.g., Gregorio’s “actuator drive circuit”) and the processor computing and outputting a value (e.g., Gregorio’s

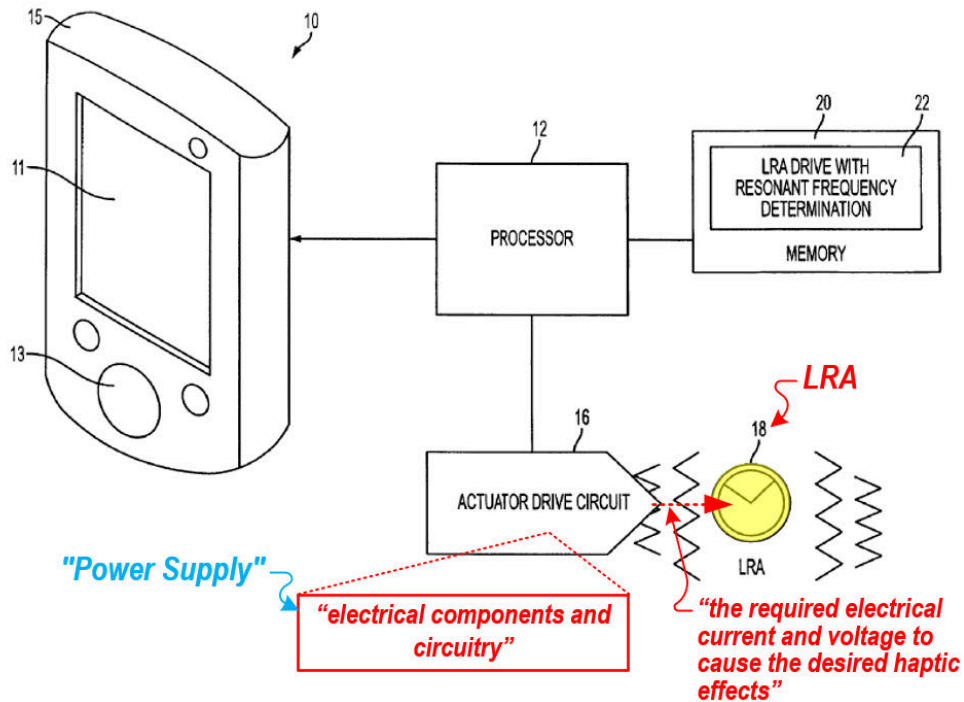
“control signals”) to the power supply. APPLE-1003, [60]-[66], [97]-[99], [103]-[110], [230]-[233], [259]-[261].

A. Gregorio’s “Actuator Drive Circuit” Teaches The Claimed Power Supply

3. In the Original Declaration (element [1c] in Ground 1A), I discussed that Gregorio’s “actuator drive circuit” teaches the claimed power supply. APPLE-1003, [97]-[99] (citing Gregorio’s FIG. 1). This analysis is based on Gregorio’s express disclosure:

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.

APPLE-1004, 2:36-39. This was also shown in annotated FIG. 1 of Gregorio in the Original Declaration. APPLE-1003, [97] (reproduced below).



APPLE-1004, FIG. 1 (annotated)

4. Indeed, Gregorio describes that the actuator drive circuit 16 includes “electronic components and circuitry used to supply LRA 18 with the required electrical current and voltage,” and therefore is qualified as a power supply because “electric power is defined by current and voltage.” APPLE-1003, [97]-[99]; APPLE-1004, 2:36-39.

5. 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.” For example, a POSITA would have understood that the power supply is “an electrical device that supplies electric power to an electrical load” (APPLE-1050, 1), and this aligns exactly with

Gregorio's description of actuator drive circuit 16, "which includes electronic components and circuitry used to supply LRA 18 with the required electrical current and voltage" (APPLE-1004, 2:36-39). *See also* APPLE-1051 ("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-1052 ("a separate unit or part of a circuit that supplies power to the rest of the circuit or to a system"); APPLE-1053 ("an electrical circuit that provides certain direct current voltage and current levels from an alternating current source for use in other electrical circuits"); *see also* ID (Paper 11), 31-32 ("Moreover, the '830 patent does not disclose any detail or structure for the controllable power supply, indicating that such a controllable power supply was well-known.").

6. Confronted with Gregorio's express discussion of the power supply, Patent Owner's expert, Dr. Goossen, introduced a new argument during his deposition that Gregorio's actuator drive circuit is only "a conduit for power" because "it does not vary the level of power." APPLE-1055, 76:20-77:2, 79:11-16, 127:16-19. In the context of the '830 patent's FIG. 6, he characterized H-bridge switch 620 as a conduit for power, which is separate from power supply 612. APPLE-1055, 128:7-129:5. Therefore, Dr. Goossen appears to argue that Gregorio's actuator drive circuit would only operate to change the polarity of current flowing through the drive circuit, based only on a "directional signal d."

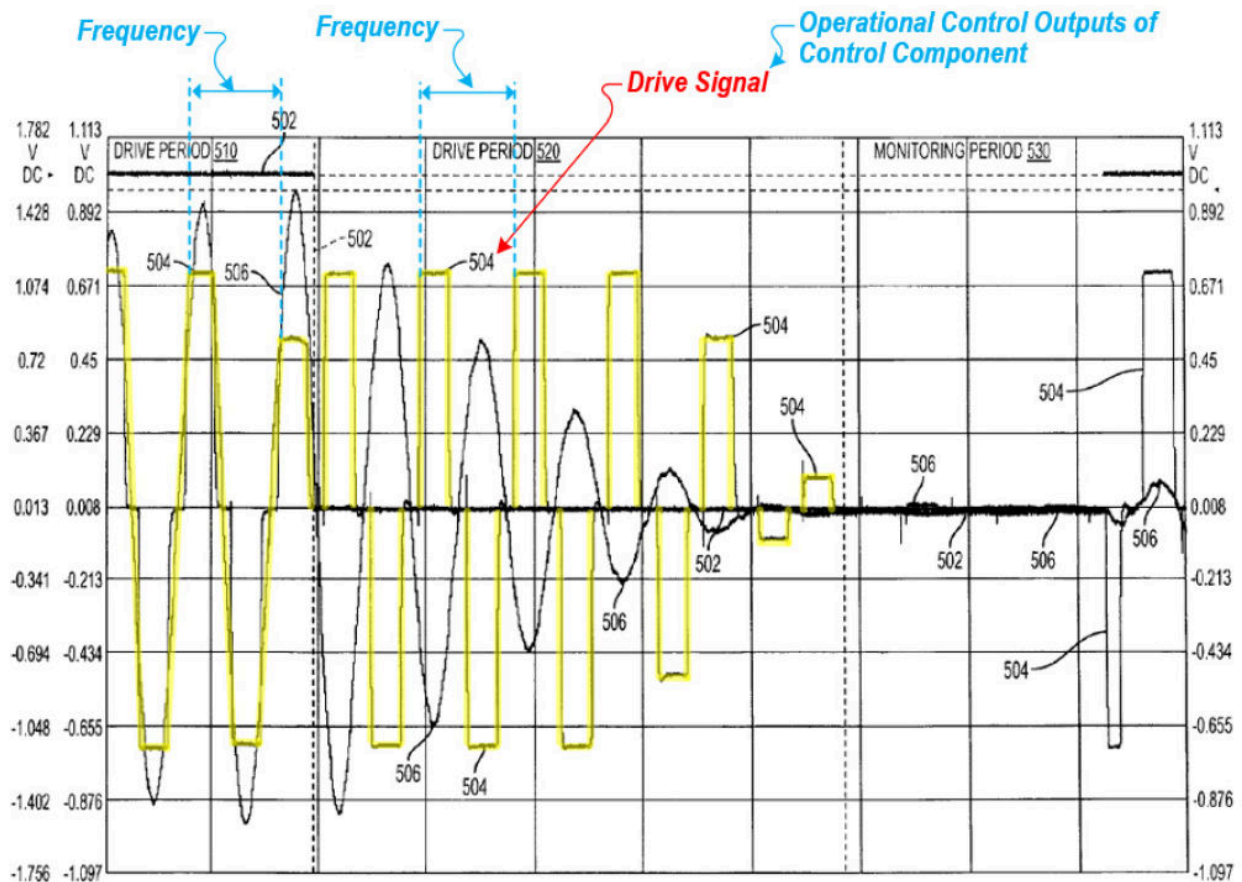
See APPLE-1001, 5:58-6:5. This assertion is conclusory, it contradicts Gregorio's disclosure, and it incorrectly assumes that Gregorio uses the same type of switching circuit disclosed in the '830 patent.

7. Indeed, Gregorio offers no reason for construing its actuator drive circuit 16 in such a way, namely only as a switch that controls the polarity of the drive signals for LRA 18. Referring to FIG. 1, Gregorio describes that the actuator drive circuit 16 is coupled to the processor 12 and the LRA 18. APPLE-1004, 2:18-20. Gregorio describes no other element that is connected to the actuator drive circuit 16. With this configuration, Gregorio describes that "[p]rocessor 12 outputs the control signals to drive circuit 16" and the drive circuit 16 "suppl[ies] LRA 18 with the required electrical current and voltage to cause the desired haptic effects." APPLE-1004, 2:36-39. Further, 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." *Id.*, 2:25-30.

8. 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-1004, 2:36-39, 2:45-50.

9. 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-1004, 4:1-2, 4:5-7, 5:60-61, FIG. 5 (reproduced below with the drive signal 504 annotated to show its varying amplitude), cl. 2 (“modifying an amplitude of one of the drive pulses in response to the signal”); *see also* APPLE-1003, [128]-[133] (element [5b]), [138]-[140] (element [6b]). As repeatedly highlighted above, such varying current or power is delivered from the actuator drive circuit 16 to LRA 18.



APPLE-1004, FIG. 5 (annotated) (cited in APPLE-1003, [131])

10. As such, the time-varying magnitude of the drive signal 504 also confirms that drive circuit 16 functions as the claimed power supply, which is controlled to provide variable current/power through the control signals from the processor 12. Dr. Goossen’s “conduit for power” argument, which is new and unsupported, does not survive scrutiny. *Id.*

B. Gregorio Teaches That The Processor Computes And Outputs A Value (“Control Signals”) To The Power Supply (Step 762 in FIG. 7C)

11. Gregorio expressly describes that the processor outputs the “control signals” (output “p”) to the actuator drive circuit (power supply), and the control signals are designed to control the actuator drive circuit to supply LRA with current or power that is variable according to the high-level parameters (“magnitude, frequency and duration”) for a desired haptic effect. APPLE-1004, 2:25-30, 2:36-39, 2:45-50, 4:1-2, 4:5-7, 5:60-61, FIG. 5, cl. 2; *see also* APPLE-1003, [128]-[133] (element [5b]), [138]-[140] (element [6b]), APPLE-1003, [259]-[261]. Because the other references (Ramsay, Rossi, and Aldrich) do not modify these aspects of Gregorio, the combination of Gregorio-Ramsay-Rossi-Aldrich does not change the above analysis based on Gregorio.

12. Nonetheless, Patent Owner argues that the Petition fails to show the “output value p” to the power supply, as shown in step 762 of FIG. 7C. POR, 19-20. In particular, Patent Owner alleges that, under the means-plus-function construction, the control component provides two values: (1) output “d” corresponding to the desired direction, as produced by the frequency timer, and (2) output “p” to the power supply, and that the Petition fails to show the latter. POR, 20. As explained above in Section I.A, this is meritless. Further, Patent Owner does not dispute that the Petition showed the features associated with output “d.” Therefore, Gregorio’s control component outputs both the desired direction “d” and the desired power “p.”

13. 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-1003, [211]-[218]; *see also* ID (Paper 11), 26 ("Petitioner further argues that it would have been obvious to use the H-bridge switch of Rossi as part of the Gregorio actuator drive circuit 16 in the asserted Gregorio-Ramsay combination to periodically switch the polarity of drive signals to electric coil 28 of Gregorio, and thus oscillate magnet 27, under the control of a signal from processor 12 of Gregorio.").

14. Contrary to Patent Owner's baseless arguments, Rossi's H-bridge does not replace the entirety of Gregorio's drive circuit 16. 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. Accordingly, Gregorio's drive circuit 16 preserves the capability to adjust the amplitude of current applied to LRA 18 to adjust the strength/magnitude of the haptic effect. *See generally* APPLE-1003, [211]-[218], [235].

15. Therefore, the analysis in the Petition ("the software executing on the microprocessor outputs a corresponding control signal to the power supply in accordance with the user") is supported by the Gregorio-Ramsay-Rossi-Aldrich combination, which implements Gregorio's processor and memory (control

component) as outputting the control signals (including outputs “p” and “d”) to the actuator drive circuit 16 (power supply), according to a user input (as shown in Ramsay). APPLE-1003, [104]-[110], [259]-[261] (citing APPLE-1006, [0022]-[0026], [0030]-[0033], [0035], [0039], [0046], [0051], [0053]-[0055]); *see also* Pet., 17-18 (citing APPLE-1004, 2:36-39, 3:12-28, 4:20-22, 4:49-65, 2:25-28), 71-72.

II. GROUND 2B RENDERS CLAIMS 14 AND 19 OBVIOUS

16. As I discussed in the Original Declaration, Wakuda provides the structure of the actuator in the Gregorio-Wakuda combination including the claimed paramagnetic flux paths. Patent Owner does not dispute this, except that the Response argues that the Petition fails to show the recited “paramagnetic material.” POR, 21. Specifically, Patent Owner alleges that “a POSITA would have understood the category of ‘magnetic’ materials in Wakuda excludes paramagnetic materials” and “would not have been motivated to replace Wakuda’s magnetic material with a paramagnetic material.” POR. 21-22.

17. Patent Owner’s lengthy argument is centered on the assumption that paramagnetic materials are not sufficient for Wakuda’s “magnetic material” for the components of the resulting actuator. POR, 21-22. Wakuda includes no statement that excludes paramagnetic materials. Further, Patent Owner’s argument directly contradicts the ’830 patent and is based on erroneous interpretations of the

evidence proffered in the Petition. Further, Patent Owner improperly requires the prior art to show more than what the '830 patent discloses for “paramagnetic material” feature.

A. Patent Owner’s Argument About Paramagnetic Materials Is In Stark Contrast With The '830 Patent’s Disclosure

18. Patent Owner first argues that paramagnetic materials are “so weakly magnetic” that they are “commonly considered to be ‘non-magnetic,” and thus a POSITA would not have considered a paramagnetic material for Wakuda’s “magnetic material.” POR, 22-23 (citing EX-2009 (Dr. Goossen’s Decl.), ¶132 (“paramagnetic materials are ‘usually thought of as ‘nonmagnetic’”).

19. However, this argument contradicts the description of paramagnetic materials in the '830 patent. Notably, claims 14 and 19 of the '830 patent describe a paramagnetic material as being used “to reduce the reluctance of one or more magnetic circuits within the vibration module,” which is created by an air gap between circuit components. APPLE-1001, 17:26-29, 18:20-22. As Patent Owner’s expert, Dr. Goossen, acknowledged, the reduction of reluctance is possible because paramagnetic materials are sufficiently magnetic (i.e., they provide sufficient magnetic permeability to provide a lower resistance path for the magnetic circuit in the vibration module and thus improve the efficiency of the magnetic field). APPLE-1055, 93:10-94:5. This is also consistent with the '830 patent’s disclosure of the general characteristics of paramagnetic materials. APPLE-1001, 14:4-19

(“When introduced into a magnetic field, paramagnetic materials provide a lower-resistance path for magnetic flux, providing that they have adequate permeability and size to avoid saturation. Paramagnetic materials of appropriate permeability and size reduce the reluctance of a magnetic circuit and can therefore allow a magnetic field to more efficiently perform more work.”).

20. Therefore, Patent Owner’s argument that paramagnetic materials are “non-magnetic” and thus inappropriate for the “magnetic material” in the Gregorio-Wakuda system contradicts Patent Owner’s own description of paramagnetic materials in the ’830 patent.

B. Patent Owner’s Alleged Preference of Ferromagnetic Materials for Wakuda Structure Does Not Obviate the Petition’s Motivation for Gregorio-Wakuda Combination

21. In the Original Declaration, I discussed why a POSITA would have been motivated and found it obvious to choose a paramagnetic material over other options (e.g., ferromagnetic materials) in implementing the Gregorio-Wakuda structure. APPLE-1003, [156]-[162]. A competing disadvantage of paramagnetic materials that the Patent Owner alleges, such smaller permeabilities than ferromagnetic materials, does not obviate the motivation arguments in the Original Declaration. Indeed, in the Original Declaration, I provided various reasons for using a paramagnetic material in the Wakuda structure (e.g., lightweight, rust/corrosion resistance, excellent electric and heat conductivity, etc.), despite the

alleged disadvantage of lower permeability than ferromagnetic materials. APPLE-1003, [154]-[162].

C. The POSITA's Knowledge and Skill Would Have Been Sufficient to Implement A Paramagnetic Material in The Gregorio-Wakuda Actuator

22. I note that the POSITA's knowledge and skill, particularly as suggested by the '830 patent's own disclosure, would have been sufficient to implement a paramagnetic material in the Wakuda actuator.

23. In the Response, Patent Owner's sole argument is that the illustrated structure of the Wakuda actuator would require a ferromagnetic material and thus a POSITA would not have been motivated to use a paramagnetic material in the Wakuda actuator. POR, 21-22. Patent Owner alleges that Wakuda's actuator structure requires "strong bending of the magnetic field lines into the casing," which is "clearly represented as ferromagnetic" while "[a] paramagnetic material would not so strongly bend the lines." POR, 26-27 ("Thus replacing the casing with a paramagnetic material would result in the device not working, according to Wakuda's design."), 29 ("A POSITA would recognize that such a weak effect would not alter the magnetic flux lines from McLyman Figure 1-10 to be concentrated as in McLyman Figure 1-11, and it would not produce the magnetic flux paths confined to the magnetic material as shown in Wakuda Figure 1B.").

24. However, Patent Owner's argument is erroneous and contradicts the POSITA's understanding in implementing the Gregorio-Wakuda actuator, particularly according to the level of knowledge and skill of the POSITA suggested in the '830 patent.

25. Indeed, the '830 patent uses the same material ("paramagnetic material") to achieve the same resulting actuator as Wakuda, and offers no other hint on how to select and use a paramagnetic material in the claimed vibration module, much less a suitable permeability of the material. Rather, the '830 patent provides limited disclosure (three paragraphs) of how to implement the claimed paramagnetic flux paths, leaving implementations details up to the knowledge and skill of a POSITA.

26. In particular, the first paragraph (APPLE-1001, 14:3-19) describes only the general characteristics of paramagnetic materials in comparison with air. The second paragraph (APPLE-1001, 14:20-35) compares two linear vibration modules without paramagnetic flux paths (FIG. 24A) and with paramagnetic flux paths (FIG. 24B). And the last paragraph (APPLE-1001, 14:36-58) describes a linear vibration module including "flux-path magnetic stops" in FIG. 25. Notably, the '830 patent does not disclose how to select a paramagnetic material or how to shape and position it in a linear vibration module, leaving such implementation details to a POSITA. Thus, the same knowledge and skill that the '830 patent

relied on for its disclosure informs the assessment of the prior art in evaluating obviousness.

27. Accordingly, as discussed in the Original Declaration, a POSITA, with the same knowledge and skill needed to implement the embodiments in the '830 patent, would have been motivated and found it obvious to use a paramagnetic material in the Gregorio-Wakuda system to achieve the intended purposes and advantages. APPLE-1003, [154]-[162]. Wakuda's disclosure cannot be held to a higher standard than the '830 patent's disclosure.

D. Patent Owner's Tangential Criticism Of The Petitioner's Other Corroborating Evidence Is Misleading

28. Without recognizing that it runs afoul of the '830 patent's disclosure, Patent Owner attacks each of the corroborating exhibits in the Petition. POR, 21-29. However, Patent Owner's interpretations of these exhibits are misleading and do not affect the Petition's analysis.

1. APPLE-1032 ("Phys251") (Discussing magnetic material types)

29. Quoting several out-of-context statements from Phys251, Patent Owner argues that a POSITA would not consider all the different magnetic materials listed in Phys251 for Wakuda's magnetic material. POR, 22. In particular, Patent Owner attempts to blur three categorizations of magnetic materials—diamagnetic, paramagnetic, and ferromagnetic—and treat diamagnetic

materials the same as paramagnetic materials, as opposed to ferromagnetic materials. POR, 22. They are clearly different. APPLE-1032, 1; APPLE-1037, 1-4; APPLE-1003, [155]. Not surprisingly, Patent Owner's own expert disagrees with this characterization. APPLE-1055, 103:3-5 ("Q. Do you really think that paramagnetic materials are nonmagnetic? A. I didn't say that.").

30. Further, Patent Owner argues that a paramagnetic material in Phys251 would not be an option for implementing Wakuda's "magnetic material" because the exhibit states "most applications of magnetic materials call for ferromagnetic materials." POR, 22 (citing APPLE-1032, 1). However, "**most** applications," are not **all** applications. APPLE-1055, 102:10-17 ("Q. Okay. But, this sentence here does not say that all applications of magnetic materials call for ferromagnetic materials, correct? A. Correct."). Patent Owner fails to identify what "most applications" would encompass. And Patent Owner fails to rebut my argument in the Original Declaration that paramagnetic materials are an example of magnetic materials that a POSITA would have been motivated to use when implementing Wakuda's "magnetic material."

2. APPLE-1037 ("Hitchhiker") (Discussing magnetism)

31. Hitchhiker also does not support Patent Owner's proposition that paramagnetic materials are non-magnetic. As set forth in the Response, the exhibit states only that "[f]erromagnetic and ferrimagnetic materials are **usually** what we

consider as being magnetic,” and, that a paramagnetic material is “so weakly magnetic that they are *usually* thought of as ‘nonmagnetic.’” APPLE-1037, 1 (emphasis added). While concluding the same in his declaration (EX-2009, ¶132), Dr. Goossen did not dispute that paramagnetic materials have a degree of magnetic characteristic. APPLE-1055, 104:12-19, 103:3-5 (“Q. Okay. Do you really think that paramagnetic materials are nonmagnetic? A. I didn't say that.”).

3. APPLE-1031 (US 8,134,437 to “Brooks”)

32. The Response argues that Brooks “clearly refers to paramagnetic materials—and to aluminum specifically—as ‘non-magnetic.’” POR, 23-24. However, nothing in Brooks equates “non-magnetic” with “paramagnetic.” APPLE-1031, 21:61-22:3. Rather, Brooks distinguishes “paramagnetic” materials from “non-magnetic, non-ferrous,” and expressly identifies paramagnetic materials as a different option from non-magnetic material. *Id.*, 21:62-64 (“the piston 92 is made of material having a suitably high ratio that is also non-magnetic, non-ferrous and, *if desired*, can be paramagnetic” (emphasis added)); 38:2-4 (“the driven element is ... comprised of one of a non-magnetic material and a paramagnetic material”); *see also id.*, 35:4-6, 36:17-19, 36:55-57.

4. APPLE-1012 (“McLyman”) (Discussing fundamentals of magnetism) in view of Wakuda’s FIG. 1B Structure

33. While the Petition and my Original Declaration rely on the McLyman textbook to demonstrate a simple, known concept that an air gap increases the

reluctance of a magnetic circuit, the Response treats McLyman as if it is part of the Gregorio-Wakuda combination, and alleges that McLyman reveals a lack of motivation to use a paramagnetic material to implement Wakuda's actuator illustrated in FIG. 1B. POR, 24-29.

34. As an initial matter, McLyman is not part of the proposed combination. It also does not support Patent Owner's argument because it is completely silent as to paramagnetic materials. Rather, McLyman merely states that "[a] vacuum has a [relative] permeability of 1.0, and nonmagnetic materials, such as air, paper, and copper have [relative] permeabilities of the same order." APPLE-1012, 27. McLyman does not identify aluminum or any other paramagnetic materials as nonmagnetic.

35. As identified in POR and acknowledged by Patent Owner's expert, Dr. Goossen, the relative permeability of aluminum is 1.000022, which is greater than the relative permeability of air (=1.00000037) or copper (=0.999994). POR, 28; APPLE-1054, 5; APPLE-1055 (cited in POR at footnote 122), 117:7-118:12. Thus, aluminum, one example of paramagnetic materials, can produce a stronger magnetic field than nonmagnetic materials, such as air. This is exactly what the '830 patent contemplates. APPLE-1001, 14:4-19; *see supra* §II.A.

III. CONCLUSION

36. The findings and opinions set forth in this declaration are based on my work and examinations to date.

37. I may continue my examinations. I may also receive additional documentation and other factual evidence over the course of this IPR that will allow me to supplement and/or refine my opinions. I reserve the right to add to, alter, or delete my opinions and my declaration upon discovery of any additional information. I reserve the right to make such changes as may be deemed necessary.

38. In signing this declaration, I recognize that the declaration will be filed as evidence in an IPR before the PTAB. I also recognize that I may be subject to cross-examination in the case and that cross-examination will take place within the United States. If cross-examination is required of me, I will appear for cross-examination within the United States during the time allotted for cross-examination.