UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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SAMSUNG ELECTRONICS CO., LTD.
Petitioner

v.

MOJO MOBILITY INC.
Patent Owner

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Patent No. 11,201,500

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# DECLARATION OF R. JACOB BAKER, PH.D., P.E. IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 11,201,500

TABLE OF CONTENTS

I, R. Jacob Baker, Ph.D., P.E., declare as follows:

## I. INTRODUCTION

1. I have been retained by Samsung Electronics Co., Ltd. ("Petitioner") as an independent expert consultant in this proceeding before the United States Patent and Trademark Office ("PTO") against Mojo Mobility Inc. ("Patent Owner") regarding U.S. Patent No. 11,201,500 ("the '500 patent") (Ex. 1001).[1] I have been asked to consider whether the prior art discloses or suggests the features recited in claims 2, 4, and 18 ("the challenged claims") of the '500 patent. My opinions are set forth below.

2. I am being compensated at a rate of $765/hour for my work in this proceeding. My compensation is in no way contingent on the nature of my findings, the presentation of my findings in testimony, or the outcome of this or any other proceeding. I have no other interest in this proceeding.

[1] Where appropriate, I refer to exhibits that I understand are to be attached to the petition for *Inter Partes* Review of the '500 patent.

## II. BACKGROUND AND QUALIFICATIONS

3. I presently serve as a Professor of Electrical and Computer Engineering at the University of Nevada, Las Vegas (UNLV). All of my opinions stated in this declaration are based on my own personal knowledge and professional judgment. In forming my opinions, I have relied on my knowledge and experience in designing, developing, researching, and teaching regarding integrated circuit design and power electronics.

4. I am over 18 years of age and, if I am called upon to do so, I would be competent to testify as to the matters set forth herein. I understand that a copy of my current curriculum vitae, which details my education and professional and academic experience, is being submitted by Petitioner as Exhibit 1003. The following provides an overview of some of my experience that is relevant to the matters set forth in this declaration.

5. I have been teaching electrical engineering at UNLV since 2012. Prior to this position, I was a Professor of Electrical and Computer Engineering at Boise State University from 2000. Prior to my position at Boise State University, I was an Associate Professor of Electrical Engineering between 1998 and 2000 and Assistant

Professor of Electrical Engineering between 1993 and 1998 at the University of Idaho. I have been teaching electrical engineering since 1991.

6. I received my Ph.D. in Electrical Engineering from the University of Nevada, Reno in 1993. I also received a MS and BS in Electrical Engineering from UNLV in 1988 and 1986, respectively.

7. As described in my CV, I am a licensed Professional Engineer and have more than 35 years of industry and academic experience, including extensive experience in power electronics circuit design. My Ph.D. dissertation developed a way to stack power MOSFETs to increase the maximum voltage that they could switch in nanoseconds. The work from this dissertation was published in the paper "Transformerless Capacitive Coupling of Gate Signals for Series Operation of Power MOS Devices," and published in the IEEE Transactions on Power Electronics. The work was well-received and it won the best paper award from this journal in 2000. Further, my research has focused on the design of inductors using novel fabrication techniques. One of my Master's students fabricated a three-dimensional inductor using thru-vias to minimize the inductor's size. This work was reported in the Thesis "Design Guide for CMOS Process On-Chip 3D Inductors using Thru-Wafer Vias" published in 2011. More recently I have been looking at

ways to supply power to remote regions of the world. This effort resulted in a doctoral student finishing his dissertation entitled "Designing, Building, and Testing a Solar Thermoelectric Generation, STEG, for Energy Delivery to Remote Residential Areas in Developing Regions" published in 2015.

8. I have taught courses in integrated circuit design (analog, digital, mixed-signal, memory circuit design, etc.), linear circuits, microelectronics, communication systems, power electronics, and fiber optics. As a professor, I have been the main advisor to over 100 Master's and Doctoral students.

9. I am the author of several books covering the area of integrated circuit design including: DRAM Circuit Design: Fundamental and High-Speed Topics (two editions), CMOS Circuit Design, Layout, and Simulation (four editions), and CMOS Mixed-Signal Circuit Design (two editions). I have authored, and coauthored, more than 100 papers and presentations in the areas of solid-state circuit design, and I am the named inventor on over 150 granted U.S. patents.

10. I have received numerous awards for my work, including the Frederick Emmons Terman (the "Father of Silicon Valley") Award. The Terman Award is bestowed annually upon an outstanding young electrical/computer engineering educator in recognition of the educator's contributions to the profession.

11. I am a Fellow of the IEEE for contributions to memory circuit design. I have also received the IEEE Circuits and Systems Education Award (2011).

12. I have received the President's Research and Scholarship Award (2005), Honored Faculty Member recognition (2003), and Outstanding Department of Electrical Engineering Faculty recognition (2001), all from Boise State University. I have also received the Tau Beta Pi Outstanding Electrical and Computer Engineering Professor award four of the years I have been at UNLV.

13. I am not an attorney and offer no legal opinions, but in the course of my work, I have had experience studying and analyzing patents and patent claims from the perspective of a person skilled in the art.

## III. MATERIALS REVIEWED

14. The opinions contained in this Declaration are based on the documents I reviewed, my professional judgment, as well as my education, experience, and knowledge regarding electrical engineering, and energy transfer systems and components, including inductive-based power transfer and related technologies.

15. In forming my opinions expressed in this Declaration, I reviewed the following materials and information:

| | |
|---|---|
| Ex. 1001 | U.S. Patent No. 11,201,500 |
| Ex. 1004 | Prosecution History of U.S. Patent No. 11,201,500 |
| Ex. 1005 | Translation of Japanese Patent Application Publication No. 2006-141170A ("*Okada*")[2] |
| Ex. 1006 | U.S. Patent No. 6,912,137 ("*Berghegger*") |
| Ex. 1007 | U.S. Patent Application Publication No. 2006/0145660A1 ("*Black*") |
| Ex. 1008 | U.S. Patent No. 6,960,968 ("*Odendaal*") |
| Ex. 1009 | U.S. Patent No. 6,489,745 ("*Koreis*") |
| Ex. 1010 | U.S. Patent No. 6,366,817 ("*Kung*") |

[2] Exhibit 1005 includes the original Japanese version and a certified English translation. Citations to *Okada* are to the English translation.

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|---|---|
| Ex. 1011 | Physics, Henry Semat et al., Rinehart & Co., Inc., 1958, Chapters 29-32 ("*Semat*") |
| Ex. 1012 | U.S. Patent No. 5,702,431 ("*Wang*") |
| Ex. 1013 | International Patent Application Publication No. WO1996040367 ("*WangII*") |
| Ex. 1014 | Handbook of Radio and Wireless Technology, Stan Gibilisco, McGraw-Hill, 1999 ("*Gibilisco*") |
| Ex. 1015 | U.S. Patent No. 4,942,352 ("*Sano*") |
| Ex. 1016 | Fundamentals of Electric Circuits, 2d., Charles Alexander et al., McGraw-Hill, 2004 ("*Alexander*") |
| Ex. 1017 | International Patent Application Publication No. WO1994/18683 ("*Koehler*") |
| Ex. 1019 | U.S. Patent Application Publication No. 2005/0068019 ("*Nakamura*") |
| Ex. 1020 | U.S. Patent Application Publication No. 2007/0109708 ("*Hussman*") |
| Ex. 1021 | U.S. Patent Application Publication No. 2003/0210106 ("*Cheng*") |
| Ex. 1023 | U.S. Patent Application Publication No. 2004/0201988 ("*Allen*") |
| Ex. 1024 | U.S. Patent No. 7,378,817 ("*Calhoon-817*") |
| Ex. 1025 | International Patent Application Publication No. WO2003/096361 ("*Cheng*") |
| Ex. 1026 | International Patent Application Publication No. WO2004/038888 ("*ChengII*") |

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| Ex. 1027 | Spiral Inductor Design for Quality Factor, Sang-Gug Lee et al., Journal of Semiconductor Technology and Science, Vol. 2. No. 1, March 2002 ("*Lee*") |
| Ex. 1028 | U.S. Patent Application Publication No. 2001/0055207 ("*Barbeau*") |
| Ex. 1029 | AN710 Antenna Circuit Design for RFID Applications |
| Ex. 1030 | U.S. Patent No. 6,606,247 ("*Credelle*") |
| Ex. 1031 | U.S. Patent No. 7,339,353 ("*Masias*") |
| Ex. 1034 | U.S. Patent Application Publication No. 2005/0135129A1 ("*Kazutoshi*") |
| Ex. 1036 | International Patent Application Publication No. WO2003/105308A1 ("*Hui*") |
| Ex. 1037 | U.S. Patent No. 5,780,992 ("*Beard-1*") |
| Ex. 1039 | U.S. Patent No. 5,631,539 ("*Beard-2*") |
| Ex. 1041 | U.S. Patent Application Publication No. 2005/0127868A1 ("*Calhoon*") |
| Ex. 1044 | U.S. Patent Application Publication No. 2007/0145830A1 ("*Lee-II*") |
| Ex. 1046 | U.S. Patent Application Publication No. 2007/0026826A1 ("*Wilson*") |
| Ex. 1047 | U.S. Patent Application Publication No. 2006/0202665 ("*Hsu*") |
| Ex. 1048 | International Patent Application Publication No. WO2009155000A2 ("*Lin*") |

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| Ex. 1049 | U.S. Patent Application Publication No. 2008/0067874 ("*Tseng*") |
| Ex. 1050 | U.S. Patent No. 9,356,473 ("*Ghovanloo*") |
| Ex. 1056 | U.S. Patent No. 6,459,383 ("*Delatorre*") |
| Ex. 1057 | International Patent Application Publication No. WO1999050806A1 ("*Cunningham*") |
| Ex. 1058 | International Patent Application Publication No. WO2004026129A1 ("*Due-Hansen*") |
| Ex. 1059 | Watson, J., Mastering Electronics, Third Ed., McGraw-Hill, Inc. (1990) ("*Watson*") |
| Ex. 1060 | Sedra, A., *et al.*, Microelectronic Circuits, Fourth Ed., Oxford University Press (1998) ("*Sedra*") |
| Ex. 1061 | GB Patent Application Publication No. 2202414 ("*Logan*") |
| Ex. 1062 | U.S. Patent No. 7,226,442 ("*Sheppard*") |
| Ex. 1063 | ATMEL e5530 Data Sheet (2002) |

16. I also reviewed any other materials I refer to in this Declaration in support of my opinions.

17. My opinions contained in this declaration are based on the documents I reviewed and my knowledge and professional judgment. My opinions have also

been guided by my appreciation of how a person of ordinary skill in the art would have understood the state of the art, the prior art, and the claims and the specification of the ’500 patent at the time of the alleged invention.

18. I understand that the ’500 patent issued from U.S. Patent Application No. 16/055,109, filed on August 5, 2018, which is a continuation or continuation-in-part of a sequence of applications dated as early as January 30, 2007. (Ex. 1001, Cover, 2.) The ’500 patent also lists multiple provisional applications dated as early as January 31, 2006. (*Id*.) For purposes of rendering my opinions, I have been asked to initially consider that the time of the alleged invention of the challenged claims of the ’500 patent to be around the timeframe from September 2006 to December 2007. In particular, I have been asked to consider the following dates as representative of the alleged inventions for the following challenged claims:

- claim 4: around September 5, 2006 to December 5, 2006;
- claims 2 and 18: around September 12, 2007 to December 12, 2007.

My opinions reflect how one of ordinary skill in the art (which I described below) would have understood the ’500 patent, the prior art to the patent, and the state of the art at the time of the alleged invention (e.g., from September 2006 to December 2007) as I was asked to consider noted above. My opinions concerning a person of

ordinary skill in the art (including, for example, such a person's state-of-art knowledge, understandings and appreciations of the teachings of the prior art (and state-of-art), the '500 patent, etc.) are the same regardless of the dates in such identified date range.

19. Based on my experience and expertise, it is my opinion that the prior art discloses and/or suggests all the features recited in challenged claims 2, 4, and 18 of the '500 patent, as I discuss in detail below.

## IV. PERSON OF ORDINARY SKILL IN THE ART AND THE TIME OF THE ALLEGED INVENTION

20. Based on my knowledge and experience, I understand what a person of ordinary skill in the art would have known at the time of the alleged invention for the challenged claims here, which I discussed above in Section III as encompassing the September 2006 to December 2007 timeframe. (*See* Section III above.) My opinions herein are, where appropriate, based on my understandings as to a person of ordinary skill in the art at that time. In my opinion, based on the materials and information I have reviewed, and based on my experience in the technical areas relevant to the '500 patent, a person of ordinary skill in the art at the time of the alleged invention of the '500 patent would have had at least a master's degree in electrical engineering, or a similar discipline, and two or more years of experience with wireless charging systems, including, for example, inductive power transfer systems. More education can supplement practical experience and vice versa. I apply this understanding in my analysis herein.

21. All of my opinions in this declaration are from the perspective of one of ordinary skill in the art, during the relevant timeframe (e.g., the time of the alleged invention), which I discussed above as encompassing the September 2006 to December 2007 timeframe. (*See* Section III above.) My opinions in this declaration

are also applicable from the perspective of such a skilled person at other related timeframes (e.g., mid-2006 to early 2007 (claim 4) and mid-2007 to early 2008 (claims 2 and 18) timeframes), and thus to the extent the time of the alleged invention was determined to be in such timeframes, my opinions in this declaration would not change.

## V. TECHNICAL BACKGROUND

22. As I discuss further below in Sections VIII and IX, it is my opinion that the features recited in the '500 patent are disclosed or suggested in the prior art. Many of the claimed features relate to technologies/techniques that were conventional and known to persons of ordinary skill in the art at the time before the time of the alleged invention of the '500 patent.

23. Below, I present a brief overview of certain aspects of technologies/techniques/concepts that were known to a person of ordinary skill in the art prior to and at the time of the alleged invention of the '500 patent (*see* above at Section IV). The features, functionalities, and concepts I describe in this technical background section reflect the state of the art that a person of ordinary skill in the art would have had knowledge of and understood prior to and at the time of the alleged invention of the '500 patent. I rely on, and incorporate as applicable (even if not expressly mentioned below in Section IX), the following disclosures and opinions to support my opinions in this Declaration, including those opinions relating to how the prior art discloses and/or suggests the challenged claims of the '500 patent and how and why a person of ordinary skill in the art would have been motivated to consider and combine the disclosures and suggestions from one or more prior art

references as I explain below in Section IX. The concepts below would have been within the knowledge and mindset of a person of ordinary skill in the art at the time.

### A. Electronic Circuits and Components

24. It was well known to a person of ordinary skill in the art prior to the alleged invention date that matter is made up of atoms, which include electrons orbiting a nucleus. (Ex. 1059, 7.) Free electrons, which are electrons that are not bound to any nucleus, are contained in large numbers in materials called conductors (e.g., metals such as copper), which conduct the flow of electrons in a uniform direction (this flow of electrons is called current, and is expressed in units of amperes). (*Id.*, 8-10.) On the other hand, "[m]aterials that are classed as insulators contain only a very few free electrons" and do not conduct current well. (*Id.*, 8.) It was well known in electrical engineering that current is at the heart of virtually all electrical principles and technologies.

25. A person of ordinary skill would have known that whereas current may flow continuously in one direction through a circuit (direct current), "[c]urrent that flows first one way and then the other is called *alternating current*, and a voltage source supplying such a current is called an *alternating voltage*." (*Id.*, 12 (emphasis in original).) It was known that "[a]lternating current is used for all mains power

supplies because a.c. [i.e., alternating current] permits the user of *transformers* to increase and decrease the voltage, so that the power can be transmitted from place to place using efficient high-voltage transmission lines." (*Id.* (emphasis in original).) It was known that alternating current and alternating voltage are periodic, and "[t]he rate at which the voltage reverses is the *frequency* of the alternation." (*Id.* (emphasis in original).)

26. A person of ordinary skill would have known that "[i]n addition to measuring the current flow, we also need to measure another factor, the potential difference between two points," which "is the energy difference between" the two points. (*Id.*, 10 (emphasis in original).) The potential difference is also called voltage and is expressed in units of volts. (*Id.*, 10.)

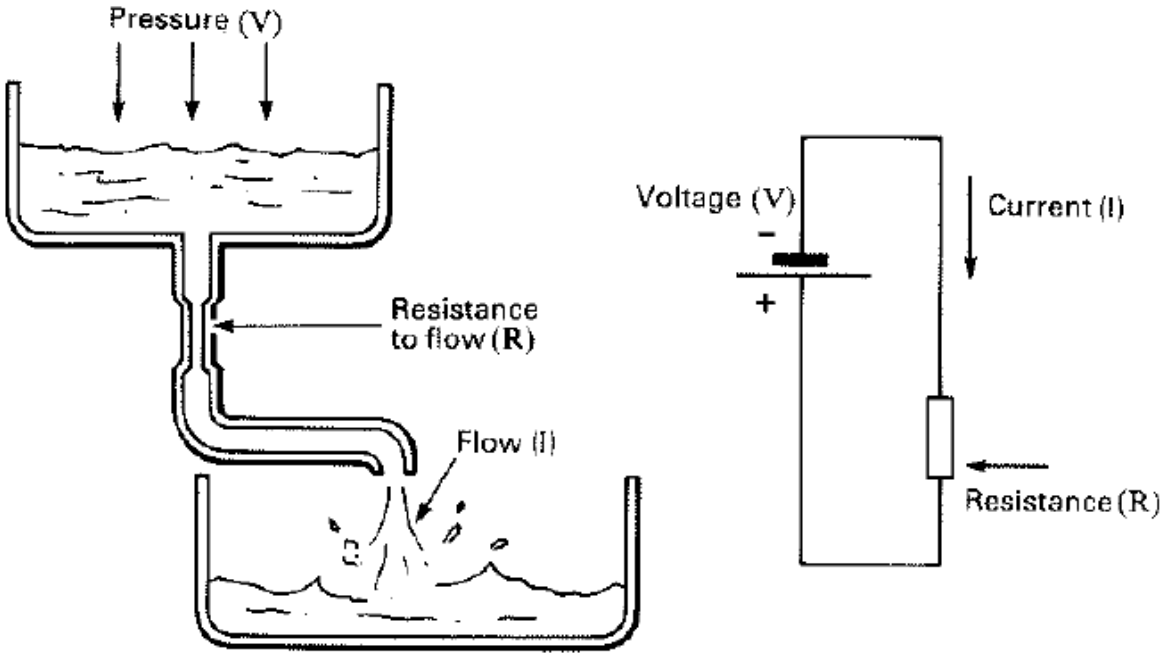
27. Additionally, a person of ordinary skill would have known that resistance is another fundamental concept involved in the flow of electrons. "Resistance is a property of all materials that reduces the flow of electricity through them," so that "[t]he higher the resistance, the more difficult it is for current to flow." (*Id.*, 10.) Resistance is expressed in units of ohms. (*Id.*, 11.)

28. A person of ordinary skill would have known that most circuit components are described as being *active* or *passive* components. (*Id.*, 19.) "Active

components use the movement of electrons ... to perform some function in the circuit," whereas "[p]assive devices ... do not control the movements of the electrons, but rather allow the electrons to flow through them." (*Id.*) A person of ordinary skill would have known that the most commonly encountered passive circuit component is the resistor, which is a "component[] intended to insert a known amount of resistance into an electrical circuit." (*Id.*)

29. The relationship between current (denoted by the letter I), voltage (denoted by the letter V), and resistance (denoted by the letter R) is given by Ohm's Law, V = I * R (i.e., voltage is current multiplied by resistance). (*Id.*, 10-11.) These three terms are shown in Figure 2.5 of *Watson* (a textbook regarding electronics), which shows how electrical principles are similar to principles relating to the flow of water.

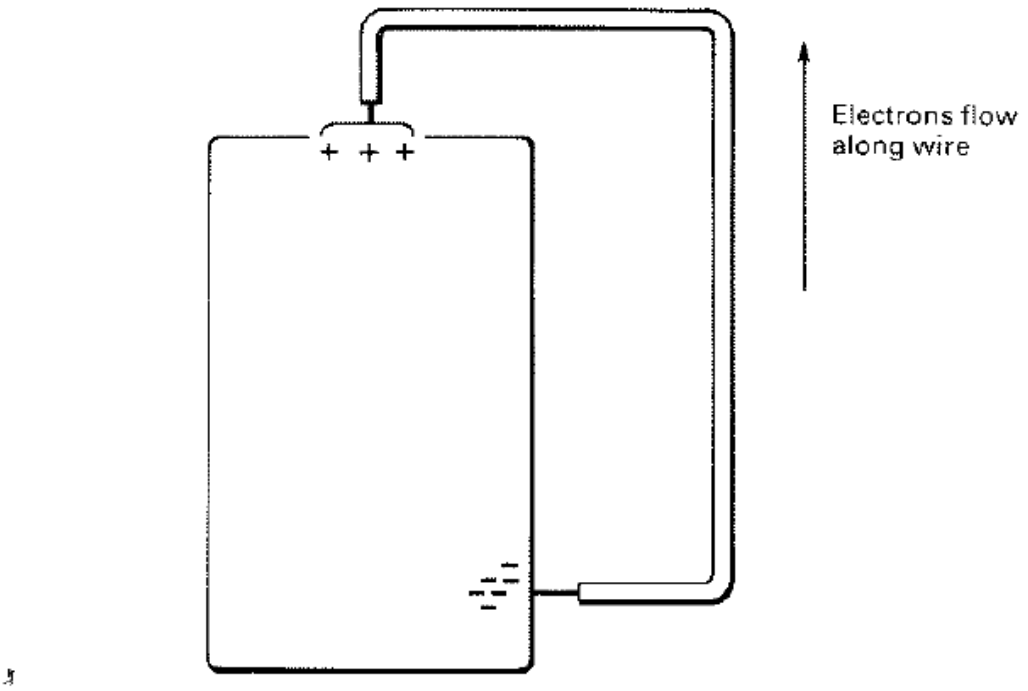
fig 2.5 *a plumbing analogy: voltage, current and resistance all have their equivalents in the water system*




(*Id.*, FIG. 2.5.)

30. A person of ordinary skill would have known that electrons (and thus current) flow in a circuit, as shown at the right side of Figure 2.5 above, and also in Figure 2.3 below.

fig 2.3 *electrons flowing in a circuit*



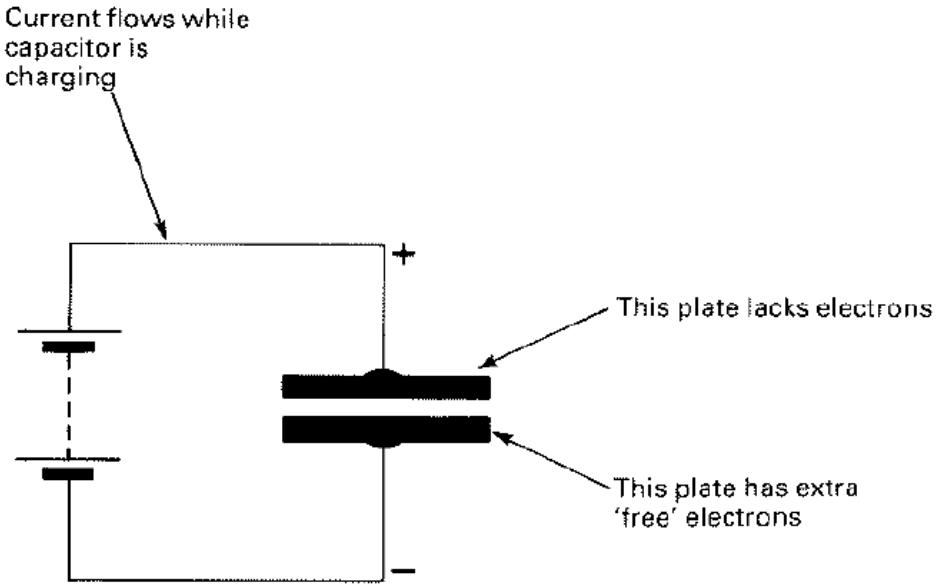

(*Id.*, FIG. 2.3.) A person of ordinary skill would have known that without such a closed path (e.g., as shown above in Figure 2.3), current cannot flow. (*Id.*, 8-11, FIGS. 2.3-2.5.)

31. It was well known that the amount of energy dissipated per unit time (power, expressed in units of watts) is expressed as the following formula: $P=VI$. (*Id.*, 19-20.)

32. A person of ordinary skill would have also known that "[n]ext to resistors, the most commonly encountered component is the *capacitor*," which is

another passive circuit component. (*Id.*, 25 (emphasis in original).) "A capacitor is a component that can store electric charge," and "[i]n essence, it consists of two flat parallel plates, very close to each other, but separated by an insulator." (*Id.*) A person of ordinary skill would have known that "[w]hen the capacitor is connected to a voltage supply, a current will flow through the circuit" as shown below in Figure 3.8 of *Watson*, and "[e]lectrons are stored in one of the plates of the capacitor" and "in the other there is a shortage of electrons." (*Id.*, 25-26.)

fig 3.8 *a capacitor connected to a power supply; current will flow until the capacitor is charged*



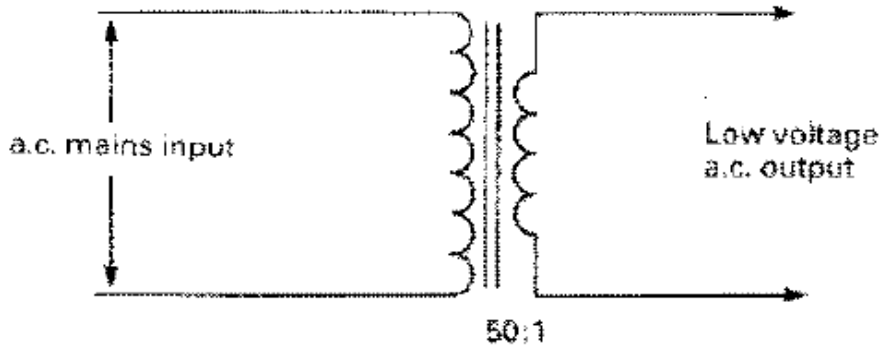

(*Id.*, FIG. 3.8.) A person of ordinary skill would have known that "[i]n this state the capacitor is said to be *charged*," and [i]f the charged capacitor is connected in a

circuit, it will, for a short time, act as a voltage source, just like a battery." (*Id.*, 27 (emphasis in original).) It was known to use capacitors, such as variable capacitors that may be varied in capacitance value, in radio frequency (RF) circuits, e.g., to tune the circuit and "improve efficiency." (*Id.*, 200-201; *see also id.*, 31 (describing "[v]ariable capacitors" as "[c]apacitors ... that can be varied in value."), 201 ("the capacitors are variable, so that the circuit can be tuned accurately," i.e., "tuned to the exact frequency" for the RF transmitter to work properly).)

33. A person of ordinary skill would have known that "[t]he third major passive component is the inductor," which may be a coil of wire. (*Id.*, 33.) "When a coil is connected in a circuit ... the flow of current through the coil causes an electromagnetic field to be created around the coil." (*Id.*, 33-34.) This phenomenon was well known and commonly applied to construct a transformer, which was a known device that was widely used to reduce an AC voltage to a lower level. (*Id.*, 12; *see also id.*, 36 (FIG. 3.17, reproduced below), 37 ("A transformer is used to reduce the voltage of the a.c. mains to something more usable in electronic circuits..."), 37-41 (describing power supplies that utilize transformers and rectifiers to convert AC power to DC power).) Transformers make use of "mutual inductance," where "a current flowing in a coil produces an electromagnetic field,

which in turn induces a current to flow in a second coil wound over the first one." (*Id.*, 34-35, FIG. 3.16.) It was known that by adjusting the "turn ratios" of a transformer, i.e., the ratio of the turns in the two coils of the transformer, the output voltage of the transformer is modified. (*Id.*, 36.)

fig 3.17 *circuit symbol for a transformer with a laminated core*




(*Id.*, 36 (FIG. 3.17, showing "circuit symbol for a transformer").)

34. A person of ordinary skill in the art would have known that in circuits, "L" signifies inductance and "C" signifies capacitance. (Ex. 1060, 884 ("The oldest technology for realizing filters makes use of inductors and capacitors, and the resulting circuits are called passive LC filters."), 909 (FIG. 11.17).)

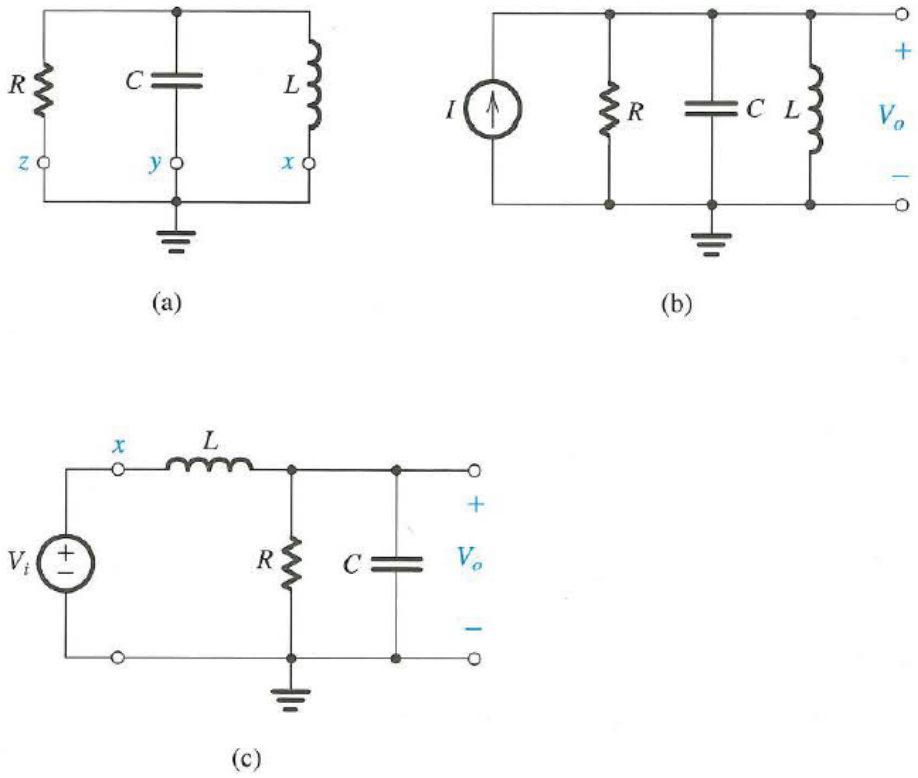



**Fig. 11.17** **(a)** The second-order parallel LCR resonator. **(b)** and **(c)** Two ways for exciting the resonator of (a) without changing its *natural structure*. The resonator poles are the poles of $V_o/I$ and $V_o/V_i$.

(*Id.*, 909 (FIG. 11.17).)

### B. Contactless Power/Data Transfer

35. A person of ordinary skill in the art would have understood that many contactless power or data transfer applications rely upon the principle of inductive coupling. Here I begin with an introduction to the well-known principles of inductance and inductive coupling that a person of ordinary skill in the art would have understood, been aware of, and considered when designing, configuring,

implementing, or modifying inductive power transfer system and/or circuits/components thereof. I then discuss applications of such known contactless power/data transfer techniques and technologies, including the use of planar inductive coils, and, the control/regulation of contactless power transfer.

### 1. Inductance and Inductive Coupling

36. It has long been known that a current carrying wire generates a magnetic field around it. (Ex. 1011, 557-558.) For example, the magnetic field generated near a straight length of a current carrying wire is circular and **in a plane perpendicular to the flow of current**. (*Id.*, 558.)

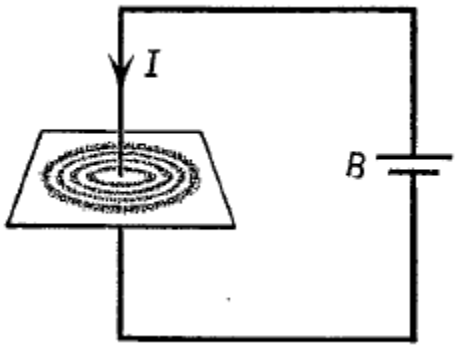



**Fig. 30-2** Pattern formed by iron filings showing the circular magnetic field around a wire carrying current.

(*Id.*, 558.)

37. Similarly, if current flows through a wire loop, a magnetic field is generated inside the loop and **perpendicular to the plane of the loop**. (*Id.*, 558-59,

FIG. 30-4 (figure caption "The magnetic field at the center is at **right angles** to the plane of the loop.").)

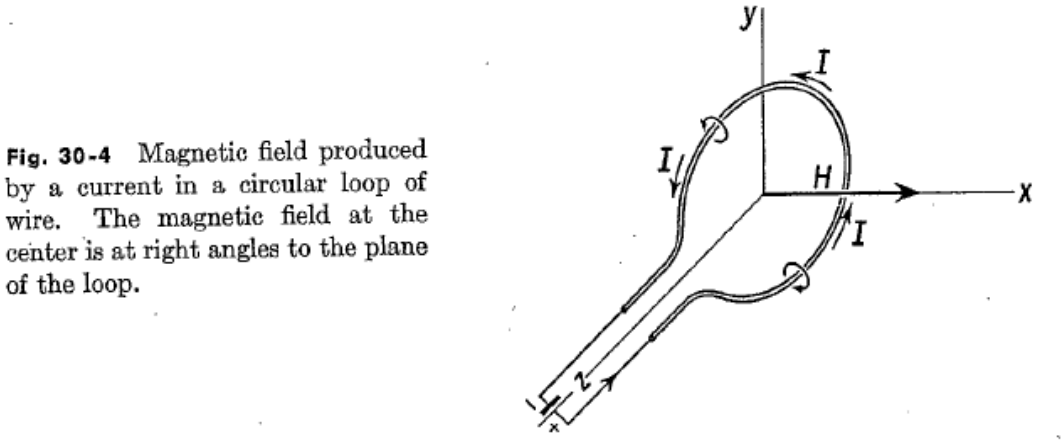



**Fig. 30-4** Magnetic field produced by a current in a circular loop of wire. The magnetic field at the center is at right angles to the plane of the loop.

(*Id.*, 559.)

38. The intensity of the magnetic field at any point around a current carrying conductor, including a coil, can be calculated using Ampère's law, which relates the magnetic field intensity H as **proportional to current I**. (*Id.*, 561-62.) A change in current propagating through the conductor results in a change in the corresponding magnetic field. (*Id.*)

39. A magnetic field results in an associated magnetic flux through a coil. **Changes in the coil current result in changes in the magnetic field and the magnetic flux**. (*Id.*, 601 ("When current is sent through a coil, a magnetic field is established through it, and any changes in the current generate changes in the

magnetic flux through the coil.").) **This change in magnetic flux results in an electromotive force (EMF) being induced in the conductor that opposes the change in current.** (*Id.*) The amount of EMF induced is proportional to the rate of change of current. (*Id.*) This effect is sometimes called inductance. (*Id.*) "A device having inductance is called an inductor" and "is represented schematically" as shown below:

Fig. 32-11 Schematic representation of an inductor.

(*Id*.)

40. The above phenomenon, which is a property of nature, can be leveraged to transfer energy between a first circuit that includes a first coil and a second circuit that includes a second coil. For example, if the second coil is positioned relative to the first coil, a changing magnetic flux generated by the first coil could result in an EMF being induced in the second coil and the resulting EMF can then provide a current to a load connected to the second coil. This is the basic principle behind transformers.

41. The use of inductive coupling to cause current flow in a second circuit was independently discovered in the early 1800s by both Michael Faraday and

Joseph Henry. (*Id.*, 593.) The circuit Faraday used in his experiments, which is illustrated below, is helpful in understanding the concept of inductive coupling. As shown below, a first circuit, which is referred to as the primary circuit, includes a battery B, a switch or key K, and a primary coil P. (*Id.*, 593-94.)

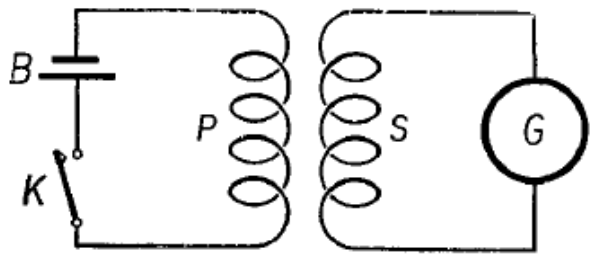



**Fig. 32-3** Faraday's experiment on electromagnetic induction.

(*Id.*, 594, FIG. 32-3.)

42. A secondary circuit includes a secondary coil S and a galvanometer G that is used to detect electrical current. (*Id.*, 593.) Faraday observed that when the switch (key) was opened and closed, and **the current flow through the primary coil P was changed, the resulting change in the magnetic flux generated by the primary coil P caused a change in the magnetic field around the secondary coil S**. (*Id.*, 593-94.) The changing magnetic flux through the secondary coil S induces an EMF in the secondary coil and produces a resulting current in the secondary circuit that Faraday measured with a galvanometer. (*Id.*)

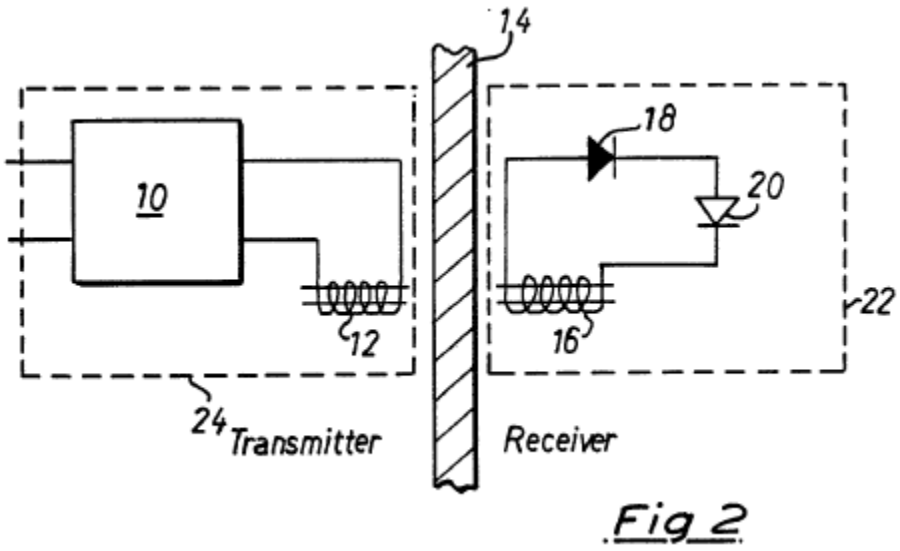
43. Therefore, in order to maintain current in the secondary circuit, the current in the first circuit can be continuously varied. By varying the current in the first circuit, the magnetic field (and therefore, magnetic flux) generated by the primary coil P is continuously varied, thereby inducing a corresponding EMF in the secondary circuit based on the inductive coupling between the primary coil P and the secondary coil S.

### 2. Applications of Contactless Power/Data Transfer

44. A person of ordinary skill would have been well versed in techniques and technologies for contactless (e.g., wireless) transmission of power and/or data signals between a transmitter and a receiver. For example, such a person would have understood that contactless power/data transfer may be performed between inductively coupled coils, e.g., between a primary coil and a secondary coil.

45. For example, *Logan* notes that "[i]t is, of course, known in principle to transmit power and data using radio waves." (Ex. 1061, 1:10-12.) It was well known to use inductor coils to facilitate wireless signal transmission. (Ex. 1062, 5:39-66 (describing "receiv[ing] power from an electromagnetic (EM) energy source" and "a coil for the receipt of electromagnetic energy"); Ex. 1061, Abstract, FIGS. 1-2, 3:19-23, 4:12-14, 6:3-5.) It was known in the art to energize a transmitter coil using

an alternating electromagnetic field to wirelessly send information to a receiver with a receiver coil. For example, *Logan* discloses features consistent with that known by a person of ordinary skill in the art regarding transmitting data wirelessly. (Ex. 1061, Title, Abstract, FIG. 2 (reproduced below).) *Logan* demonstrates it was known to use an "electromagnetic signal … of sinusoidal form" to convey power between a transmitter 24 and a receiver 22. (*Id.*, 6:12-14, FIG. 2.) Likewise, *Logan* provides guidance about "energising a transmitter coil 12 to create an alternating electromagnetic flux," which "induces an E.M.F. in a receiver coil 16" (*id.*, 3:19-23) "to [wirelessly] convey information to a demodulator in the receiver" (*id.*, 3:24-25).




(*Id.*, FIG. 2.)

46. Thus, the use of inductor coils to facilitate the wireless transmission of power/data was known by those of ordinary skill in the art at the time, including the circuitry and components, and techniques and characteristics of those circuits/components to provide such contactless power/data transfer. (Ex. 1062, 5:39-66 (describing "receiv[ing] power from an electromagnetic (EM) energy source" and "a coil for the receipt of electromagnetic energy"); Ex. 1061, Abstract, FIGS. 1-2, 3:19-23, 4:12-14, 6:3-5.) Moreover, *Koreis* discloses using a contactless power supply to charge a battery:

> Referring to the drawings, **a contactless power supply** according to the present invention is illustrated and generally indicated by reference numeral 10 in FIG. 1. The **contactless power supply comprises an inductive coil 12 disposed within a charging unit 14**, along with a receptor 16 disposed within or on a computing device 18, wherein the computing device 18 is positioned proximate the charging unit 14 as shown. **When energized, the *inductive coil 12 generates magnetic fields to provide electrical current to the receptor 16*, which powers the computing device 18. Further, the electrical current may also be used to charge batteries** (not shown) of the computing device 18 in addition to supplying power. . . .

> **More specifically, the contactless power supply 10 comprises a two-part transformer,** wherein the transformer has a flat configuration so as to fit within, for example, a seatback tray or a desktop. **The first part of the transformer is located within the seatback tray** and is coupled to a source of AC power. **The second part of the transformer, hereinafter referred to as receiving coil and core, is located within the computing device 18** and is coupled to a rectifier that converts AC power to DC power. **When magnetic field lines are approximately 90 degrees to the first part of the transformer when the *receiving coil* and core are placed within the field, *current is induced into the computing device 18*.**

(Ex. 1009, 2:46-3:8; *see also id.*, FIG. 1.)[3]

[3] I have added any emphasis herein unless indicated otherwise.

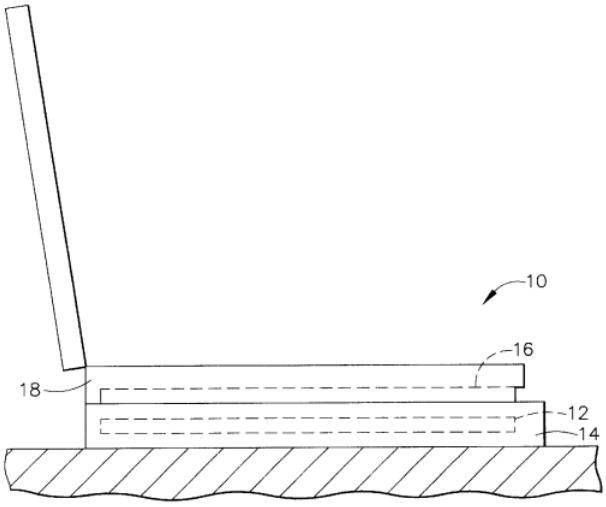



FIG. 1

(*Id.*, FIG. 1.)

47. *Odendaal* also shows that contactless power transfer technology has been used in various applications:

> **Contactless power transfer** has been used in applications such as the non-intrusive charging of pacemaker batteries, the charging of hybrid vehicle batteries, etc. **In such applications, inductive coupling is used** exclusively **so that a *current is induced from a power station to a load.*** In such systems, the power transfer is exclusively accomplished by means of coupling **magnetic flux of the power station and the load.**
>
> For example, road systems that would encourage the use of electric vehicles have been studied by states such as

> California. In such a system, **inductively coupled flat coils are embedded in the roadway**, or cables that are embedded in the roadway **are energized, so that an *induction coil of the vehicle receives induced current from the roadway coils* to permit battery charging and/or even propulsion.**

(Ex. 1008, 1:13-27; *see also* Ex. 1013, Abstract ("[c]urrent is induced in a secondary coil"), 4:29-5:2; Ex. 1025, 1:10-15, 12:5-9, FIG. 1.)

48. As a further example, *Kung* discloses "identif[ying] those primary coils that are closest to the secondary coil, and a current director that, responsive to the proximity detector, selectively directs time-varying currents through the closest primary coils."

> An electromagnetic field source (EFS) for **providing electromagnetic energy to a secondary coil**, including **two or more primary coils that each carry a time-varying current** to produce an electromagnetic field, and a controller that selectively provides current to one or more primary coils **based on their position with respect to the secondary coil**… The controller includes a **proximity detector that identifies those primary coils that are closest to the secondary coil**, and **a current**

> **director that, responsive to the proximity detector, selectively directs time-varying currents through the closest primary coils**. The controller may also include an orientation detector, coupled to the current director, that determines an orientation of the secondary coil with respect to the closest primary coils. In one implementation, the proximity detector identifies the quantity of closest primary coils utilizing a resonance frequency shift detector that detects a shift in inductance of one or more primary coils due to the proximity of the secondary coil.

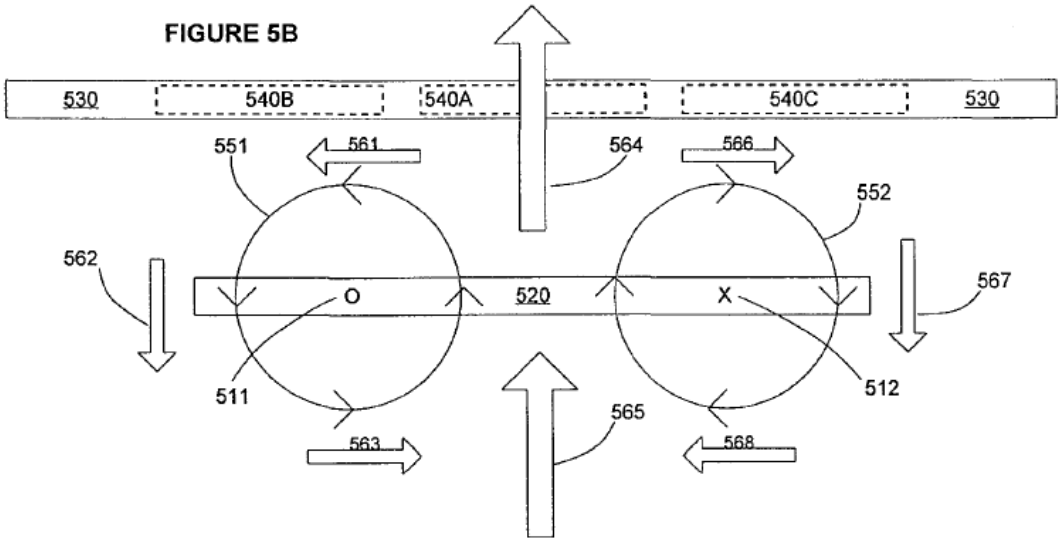
(Ex. 1010, Abstract.)

49. *Kung* also explains how the generated magnetic field traverses across the space. For example, *Kung* shows that a magnetic field represented by arrows 564 and 565 is perpendicular to plane 520 of charger and primary coil 510 and/or plane 540A of secondary coil 230.

> Components of the magnetic fields generated by loop segments 511 and 512 generally reinforce each other in certain areas, such as the interior area of coil 510. These reinforced **magnetic field components are represented by large arrows 564 and 565 that are directed upward from plane 520 toward plane 530**. More specifically,

> magnetic fields represented by exemplary iso-magnetic contour lines 551 and 552 are oriented in the same direction (upward toward plane 530), and thus are reinforcing, in the regions of arrows 564 and 565. Elsewhere, such as in the regions of small arrows 561 and 566, there is no such reinforcement.
>
> **If secondary coil 230 is in position 540A, i.e., in a plane parallel to that of primary coil 510 and generally vertically aligned with the interior of coil 510**, then, **as is well known by those skilled in the relevant art, primary coil 510 induces a current to flow in secondary coil 230**. **The magnetic field that induces this current flow is represented by arrows 564 and 565.** In contrast, if secondary coil 230 is disposed in plane 530 at a position generally outside of the interior of coil 510, such as positions 540B or 540C, then primary coil 510 generally does not induce a current to flow in secondary coil 230.

(*Id.*, 8:55-9:52.)




(Ex. 1010, FIG. 5B; *see also id.*, FIGS. 1-5A, FIGS. 6A-10, 7:21-8:54, 9:53-10:22, 11:27-14:67; Ex. 1011, 557-562, 593-594, 601; Ex. 1029, 3-4, 27-50.)

### 3. Use of Planar Coils

50. Because the inductive coils, such as those mentioned above, were often integrated into a portable device and/or a power transmitting device having a thin form factor (e.g., charging pad, etc.), a person of ordinary skill in the art would have considered the form factor of the coils to be installed in a portable device, such as cell phones, computers, PDAs, or in an inductive charger or a host object of such a charger, such as pads, desks, tabletops, and other supporting surfaces. A planar coil, given its relatively flat and thin structure, is known to be suitable for use in portable devices or in thin objects/surfaces. For example, *Odendaal* explains that the planar

coils of the planar power resonator "may have a thin and/or relatively flat top coil surface" and the coils "are preferably **integrated into a planar (flat/thin) structure**." (Ex. 1008, 2:44-64, 3:3-5.)

51. *Lee*, for example, also discusses the known use of a planar spiral coil inductor consistent with the knowledge of a person of ordinary skill in the art:

> Since the arrival of the silicon-based RF IC era, much effort has been put into the **spiral inductor designs**. The main focus of the endeavor was to improve the quality factor. The major concern for the silicon-based spiral inductors has been the resistivities of the metal and the silicon substrate. **Numerous techniques have been proposed** to reduce the resistivities of the interconnect lines and the silicon substrates [1,2]. Yet, **many planar spiral inductor structures have been designed and evaluated** without a clear understanding for the layout dependences of the quality factor. Simple and clear guidelines of inductor layout rules for optimum quality factor are presented for the required inductance and process information. . . . **Figure 1 shows the top view of a square spiral inductor layout.** Mohan [3] reported a simple and very accurate expression for the **planar spiral inductor inductances.** Modifying the Mohan's work, for

> the inductor dimensions shown in Fig. 1, the inductance can be expressed as . . .

(Ex. 1027, 1; *see also id.*, 1-3.)

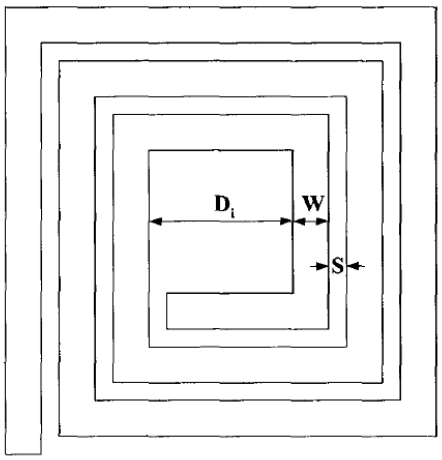



**Fig. 1.** A planar square spiral inductor structure.

(*Id.*, FIG. 1 (showing a "**planar square spiral inductor** structure").)

52. Additionally, *Sano* (Ex. 1015) discusses the known use of a thin coil and a flat disk-like core.

> Currently, the preferred form of the power receiving coil 54 is a **thin coil** which facilitates efficient interlinkage of the magnetic flux developed from the power supplying coil 18 with the power receiving coil 54. More particularly, the currently preferred power receiving **coil** 54 is a **flat disc-like core** on which is formed a single layer or several layers of wire-like electrical conductors. Such

> conductors can be formed, for example, by depositing conductive material on a side of the disc-like core that faces the power supplying apparatus 10. FIG. 3 is a front view of such a **sheet coil** and FIG. 4 is a vertical sectional view taken along its middle plane.

(Ex. 1015, 3:39-51; *see also id.*, FIGS. 1-2, 3-4, 7-12, Abstract, 1:5-2:29, 2:64-3:27, 5:5-47, 5:48-9:5.)

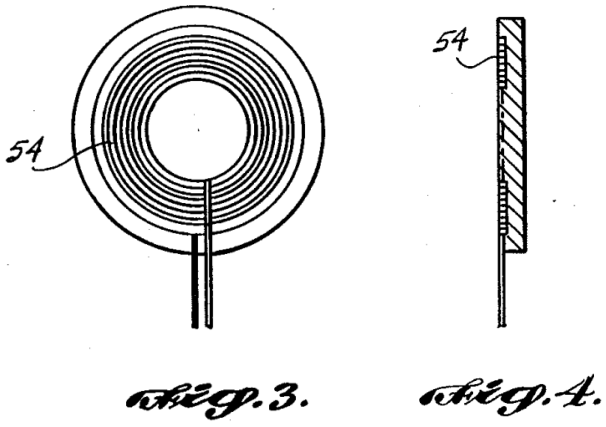



Fig. 3. Fig. 4.

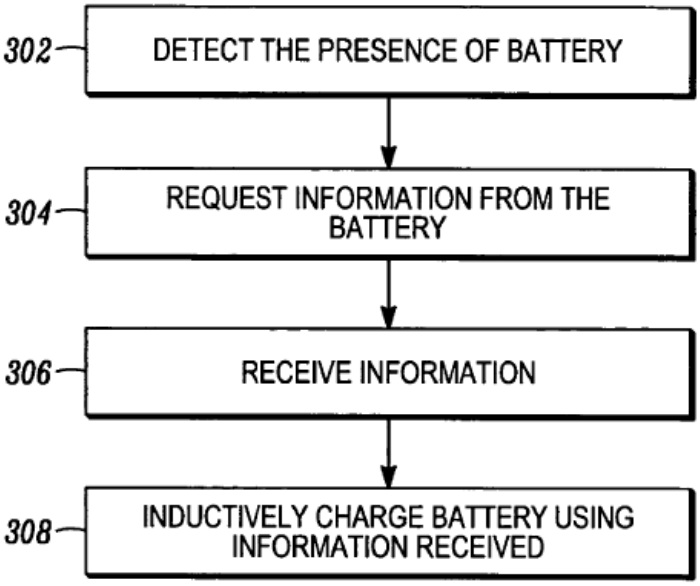
(*Id.*, FIGS. 3-4.)

53. There are other state of the art references that demonstrate and exemplify the knowledge of a person of ordinary skill in the art associated with using planar coils. (Ex. 1047, FIGS. 1-3, 6, 8A-9, ¶¶0002, 0006-0007, 0018-0025-0034; Ex. 1025, FIGS. 1, 3, 8-9, 13, 1:10-2:3, 2:5-12 (reasons to consider thin coil designs), 2:14-3:2, 4:19-32, 7:25-9:28, 12:27-32 (very thin printed coil), 14:4-17; Ex. 1026,

FIGS. 1-2, 5 (conventional primary coil array arrangement), 9A-9C, Abstract, 1:3-4:4 (conventional designs), 4:6-9:4, 11:4-15 (concentric selectively active flat coils); Ex. 1009, Abstract, FIGS. 1-3, 1:4-51, 1:54-2:26, 2:47-3:8 (flat configurations), 3:9-39 (thin flat coil), 4:18-60; Ex. 1024, FIGS. 3, 8-9, 1:12-15, 1:39-2:29, 9:41-53, 10:45-57, 11:60-13:4; Ex. 1029, 1-4, 9-19 (planar, spiral coils); Ex. 1030, FIGS. 3-7B, 1:5-9, 1:59-61, 3:19-56, 4:62-567, 5:25-44.) A person of ordinary skill in the art would have understood complementing a primary/secondary-side planar coil with a second/primary-side planar coil would provide for efficient transmission of energy between the two planar coils in an inductive charging/power systems, especially where the coils were aligned to face each other to allow the perpendicular magnetic field generated from the transmitting planar coil to be received by the receiving planar coil. (*See* my discussions above in Section V.B.1.) Thus, in my opinion, where design applications in an inductive power transfer system called for planar transmitting or receiving coil designs (e.g., to provide for thin, compact, versatile devices), such a skilled person would have had reasons to likewise consider design options where the receiving or transmitting coil likewise incorporated planar-type coil(s).

### 4. Controlling and Regulating Contactless Power/Data Transfer

54. A person of ordinary skill in the art would have known that different types of batteries or electronic devices may have different requirements for the amount or level of power/voltage/current supplied to the batteries or devices. Mechanisms have existed in the early 2000s that provide communications between the charger and the device subject to charging such that the charger may determine relevant parameters or settings used during the charging process. For example, *Black* discloses a procedure for "device identification and charging" that I summarized below. (Ex. 1007, ¶0020.)



(Ex. 1007, FIG. 3.) The procedure involves the charger first detecting the **presence** of a battery placed near the charger, then requesting **information from the battery**, such as the ID of the battery/device. (*Id.*, ¶0020.) The battery may also provide information to the charger, such as "encryption information, battery characteristics or charging profile or the like." (*Id.*, ¶¶0021-0022.) *Black* explains that the charger uses the provided information "[t]o determine **how** to inductively charge the battery." (*Id.*) In fact, it was known that "[c]onsideration of the…charging characteristics" of a battery is "**necessary for maximizing the amount of energy the battery will hold and to prevent overcharging of the battery**" and also for avoiding some potentially serious safety issues. (Ex. 1037, 1:56-2:6.)

> An incorrectly charged, improperly charged, overcharged or undercharged battery may **lose the ability to store an electric charge, may produce a voltage less than the nominal voltage or may combust or explode**, for example. Additionally, the number of charge cycles the battery is capable of undergoing may be significantly reduced **causing premature battery failure** which may require specialized reconditioning in order to return the battery to a proper operational state. Improper battery charging may also lead to **permanent premature battery failure**. Thus, the battery charging process **must account**

> **for the characteristic charging behavior** of the particular electrochemical cells in order to ensure proper functioning and maximized output and lifespan of the battery to be utilized.

(Ex. 1037, 1:59-2:6.)

55. Additionally, mechanisms for identifying whether a device subject to charging is **present** and **properly placed** on the charger (e.g., primary and secondary coils are properly aligned) were also well known. A way to do this is for the charger to send a signal to the device subject to charging. If there is a response from the device, and, based on the strength of the responsive signal, the charger can determine whether a device is present and properly placed/aligned on the charger. This is to ensure that the charger does not transmit power to unknown object(s) and also that the power transmission is performed where there is a high power transmission efficiency. For example, *Nakamura* discusses such features consistent with that known by a person of ordinary skill in the art at the time. (*See, e.g.*, Ex. 1019, ¶¶0080-0083, FIGS. 11A-11B.) *Nakamura* explains:

> [T]he power transmission enable/disable determination circuit 33 determines whether or not power reception equipment is placed on the power transmission apparatus

> 1, based on the "code indicating being power reception equipment" (step S3). **If a predetermined "code indicating being power reception equipment" is received, it is determined that power reception equipment is placed on the power transmission apparatus 1** and it is **determined whether or not the power reception equipment is correctly placed on the power transmission apparatus 1** (step S4). On the other hand, unless the predetermined "code indicating being power reception equipment" is received, it is determined that no power reception equipment is placed on the power transmission apparatus 1, and the carrier wave is outputted again (step S2).

(Ex. 1019, ¶0078.)

> Next, as for **determination on whether or not the power reception equipment is correctly placed on the power transmission apparatus 1**, the meaning of this phrase is whether or not the coil of the power receiving side and the coil of the power transmission side are **arranged at positions where a high power transmission efficiency** in a non-contact power supply system is obtained. In other words, whether or not the transmission apparatus 1 and the portable telephone 2 which is power reception equipment,

> shown in FIG. 2, are arranged at positions where a high coupling degree in magnetic coupling is established between the primary side core 15 of the power transmission apparatus 1 and the secondary side core 16 of the portable telephone 2.

(*Id.*, ¶0079.)

56. Moreover, once the power transmission process has started, mechanisms were known to adjust the power output to the device subject to charging based on the device's power demand. This is to accommodate the fact that the power demand may be variable in time. For example, *Berghegger* (which I also discuss below in Sections VIII and IX) discloses using a detection means 42 to measure the power demand at the load (e.g., power demand by a battery), and then providing the power demand information to a drive circuit of the charger in order to adjust or control the power transmission to the load. (Ex. 1006, 5:65-6:37.)

### C. Issues Relating to Harmonics in Contactless Power/Data Transfer

57. It was known to a person of ordinary skill in the art that alternating or pulsed signals, such as those provided to a primary coil in a contactless powering/charging system, included harmonic waves/signals that were multiple of the frequency of the reference wave/signal. Such harmonics were known to create

unwanted radiation that generated heat, resulting in inefficiencies in signal transmission, such as power signals transferred in a contactless inductive power transfer system.

58. For example, *WangII* (also discussed below in Sections VIII and IX) describes features consistent with that known in the art at the time, such as:

> The primary and secondary coils form a transformer so that electrical current in the primary induces current in the secondary coil. An approximation to a half-wave sinusoidal voltage is developed across the primary winding by the action of a field effect transistor (FET) switching a direct current (DC) voltage source across a tuning capacitor. Because, however, of the construction of the energy transmission device, **high frequency harmonic components are present in the waveform**. These high frequency components induce eddy currents in the implanted device which houses the electronics. The can temperature increases in response to the eddy currents. **A rise in temperature** of the outer surface of the can may be detrimental to operation of the medical device and surrounding body tissue. To prevent this temperature rise, the prior art charging devices must be operated at very low power levels.

(Ex. 1013, 3:29-4:5.)

> It would be desirable, therefore, to provide a battery charging system that overcomes these and other problems associated with rechargeable implantable devices. In particular, it would be **desirable to construct a battery charging device which can efficiently charge a battery** in an implanted medical device at a relatively high power **without excessively heating the device**….

(Ex. 1013, 4:19-28.)

59. Likewise, *Lee-II* explains that

> When a power MOSFET is switched while its source drain current is still nonzero, the flywheel actions of the choke and the main inductor will try to maintain the current during the switch transition, **thereby creating large voltage spikes with high harmonic content which lowers the overall power efficiency as well as distorting the output waveform**.

(Ex. 1044, ¶0084.)

60. Since unmanaged harmonics would reduce energy transmission efficiency, and lead to unwanted heating of surrounding/nearby electronic components, there were known ways to mitigate these issues, which I discuss below.

61. To mitigate the negative effects of harmonics, resonant circuits including a capacitor and/or other components were widely utilized and known to reduce harmonics in power and/or data transmission applications.

62. For example, the textbook, Fundamentals of Electric Circuits, 2d., Charles Alexander et al., McGraw-Hill, 2004 ("*Alexander*") (Ex. 1016), explains that filters may be formed using a combination of components including a capacitive component to reduce harmonics.

> [r]esonance is a condition in **an RLC circuit** in which the **capacitive** and inductive reactances are equal in magnitude, thereby resulting in a purely resistive impedance. **Resonant circuits (series or parallel) are useful for constructing filters**.

(Ex. 1016, 631.)

> [a] bandpass **filter** is designed to pass all frequencies within a band of frequencies, w1 < w < w2. . . . the bandpass filter in Fig. 14.35 is a series resonant circuit.

(*Id.*, 641.)

> **a bandpass filter** . . . [i]f the filter is made highly selective . . ., the filter passes only the fundamental component (n=1) of the input and **blocks out all higher harmonics**.

(*Id.*, 798.)

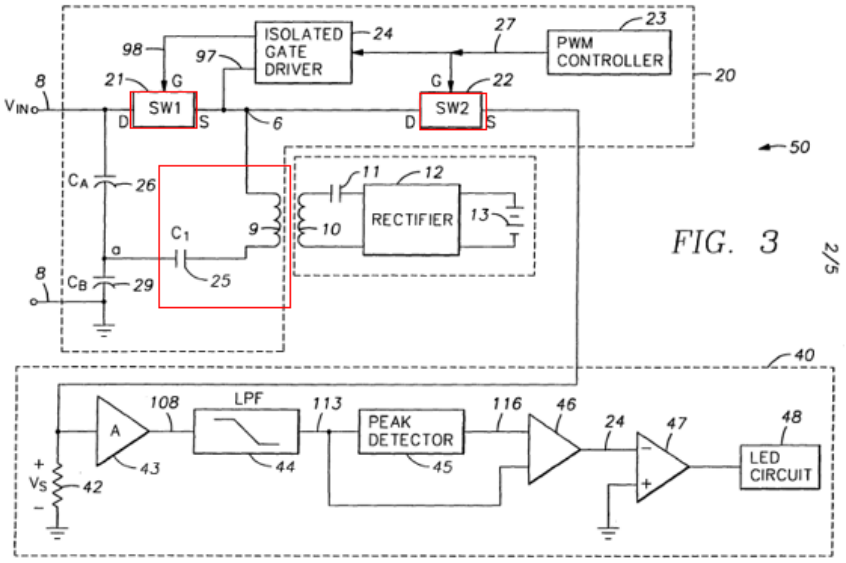
63. Likewise, *Lee-II* explains that:

> **The series LC resonator 101 and 115** provides a high "Q" environment to **filter out higher harmonics** and enhance the fundamental frequency to produce a substantially sinusoidal waveform at the output ports 102 and 103.

(Ex. 1044, ¶0083.)

64. *WangII* also discusses the use of capacitive components to reduce harmonics. For example, *WangII* discloses using capacitor-based resonant circuit with switches that provides full sinusoidal wave to "**reduce harmonics** and eddy current" to minimize heat and "without causing excessive energy loss." (Ex. 1013, 4:29-5:7; *see also* Abstract, 3:29-4:5 (discussing prior art where primary/secondary coils arrangement using a switching DC voltage across a tuning capacitor where "high frequency harmonic components are present in the waveform," which "induce eddy currents" that increase temperature that is detrimental to operation of the device), 4:19-28 (battery charging device to efficiently charge a battery in device without excessive heat), 7:24-8:14, 8:17-23 (tuning capacitor 25 designed so that a

sinusoidal waveform "flows through the primary coil 9 with **little high order frequency content**"), 24-31, 9:26-12:27.)




(Ex. 1013, FIG. 3 (annotated); *see also id.*, FIG. 6.)

65. Other references provide similar disclosures consistent with a person of ordinary skill in the art at the time. (Ex. 1012, FIGS. 2, 5 (C1 25, inductor 9), 8 (same), 3:30-62, 8:47-9:51; Ex. 1014, 67-68 ("In a narrowband transmitter, a low-pass filter might be built in for ***reduction of harmonic output***"); *id.*, 62-68; Ex. 1015, FIGS. 1-2, 5-12, Abstract, 1:55-2:10, 3:28-51, 4:22-44 (providing a capacitor 20 in parallel with power supply coil "so that [there is] a resonance"), 5:45-6:4 ("the resonant frequency $f_R$" is set to a level as low as approximately 1.5 times of the output frequency f*o* of the frequency converter 16 . . . [and] oscillation at a frequency

of 2 f*o* was optimal from the standpoint of maximum circuit efficiency"); Ex. 1020, Abstract, (disclosing tuning capacitor 22 in a resonant circuit in an inductively coupled power transfer system that results in reduce harmonics); Ex. 1025, ¶¶00164-0165 ("[i]t was known in the art to drive coils using parallel or series resonant circuits" to allow "maximum current flow[] through the primary coil"); Ex. 1029, 19 ("antenna coils . . . can be formed by a metallic or conductive trance on PCB board or on flexible substrate"), 22-25; Ex. 1017, 1:9-8:22 (discussing known issues with harmonics and conventional and revised ways to reduce harmonics in AC-DC/DC-AC conversion power systems with application to "battery chargers"); Ex. 1023, FIGS. 1-4, 6A-6C, 14, Abstract, ¶¶0007-0024, 0027, 0032-34, 0074-0078 (describing mechanisms/techniques to reduce harmonics in AC and DC driven lighting systems and benefits for doing so).)

## VI. OVERVIEW OF THE '500 PATENT

66. The '500 patent relates "generally to power supplies, power sources, and particularly to a system and method for inductive charging of portable devices." (Ex. 1001, 2:16-18.) For example, the patent explains that "[s]ystems and methods are provided for inductive powering and/or charging of electric or electronic devices or batteries. The system typically includes a base unit, such as a charger or power supply, which includes one or more primary coils generally having a planar or curved surface. Each of the one or more primary coils can be activated to generate a magnetic field in a direction substantially perpendicular to the planar or curved surface to provide power to one or more inductive power receiver coils of one or more receivers to power or charge one or more portable devices or batteries." (*Id.*, 4:13-22.)

67. In my opinion, a person of ordinary skill in the art would have recognized and understood that these features, and other features recited in the challenged claims of the '500 patent, were known and consistent with contactless/inductive power/data transfer technologies and techniques, and related circuit designs, at the time of the alleged invention, as I discussed above and further below. (*See* my discussions above in Section V and below in Sections VIII-IX.)

## VII. CLAIM CONSTRUCTION

68. I understand that claim terms are typically given their ordinary and customary meanings, as would have been understood by a person of ordinary skill in the art at the time of the alleged invention. For the claims I address in this declaration, namely claims 2, 4, and 18, I have been asked to apply the plain and ordinary meaning of the terms in those claims (although I may address other interpretations that I have been asked to consider below in my analysis of those claims in Section IX if applicable). My opinions concerning the interpretation of the claim terms are based on the time of the alleged invention I have been asked to consider as I noted above in Sections III and IV. I understand that in considering the meaning of the claims, one must consider the language of the claims, the specification, and the prosecution history of record. I have done so to support my opinions in this Declaration where appropriate.

## VIII. OVERVIEW OF THE PRIOR ART

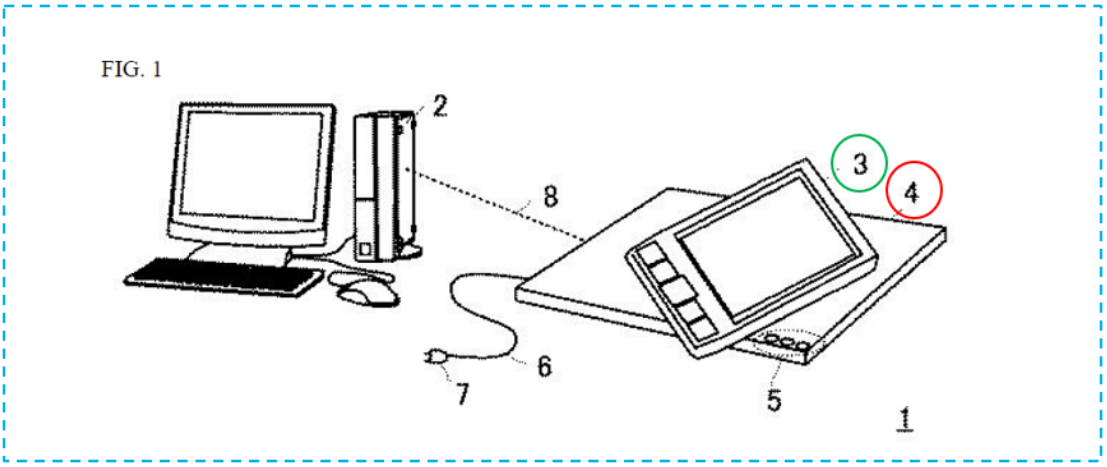
69. I rely on the disclosures and analysis thereof of the prior art discussed in this section VIII for my opinions regarding their respective teachings and suggestions as applied to the challenged claims of the ’500 patent below in Section

IX. Accordingly, the following discussions are incorporated into my analysis below in Section IX.

### A. *Okada* (Ex. 1005)

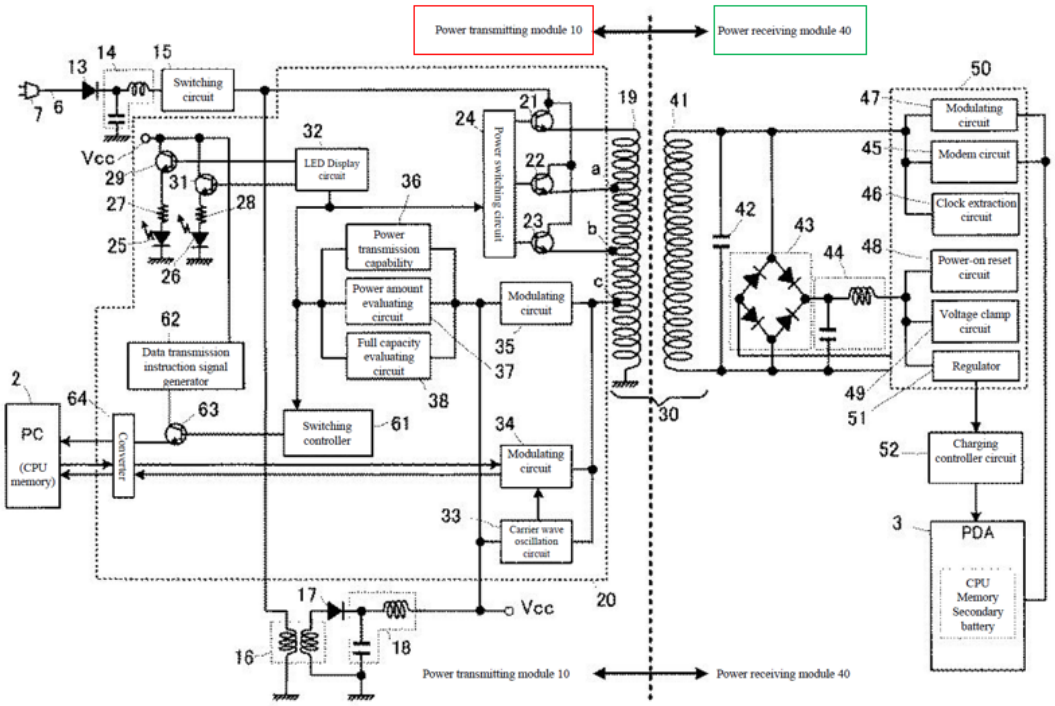
70. I understand that *Okada* is a published Japanese patent application. (Ex. 1005, Cover.) I rely on (and cite to in support of my opinions) the English translation of *Okada* that accompanies the copy of the original *Okada* published patent application. My understanding is that *Okada* was published June 1, 2006. (*Id.*) I rely on the disclosures and analysis thereof of *Okada* discussed in this section VIII for my opinions regarding *Okada*'s teachings and suggestions as applied to the challenged claims of the '500 patent below in Section IX.

71. *Okada* discloses a system for inductive powering or charging of portable devices such as mobile phones and PDAs with batteries. (Ex. 1005, Abstract, ¶¶0001, 0015, 0047, FIG. 2, claim 4.) *Okada*'s FIG. 1 shows a power supply system 1 (**blue**) including PC 2, PDA 3 (**green**), and cradle 4 (**red**), which receives commercial power via cord 6 and AC plug 7. (Ex. 1005, ¶¶0034-0036.)




(Ex. 1005, FIG. 1 (annotated).) *Okada* explains that "magnetic coupling" occurs between cradle coil(s) (primary coil(s)) and PDA 3 coil (secondary/receiver coil), which "induces voltage at both ends of the coil in the PDA" to "suppl[y] power to the PDA." (*Id.*, ¶0035; *see also id.*, ¶0051 ("The primary-side coil 19 together with the secondary-side coil 41 constitute the transformer 30 and magnetic coupling induces a voltage on both ends of the secondary-side coil 41.").)

72. *Okada*'s FIG. 2 describes an exemplary system, where each of cradle 4 and PDA 3 includes circuitry/components and at least one coil. (Ex. 1005, ¶¶0035, 0037 ("PDA equipped with the power receiving module 40"), FIG. 2.) Cradle 4 includes a **power transmitting module 10** ("PTM10"), and PDA 3 includes a **power receiving module 40** ("PRM40"). (*Id.*, FIG. 2, ¶¶0035-0037, 0038-0058, FIG. 8, ¶¶0110-0111.)

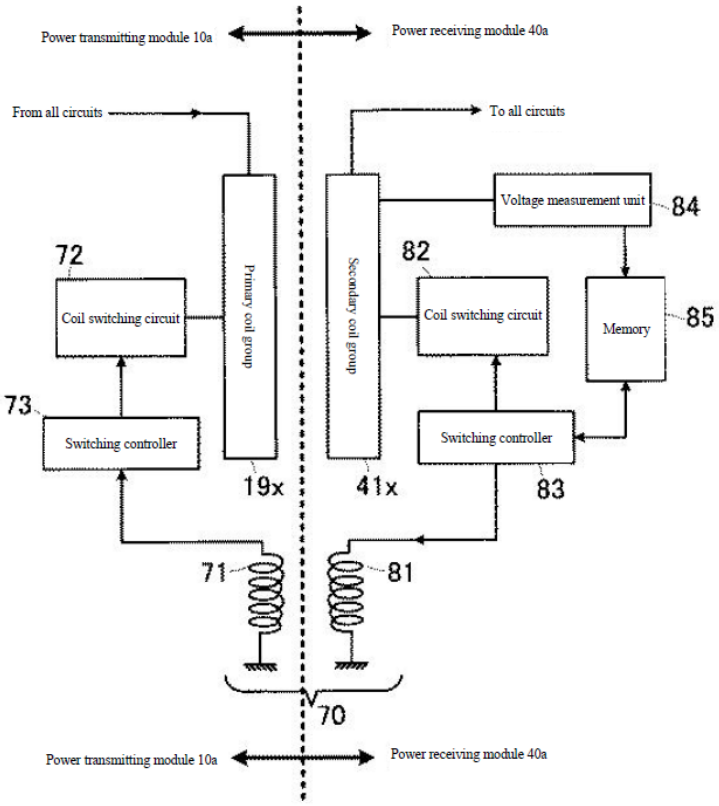



(Ex. 1005, FIG. 2 (annotated).)

73. *Okada* explains that PTM10 converts received power (e.g., via cord/plug 6/7) to a DC signal via circuits 13-14. (Ex. 1005, ¶¶0038, 0049.) Switching circuit 15 generates a switching pulse signal using the DC signal (*id.*), which is converted to a DC signal ($V_{CC}$) powering PTM10 components (via circuits 16-18). (*Id.*, ¶0039.) *Okada* also explains that the switching pulse signal is also supplied to primary coil 19 via one of switches 21/22/23 respectively connected to different coil taps. (*Id.*, ¶¶0040, 0049-0051.) A power switching circuit 24 selects a switch 21/22/23 to allow the switching pulse signal to traverse selected turns of

coil 19, enabling the system to select/adjust the power level inductively transmitted from PTM10 (e.g., cradle 4) to PRM40 (e.g., PDA 3). (*Id.*, ¶¶0040, 0051, 0057, 0069-0073, FIG. 2.)

74. *Okada* discloses various configurations/applications of such a system (e.g., inductive power transfer system) providing similar functionalities associated with PTM10 and PRM40, in connection with, for example, FIGS. 2, 7-17. (Ex. 1005, ¶¶0009-0032, 0094-0154). For one example, FIG. 7 (below) shows PTM10 including multiple primary coils (e.g., group 19x) and PRM40 including multiple secondary coils (e.g., group 41x). (Ex. 1005, FIG. 7, ¶¶0094-0096.)




(Ex. 1005, FIG. 7.) *Okada* explains that circuits in PTM10 and PRM40 selectively activate coils "having a highest power transmission efficiency" for power transmission, to, e.g., accommodate shifted positions of PDA 3 relative to cradle 4. (*Id.*, ¶¶0103-105; *see also id.*, ¶¶0097-0102, 106-109.)

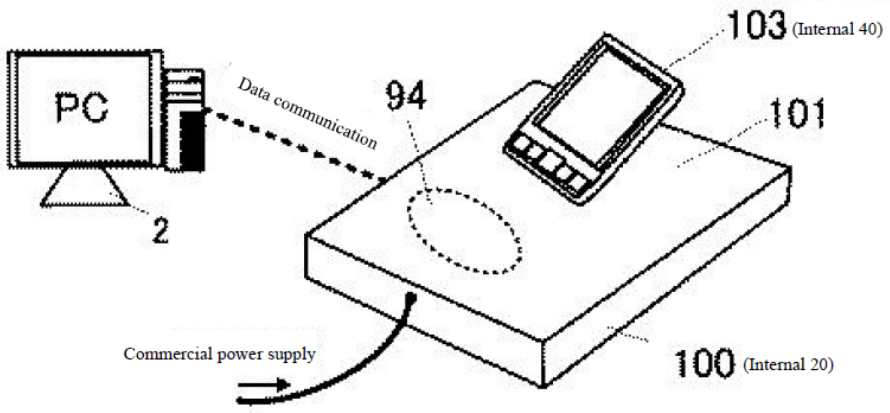
75. A person of ordinary skill in the art would have understood that applications/disclosures of these features of *Okada* (that I discussed above and below in this section) are also described in *Okada* with respect to (and are applicable to) other exemplary system(s)/configuration(s)/figure(s). (Ex. 1005, ¶0107 ("one of

these [modules] consists of [multiple] coils and the other consists of one coil"), FIG. 9 (below), ¶¶0116-0118 (tabletop with charging pad having "a plurality of the primary-side coil 19"), FIG. 10, ¶0119 (charging multiple devices), FIGS. 11(a)-(b) (below), ¶¶0120-0122 (multiple PTM10s powering/charging multiple devices each with PRM40), FIGS. 12(a)-(b) (below), ¶¶0123-0126, FIGS. 13(a)-(b) (below), ¶¶127-132 (mouse pad with multiple coils 19).) For example, *Okada* explains:

> With the power supply system of the present invention, electric power is supplied by placing an electronic device such as a PDA, mobile phone, or the like, equipped with the power receiving device of the present invention on a common cradle or the like equipped with the power transmitting device of the present invention . . . Furthermore, the power transmitting device of the present invention can be incorporated into all types of products, not just a common cradle, but also showcases, mouse pads, and the like, and therefore the device is highly versatile, because an electronic device incorporating the power receiving device of the present invention can receive power supplied from the product.

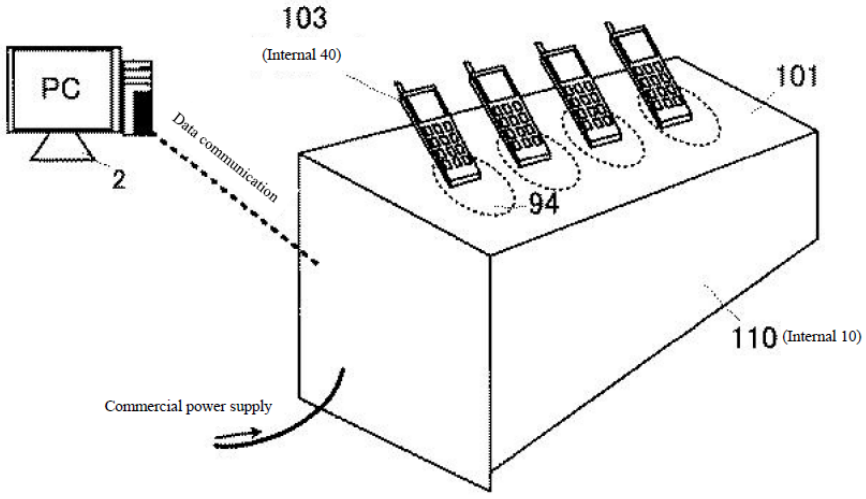
(Ex. 1005, ¶0030.)

FIG. 9



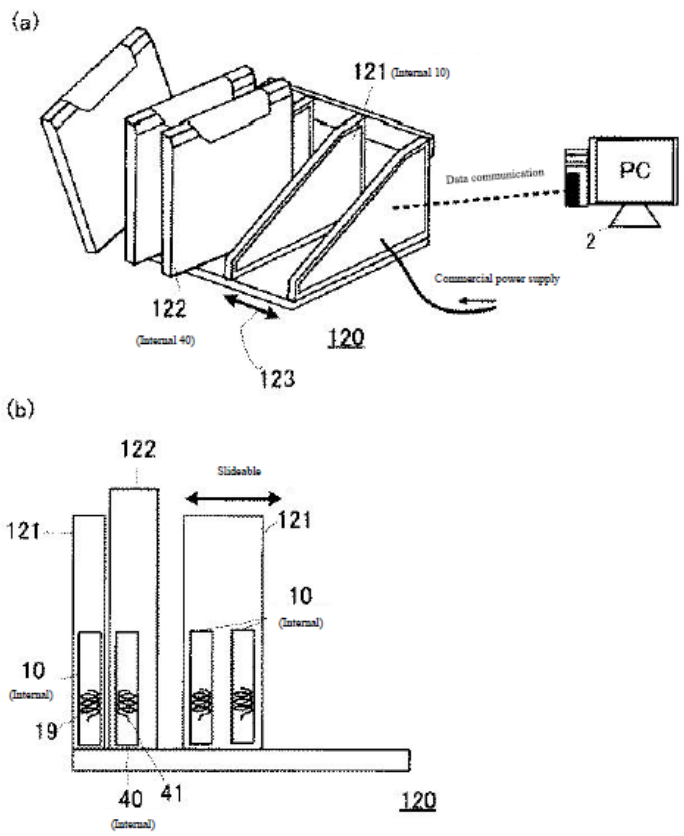

(Ex. 1005, FIG. 9.)

FIG. 10



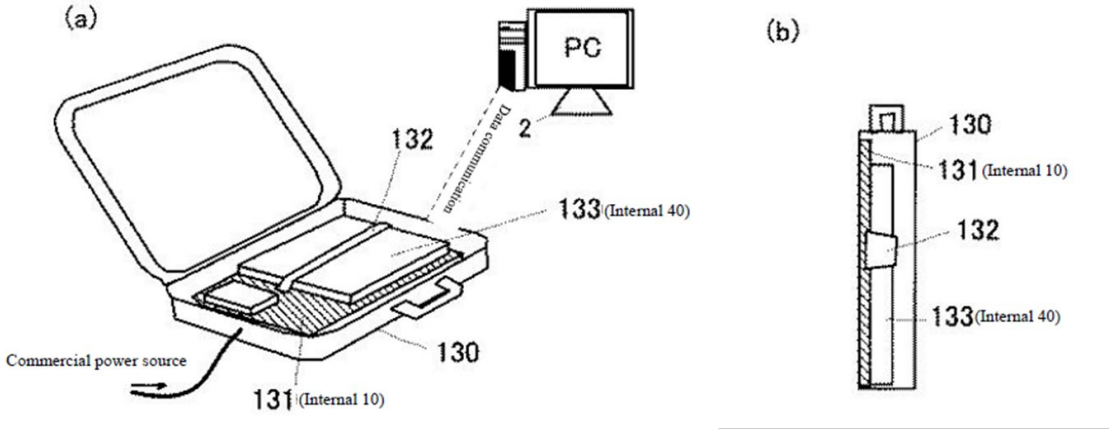

(*Id.*, FIG. 10.)

FIG. 11

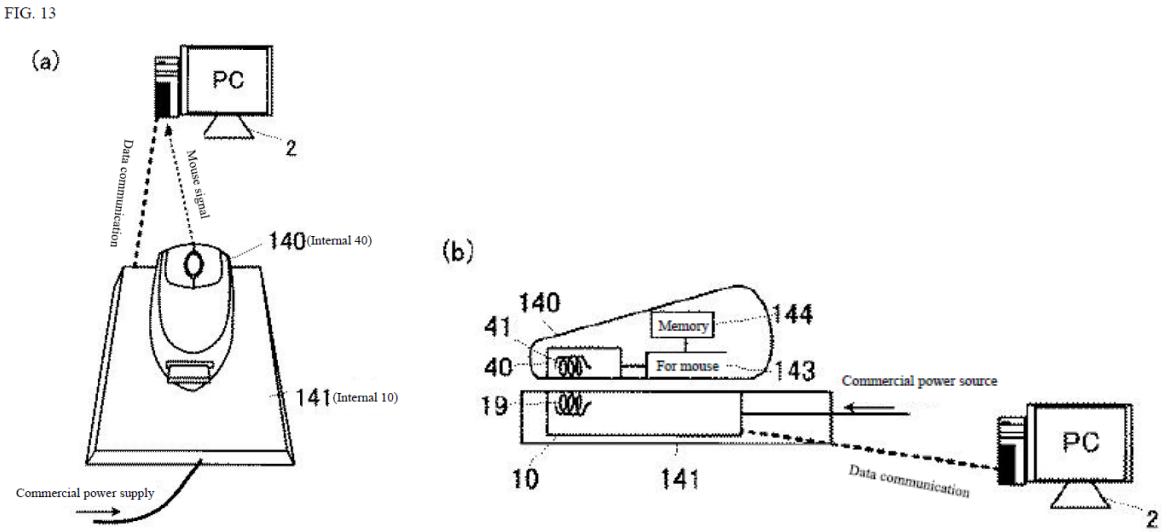



(*Id.*, FIGS. 11(a), 11(b).)

FIG. 12

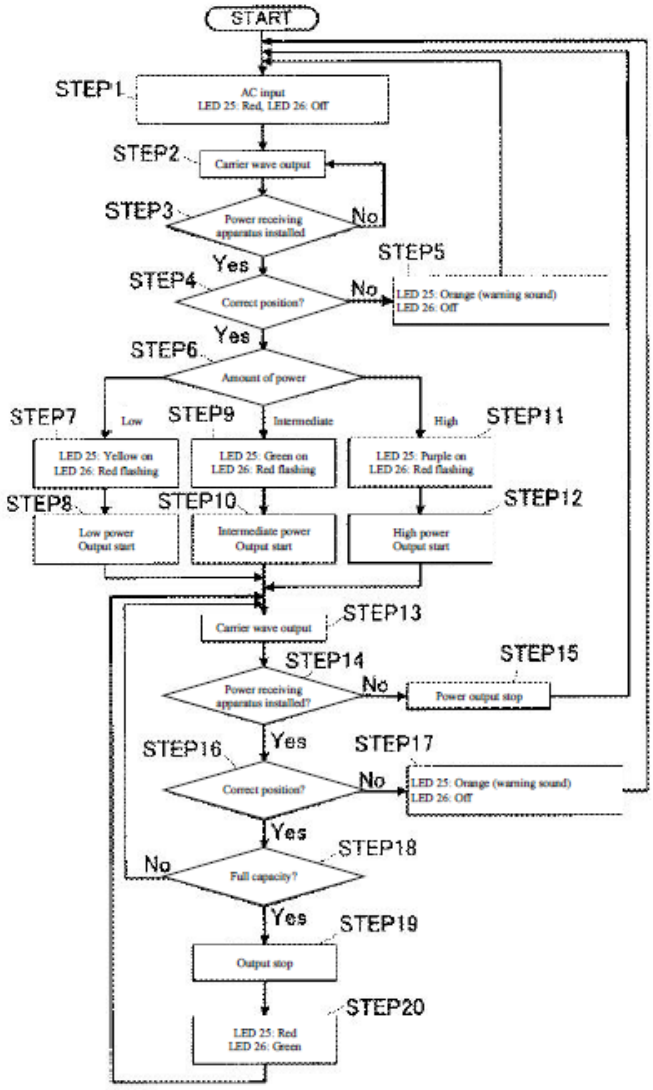


(*Id.*, FIGS. 12(a), 12(b).)




(*Id.*, FIGS. 13(a), 13(b).)

76. *Okada*'s FIG. 3 (below) shows "power supply operations carried out between [PTM10 and PRM40]," applicable to the configurations (such as those I explained above and below) disclosed by *Okada*. (Ex. 1005, FIG. 3, ¶¶0059, 0060-0090, 0094-0115.)




(Ex. 1005, FIG. 3.)

77. In *Okada*, PTM10 (e.g., of cradle 4) transmits a carrier wave signal to PRM40 (e.g., of a portable device such as PDA 3), resulting in a portable device

such as PDA 3 to generate and send a modulated signal/wave[4] including device information relating to the portable device (e.g., **"the code indicating that a device is capable of receiving power," "power consumption information," "full capacity information"**) back to PTM10 via magnetically coupled secondary-side coil 41 and primary-side coil(s) 19. Demodulating circuit 35 of PTM10 "demodulates modulated signals included with the voltage from" primary coil 19 (Ex. 1005, ¶0042), and the information is evaluated by power transmission capability evaluating circuit 36, power amount evaluating circuit 37, and full capacity evaluating circuit 38 (which "perform various decision-making processes based on information included in the signal demodulated by the demodulating circuit 35" (*id.*, FIG. 2, ¶0042, FIG. 3, ¶¶0060-0077)) and also used by other components for *Okada*'s power transfer operations. (*Id.*, FIGS. 2-3, ¶¶0056-0077.) For example, *Okada* explains:

> **A carrier wave** output from the carrier wave oscillating circuit 33 is applied to the tap c of the primary-side coil

[4] *Okada* explains that such a modulation method may be based on "periodic intensity modulation of a carrier wave and may use a phase modulation method to express 0/1 information via phase change information of a signal." (Ex. 1005, ¶0058.)

19, which, when the PDA 3 is mounted on the common cradle 4, **is transmitted to the magnetically coupled secondary-side coil 41**. This carrier wave transmitted to the secondary-side coil 41 is rectified, smoothed, and converted to a DC voltage via the smoothing capacitor 42, the rectifying circuit 43, and the smoothing circuit 44 as described above. Furthermore, the power-on reset circuit 48 detects the DC voltage converted from this carrier wave and recognizes that the carrier wave has been transmitted. Furthermore, the clock extracting circuit 46 connected to the secondary-side coil 41 extracts a clock signal necessary for **modulation from the carrier wave**, and a **modulating circuit 47 applies to the secondary-side coil 41 a modulated wave in which the carrier wave is modulated based on information on the PDA 3: such as "the code indicating that a device is capable of receiving power," "power consumption information," and "full capacity information."** . . .

**The modulated wave provided to the secondary-side coil 41 from the modulating circuit 47 is transmitted to the magnetically coupled primary-side coil 19. Furthermore, a demodulating circuit 35 connected to the tap c of the primary-side coil 19 receives and**

> **demodulates the transmitted modulated wave, and provides the "code indicating that a device is capable of receiving power," "power consumption information," and "full capacity information" included in the demodulated information signal** to the power transmission capability evaluating circuit 36, the power amount evaluating circuit 37, and full capacity evaluating circuit 38. . . .

(Ex. 1005, ¶¶0063-0064.)

78. *Okada* explains that such device information (e.g., "code indicating that a device is capable of receiving power," "power consumption information," "full capacity information") received from PRM40 is used in *Okada*'s inductive power transfer operations (e.g., for providing power from an inductive power source such as cradle 4 to a portable device such as PDA 3). (*See, e.g.*, Ex. 1005, FIGS. 2-3, ¶¶0057, 0060-0077.) For example, *Okada* explains:

> . . . the clock extracting circuit 46 connected to the secondary-side coil 41 extracts a clock signal from the carrier wave necessary for modulation, and the modulating circuit 47 uses the clock signal provided by the clock extraction circuit 46 to modulate the carrier wave based on information on a PDA 3: such as "a code indicating that a

device is capable of receiving power," "power consumption information," and "full capacity information." A modulated wave generated by this modulation is applied to the secondary-side coil 41. **When a device (PDA 3) is mounted on the common cradle 4, this "code indicating that a device is capable of receiving power" is used by the power transmission capability evaluating circuit 36 of the power transmitting module 10 to evaluate whether supplying power to the device via the common cradle 4 is feasible (whether the device is equipped with the power receiving module 40)**, as described below. Note that a device where supplying power via the common cradle 4 is feasible (common cradle 4 compatible device) is referred to as a "device capable of receiving power" hereinafter. Also, as described below, **the "power consumption information" is used by the power amount evaluating circuit 37 of the power transmitting module 10 to determine the amount of power to supply to the device (PDA 3) placed on the common cradle 4, and for instructing providing of the signal thereof to the power switching circuit 24 to change the turn ratio of the transformer 30.** Furthermore, the **"full capacity information" is used by the full capacity evaluating**

> **circuit 38 to determine whether charging of the compatible device (PDA 3) is completed**, as described below.

(Ex. 1005, ¶0057; *see also id.*, FIGS. 2-3, ¶¶0060-0077.)

79. *Okada* explains that the "code indicating that a device is capable of receiving power" is used to determine/verify that a portable device / power receiving apparatus (e.g., PDA 3) is a "device capable of receiving power" from (e.g., also referred to as a "compatible" device (*id.*, ¶¶0057, 0064, 0073) with) an inductive power source / power transmitting device (e.g., cradle 4) and that the portable device and its secondary/receiver coil 41 are present and properly aligned with the inductive power source (e.g., cradle 4) and its primary coil(s), where there is appropriate magnetic coupling for high power transmission efficiency between the primary and secondary coils (before transmitting power inductively from the source to the portable device). (*See, e.g.*, Ex. 1005, ¶¶0064-0069, 0074-0076, FIGS. 2-3, 4(a)-(b).) For example, *Okada* explains:

> . . . Here, the power transmission capability evaluating circuit 36 determines **whether a power receiving apparatus is mounted onto a power transmitting device 1 based on the "code indicating that a device is**

**capable of receiving power" (STEP 3). If a prescribed "code indicating that a device is capable of receiving power" is received (STEP 3: Yes), it is recognized that a device capable of receiving power is mounted onto the common module 4 [sic - common cradle 4]. Next it is determined whether the device capable of receiving power (compatible device) is correctly mounted onto the common cradle 4 (STEP 4). Meanwhile, if no prescribed "code indicating that a device is capable of receiving power" is received (STEP 3: No), it is determined that no device capable of receiving power is mounted onto the common cradle 4**, and a carrier wave is output again (STEP 2).

Next, the determination as to whether a device capable of receiving power is correctly mounted onto the common cradle 4 is described. **Determining whether a device capable of receiving power is correctly mounted onto the common cradle 4 determines whether the primary-side coil 19 in the power transmitting module 10 and the secondary-side coil 41 in the power receiving module 40 are arranged at positions having high power transmission efficiency, and providing this determination step allows for the selection not to carry**

**out power transmission when the mount position has significantly poor power transmission efficiency.**

**FIG. 4 illustrates the relationship between relative positions of the common cradle 4 and the PDA 3, transmission efficiency of power and an information signal.** Here, the information signal is the modulated wave described above, returned by the power receiving module 40 in response to a carrier wave transmitted by the power transmitting module 10. In FIG. 4, (a) illustrates an absolute value of a transmission efficiency of power (solid line) and an information signal (dashed line), and (b) illustrates a relative value of the power (solid line) and the information signal (dashed line). In both (a) and (b), the **horizontal axis represents an amount of offset of the common cradle 4 and the PDA 3, with 0 being a case where the common cradle 4 and the PDA 3 are positioned at positions at which magnetic coupling of the primary-side coil 19 of the common cradle 4 and the secondary-side coil 41 of the PDA 3 is highest, illustrating the amount of offset of the PDA 3 from this position either left to right or front to back in units of mm.**

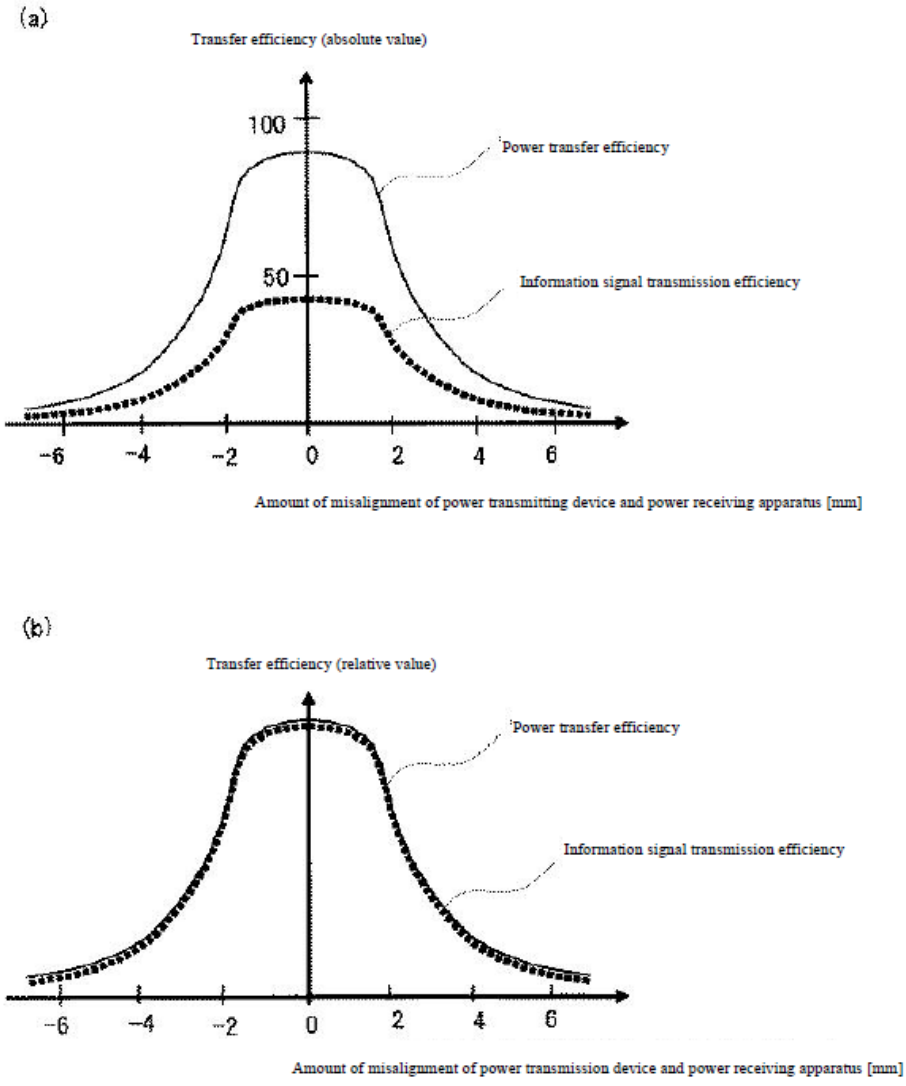
As illustrated in FIG. 4(a), **the greater the amount of offset of the positions of the common cradle 4 and the PDA 3, the worse the power transmission efficiency and information signal transmission efficiency.** As illustrated in FIG. 4(b), this power transmission efficiency and information signal transmission efficiency decrease by the same percentage as the amount of positional offset of the common cradle 4 and the PDA 3, so even when the common cradle 4 is in a state where power is not being transmitted, by measuring a signal intensity of the information signal, the amount of positional offset of the common cradle 4 and the PDA 3 can be recognized.

**The greater the amount of positional offset of the common cradle 4 and the PDA 3, the worse the power transmission efficiency, so when power transmission efficiency is significantly low, the PDA 3 cannot receive power even if power is transmitted from the common cradle 4, which defeats the purpose of transmitting power. Therefore, after evaluating whether an amount of positional offset of the common cradle 4 and the PDA 3 exceeds a prescribed amount of offset (STEP 4), when exceeded (STEP 4: No), power is not transmitted from the power transmitting device 1** . . .

> Meanwhile, **when the amount of positional offset of the common cradle 4 and the PDA 3 does not exceed the prescribed amount of offset (STEP 4: Yes), processing proceeds to evaluating an amount of power to transmit (STEP 6)**. . . .

(Ex. 1005, ¶¶0064-0069; *see also id.*, FIGS. 3, 4(a)-(b), ¶¶0074-0076.)

FIG. 4




(Ex. 1005, FIGS. 4(a) and (b) ("Amount of ***misalignment*** of power transmission device and power receiving apparatus [mm]").) Thus, *Okada* discloses that power is delivered (e.g., from the inductive power source / power transmission device (e.g., cradle 4 with PTM10) to portable device / power receiving apparatus (e.g., PDA 3

with PRM40)) only when such a "compatible" portable device (and its secondary/receiver coil) is present and properly placed/aligned with the source (e.g., cradle 4) and its primary coil(s). (Ex. 1005, ¶¶0057, 0064-0069, 0074-0076, FIGS. 2-3, 4(a)-(b).)

80. In the multi-coil system configuration (e.g., FIG. 7 (with primary coil group 19x and secondary coil group 41x)) I discussed above, *Okada* explains how switching controller circuitry (e.g., 73) in PTM10 can select a coil from primary coils group 19x based on detected voltage values so that a pair of primary and secondary coils "having a highest power transmission efficiency" (e.g., least misalignment) is used for power transfer. (Ex. 1005, ¶0105; *see also id.*, ¶¶0017, 0094-0115, Claims 9-10.)

81. *Okada* also discloses verifying portable device / PDA 3's presence by measuring intensity of the signal(s) communicated via primary coil(s) 19 and secondary coil 41. (Ex. 1005, FIGS. 4(a)-4(b), ¶¶0066 ("transmission efficiency of power and the information signal"), 0067-0068, 0074-0076, FIG. 8 (current sensor 91), ¶¶0110 ("current measuring sensor" measuring current "through the primary-side coil 19" when PDA 3 "is in proximity" of cradle 4), 0111.)

82. *Okada* explains that selection/adjustment of the power level (e.g., high, intermediate, low) of power transmitted (e.g., from cradle 4 to a portable device such as PDA 3) may be determined based on the device's "power consumption information" provided by PRM40 to PTM10. (*Id.*, ¶¶0057, 0063-0064, 0069-0073, 0090, FIGS. 2-3.) For example, *Okada* explains:

> when the amount of positional offset of the common cradle 4 and the PDA 3 does not exceed the prescribed amount of offset (STEP 4: Yes), **processing proceeds to evaluating an amount of power to transmit (STEP 6). This evaluation process is conducted using the power amount evaluating circuit 37 based on the "power consumption information" included in the information signal demodulated by the demodulating circuit 35, recognizes the PDA 3 power based on the "power consumption information," and depending on this power, adjusts power transmission output in three levels: high, intermediate, and low.** An evaluation result from the power amount evaluating circuit 37 is relayed to the LED display circuit 32 and the power switching circuit 24, and depending on the determination result of high, intermediate, and low, a process such as described below is conducted.

**First, when the evaluation result is low (STEP 6: Low)**, the LED display circuit 32 turns ON the light emitting diode 25 yellow and turns ON the light emitting diode 26 red (STEP 7). By changing a combination of colors of light emitted by the light emitting diode 27 and the light emitting diode 28 depending on a magnitude of the power transmission output, a user can visually recognize the magnitude of the power transmission output currently being conducted by the common cradle. **The power switching circuit 24 controls the transistor 21 into an ON state. When the transistor 21 is in the ON state, a pulse voltage from the switching circuit 15 is applied to an entire winding wire of the primary-side coil 19, and power transmission is started (STEP 8).**

Next, **when the evaluation result is intermediate (STEP 6: Intermediate), it means that intermediate power transmission will be conducted**, and the LED display circuit 32 turns ON the light emitting diode 25 green and turns ON the light emitting diode 26 red (STEP 9). **The power switching circuit 24 controls the transistor 22 into an ON state. When the transistor 22 is in the ON state, a pulse voltage from the switching circuit 15 is**

**applied to a tap a of the primary-side coil 19, and power transmission is started (STEP 10).**

Also, **when the evaluation result is high (STEP 6: High), it means that high power transmission will be conducted**, and the LED display circuit 32 turns ON the light emitting diode 25 purple and turns ON the light emitting diode 26 red (STEP 11). **The power switching circuit 24 controls the transistor 23 into an ON state. When the transistor 23 is in the ON state, a pulse voltage from the switching circuit 15 is applied to a tap b of the primary-side coil 19, and power transmission is started (STEP 12).**

**Switching the transistor 21, the transistor 22, or the transistor 23 changes the position at which pulse voltage from the switching circuit is applied on winding wire of the primary-side coil 19. That is, because the effective number of actual turns of the primary-side coil 19 changes, the turn ratio of the primary-side coil 19 and the secondary-side coil 41 changes. As such, power can be transmitted depending on the power of a compatible device.** Note that the present example switches between three levels: high,

> intermediate, and low, however, the number of switches may be further increased.

(Ex. 1005, ¶¶0069-0073; *see also id.*, ¶0057, FIG. 3.)

83. *Okada* explains that "[e]ven after power transmission has begun," the carrier wave is "periodically transmitted" from PTM10 to PRM40 (e.g., to receive the above-discussed device information in return from PRM40) to determine whether the portable device/PDA 3 (and its coil) remains present and properly positioned/aligned with cradle 4 (and its coil(s)) (e.g., as I discussed above, using the above-mentioned "code indicating that a device is capable of receiving power") and whether the portable device/PDA 3 (e.g., its battery) is fully charged (e.g., using the above-mentioned "full capacity information"). (Ex. 1005, ¶¶0074-0076, FIG. 3.) For example, *Okada* explains:

> **Even after power transmission has begun, a carrier wave is periodically transmitted (STEP 13), and first, based on information included in a modulated wave returned in response to this carrier wave, it is verified whether the PDA 3 has been removed from the common cradle 4 (STEP 14).** As in STEP 3, for this verification, the power transmission capability evaluating circuit 36 **determines whether a device capable of**

**receiving power is mounted onto the common cradle 4 based on the "code indicating that a device is capable of receiving power."** Furthermore, if no prescribed "code indicating that a device is capable of receiving power" is received (STEP 14: No), it is determined that the device capable of receiving power has been removed from off of the common cradle 4, the power switching circuit 24 controls all of the transistors including the transistor 21, the transistor 22, and the transistor 23 into an OFF state and stops power transmission (STEP 15).

Meanwhile, **if a prescribed "code indicating that a device is capable of receiving power" is received (STEP 14: Yes), it is recognized that a device capable of receiving power is mounted on the common cradle 4. Next it is determined whether the device capable of receiving power is correctly mounted onto the common cradle 4 (STEP 16). As in STEP 4, this determination is conducted by evaluating whether an amount of positional offset of the common cradle 4 and the PDA 3 exceeds a prescribed amount of offset.** Furthermore, if this amount of offset exceeds the prescribed amount of offset (STEP 16: No), no power is transmitted from the common cradle 4, the light emitting diode 25 is turned ON

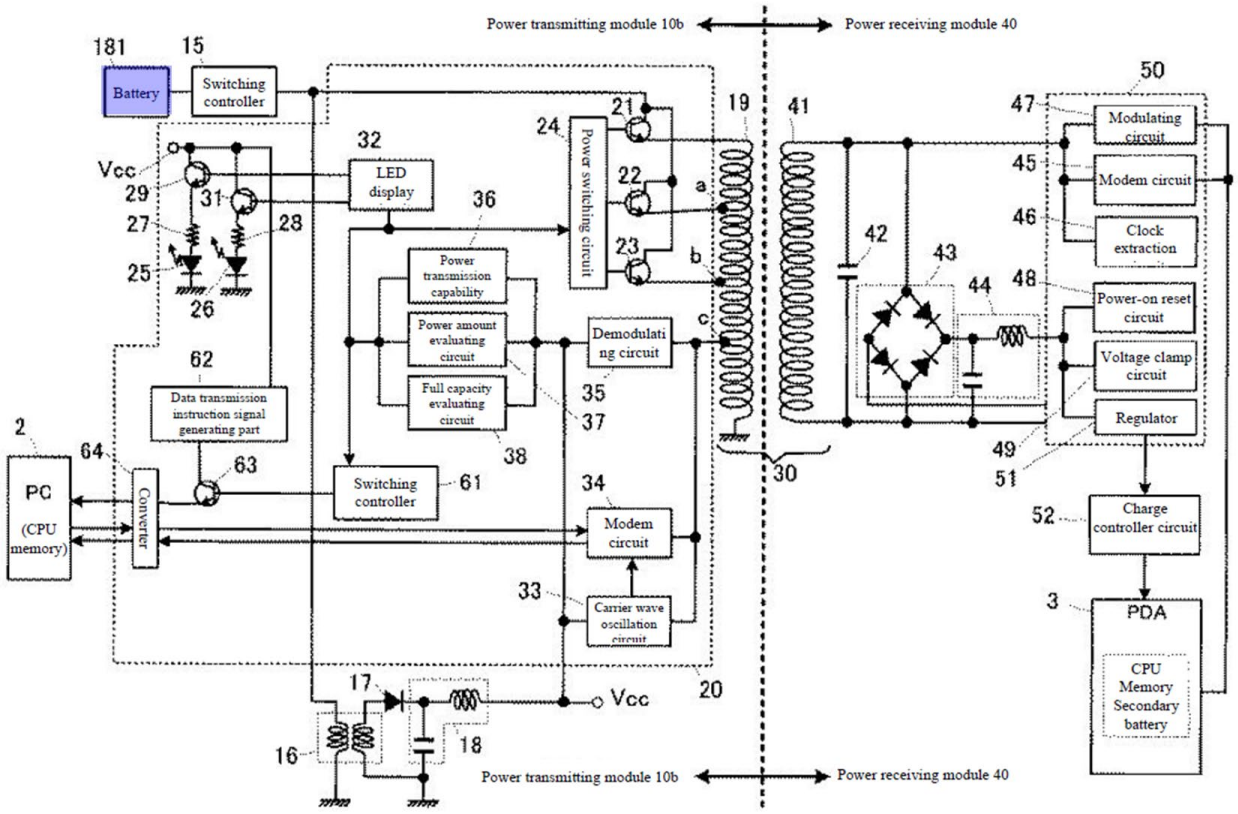
orange and the light emitting diode 26 is turned OFF as a warning display similar to STEP 5 (STEP 17). A warning sound may also be generated at this time.

Meanwhile, **when the amount of positional offset of the common cradle 4 and the PDA 3 does not exceed the prescribed amount of offset, processing proceeds to evaluating whether a charged state of the PDA 3 is at full capacity (STEP 18).** This evaluation process is conducted by the full capacity evaluating circuit 38 evaluating whether the PDA 3 is at full capacity **based on "full capacity information" included in the information signal demodulated by the demodulating circuit 35. Furthermore, if at full capacity (STEP 18: Yes), the power switching circuit 24 controls all of the transistors including the transistor 21, the transistor 22, and the transistor 23 into an OFF state, ends power output (STEP 19), meaning that the power transmission is stopped because the power receiving apparatus is a full capacity state**, turns ON the light emitting diode 25 red, turns ON the light emitting diode 26 green (STEP 20), and **continues to confirm the state of the power receiving apparatus by outputting carrier waves (STEP 13)**. **On the other hand, if not at full**

> **capacity (STEP 18: No), the state of the power receiving apparatus continues to be verified while power is transmitted** (STEP 13). As described above, power is supplied from the common cradle 4 to the PDA 3.

(Ex. 1005, ¶¶0074-0076; *see also id.*, FIGS. 2-3.)

84. *Okada* (in addition to that I explained above) also discloses a system, which instead of using AC power, uses an internal battery to power/charge a portable device such as PDA 3. For example, *Okada* discloses configurations where PTM10 can be powered by an internal rechargeable battery that provides power to switching circuit 15. (Ex. 1005, ¶¶0148 ("these devices may be provided with an internal battery and may supply power from this battery"), 0149 (FIG. 17 configuration "is identical to that in FIG. 2, except that DC power is supplied from the battery 181"), 0150-0151, FIG. 17 (annotated below highlighting the battery in purple).)




(Ex. 1005, FIG. 17 (annotated).) Moreover, *Okada* explains that "each of the examples described above, the common cradle 4 [Figure 1], power supply pad 100 [Figure 9], side panel 121 [Figure 11], side panel 131 [Figure 12], [and] mouse pad 141 [Figure 13]" may be provided with an internal battery and "may supply power from this battery." (*Id.*, ¶0148, FIGS. 1, 9, 11(a), 12-13 (*see* these figures above in this section).)

### B. *Odendaal* (Ex. 1008)

85. I understand that *Odendaal* is an issued United States patent. (Ex. 1008, Cover.) My understanding is that *Odendaal* was filed June 26, 2002 and issued November 1, 2005. (*Id.*) I rely on the disclosures and analysis thereof of *Odendaal* discussed in this section VIII for my opinions regarding *Odendaal*'s teachings and suggestions as applied to the challenged claims of the '500 patent below in Section IX.

86. *Odendaal* discloses a contactless inductive power/charging system (e.g., "contactless power transfer system[]") that uses inductive coupling (e.g., "coupling between battery charging circuit and the battery [that] may comprise capacitive coupling and/or **magnetic coupling, and wherein power is transferred by the coupling of** an electric field and/or **magnetic flux** across the IOET [interface-of-energy-transfer]") between primary and secondary coils (e.g., thin, planar-type coils) to provide power to a mobile device (e.g., cellphone, computer, etc.) through its secondary coil placed on or near primary coils in the surface of a powering device (e.g., charger for cellphones, powering pad, or charger embedded in a thin surface,

including fabrics, etc.). (Ex. 1008, 1:5-3:57; *see also id.*, Title, Abstract, FIGS. 1A-4, 11-12, 4:50-5:8, 5:24-28, 6:59-64.)

87. *Odendaal* discloses the known use of thin, planar-type inductor coils for use in a contactless power/data transfer system that transfers power/data via magnetic coupling for, e.g., charging a battery of a cellphone, computer, wearable items, etc. (*Id.*, FIGS. 1A-1B, 2A, 2C, 8E, 1:58-2:43.) For example, *Odendaal* explains:

> **The spiral-shaped conductor may comprise pcb spiral-wound conductors. In addition, a battery charging circuit can be coupled to one of the first and second spiral-shaped conductors, and a load can be coupled to the other of the first and second spiral-shaped conductors**. The coupling between battery charging circuit and the battery may comprise capacitive coupling and/or **magnetic coupling, and wherein power is transferred by the coupling of an electric field and/or magnetic flux across the IOET** [interface-of-energy-transfer].
>
> According to an aspect of the present invention, a signal applied to the first spiral-shaped conductor can be transferred to the second spiral-shaped conductor by

> coupling of magnetic flux of the first and second spiral-shaped conductors across the IOET.
>
> **The first and second spiral-shaped conductors** and the IOET are preferably integrated into **a planar (flat/thin) structure**.

(*Id.*, 2:55-3:5.) *Odendaal* also explains:

> According to another aspect of the invention, an isolating coupling interface and a resonant tank are functionally integrated into a planar configuration for transferring power with isolation properties. **The device may comprise two separable structures on either side of the IOET, such as, for example, a cellphone and its charger**. . . .
>
> An advantage of the present invention is that it facilitates the use of **wearable electronics**. For example, **flex circuits may be used so as to cause the surface of the coils to be flexible.** In addition to the flexibility, the coils may be formed in any arbitrary shape to facilitate woven wire arranged in **a fabric, or pads with embedded conductors that can be attached to clothes**. In this way, for example, **one could charge a radio, cellphone, and/or computer (just to name a few of the many**

> **wearable items) by bringing the device in close proximity to the fabric.** Thus, implementation of the invention with wearable electronics could provide an **interface between the wearable device(s) and external power sources. Digital or analog signals may also be transmitted across such interfaces to, for instance, up- or download digital information.**

(*Id.*, 2:16-43; *see also id.*, 2:44-54 (explaining that the "interface-of-energy-transfer" (IOET) of the planar power resonator "may have a **thin and/or relatively flat top coil surface**" and may have coils arranged in upper and lower configurations "with an air gap"); *see also id.*, 2:1-15 (transferring power across IOET "in **either** an electric **or magnetic form**, or both" and "**transformer action** with or **without** capacitive energy transfer"), 4:44-5:8, 6:1-18 (air coil transformer).)

88. As noted in the quote above, *Odendaal* explains that in addition to charging "a radio, cellphone, and/or computer," etc. (Ex. 1008, 2:30-41), its system can also transmit "**digital**" signals through the IOET (e.g., between the primary side and the secondary side) for uploading/downloading "**digital information**" (*id.*, 2:41-44). (Ex. 1008, 2:30-44; *see also id.*, 2:65-3:2 ("According to an aspect of the present invention, a signal applied to the first spiral-shaped conductor can be

transferred to the second spiral-shaped conductor by coupling of magnetic flux of the first and second spiral-shaped conductors across the IOET.").)

### C. *Berghegger* (Ex. 1006)

89. I understand that *Berghegger* is an issued United States patent. (Ex. 1006, Cover.) My understanding is that *Berghegger* was filed November 28, 2002 and issued June 28, 2005. (*Id.*) I rely on the disclosures and analysis thereof of *Berghegger* discussed in this section VIII for my opinions regarding *Berghegger*'s teachings and suggestions as applied to the challenged claims of the '500 patent below in Section IX.

90. *Berghegger* discloses an inductive contactless power system using primary and secondary coils for powering/charging a device and/or its battery. For example, *Berghegger* explains:

> The present invention relates to **an inductive contactless power transmitter having a primary side including a first inductor ($L_P$) on the primary side** and an oscillator for **producing an alternating signal which is supplied to the inductor ($L_P$) on the primary side, and having a secondary side which includes an inductor on the secondary side that can be coupled to the inductor ($L_P$) on the primary side**, a load ($R_L$) which is variable in time,

> and a detection means (42) for determining a power demand of the load on the secondary side, the first oscillator being a voltage-controlled oscillator having a frequency that is adjustable in response to the power demand determined by the detection means (42).

(Ex. 1006, Abstract; *see also id.*, FIGS. 1a-1b, 4-6, 1:65-2:17, 2:18-3:30, 5:27-30, 6:12-19 (load can include batteries), 6:37-45 (charging tray for mobile phone).) *Berghegger* explains that a controller 40 drives resonant capacitor $C_P$ and primary-side inductor $L_P$ that is "magnetically coupled to" secondary-side inductor $L_S$ to induce an AC voltage on $L_S$, which is rectified by rectifier GL and supplied to load $R_L$ (including a battery). (*Id.*, 6:5-15; *see also id.*, 6:38-40 ("charging tray" and "mobile...telephone").)

91. *Berghegger* explains that controller 40 (*see, e.g.*, FIG. 4) includes a drive circuit 2 (*see, e.g.*, FIG. 2) and MOSFET switches S1-S2 (*see, e.g.*, FIG. 1b) for "driving the inductor $L_P$ and the resonant capacitor $C_P$ on the primary side." (Ex. 1006, 6:5-8.)

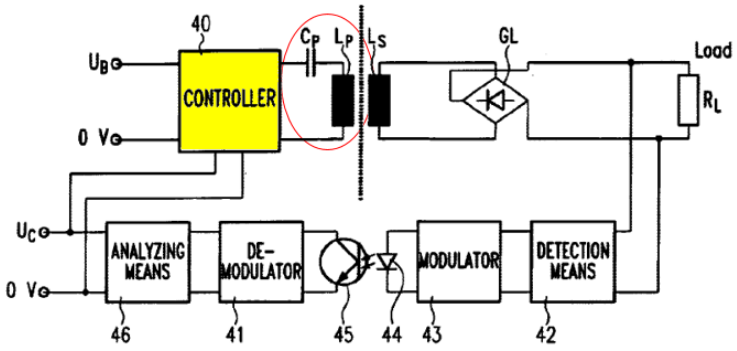



Fig.4

(Ex. 1006, FIG. 4 (annotated).)

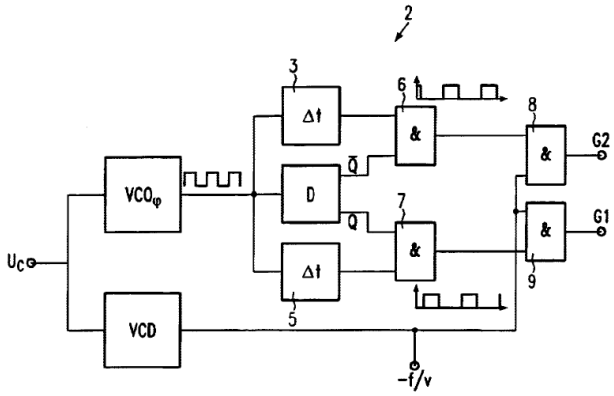



Fig.2

(*Id.*, FIG. 2.)

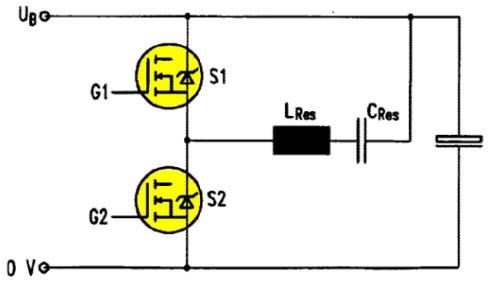



Fig.1b

(*Id.*, FIG. 1b (annotated).)

92. *Berghegger* also explains that drive circuit 2 receives a control signal $U_C$ that ultimately determines the frequency of AC signals provided by electrodes G1-G2, where $U_C$ "depends on the power demand of the secondary side." (*Id.*, 4:51-61 ("G1 and G2 are controlled by the drive circuit 2 shown in FIG. 2" and voltage-controlled oscillator ($VCO_P$) and voltage-controlled duty cycle control unit (VCD) both receive $U_C$).) For example, *Berghegger* explains:

> the control electrodes G1 and G2 are controlled by the drive circuit 2 shown in FIG. 2. The drive circuit 2 comprises a voltage-controlled oscillator ($VCO_P$), two delay elements 3 and 5, a delay flip-flop D and gates 6, 7, 8, 9 as well as a duty cycle control unit VCD. Both the voltage-controlled oscillator $VCO_P$ and the duty cycle control unit VCD have a control signal $U_C$ supplied thereto. The control signal $U_C$ depends on the power demand of the secondary side. It will be explained further

> below with reference to FIGS. 4 and 5 how the control signal is generated.

(Ex. 1006, 4:51-61; *see also id.*, 4:62-5:64 ($U_C$ determines frequency of ac signal provided by G1-G2).) Signals from G1-G2 control the frequency at which MOSFETs S1/S2 operate to drive inductor $L_P$ and resonant capacitor $C_P$. (*Id.*, 3:51-4:50.) (*E.g.*, *Berghegger* teaches using a control signal ($U_C$) provided to a drive circuit to adjust the switching frequency of switches (S1-S2) that drive a primary coil based on device power demand to ensure "a sufficient amount of electrical power is always available on the secondary side." (Ex. 1006, 2:28-34, 3:51-6:37, FIGS. 1(b), 2, 4.)) A person of ordinary skill in the art would have understood that the FIG. 5 (below) configuration is similar to FIG. 4 (above) (Ex. 1006, 5:65-6:37), but where $U_C$ is provided using coils $L_S$ and $L_P$. (*Id.*, 6:50-53, 6:53-8:8.)

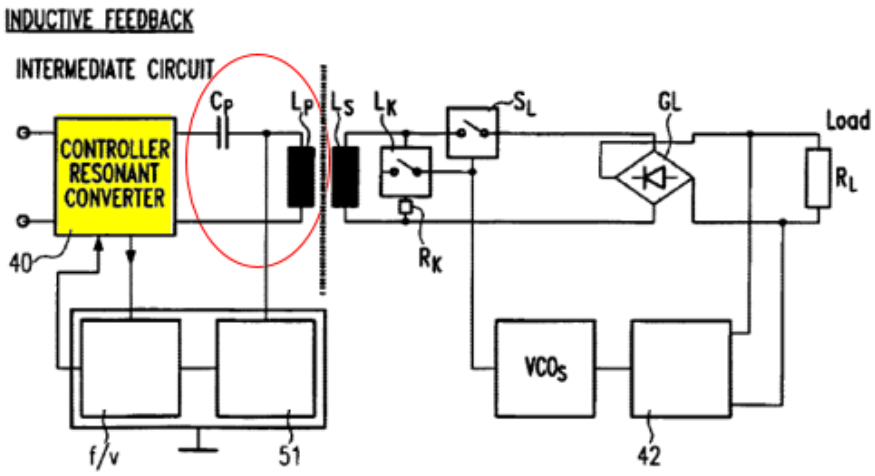



Fig.5

(Ex. 1006, FIG. 5 (annotated).)

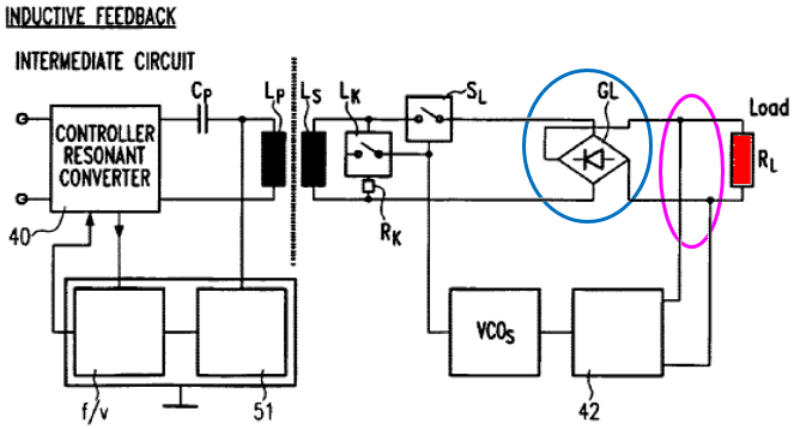
93. Thus, a person of ordinary skill in the art would have understood that *Berghegger*'s controller 40 discloses a drive circuit that includes FET driver(s) (e.g., components in circuit 2) controlling the oscillating frequency of FET switches (e.g., S1/S2) for powering a primary coil, and a resonant capacitor (e.g., resonant capacitor $C_P$) coupled to the primary coil (e.g., inductor $L_P$). (*See* my analysis, discussions, and citations in this section; Ex. 1006, 4:12-19 ("connecting $L_P$ and $C_P$").)

94. *Berghegger* also teaches using a capacitor with the primary-side inductor "to obtain a serial resonant circuit [which] has the advantage that the power transmission from the primary side to the secondary side is improved" (Ex. 1006, 2:58-61) and also choosing the highest frequency produced by the VCO to be "equal

to the resonant frequency of said serial resonant circuit" (*id.*, 2:61-64). For example, *Berghegger* explains that "[t]he inductor Lp on the primary side forms a resonant circuit with the resonant capacitor Cp." (*Id.*, 3:58-59; *see also id.*, FIGS. 1a, 4-5.)

95. *Berghegger* also explains that when a load is placed on the secondary side, "the oscillation frequency [e.g., of a drive circuit] approaches the resonant frequency, whereby the transmitted power increases." (Ex. 1006, 4:32-40.) In my opinion, a person of ordinary skill in the art would have understood that such resonant frequency is that of a circuit formed by primary-side components (including primary coil and drive circuitry (including resonant capacitor)) and secondary-side components (including secondary/receiver coil and receiver circuitry). (*Id.*) *Berghegger* explains that **when there is no load** to the secondary side, the resonance frequency is that of a circuit "formed by the inductor $L_P$ on the primary side and the resonant capacitor $C_P$." (Ex. 1006, 4:27-32.) *Berghegger* also explains that **when a load exists on the secondary side**, the resonant frequency factors into the impedance of the components on the secondary side. (*Id.*, 4:32-35 ("A load on the coil on the secondary side results in a change in impedance of the coil $L_S$ on the secondary side and thus in an off-resonance setting of the resonant circuit towards higher frequencies.").)

96. Moreover, as I discussed above, *Berghegger* describes communicating power demand information associated with a receiving device load. For example, *Berghegger* explains how power demand information at the load can be measured as a voltage at the output of a receiver rectifier circuit, which is induced by the signals communicated from the primary coil to the secondary coil. For example, a detection means 42 measures the voltage (**pink** below) rectified by rectifier GL (**blue** below) across the load $R_L$ or batteries (**red** below) that is fed back to the primary-side and used as a control signal $U_C$ to allow controller 40 to adjust the switching frequency of the primary coil via switches S1-S2 (FIG. 1(b)). (Ex. 1006, FIGS. 1(b), 2, 4-5, 5:65-6:37.) As shown in FIG. 5 (below), the "**signal about the power demand on the secondary side [may be] transmitted via the two inductors $L_P$ and $L_S$ to the primary side**," e.g., a voltage signal measured by detection means 42 at the output of rectifier GL or across the battery/load. (*Id.*, 6:16-20, 6:50-53.)




(Ex. 1006, FIG. 5 (annotated).)

97. *Berghegger* also discloses operating a circuit (e.g., drive circuit) in a "ZVS (zero voltage switching)" mode. (Ex. 1006, 4:34-40.) For example, *Berghegger* explains:

> As a consequence, at a constant oscillator frequency $f_o$, the oscillation frequency approaches the resonant frequency, whereby the transmitted power increases. To avoid switching looses and high-frequency disturbances, switching is carried out in the voltage-free state. This is referred to as ZVS (zero voltage switching).

(Ex. 1006, 4:34-40.)

### D. *Black* (Ex. 1007)

98. I understand that *Black* is a published United States patent application. (Ex. 1007, Cover.) My understanding is that *Black* was filed December 8, 2005 and published July 6, 2006. (*Id.*) I rely on the disclosures and analysis thereof of *Black* discussed in this section VIII for my opinions regarding *Black*'s teachings and suggestions as applied to the challenged claims of the '500 patent below in Section IX.

99. *Black* discloses inductively charging a portable device battery, where the battery includes a transceiver for communications with a charger. (Ex. 1007, Abstract, FIGS. 1-2, ¶¶0002, 0013-0017.) As *Black*'s FIGS. 1-2 (below) show, a battery 100/200 includes a charging coupler 108/208 coupled to cell 104/204 through a charging circuit 110/210, and a communications coupler 112/212. (*Id.*, ¶¶0015, 0017.)

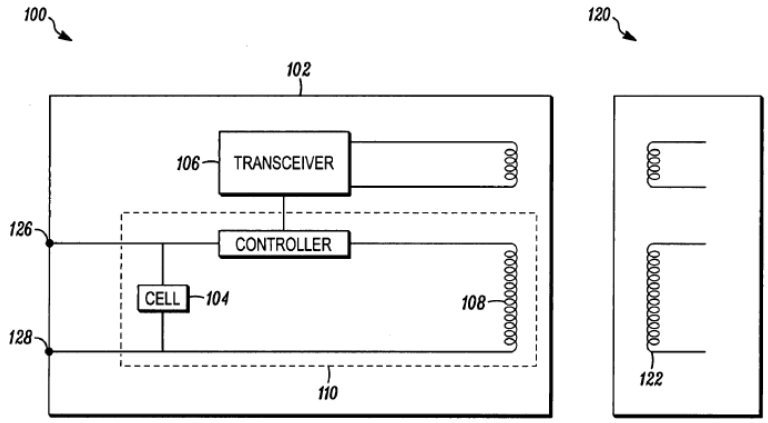
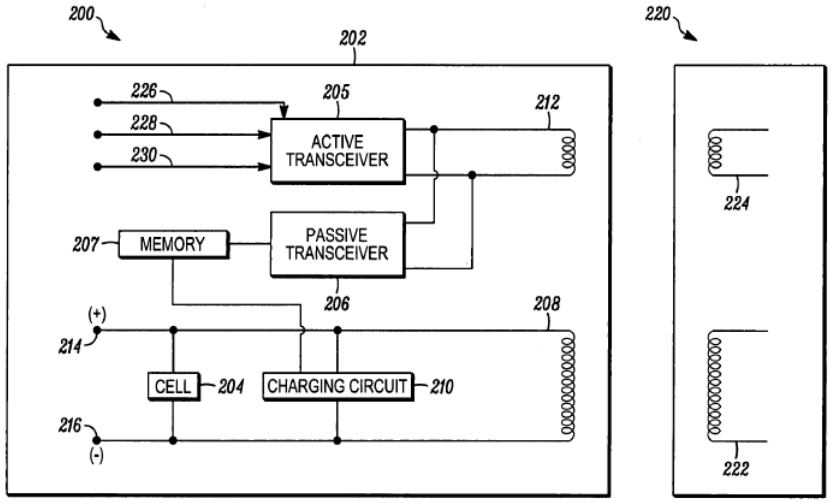



*FIG. 1*

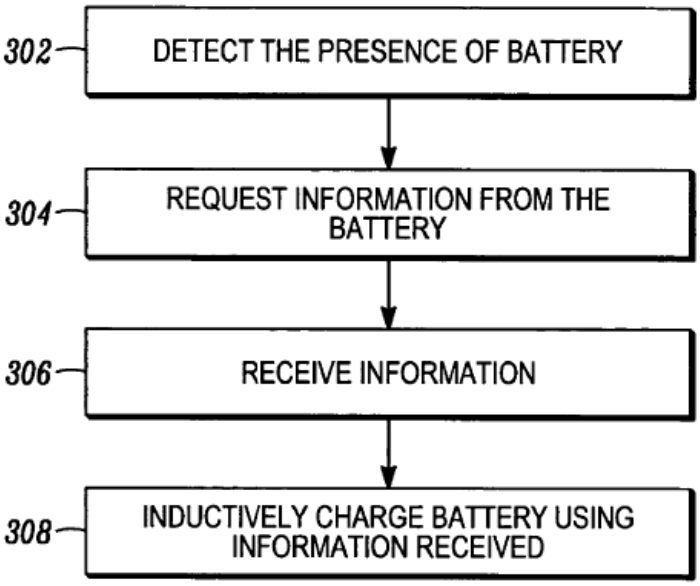
(Ex. 1007, FIG. 1.)




(*Id.*, FIG. 2.) Black explains that "[t]he **first coil 212 may be a portion of the second coil 208**." (*Id.*, FIG. 2, ¶0018.) Black also explains that when the battery is

placed in range of the inductive charger, communications between them "may take place and inductive charging can occur." (*Id.*, ¶0019.)

100. *Black* also discloses a procedure for "device identification and charging," where battery information is requested/received upon detecting the presence of the battery. (Ex. 1007, FIG. 3, ¶0020.)




(Ex. 1007, FIG. 3.) *Black* explains:

> . . . In step 302 the charger 120 detects the presence of a near field communication (NFC) device. In this exemplary embodiment the NFC device is the battery 100, 200. The charger 120 requests, in step 304, information from the device 100. The battery may respond with information, the device ID for example.

> If the battery has the capacity to provide power, more information may be transmitted to the charger 120, such as the type of device the battery 100 is coupled to, encryption information, battery characteristics or charging profile or the like. The information may come from the battery memory 207 or memory in the device. The battery may also only send a Device ID, charging profile or the like, particularly when only the passive transceiver can operate because, for example the battery has been depleted and no other power source is available.
>
> The charger receives, in step 306 the information and based thereon, inductively charges, in step 308, the battery 100. To determine how to inductively charge the battery 100, the charger 120, in one exemplary embodiment, may use a lookup table or database to compare the information sent by the battery to that in the charger 120, such as device ID to indicate a valid battery, to determine the charger profile or settings for that particular battery 100. If more information is sent by the battery 100, the charger 120 may use that information to set the charging parameters.

(Ex. 1007, ¶¶0020-0022.) Thus, *Black* explains that such device/battery information may include, e.g., device ID and additional information, e.g., "the type of device the

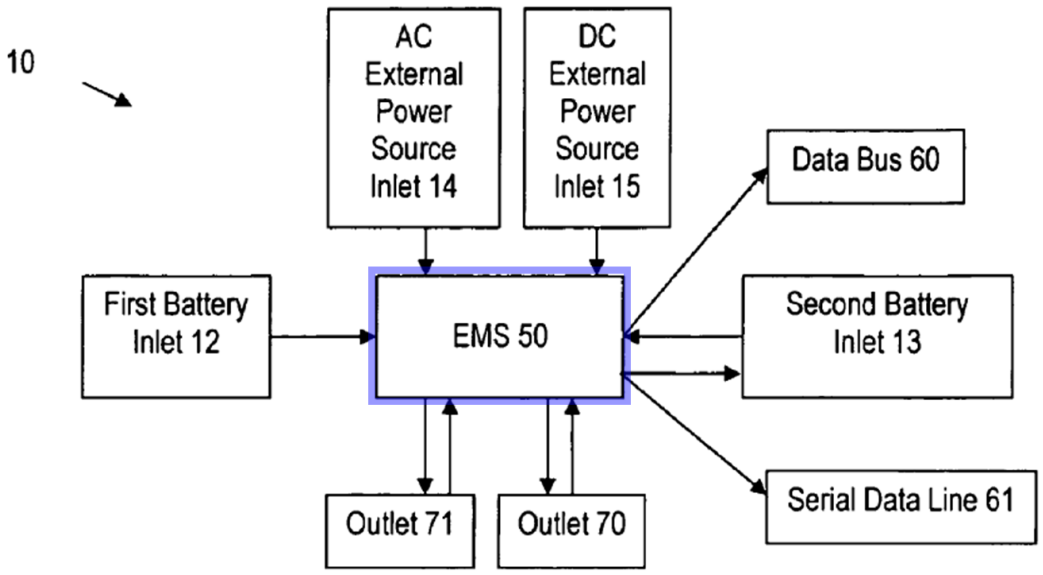
battery 100 is coupled to, encryption information, **battery characteristics** or **charging profile**." (*Id.*, ¶0021.) Charger 120 inductively charges the battery based on the received battery information. (*Id.*, ¶0022 ("[t]o determine how to inductively charge the battery 100, . . . determine the charger profile or settings for that particular battery 100" and "more information" to "set the charging parameters.").)

**E. *Masias* (Ex. 1031)**

101. I understand that *Masias* is an issued United States patent. (Ex. 1031, Cover.) My understanding is that *Masias* was filed March 10, 2004 and issued March 4, 2008. (*Id.*) I rely on the disclosures and analysis thereof of *Masias* discussed in this section VIII for my opinions regarding *Masias*'s teachings and suggestions as applied to the challenged claims of the '500 patent below in Section IX.

102. *Masias* discloses "[a] power source system including a power distribution apparatus." (Ex. 1031, Abstract.) The "power distribution apparatus has an energy management system for managing the provision of power from multiple power sources to multiple electrical devices." (*Id.*) *Masias* explains that a power distribution apparatus 10 (*see* FIG. 1 below) includes an energy management system (EMS) 50 having first and second battery inlets (12/13), AC and DC external

power source inlets (14/15), outlets (70/71), among other things. (*Id.*, 4:5-9.) EMS 50 manages "allocation of power from one or more power sources connected at the inlets," and also manages "the supply of power to a plurality of outlets at multiple and customizable voltage levels." (*Id.*, 4:9-13.) *Masias* explains that the inlet and outlet couplings can involve "inductive" connections. (*Id.*, 2:8-12, 3:26-29, 4:9-24, 7:9-41 (recharging done "inductively").)




(Ex. 1031, FIG. 1 (annotated).)

103. *Masias* discloses that EMS 50 (e.g., as shown in FIG. 4) may "include a voltage regulator device or process to provide multiple, constant, preprogrammed output voltages in any range . . . dependent on power needs of various equipment."

(Ex. 1031, 6:5-13; *see also id.*, 6:3-5 ("devices can be operated concurrently by connection at outlets 70 and 71"), FIG. 4.)

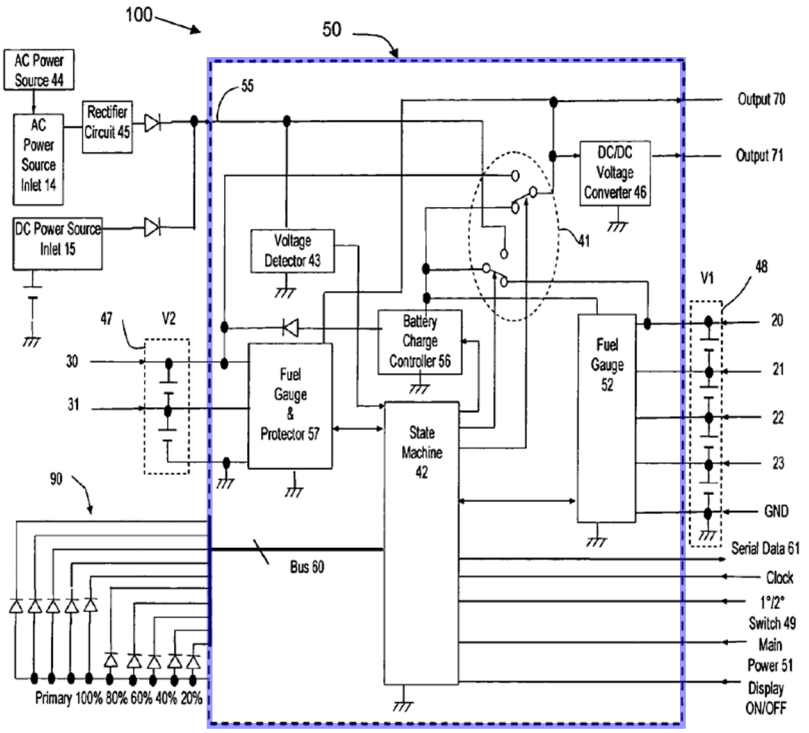



FIG. 4

(Ex. 1031, FIG. 4 (annotated).) *Masias* explains that the power source system 100 uses various available power sources based on power criteria such as "output power requirements" and monitors/displays charge state, capacity, voltage, current, recharging status, etc. (*See id.*, 6:14-8:14; *see also id.*, 9:7-62 (mobile power source system), 10:56-12:65.)

### F. *Calhoon* (Ex. 1041)

104. I understand that *Calhoon* is a published United States patent application. (Ex. 1041, Cover.) My understanding is that *Calhoon* was filed December 12, 2003 and published June 16, 2005. (*Id.*) I rely on the disclosures and analysis thereof of *Calhoon* discussed in this section VIII for my opinions regarding *Calhoon*'s teachings and suggestions as applied to the challenged claims of the '500 patent below in Section IX.

105. *Calhoon* discloses an inductive powering/charging system for a mobile device's battery charger/battery pack. (Ex. 1041, Abstract, FIGS. 2-3, ¶¶0002, 0008-0010, 0022-0029, 0045, 0065.)

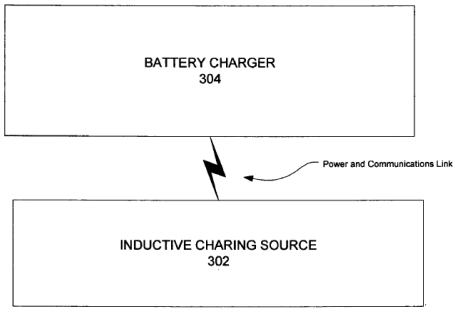



FIGURE 2

(Ex. 1041, FIG. 2.)

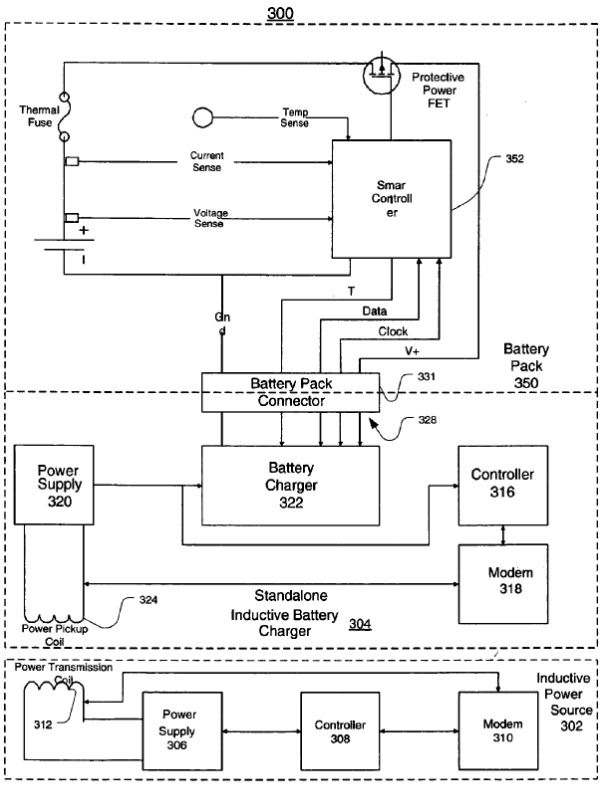



FIGURE 3

(*Id.*, FIG. 3.) *Calhoon* discloses obtaining an ID/serial number of an inductive power receiver, e.g., a battery charger (charger assembly 304) or a battery (battery pack 350) and wirelessly communicating that information to an inductive power source (e.g., inductive charging source 302). (Ex. 1041, Abstract, ¶¶0022, 0034, 0046-0048, 0050-0052, 0056, FIGS. 3, 5A, 6.) *Calhoon* also explains that controller 316 in battery charger 304 may include data, "such as **a battery charger ID number**, **serial number**, **manufacturer's name**," which can be used "for novel power

operations . . . such as shown in FIGS. 5A, 5B, and 6." (*Id.*, ¶0038; *see also id.*, FIGS. 5A-6, ¶¶0034, 0042-0044, 0045-0048, 0049, 0050-0052, 0056.)

106. *Calhoon* discloses that information such as the above-discussed battery charger ID number, serial number, and manufacturer's name as well as device power requirement information (e.g., charging parameters, charging voltage, maximum power requirement), etc. is transmitted wirelessly from an inductive power receiver (e.g., charger assembly 304/battery pack 350) to an inductive power source (e.g., inductive charging source 302) to be used for power/data transfer operations (e.g., "for **security, data integrity, or other purposes**" or for determining/ensuring that the inductive power source "can supply the requested voltage and power to" an inductive power receiver). (*See, e.g.*, Ex. 1041, ¶¶0034, 0036-0038, 0040-0052, 0056, FIGS. 3, 5A, 6.) For example, *Calhoon* explains:

> [T]he **source 302 may request information or charging parameters from the battery charger assembly 304, such as the required charging voltage and maximum power requirement.** Nevertheless, the **inductive charging source 302** can request other information relevant to the **battery charger assembly 304**, such as a **battery charger identification (ID) number** . . . **serial number of the battery charger** or the **serial number of**

> **the battery pack**. *This information can be used for* **security, data integrity, or other purposes**. In process block 508, the **battery charger assembly 304 transmits the requested information**. In process block 510, the **source 302**, via controller 308, **determines if it can supply the requested voltage and power to battery charger assembly 304**. . . . if the source 302 can provide the voltage and/or power, then the process flows to process block 514 for the charging mode.
>
> After the negotiation process, in process block 514, when the **battery charger assembly 304 begins to receive its requested voltage and power**, the controller 316 may turn on the battery charger 322 in order to charge the battery pack 350.

(Ex. 1041, ¶¶0047-0048.)

### G. *Kazutoshi* (Ex. 1034)

107. I understand that *Kazutoshi* is a published United States patent application. (Ex. 1034, Cover.) My understanding is that *Kazutoshi* was filed December 3, 2004 and published June 23, 2005. (*Id.*) I rely on the disclosures and analysis thereof of *Kazutoshi* discussed in this section VIII for my opinions

regarding *Kazutoshi*'s teachings and suggestions as applied to the challenged claims of the '500 patent below in Section IX.

108. *Kazutoshi* discloses a "contactless power supply system" with a power supply device 21 providing power to portable object (cart 3). (Ex. 1034, Abstract, FIG. 1, ¶¶0001, 0005-0014, 0024-0030.) *Kazutoshi* explains that power supply device 21 provides power through inductive wires 19, where power is induced on a signal pickup coil 20A used to operate a load (motor 15) in the portable object. (Ex. 1034, FIG. 3, ¶0029.)

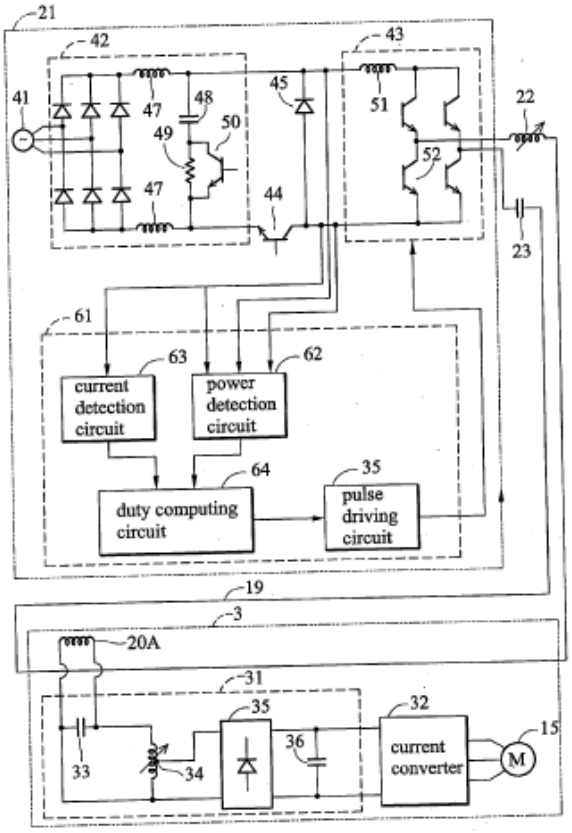



FIG. 3

(Ex. 1034, FIG. 3.)

109. Power supply device 21 includes a controller 61, which comprises power detection circuit 62, current detection circuit 63, duty computing circuit 64, and pulse driving circuit 65. (*Id.*, ¶¶0037-0038.) Duty computing circuit 64 receives signals (associated with the output of current converter 42 and current alternator 43, and output power of power supplying inductive wires 19) from power detection circuit 62 and current detection circuit 63. (*Id.*) Duty computing circuit 64 "employs

the output current of the current detection circuit 63 as a reference, [] evaluates the duty of the square wave driving the transistor 52 in the current alternator 43," and provides an output signal to pulse generating circuit 65 to drive transistor 52 and inductive wires 19 in order to power cart 3. (*Id.*, ¶¶0038, 0043.)

110. *Kazutoshi* discloses that duty computing circuit 64 (e.g., shown in FIG. 5 below) "comprises a subtractor 71, a multiplier 72, an integrator 73, a differentiator 74, an adder 75, and a gain configurator 76," where "[t]he multiplier 72, the integrator 73, and the differentiator 74 make up a proportional integral derivative (PID) controller." (Ex. 1034, ¶0039.) A person of ordinary skill in the art would have understood that the controller uses the difference between the output current (current detection circuit 63) and a reference value to determine an output signal to pulse generating circuit 65 for driving transistor 52 and inductive wires 19 to inductively power cart 3. (*Id.*; *id.*, ¶¶0040-0043.) A person of ordinary skill in the art would have understood that the proportional integral derivative (PID) controller provides "an output voltage for load resistance R and an output current within the range of the reference current." (*Id.*, ¶0043; *see also id.*, ¶0044.)

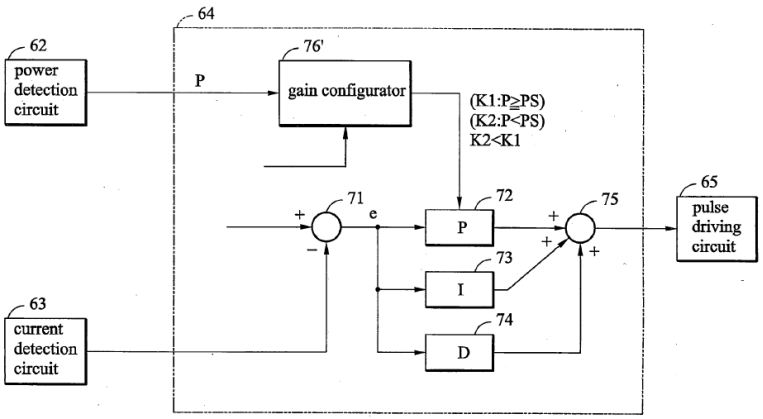



FIG. 5

(Ex. 1034, FIG. 5.)

# IX. THE PRIOR ART DISCLOSES OR SUGGESTS ALL RECITED FEATURES OF CLAIMS 2, 4, AND 18 OF THE '500 PATENT[5]

## A. Ground 1: *Okada* in view of *Odendaal*, *Berghegger*, *Black*, and *Masias* Discloses and/or Suggests the Features of Claim 2

111. In my opinion, *Okada* in view of *Odendaal*, *Berghegger*, *Black*, and *Masias* discloses and/or suggests all of the features of claim 2 of the '500 patent. Because claim 2 depends from claim 1, I address claim 1 first in my analysis below.

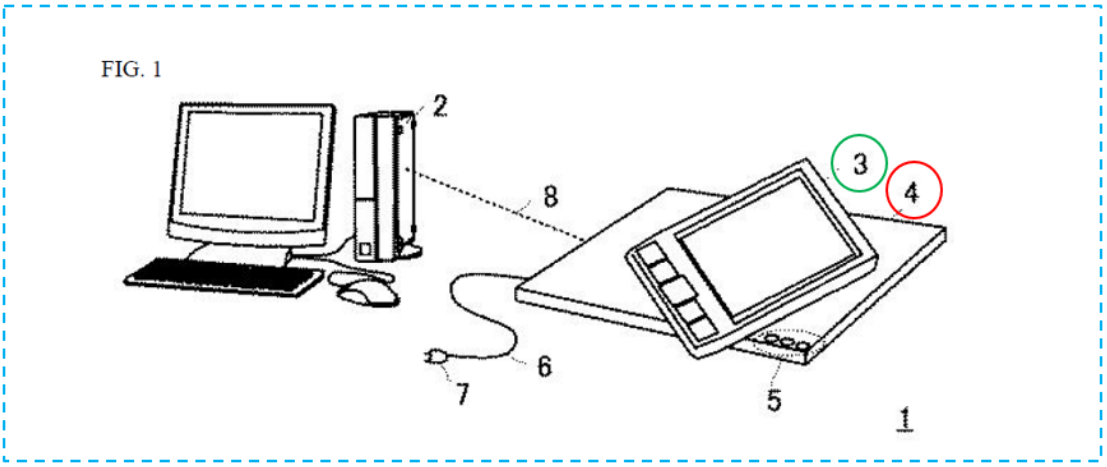
### 1. Claim 1

#### a) A system for inductive powering or charging of portable devices, the system comprising:

112. I understand that this phrase is the preamble of claim 1, and I have been asked to assume that the preamble limits the claim. Under that assumption, it is my opinion that *Okada* discloses the limitation(s) in the preamble. (*See* my analysis and discussions below for this section; *see also* my analysis and discussions below for Sections IX.A.1(b)-(l).)

[5] In this section (Section IX), I refer to exhibits other than those identified prior art reference(s) that disclose and/or suggest the claimed limitations. Such exhibits reflect the state of the art known to a person of ordinary skill in the art at the time of the alleged invention. (*See also* my discussions above in Section V.)

113. For example, *Okada* discloses a system for inductive powering or charging of portable devices such as mobile phones and PDAs. (Ex. 1005, Abstract, ¶¶0001, 0047.) For example, *Okada*'s FIG. 1 (annotated below) shows power supply **system** 1 (shown **blue**) including PC 2, PDA 3 (shown **green**), and cradle 4 (shown **red**), which receives commercial power via cord 6 and AC plug 7. (Ex. 1005, ¶¶0034-0036.)




(Ex. 1005, FIG. 1 (annotated).) *Okada* explains that "**magnetic coupling**" occurs between cradle coil(s) and PDA 3 coil, which "**induces** voltage at both ends of the coil in the PDA" to "suppl[y] power to the PDA." (*Id.*, ¶0035.) *Okada* explains:

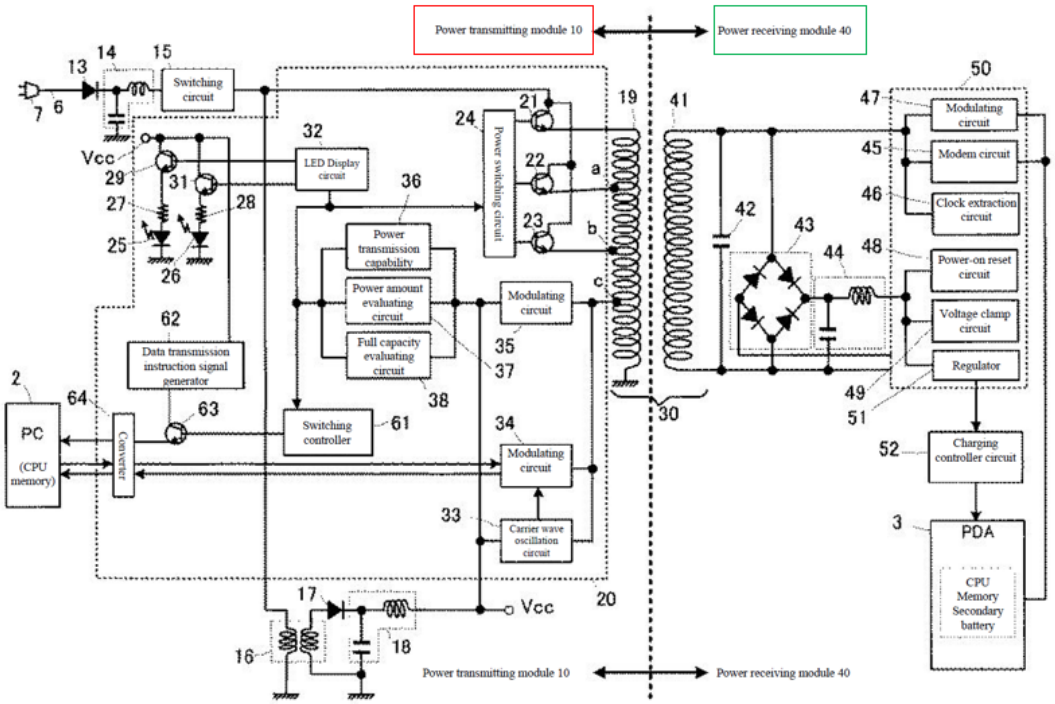
> In FIG. 1, when the AC plug 7 is inserted into an AC outlet (not shown) and the PDA 3 is placed in a prescribed position on the common cradle 4, commercial voltage is supplied to the common cradle 4 via the cord 6. In

> addition, as described below, if the PDA 3 and the common cradle 4 each have an internal coil, when commercial voltage is applied to the common cradle 4, ***magnetic coupling occurs between the coil in the common cradle 4 and the coil in the PDA 3, which induces voltage at both ends of the coil in the PDA, and this induced voltage supplies power to the PDA***. *Note that* ***the internal circuit of the common cradle 4, which is the power supply side, is referred to as the power transmitting module 10, and the internal circuit of the PDA 3, which is the side power is supplied to, is referred to as the power receiving module 40***. At this time, the power transmitting module 10 and the power receiving module 40 are respectively configured including the aforementioned coils.

(*Id.*, ¶0035.) In one example, *Okada*'s charger (*e.g.,* cradle 4) and/or its components (*e.g.,* PTM10 discussed below) is an exemplary "**system**."

114. *Okada*'s FIG. 2 (annotated below) describes an exemplary system ("**system for inductive powering or charging of portable devices**"), where each of cradle 4 and PDA 3 includes circuitry/components and at least one coil. (Ex. 1005, ¶¶0035, 0037 ("PDA equipped with the power receiving module 40"), FIG.

2.) Cradle 4 includes a **power transmitting module 10** (which as I did in Section VIII.A, refer to as "PTM10"), and PDA 3 includes a **power receiving module 40** (which as I did in Section VIII.A, refer to as "PRM40"). (*Id.*, ¶¶0035-0037, 0038-0058, FIG. 8, ¶¶0110-0111.)




(Ex. 1005, FIG. 2 (annotated).)

115. *Okada* explains that PTM10 converts received power (e.g., via cord/plug 6/7) to a DC signal via circuits 13-14. (Ex. 1005, ¶¶0038, 0049.) Switching circuit 15 generates a switching pulse signal using the DC signal (*id.*), which is converted to a DC signal ($V_{CC}$) powering PTM10 components (via circuits

16-18). (*Id.*, ¶0039.) *Okada* also discloses that the switching pulse signal is also supplied to primary coil 19 via one of switches 21/22/23 respectively connected to different coil taps. (*Id.*, ¶¶0040, 0049-0051.) A power switching circuit 24 selects a switch 21/22/23 to allow the switching pulse signal to traverse selected turns of coil 19, enabling the system to select/adjust the power level transmitted from PTM10 (e.g., cradle 4) to PRM40 (e.g., PDA 3). (*Id.*, ¶¶0040, 0051, 0057, 0069-0073.) *Okada* explains:

> The pulse voltage switched by the switching circuit 15 is applied to both ends of the primary-side coil 19 through one of the transistors, namely transistor 21, transistor 22, or transistor 23, controlled by the power switching circuit 24. ***The primary-side coil 19 together with the secondary-side coil 41 constitute the transformer 30 and magnetic coupling induces a voltage on both ends of the secondary-side coil 41.*** A magnitude of the voltage generated at this time is affected by a transformation ratio of the primary-side coil 19 and secondary-side coil 41. This transformation ratio can be changed because the number of turns of the primary-side coil 19 changes depending on which transistor among transistor 21, transistor 22, and transistor 23 that a power switching circuit 24 brings into an ON state, as described above.

115

(Ex. 1005, ¶0051; *see also id.*, ¶¶0040, 0057, 0069-0073.)

116. *Okada* further discloses that the selection/adjustment of the transmitted power level may be determined based on the device's "power consumption information" provided by PRM40 to PTM10. (*Id.*, ¶¶0057, 0063-0064, 0069-0073.) For example, *Okada* states:

> The voltage induced at both ends of the secondary-side coil 41 by the signal from the carrier wave oscillating circuit 33 is converted to a DC voltage after being rectified and smoothed by a smoothing capacitor 42, a rectifying circuit 43, and a smoothing circuit 44. When this DC voltage is applied to the power-on reset circuit 48, the power receiving module 40 (power receiving control IC 50) recognizes that a carrier wave is sent from the carrier wave oscillating circuit 33.
>
> Furthermore, the clock extracting circuit 46 connected to the secondary-side coil 41 extracts a clock signal from the carrier wave necessary for modulation, and the modulating circuit 47 uses the clock signal provided by the clock extraction circuit 46 to ***modulate the carrier wave based on information on a PDA 3: such as "a code indicating that a device is capable of receiving power," "power consumption information," and "full capacity***

***information." A modulated wave generated by this modulation is applied to the secondary-side coil 41.***

When a device (PDA 3) is mounted on the common cradle 4, this "code indicating that a device is capable of receiving power" is used by the power transmission capability evaluating circuit 36 of the power transmitting module 10 to evaluate whether supplying power to the device via the common cradle 4 is feasible (whether the device is equipped with the power receiving module 40), as described below. Note that a device where supplying power via the common cradle 4 is feasible (common cradle 4 compatible device) is referred to as a "device capable of receiving power" hereinafter.

Also, as described below, ***the "power consumption information" is used by the power amount evaluating circuit 37 of the power transmitting module 10 to determine the amount of power to supply to the device (PDA 3) placed on the common cradle 4, and for instructing providing of the signal thereof to the power switching circuit 24 to change the turn ratio of the transformer 30.*** Furthermore, the "full capacity information" is used by the full capacity evaluating circuit

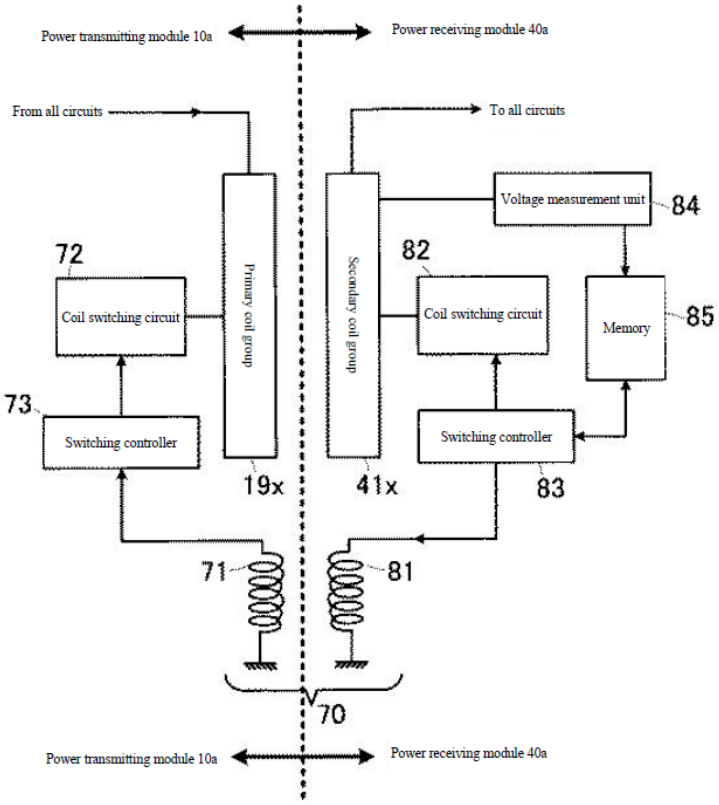
> 38 to determine whether charging of the compatible device (PDA 3) is completed, as described below.

(Ex. 1005, ¶0057; *see also id.*, ¶0069 (below).)

> [W]hen the amount of positional offset of the common cradle 4 and the PDA 3 does not exceed the prescribed amount of offset (STEP 4: Yes), processing proceeds to **evaluating an amount of power to transmit (STEP 6)**. ***This evaluation process is conducted using the power amount evaluating circuit 37 based on the "power consumption information" included in the information signal demodulated by the demodulating circuit 35***, recognizes the PDA 3 power based on the "power consumption information," and depending on this power, adjusts power transmission output in three levels: high, intermediate, and low. An evaluation result from the power amount evaluating circuit 37 is relayed to the LED display circuit 32 and the power switching circuit 24, and depending on the determination result of high, intermediate, and low, a process such as described below is conducted"), FIG. 3.)

117. In my opinion, a person of ordinary skill in the art would have understood that *Okada* discloses various configurations/applications of such a

"**system**" ("**system for inductive powering or charging of portable devices**") providing similar functionalities associated with PTM10 working with PRM40, in relation to, for example, FIGS. 2, 7-17. (Ex. 1005, ¶¶0009-0032, 0094-0154). In one example, FIG. 7 (below) shows PTM10 including multiple primary coils (e.g., group 19x) working with PRM40 including multiple secondary coils (e.g., group 41x). (Ex. 1005, FIG. 7, ¶¶0094-0096.)

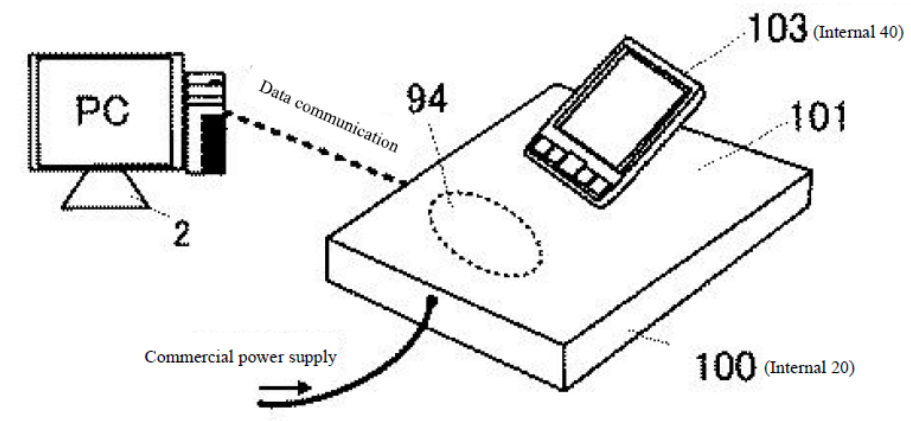



(Ex. 1005, FIG. 7.) *Okada* explains that circuits in PTM10 and PRM40 selectively activate coils "having a highest power transmission efficiency" for power

transmission, to, e.g., accommodate shifted positions of PDA 3 relative to cradle 4. (*Id.*, ¶¶0103-105; *see also id.*, ¶¶0097-0102, 106-109.)

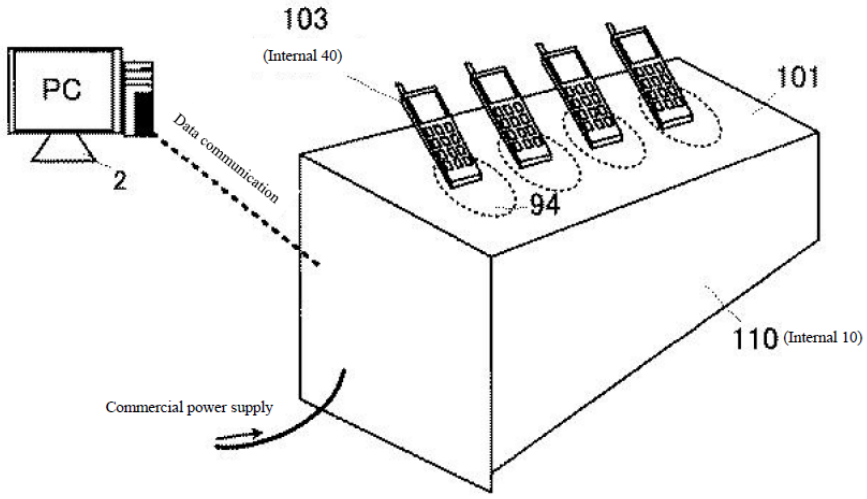
118. In my opinion, a person of ordinary skill in the art would have understood that applications of these features are described in *Okada* with respect to other exemplary "system(s)." (Ex. 1005, ¶0107 ("one of these [modules] consists of [multiple] coils and the other consists of one coil"), FIG. 9 (below), ¶¶0116-0118 (tabletop with charging pad having "a plurality of the primary-side coil 19"), FIG. 10, ¶0119 (charging multiple devices), FIGS. 11(a)-(b) (below), ¶¶0120-0122 (multiple PTM10s powering/charging multiple devices each with PRM40), FIGS. 12(a)-(b) (below), ¶¶0123-0126, FIGS. 13(a)-(b) (below), ¶¶0127-0132 (mouse pad with multiple coils 19).)

FIG. 9



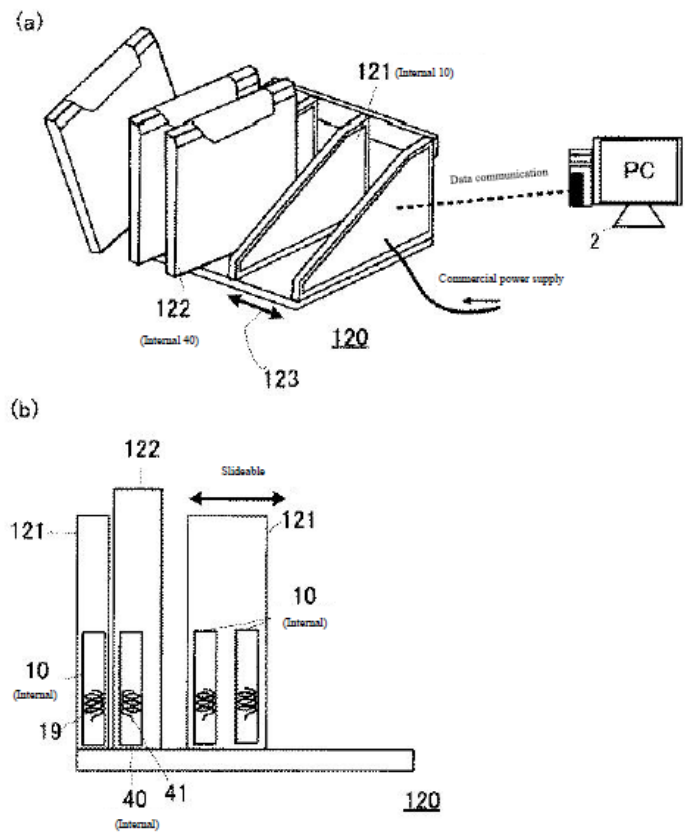

(Ex. 1005, FIG. 9.)

FIG. 10



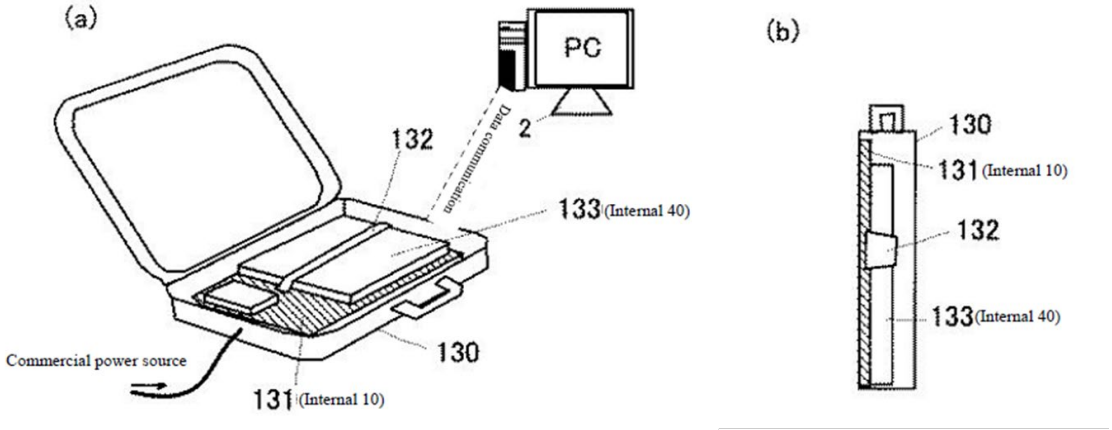

(*Id.*, FIG. 10.)

FIG. 11

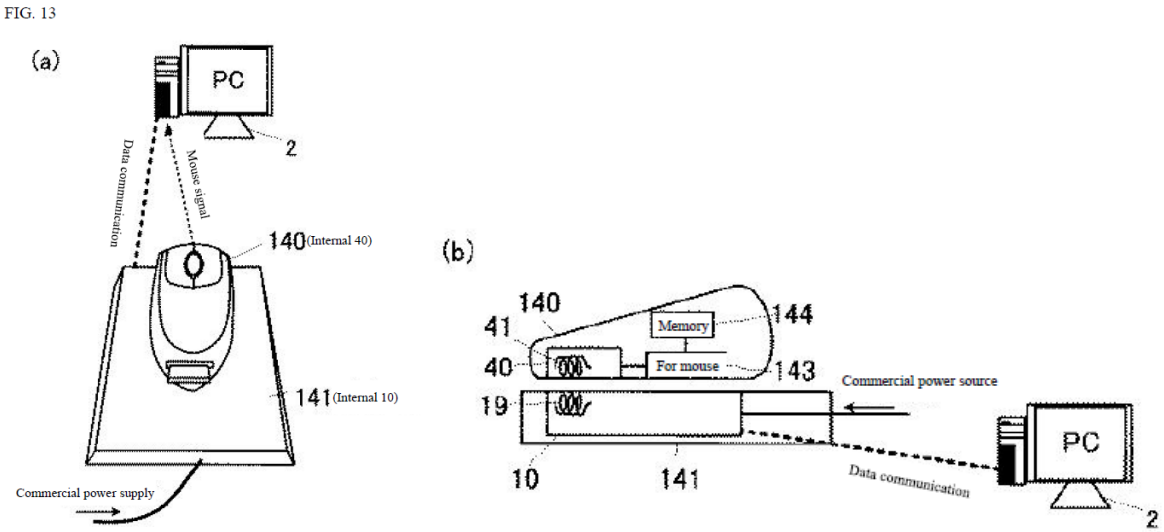



(*Id.*, FIGS. 11(a), 11(b).)

FIG. 12

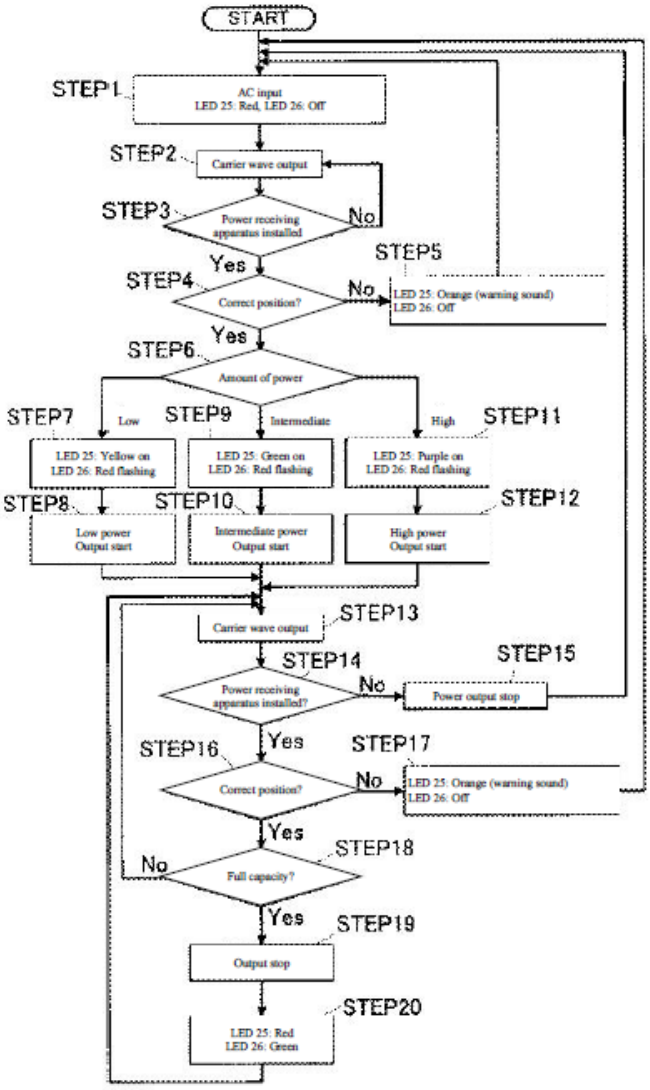


(*Id.*, FIGS. 12(a), 12(b).)




(*Id.*, FIGS. 13(a), 13(b).)

119. In my opinion, a person of ordinary skill in the art would have understood that *Okada*'s FIG. 3 (below) shows "power supply operations carried out between [PTM10 and PRM40]," applicable to the configurations (such as those I explained above and below) disclosed by *Okada*. (Ex. 1005, FIG. 3, ¶0059; *see also id.*, ¶¶0060-0090, 0094-0115; *see also* my analysis and discussions above in this section and in Section VIII.A; *see also* my analysis and discussions in Sections IX.A.1(b)-(l).)




(Ex. 1005, FIG. 3.)

120. Thus, and for reasons I explained above and below, in my opinion, a person of ordinary skill in the art would have understood that any disclosed configurations of *Okada* including features as recited in the limitations of claim 1 (including as modified) I explained above and below is a "**system**" ("**system for**

**inductive powering or charging of portable devices**") (*see, e.g.*, *Okada*'s FIGS 1, 2, 7, 9-13, etc.). *Okada* further explains:

> With the power supply system of the present invention, electric power is supplied by placing an electronic device such as a PDA, mobile phone, or the like, equipped with the power receiving device of the present invention on a common cradle or the like equipped with the power transmitting device of the present invention . . . Furthermore, *the power transmitting device of the present invention can be incorporated into all types of products, not just a common cradle, but also showcases, mouse pads, and the like, and therefore* ***the device is highly versatile***, because an electronic device incorporating the power receiving device of the present invention can receive power supplied from the product.

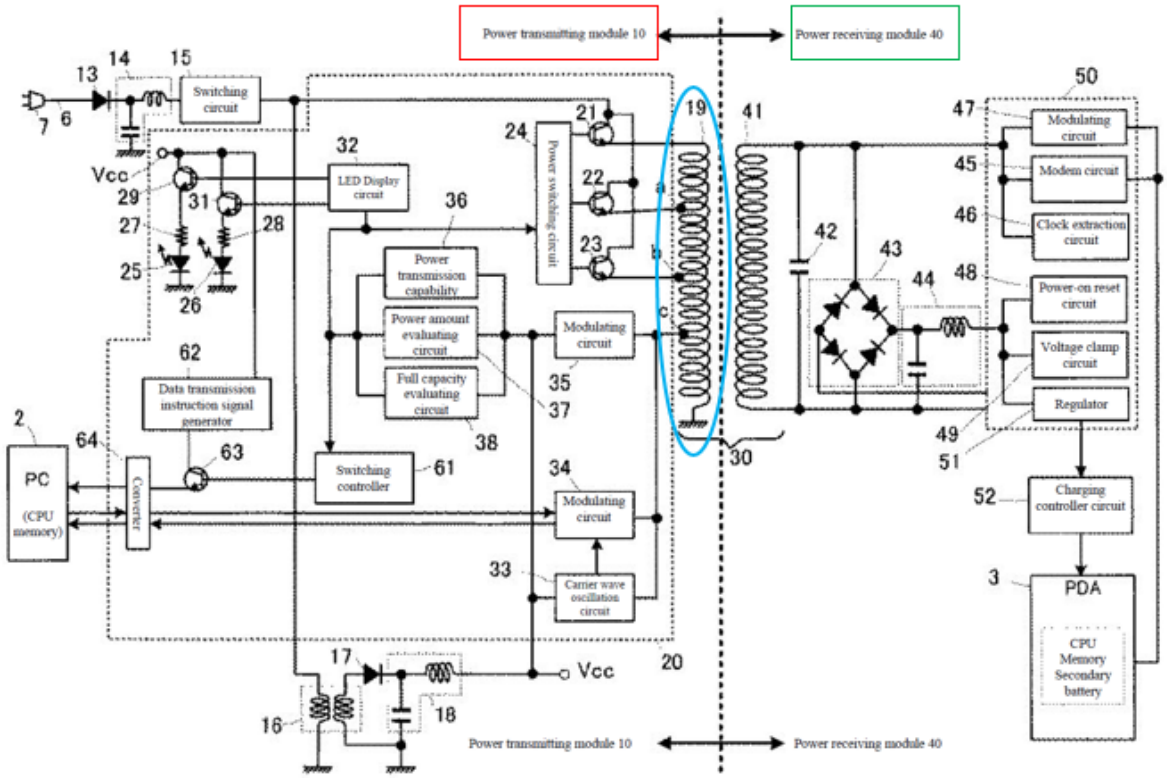
(Ex. 1005, ¶0030; *see also* my analysis and discussions above in this section and in Section VIII.A; *see also* my analysis and discussions in Sections IX.A.1(b)-(l).)

**b) one or more primary coils that are substantially planar and parallel to a surface of the system for powering or charging one or more compatible portable devices including batteries and receiver units, each receiver unit including a receiver coil and a receiver circuit including a receiver rectifier circuit;**[6]

121. In my opinion, *Okada* in view of *Odendaal* discloses and/or suggests this limitation. (*See* my analysis and discussions below in this section; *see also* my analysis and discussions in Sections IX.A.1(a), IX.A.1(c)-(l); *see also* my analysis and discussions in Sections VIII.A, VIII.B.)

122. For example, as I explained, *Okada*'s "**system**" includes "**one or more primary coils**." (Ex. 1005, FIG. 2 (**blue** below), ¶¶0040, 0050, FIG. 7, ¶¶0095-0107, FIGS. 9-10, ¶¶0116-119, FIGS. 11(a)-(b), ¶0121, FIGS. 12(a)-(b), ¶¶0123-0125, FIG. 13, ¶0132; *see also* my analysis and discussions in Sections VIII.A, IX.A.1(a).)

[6] For purposes of rendering my opinions, I have been asked to assume that the plain claim language of this limitation to at least encompass that the one or more "compatible portable devices" includes at least one "batter[y]" and at least one "receiver unit[]."




(Ex. 1005, FIG. 2 (annotated).)

123. In my opinion, a person of ordinary skill in the art would have understood that *Okada*'s "**primary coil(s)**" is/are used for "**powering[/]charging one or more compatible portable devices**." For example, as I explained above, *Okada* discloses that switches 21/22/23 are selected in order to provide selected power level(s) transmitted to PRM40. (*See* my analysis and discussions in Section IX.A.1(a); Ex. 1005, FIG. 3, ¶¶0040, 0051, 0057, 0069-0073.) *Okada* also explains that PTM10 determines a "**compatible** portable device" is properly positioned

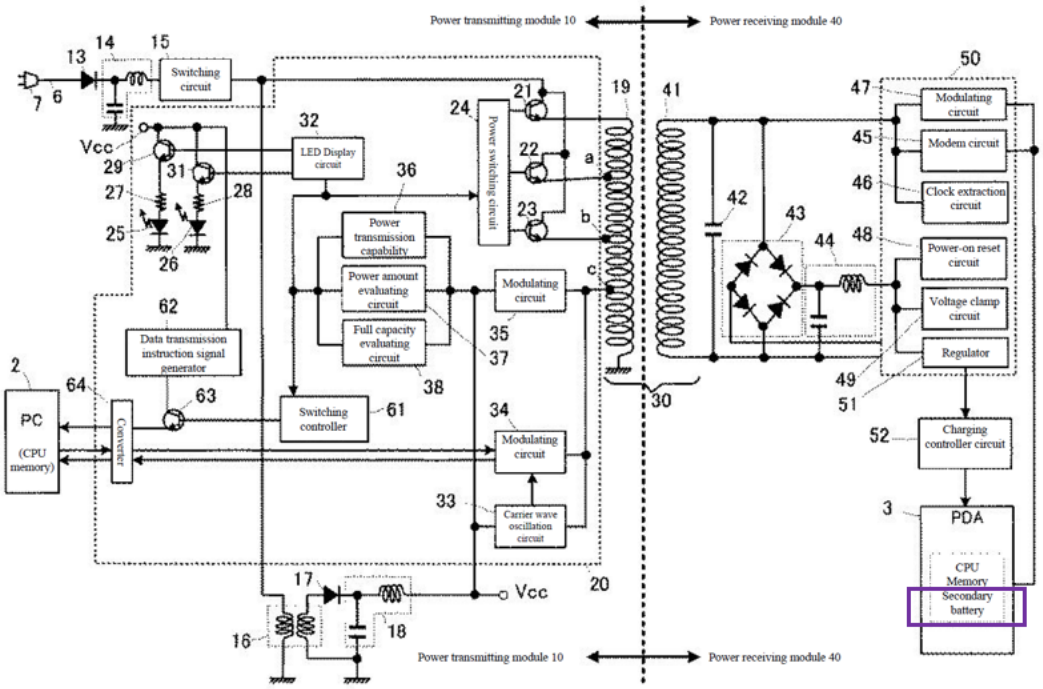
before powering/charging the device. (Ex. 1005, FIG. 3, ¶0057.) For example, *Okada* explains:

> . . . the modulating circuit 47 uses the clock signal provided by the clock extraction circuit 46 to modulate the carrier wave based on information on a PDA 3: such as "a ***code indicating that a device is capable of receiving power***," "***power consumption information***," and "***full capacity information***." A modulated wave generated by this modulation is applied to the secondary-side coil 41. *When a device (PDA 3) is mounted on the common cradle 4, this "code indicating that a device is capable of receiving power" is used by the power transmission capability evaluating circuit 36 of the power transmitting module 10 to* ***evaluate whether supplying power to the device via the common cradle 4 is feasible*** (whether the device is equipped with the power receiving module 40), as described below. ***Note that a device where supplying power via the common cradle 4 is feasible (common cradle 4 compatible device) is referred to as a "device capable of receiving power" hereinafter***.
>
> Also, as described below, the "power consumption information" is used by the power amount evaluating circuit 37 of the power transmitting module 10 to

> determine the amount of power to supply to the device (PDA 3) placed on the common cradle 4, and for instructing providing of the signal thereof to the power switching circuit 24 to change the turn ratio of the transformer 30. Furthermore, the "full capacity information" is used by the full capacity evaluating circuit 38 to determine whether charging of the ***compatible*** **device** (PDA 3) is completed, as described below.

(Ex. 1005, ¶0057.) *Okada* thus refers to such a device as a "**compatible** device (PDA 3)," "common cradle 4 **compatible** device," or "device capable of receiving power." (*Id.*, ¶¶0057, 0064-0073.) Accordingly, a person of ordinary skill in the art would have understood that *Okada*'s "**primary coil(s)**" is/are used for "**powering[/]charging one or more compatible portable devices**." (*Id.*)

124. In my opinion, a person of ordinary skill in the art would have understood that *Okada*'s "**one or more compatible portable devices**" (e.g., PDA 3) includes "**batter[ies] and receiver unit[s]**." For example, *Okada* explains that PDA 3 includes a "secondary battery" and PRM40. (Ex. 1005, ¶¶0012 ("power receiving device is equipped with a rechargeable secondary battery"), 0015, 0037, FIG. 14, ¶¶0134-0136, FIG. 15, ¶¶0138-0140, FIG. 16, ¶¶0142-0144, claim 4, FIG. 2 (**purple** below)).)

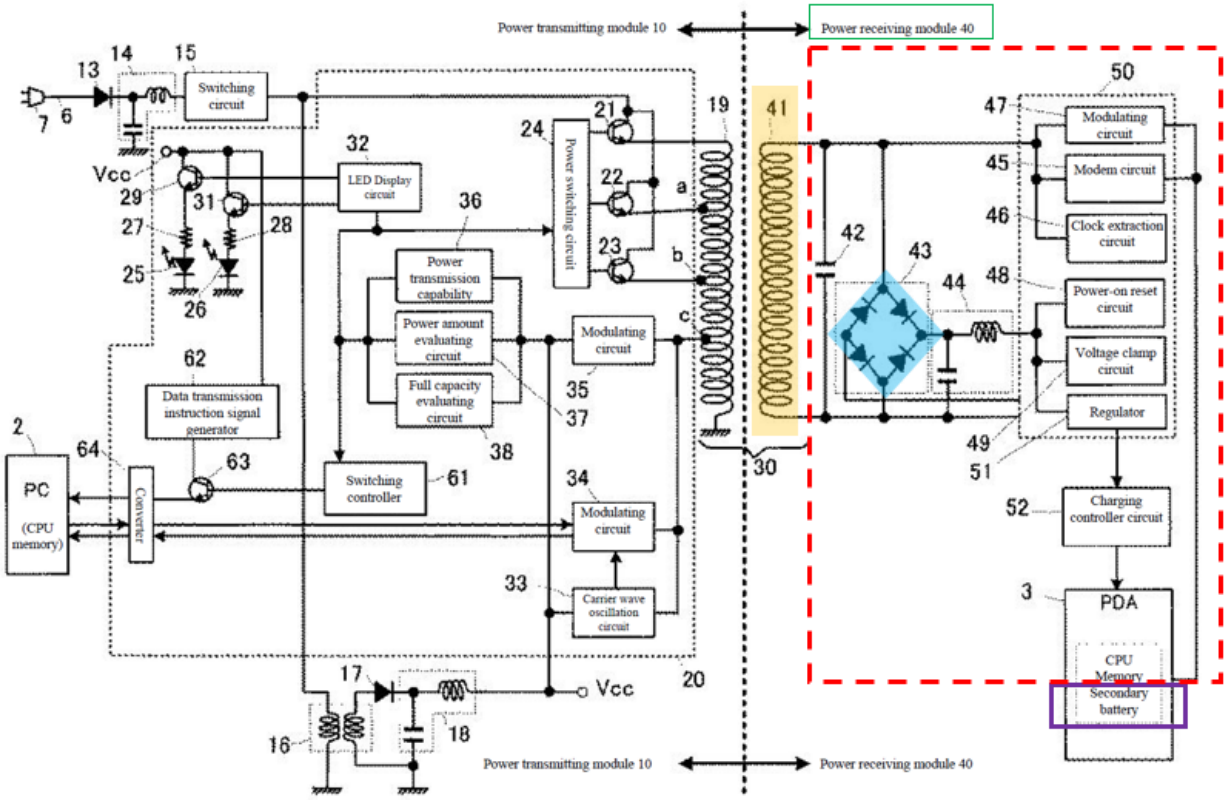



(Ex. 1005, FIG. 2 (annotated).)

125. In my opinion, a person of ordinary skill in the art would have understood that PRM40 of each exemplary portable device is an example of a "**receiving unit**" including "**a receiver coil and a receiver circuit including a receiver rectifier circuit**" as claimed. (*See* my analysis and discussions in this section and in Section IX.A.1(a); *see* the citations to *Okada* I provided in this section and also in Section IX.A.1(a); *see also* my analysis and discussions in Sections VIII.A, IX.A.1(c)-(l).) For example, a person of ordinary skill in the art would have understood that FIG. 2 (annotated below) exemplifies a PRM40 ("**each receiver**

**unit**") with coil 41 (**orange**) ("**receiver coil**") (Ex. 1005, ¶0040), and a "**receiver circuit**" (e.g., **red** below), which includes at least rectifying circuit 43 (**blue**) ("**a receiver rectifier circuit**"), clock circuit 46, modulating circuit 47, and may further include one or more other components in PRM40 (other than the **battery**) (e.g., one or more of circuits 42, 44-45, 48-49, and 51-52). (Ex. 1005, ¶0047, FIG. 2.)[7]

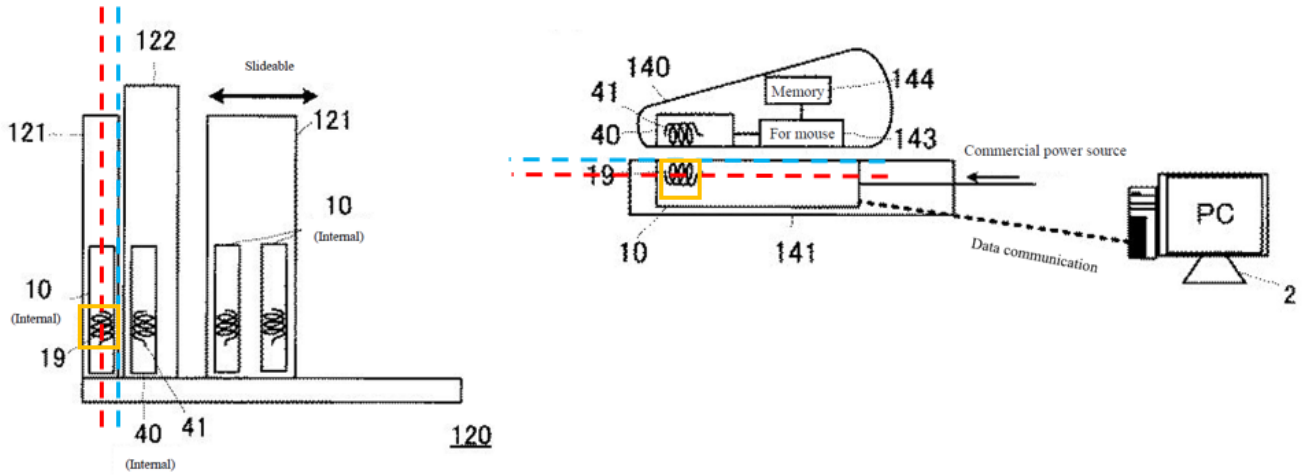
[7] The annotated figures I provide here (and below) are exemplary visual aids and are not intended to describe or define precise boundaries, schematics or limit/constrain the mappings/analysis that I provide of the prior art to the claim language (alone or as modified as applicable below). A person of ordinary skill in the art would have understood that variations of components or other components/circuitry, etc. that are not shown but are described or suggested by *Okada* (alone or as modified as applicable below) are or would have been contemplated portions of such mappings. Also, as I explained above, other figures in *Okada* are equally applicable with such mappings. (*See* my analysis and discussions in Section IX.A.1(a).)




(Ex. 1005, FIG. 2 (annotated).)

126. In my opinion, a person of ordinary skill in the art would have understood that the "**one or more primary coils**" in *Okada* are "**substantially . . . parallel to a surface of the system . . .**" similar to that claimed in claim 1 of the '500 patent. For example, the annotated versions of Figures 11(b) and 13(b) below show examples of coil 19 positioned substantially parallel to a surface (**blue** parallel (**red**) to coil 19 (**orange**)) of the system. (Ex. 1005, FIGS. 11(b) (below left) and 13(b) (below right) (annotated below); *see also* my analysis and discussions in

Section IX.A.1(a).) In my opinion, a person of ordinary skill in the art would have understood a similar arrangement exists with the other exemplary systems/configurations I discussed above. (*See* my analysis and discussions above in this section and in Sections VIII.A, IX.A.1(a).)




(Ex. 1005, FIG. 11(b) (left), FIG. 13(b) (right) (annotated).)

127. In my opinion, while *Okada* does not expressly state that the "**primary coils [] are *substantially planar* and parallel to a surface of the system**," a person of ordinary skill in the art would have been motivated to configure the *Okada* system to implement and use planar primary coils (and planar secondary/receiver coil(s)) in view of *Odendaal* (complemented by such a skilled person's knowledge in the art) in context of *Okada*, which contemplates thin form factor applications (e.g.,

charging pad). (*See* my analysis and discussions in this section and in Sections IX.A.1(a), (b)-(l); *see also* my analysis and discussions in Sections V.B.3, VIII.A-B.)

128. In my opinion, a person of ordinary skill in the art would have appreciated that inductive power/data transfer (consistent with that disclosed by *Okada*) uses inductive coils to wirelessly transfer power/data to another electronic device. (*Id.*) In my opinion, a person of ordinary skill in the art was aware of and appreciated that different types of coil designs were available to achieve desired applications of inductive power/data transfer. (*Id.*) For example, planar coils placed in parallel to a power transfer system's surface were known by a person of ordinary skill in the art, as were their characteristics and design techniques for implementing circuits/systems/devices that use them to achieve desired contactless/inductive power/data transfer. (*Id.*) In my opinion, several state of the art references describe features consistent with such a skilled person's knowledge at the time. (*Id.*)

129. For one example, *Lee* (Ex. 1027)[8] discusses the known use of a planar spiral inductor.

> Since the arrival of the silicon-based RF IC era, much effort has been put into the **spiral inductor designs**. The main focus of the endeavor was to improve the quality factor. The major concern for the silicon-based spiral inductors has been the resistivities of the metal and the silicon substrate. **Numerous techniques have been proposed** to reduce the resistivities of the interconnect lines and the silicon substrates [1,2]. Yet, **many planar spiral inductor structures have been designed and evaluated** without a clear understanding for the layout dependences of the quality factor. Simple and clear guidelines of inductor layout rules for optimum quality factor are presented for the required inductance and process information. . . . **Figure 1 shows the top view of**

[8] As I noted previously, I reference and cite Ex. 1027 and other references/exhibits below/herein to support my opinions regarding the state of art knowledge of a person of ordinary skill in the art at the relevant time (like other extraneous references I may refer to throughout this Declaration when discussing what such a skilled person would have understood/appreciated, etc.). (*See* my discussions in Section V.)

> **a square spiral inductor layout.** Mohan [3] reported a simple and very accurate expression for the **planar spiral inductor inductances.** Modifying the Mohan's work, for the inductor dimensions shown in Fig. 1, the inductance can be expressed as . . .

(Ex. 1027, 1; *see also id.*, 1-3.)

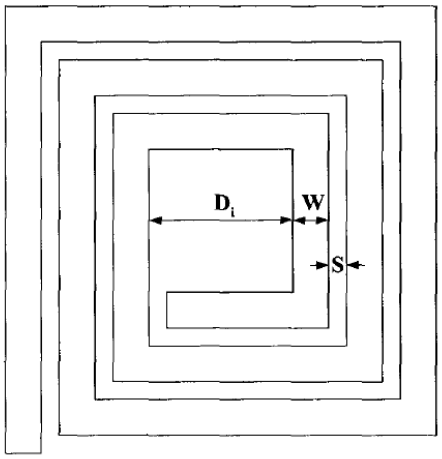



**Fig. 1.** A planar square spiral inductor structure.

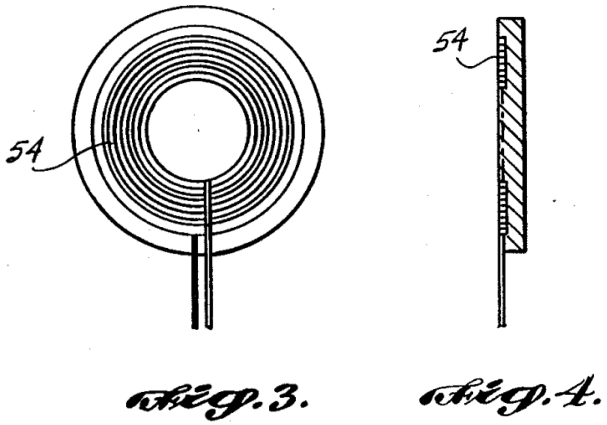
(*Id.*, FIG. 1 (showing a "**planar square spiral inductor** structure").)

130. Also, references such as *Sano* (Ex. 1015) (which also disclose features consistent with the state of art knowledge of a person of ordinary skill in the art at the time) discuss a thin coil and a flat disk-like core.

> Currently, the preferred form of the power receiving coil 54 is a **thin coil** which facilitates efficient interlinkage of the magnetic flux developed from the power supplying

> coil 18 with the power receiving coil 54. More particularly, the currently preferred power receiving **coil** 54 is a **flat disc-like core** on which is formed a single layer or several layers of wire-like electrical conductors. Such conductors can be formed, for example, by depositing conductive material on a side of the disc-like core that faces the power supplying apparatus 10. FIG. 3 is a front view of such a **sheet coil** and FIG. 4 is a vertical sectional view taken along its middle plane.

(Ex. 1015, 3:39-51; *see also id.*, FIGS. 1-2, 3-4, 7-12, Abstract, 1:5-2:29, 2:64-3:27, 5:5-47, 5:48-9:5.)



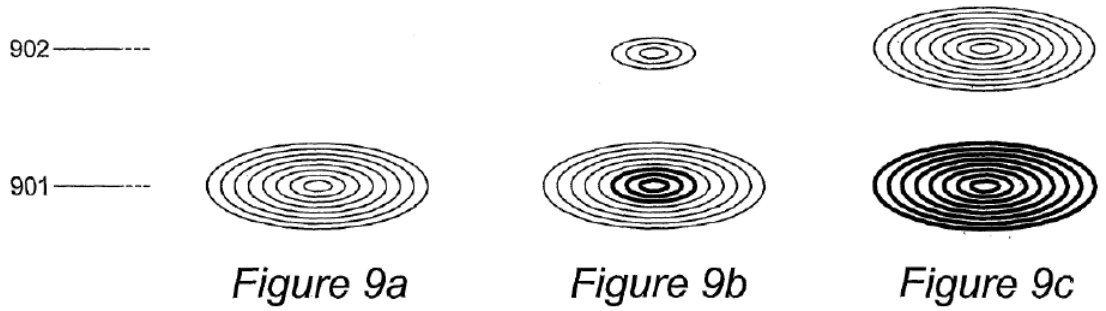

(*Id.*, FIGS. 3-4.)

131. References such as *ChengII* (Ex. 1026) (which also disclose features consistent with the state of art knowledge of a person of ordinary skill in the art at

the time) also show the known use of thin, planar-type coils in an inductive power source/charger and an inductive power receiver (device).

> Figure 9 extends these two means of generating a rotational degree of freedom by adding universality. A charger 901 consists of a number of such coils, arranged concentrically, each of which can be driven independently. The charger behaves differently depending on which type of device is present 902.
>
> • In Figure 9a no device is present, and so no charger coils are driven.
>
> • In Figure 9b a physically small device with correspondingly small power requirements is present, and so only a few of the inner coils are driven.
>
> • In Figure 9c a physically large device with correspondingly large power requirements is present, and so many of the coils are driven.

(Ex. 1026, 11:4-12; *see also id.*, Abstract.)




(*Id.*, FIGS. 9a-9c.)

132. There are other state of art references that demonstrate and exemplify the above-discussed knowledge of a person of ordinary skill in the art. (*See, e.g.*, Ex. 1027, 1-3 (planar spiral inductor); Ex. 1015, FIGS. 1-2, 3-4, 7-12, Abstract, 1:5-2:29, 2:64-3:27, 3:39-51 (thin coil, flat disc-like core), 5:5-47, 5:48-9:5; Ex. 1047, FIGS. 1-3, 6, 8A-9, ¶¶0002, 0006-0007, 0018-0025-0034; Ex. 1025, FIGS. 1, 3, 8-9, 13, 1:10-2:3, 2:5-12 (reasons to consider thin coil designs), 2:14-3:2, 4:19-32, 7:25-9:28, 12:27-32, 14:4-17; Ex. 1026, FIGS. 1-2, 5, 9A-9C, Abstract, 1:3-4:4, 4:6-9:4, 11:4-15 (flat coils); Ex. 1009, Abstract, FIGS. 1-3, 1:4-51, 1:54-2:26, 2:47-3:8 (flat configurations), 3:9-39 (thin flat coil), 4:18-60; Ex. 1024, FIGS. 3, 8-9, 1:12-15, 1:39-2:29, 9:41-53, 10:45-57, 11:60-13:4; Ex. 1028, Abstract, FIGS. 2-7, ¶¶0001, 0004-0007, 0025-0032, 0041; Ex. 1029, 1-4, 9-19 (planar, spiral coils); Ex. 1030, FIGS. 3-7B, 1:5-9, 1:59-61, 3:19-56, 4:62-567, 5:25-44; Ex. 1036, Abstract, 2:22-3:6 ("primary winding…***substantially parallel*** to [] planar charging surface"

and "formed on a ***planar printed circuit board***"), 5:22, 11:18, 23:20-24:8 ("Each secondary charging module 200 is provided with a housing 203," where "[t]he housing 203 should have at least one preferably flat surface" and "**[t]his flat surface is preferably parallel to the plane of the secondary winding** within the housing such that when the secondary module is placed in a slot of the primary extension system the secondary winding is substantially parallel to the primary winding beneath the surface of the slot."), 24:19-22 ("The secondary coil or PCB winding **should be placed close to the (preferably flat) 20 surface of the housing of the secondary charging module so as to pick up maximum changing AC magnetic flux** from the primary inductive charging extension system or platform."); *see also* my discussions above in Section V.)

133. Therefore, in my opinion, a person of ordinary skill in the art would have been aware of available designs and options for implementing inductor coils to facilitate contactless inductive power/data transfer, including the related circuitry, and the tradeoffs, benefits, advantages, etc. associated with their use. (*Id.*; *see also* my analysis, discussions, and citations in this section; *see also* Section V.) In my opinion, a person of ordinary skill in the art would have relied on such knowledge when considering design and implementation options for the *Okada* system/device,

and would have appreciated how various coil designs (including planar coils) would have improved the system/device based on given applications taking into account factors, such as size, weight, form factors, cost, efficiencies, performance, design constraints, etc. (*Id.*; *see e.g.*, Ex. 1047, ¶0033 (describing size/shape attributes of coils and known characteristics in a contactless inductive power/charge system).) In my opinion, a person of ordinary skill in the art would have considered the tradeoffs and potential benefits provided by planar coils when contemplating ways to design, configure, and implement an inductive power transfer system similar to *Okada*. (*Id.*) In my opinion, one source of such relevant guidance and knowledge is *Odendaal*.

134. In my opinion, a person of ordinary skill in the art would have had reasons to consider the teachings/suggestions of *Odendaal* in context of *Okada* since *Odendaal* describes a contactless inductive power/charging system including techniques/technologies similar and related to those of *Okada*. (*See* my analysis and discussions in Section IX.A.1(a); *see, e.g.*, Ex. 1008, Title, Abstract, Figs. 1A-4, 11-12, 1:5-3:57, 4:50-5:8, 5:24-28, 6:59-64; *see also* my analysis and discussions in Sections VIII.A-B, IX.A.1(c)-(l).) For example, *Odendaal* (like *Okada*) discloses a contactless inductive power/charging system that uses inductive coupling to provide power to a mobile device (e.g., cellphone, computer, etc.) having a secondary coil

placed on or near the primary coils in the surface of a powering device (e.g., charger for cellphones, powering pad, or charger embedded in a thin surface, including fabrics, etc.). (Ex. 1008, Title, Abstract, 1:5-3:57.) For example, *Odendaal* explains that "[t]he present invention is related to **contactless power transfer systems**" (Ex. 1008, 1:6-7) and discloses configurations of its invention, including one where:

> a battery charging circuit can be coupled to one of the first and second spiral-shaped conductors, and a load can be coupled to the other of the first and second spiral-shaped conductors. **The coupling between battery charging circuit and the battery may comprise** capacitive coupling and/or **magnetic coupling, and wherein power is transferred by the coupling of an electric field and/or magnetic flux** across the IOET [interface-of-energy-transfer].

(*Id.*, 2:56-64; *see also id.*, Title, Abstract, FIGS. 1A-4, 11-12, 1:5-3:57 (1:6-67 (known use of planar coils)), 4:50-5:8, 5:24-28, 6:59-64; *see also* my analysis, discussions, and citations regarding *Okada* above in this section and in Section IX.A.1(a); *see also* my analysis and discussions in Sections VIII.A-B.)

135. Thus, in my opinion, a person of ordinary skill in the art would have understood that *Odendaal* is in the same technical field as the '500 patent and *Okada*

because *Odendaal* also describes a system and processes for powering/charging a mobile device/battery using inductive contactless power transfer techniques/technologies. (*Id.*; Ex. 1008, Title, Abstract, FIGS. 1A-4, 11-12, 1:5-3:57, 4:50-5:8, 5:24-28, 6:59-64; Ex. 1001, Abstract, 4:13-14; *see also* my analysis and discussions in Section IX.A.1(a).) In my opinion, a person of ordinary skill in the art would have appreciated that *Odendaal* (like *Okada*) also discloses features that were reasonably pertinent to one or more particular problems the '500 patent discusses. (*See, e.g.*, Ex. 1001, 4:13-29; Ex. 1008, Abstract, 1:5-3:57, 4:50-5:8, 5:24-28, 6:59-64; Ex. 1005, FIGS. 1, 2, 7, 9-12, ¶¶0037-0048, 0049-0058, 0094-0109, 0116-0126; *see also* my analysis and discussions in Sections VIII.A-B, IX.A.1(a)-(b).) As I discussed above and below, *Odendaal* also discloses techniques and technologies for addressing the need to power mobile devices using contactless inductive coupling. Therefore, in my opinion, a person of ordinary skill in the art contemplating designing and configuring a system like that described by *Okada* would have considered teachings/suggestions like those provided in *Odendaal* and thus would have been motivated to modify *Okada*'s system to include planar primary coils that are parallel to a surface of the system to provide features like those discussed herein and claimed (and complemented such a design with corresponding

planar secondary/receiver coil(s) in an inductive power receiver / portable device). (*Id.*)

136. *Odendaal* discloses the known use of **planar-type inductor coils** in a contactless/inductive power transfer system that transfers power via magnetic coupling, for, e.g., charging a battery of a cellphone, computer, wearable items, etc. (Ex. 1008, FIGS. 1A-1B, 2A, 2C, 8E, 1:5-3:57.) For example, *Odendaal* explains:

> ***The spiral-shaped conductor may comprise pcb spiral-wound conductors.*** In addition, a battery charging circuit can be coupled to one of the first and second spiral-shaped conductors, and a load can be coupled to the other of the first and second ***spiral-shaped conductors***. The coupling between battery charging circuit and the battery may comprise capacitive coupling and/or ***magnetic coupling, and wherein power is transferred by the coupling of an electric field and/or magnetic flux across the IOET*** [interface-of-energy-transfer].
>
> According to an aspect of the present invention, a signal applied to the first spiral-shaped conductor can be transferred to the second spiral-shaped conductor by coupling of magnetic flux of the first and second spiral-shaped conductors across the IOET.

> ***The first and second spiral-shaped conductors*** and the IOET are preferably integrated into ***a planar (flat/thin) structure***.

(Ex. 1008, 2:55-3:5.) *Odendaal* also explains:

> According to another aspect of the invention, an isolating coupling interface and a resonant tank are functionally integrated into a planar configuration for transferring power with isolation properties. ***The device may comprise two separable structures on either side of the IOET, such as, for example, a cellphone and its charger***. . . .
>
> An advantage of the present invention is that it facilitates the use of ***wearable electronics***. For example, ***flex circuits may be used so as to cause the surface of the coils to be flexible.*** In addition to the flexibility, the coils may be formed in any arbitrary shape to facilitate woven wire arranged in ***a fabric, or pads with embedded conductors that can be attached to clothes***. In this way, for example, ***one could charge a radio, cellphone, and/or computer (just to name a few of the many wearable items) by bringing the device in close proximity to the fabric.*** Thus, implementation of the invention with wearable electronics could provide an ***interface between the wearable device(s) and external power sources.*** Digital or analog signals may

> also be transmitted across such interfaces to, for instance, up- or download digital information.

(Ex. 1008, 2:16-43; *see also id.*, 2:1-15, 2:44-3:5, 4:44-5:8, 6:1-18.)

137. *Odendaal* explains that it would be advantageous to provide a planar resonator for wireless power transfer that exhibits characteristics of an integrated inductor-capacitor transformer. (*Id.*, 1:53-57.) The planar resonator includes a coil arrangement where spirals arranged on opposite sides of each other can be used for energy transfer "so that a battery of a cellphone could be charged without physical wires connecting the cellphone to a charger." (*Id.*, 1:60-67.) Depending on the physical arrangement and/or material used, the planar resonator "transfer[s] power across the "interface-of-energy-transfer" (IOET) in either an electric or **magnetic form**, or both." (*Id.*, 2:1-7.) Thus, while *Odendaal* discusses capacitive-type energy transfer, *Odendaal*'s configurations / "[t]he physical arrangement and/or material can *permit transformer action with or* ***without*** [such] capacitive energy transfer." (*Id.*, 2:7-10; *id.*, 2:65-3:5 (signal transfer between spiral coils "***by coupling of magnetic flux***"), 4:44-5:8, 6:1-18 (air coil transformer).)

138. Moreover, *Odendaal* explains that the planar coils of the planar power resonator "may have a thin and/or relatively flat top coil surface" and may be

arranged in upper and lower configurations "with an air gap." (*Id.*, 2:44-54.) Also, as discussed above, *Odendaal* explains that "[t]he spiral-shaped conductor may comprise ***pcb spiral-wound conductors***" and "***a battery charging circuit can be coupled to one of the first and second spiral shaped conductors, and load can be coupled to the other*** . . ." where "coupling between the battery charging circuit and the battery may comprise . . . ***magnetic coupling***, wherein power is transferred by the ***coupling of . . . and/or magnetic flux*** across the IOET." (*Id*., 2:55-64.) Therefore, in my opinion, *Odendaal*'s known use of "**planar**" coils in an inductive charging system (*id.*, 1:60-67; *see also* my analysis and discussions above) is consistent with that known in the art. (Ex. 1008, 1:23-31 (conventional road embedded coils), 1:60-67, 2:19-21, 2:29-44 (coils embedded in fabric or pads), 3:65-67 (spirals arranged within substrate material); *see also* my analysis and discussions regarding state of art knowledge of a person of ordinary skill in the art above in this section; *see also* my analysis and discussions in Sections V, VIII.B.)

139. Moreover, in my opinion, a person of ordinary skill in the art would have understood that consistent with the thin form factor configurations of *Okada* (e.g., charging pads, case, etc.), *Odendaal* discloses that "[t]he ***first and second spiral-shaped conductors*** and the IOET are preferably integrated into a ***planar***

***(flat/thin) structure***" (Ex. 1008, 3:3-5) and may conform to the housing surface to facilitate charging a device "in close proximity" (*id.*, 2:29-44). A person of ordinary skill in the art would have understood that such arrangements disclose coils that are parallel to a system's surface. (*Id.*; *see also* my analysis and discussions above in this section; *see also* my analysis and discussions in Sections VIII.A-B, IX.A.1(a).)

140. In my opinion, in light of such above-discussed teachings, and state of art knowledge, a person of ordinary skill in the art would have been motivated to modify the *Okada* system to use "**primary coils that are substantially planar and parallel to a surface of the system** . . ." (and complemented such a design with corresponding planar secondary/receiver coil(s) in the portable device) to expand/complement applications compatible with those contemplated by *Okada* to use thin(ner) primary-side and secondary-side units/devices. (*See* my analysis and discussions in Section IX.A.1(a); *see also* my analysis and discussions in Sections VIII.A-B, IX.A.1(c)-(l).) In my opinion, such a modification would have provided options to reduce the volume the coil(s) occupy, reduce the device size/weight, and expand/enhance applications of systems/devices contemplated by *Okada* (e.g., charge pads, tables/objects/surfaces with inductive powering/charging capabilities, portable devices such as PDAs, cellphones, etc.). (*Id.*; *see* my analysis and

discussions in Sections VIII.A, IX.A.1(a), IX.A.1(c)-(l); Ex. 1005, FIGS. 1, 9, 10-16, ¶¶0033-0034, 0116-0146.) Moreover, in my opinion, a person of ordinary skill in the art would have understood that planar coils provided options to reduce the distance between primary and secondary coils (promoting close proximity coupling (*see, e.g.*, Ex. 1008, 2:29-44)) for improving power transmission efficiency, reducing energy waste, and shortening charging time. (Ex. 1005, ¶¶0066-0068, 0112, FIGS. 4(a)-4(b); Ex. 1036, 24:19-22 ("The . . . winding **should be placed close to the (preferably flat) 20 surface of the housing . . . so as to pick up maximum changing AC magnetic flux** . . ."); *see* my analysis and discussions in Section IX.A.1(a); *see also* my analysis and discussions in Sections V, VIII.A-B, IX.A.1(c)-(l).)

141. Further, as I explained above (*see* Section V.B.3), a person of ordinary skill in the art would have understood complementing a primary/secondary-side planar coil with a secondary/primary-side planar coil would provide for efficient transmission of energy between the two planar coils in an inductive charging/power systems, especially where the coils were aligned to face each other to allow the perpendicular magnetic field generated from the transmitting planar coil to be received by the receiving planar coil. (*See* my discussions above in Section V.B.1.)

Thus, in my opinion, where design applications in an inductive power transfer system called for planar transmitting or receiving coil designs (e.g., to provide for thin, compact, versatile devices), such a skilled person would have had reasons to likewise consider design options where the receiving or transmitting coil likewise incorporated planar-type coil(s). Such knowledge (supported by the state of art references I discuss above) in context of the teachings of *Okada* and *Odendaal* would have motivated a person of ordinary skill in the art to consider and implement the use of planar coil(s) for the charger (e.g., cradle 4) in *Okada*'s system, and also to complement its inductive power transmission features, via use of a planar coil for a portable device (e.g., PDA 3, cellphone). (*See also* my analysis and discussions in Section IX.A.1(c)(2).)

142. In my opinion, a person of ordinary skill in the art would have had the skills, knowledge, and rationale in light of the teachings/suggestions of *Okada*, *Odendaal*, and a person of ordinary skill in the art's state of art knowledge, to implement the above-modification while considering design tradeoffs and techniques/technologies with a reasonable expectation of success. For example, such a skilled person would have known how to configure the modification such that the modified system/device operated as intended and in accordance with design

parameters for a given application consistent with the teachings of *Okada*. (*Id.*; *see also* my analysis and discussions above in this section; *see also* my analysis and discussions in Sections VIII.A-B, IX.A.1(a).) In my opinion, implementing the above-modification would have involved applying known technologies (e.g., known planar coils and related circuitry (e.g., *Odendaal* and a person of ordinary skill in the art's state of art knowledge as I discussed above)) with wireless inductive power transfer/charging systems (*Okada* and *Odendaal*) according to known methods and techniques (e.g., using planar-type coils to transfer power/data similar to known coil designs (*Okada* and *Odendaal*)) that would have led a skilled person to provide an inductive powering/charging system with thinner charger units and portable devices, like that contemplated by *Okada* and *Odendaal*. (*Id.*; *see also* my analysis and discussions above in this section; *see also* my analysis and discussions in Sections V, VIII.A-B, IX.A.1(a), IX.A.1(c)-(l).)

**c) Limitation 1(c)**

143. In my opinion, *Okada* in view of *Odendaal* and *Berghegger* discloses and/or suggests this limitation. (*See* my analysis and discussions below in this section; *see also* my analysis and discussions in Sections IX.A.1(a)-(b), IX.A.1(d)-(l); *see also* my analysis and discussions in Sections VIII.A-C.)

**(1) 1(c)(1): one or more drive circuits including one or more FET drivers, FET switches, and capacitors coupled to the one or more primary coils…**

144. *Okada* explains that switching circuit 15 in PTM10 generates a switching pulse signal supplied to primary coil 19 via one of switches 21/22/23, which is selected by power switching circuit 24. For example, *Okada* explains:

> The ***power transmitting module 10 has the switching pulse voltage output from the switching circuit 15*** input thereto and also includes a primary-side coil 19 that together with the secondary-side coil 41 equipped in the power receiving module 40, described below, constitutes a transformer. ***The primary-side coil 19 is configured to have the switching pulse voltage supplied via one of switching element 21, switching element 22, or switching element 23.*** Therefore, the transformation ratio of the transformer 30 constituting the selected switching element and the secondary-side coil 41 changes. In addition, ***the power transmitting module 10 is provided with a power switching circuit 24 that controls ON/OFF switching of the switching element 21, switching element 22, and switching element 23 based on a control signal from the power switching circuit 24.*** Note that the number of switching elements that determine the transformation ratio

> of the transformer 30 constituted by the primary-side coil 19 and the secondary-side coil 41 is configured by three elements, switching element 21, switching element 22, and switching element 23 in FIG. 2 but this number is not limited to three.

(Ex. 1005, ¶0040.) *Okada* explains that Switches 21/22/23 can be MOSFETs ("**FET switch**"). (Ex. 1005, ¶0049.)

145. The switching pulse signal is also converted (via circuits 16-18) to $V_{CC}$ for powering PTM10 components. (*See* my analysis and discussions in Section IX.A.1(a); Ex. 1005, ¶¶0038-0040, 0046, 0049-0051, FIG. 2.) In my opinion, a person of ordinary skill in the art would have understood that such PTM10 components are (directly/indirectly) coupled to, and configured to, drive/power primary coil 19. (*Id.*) For example, circuits 16-18 provide power to other components, e.g., circuit 33, which outputs signals driving coil 19 to send a carrier wave signal to PRM40. (Ex. 1005, ¶¶0062-0063, ¶¶0010-0014, 0042-0046, 0055-0058, Claims 2-3, 6; *see also* my analysis and discussions in Sections IX.A.1(a)-(b), IX.A.1(d)-(l).) As I explained above, switching circuit 15 also provides the switching pulsed signal to (FET) switches 21/22/23, and together with circuit 24,

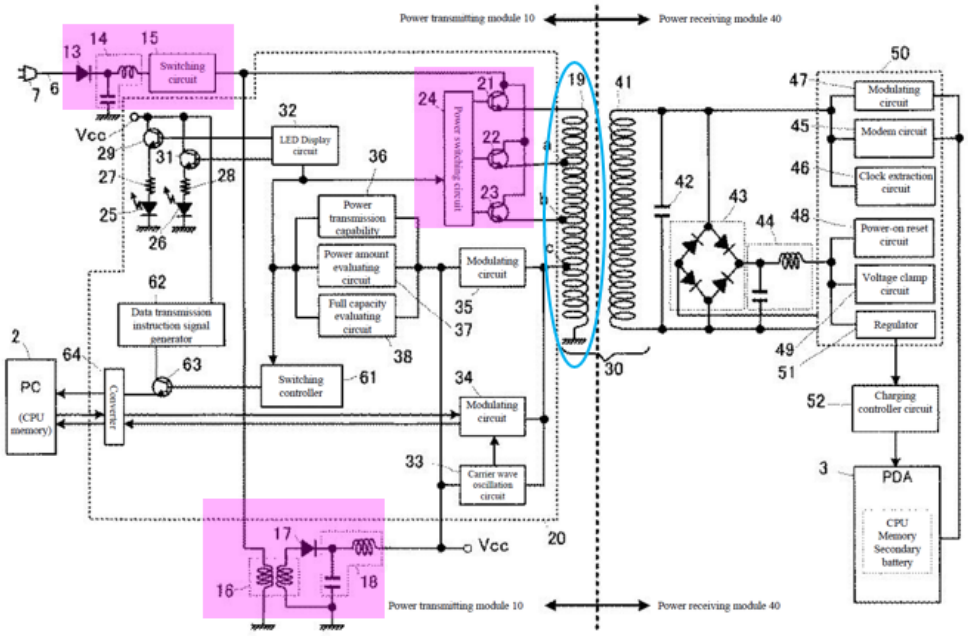
provides signals that drive coil 19 to transfer power. (*Id.*; Ex. 1005, ¶¶0040, 0049-0051, 0070-0073.)

146. Accordingly, in my opinion, a person of ordinary skill in the art would have understood that *Okada*'s examples of "**one or more drive circuits**" include at least:

> **(1)** switching circuit 15 (with/without circuits 13-14 (rectifying circuit 13, smoothing circuit 14)) and circuits 21-24 ((FET) switches 21/22/23, power switching circuit 24);
>
> **(2)** circuits 16-18 (transformer 16, rectifying circuit 17, smoothing circuit 18) (providing Vcc for power transmission control IC 20, including power switching circuit 24 which controls (FET) switches 21/22/23); or
>
> **(3)** a combination of such components (with/without other circuitry in power transmission control IC 20).

(*See* FIG. 2, annotated below in **pink**; *see also* my analysis, citations, and discussions above.) In my opinion, such a skilled person would have understood that the "**drive circuit**" includes "**one or more FET drivers**" (e.g., switch 15, circuit 24, and/or one or more of circuits 16-18, or a combination of such components) and

"**FET switches**" (e.g., switches 21/22/23). (*See* my analysis, citations, and discussions above and below in this section; *see also* my analysis and discussions in Section IX.A.1(g) (modified *Okada-Odendaal-Berghegger* system including claimed drive circuit(s), FET driver(s), and FET switch(es)).)[9]




(Ex. 1005, FIG. 2 (annotated).)

[9] In my opinion, a person of ordinary skill in the art would have understood that *Okada*'s circuitry that provides a switching signal to power primary coil 19 is similar to drive circuitry discussed in the '500 patent. (*See* my analysis and discussions in Section IX.A.1(a); Ex. 1001, 21:48-51, 23:5-6, 40:33-43, 43:5-6.)

147. *Okada* does not expressly disclose the drive circuit(s) having "**one or more FET drivers, FET switches, *and capacitors coupled to the one or more primary coils***."[10] Also, while capable of adjusting power levels based on device power requirements and selective switching at the **onset** of a charging process, *Okada* does not expressly indicate adjusting power levels **during** the charging process.[11] (Ex. 1005, ¶¶0069-0076, FIG. 3; *see also* my analysis and discussions in Sections VIII.A, IX.A.1(a).) Nevertheless, in my opinion, a person of ordinary skill in the art would have been motivated to modify the *Okada-Odendaal* system to

[10] Dependent claim 3 of the '500 patent separately recites the "drive circuits" and "capacitors." (Ex. 1001, 71:26-30.) Thus, I have been asked to consider for purposes of my opinions that the claimed "**one or more drive circuits**" of limitation 1(c) may or may not include the "capacitor(s)."

[11] The modification associated with these features (that I discuss here for this limitation) are also applicable to later limitations, such as for example, limitations 1(f)-(g), etc. (*See* my analysis and discussions in this section and in other sections (e.g., IX.A.1(f)-(g)).)

include such features in view of *Berghegger*. (*See* my analysis and discussions below; *see also* my analysis and discussions in Section VIII.C.)

148. Similar to *Okada* and *Odendaal*, *Berghegger* discloses a system for inductively powering/charging a device/battery. For example, *Berghegger* explains:

> The present invention relates to an inductive contactless power transmitter having a primary side including a first inductor ($L_P$) on the primary side and an oscillator for producing an alternating signal which is supplied to the inductor ($L_P$) on the primary side, and having a secondary side which includes an inductor on the secondary side that can be coupled to the inductor ($L_P$) on the primary side, a load ($R_L$) which is variable in time, and a detection means (42) for determining a power demand of the load on the secondary side, ***the first oscillator being a voltage-controlled oscillator having a frequency that is adjustable in response to the power demand determined by the detection means (42)***.

(Ex. 1006, Abstract; *see also id.*, FIGS. 1a-1b, 4-6, 1:65-2:17 (discussing known inductive power transmitter system), 2:18-3:30, 5:27-30 (mobile device is placed in the charging tray), 6:12-19 (load can include batteries), 6:37-45 (charging tray for mobile phone).) *Berghegger* explains that a controller 40 drives primary-side

inductor $L_P$ that is "magnetically coupled to" secondary-side inductor $L_S$ to induce an AC voltage on $L_S$, which is rectified and supplied to load $R_L$ (including a battery). (*Id.*, 6:5-15; *see also id.*, 6:38-40 ("charging tray" and "mobile...telephone").)

149. Thus, in my opinion, a person of ordinary skill in the art would have understood that *Berghegger* is in the same technical field as the '500 patent, *Okada*, and *Odendaal* because *Berghegger* also describes a system and processes for powering/charging a mobile device/battery using inductive contactless power transfer techniques/technologies. (*Id.*; Ex. 1006, FIGS. 1a-1b, 4-6, Abstract, 1:65-2:17, 2:18-3:30, 5:27-30, 6:12-19, 6:37-45; Ex. 1008, Title, Abstract, FIGS. 1A-4, 11-12, 1:5-3:57, 4:50-5:8, 5:24-28, 6:59-64; Ex. 1001, Abstract, 4:13-14; *see also* my analysis, discussions, and citations regarding *Okada* and *Odendaal* in Sections IX.A.1(a)-(b); *see also* my analysis and discussions in Sections VIII.A-C.)

150. In my opinion, a person of ordinary skill in the art would have appreciated that *Berghegger* (like *Okada* and *Odendaal*) also discloses features that were reasonably pertinent to one or more particular problems the '500 patent discusses. (*See, e.g.*, Ex. 1001, 4:13-29; Ex. 1008, Abstract, 1:5-3:57, 4:50-5:8, 5:24-28, 6:59-64; Ex. 1005, FIGS. 1, 2, 7, 9-12, ¶¶0037-0048, 0049-0058, 0094-0109, 0116-0126; Ex. 1006, FIGS. 1a-1b, 4-6, Abstract, 1:65-2:17, 2:18-3:30, 5:27-

30, 6:12-19, 6:37-45; *see also* my analysis and discussions in Sections VIII.A-C, IX.A.1(a)-(b).) As I discussed above and below, *Berghegger* also discloses techniques and technologies for addressing the need to power mobile devices using contactless inductive coupling. In my opinion, a person of ordinary skill in the art would have understood that such teachings address similar problems identified in the '500 patent (and such a skilled person was trying to solve), and thus would have consulted such teachings while looking to address and solve such issues/problems and others relating to the design and implementation of a contactless inductive charging system, including those described by *Okada-Odendaal*. (*Id.*)

151. *Berghegger* explains that controller 40 (*see, e.g.*, FIG. 4) includes a drive circuit 2 (*see, e.g.*, FIG. 2) and MOSFET switches S1-S2 (*see, e.g.*, FIG. 1b) for "driving the inductor $L_P$ and the resonant capacitor $C_P$ on the primary side." (Ex. 1006, 6:5-8.)

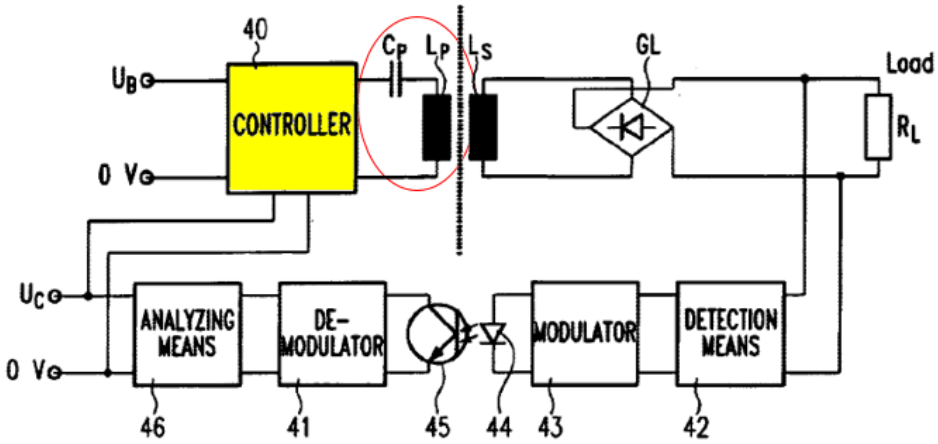



Fig.4

(Ex. 1006, FIG. 4 (annotated).)

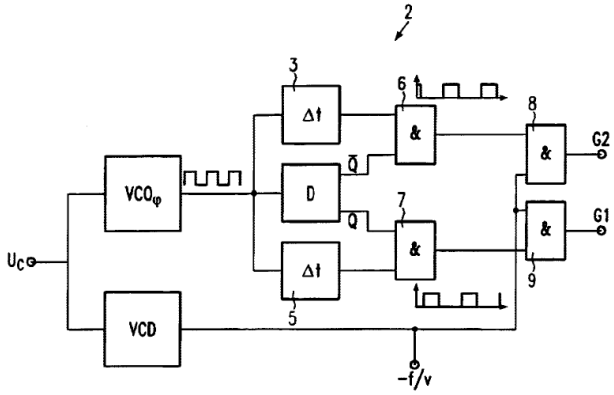



Fig.2

(*Id.*, FIG. 2.)

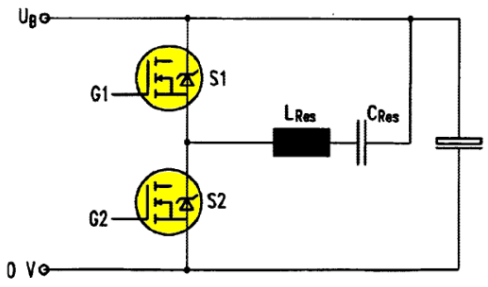



Fig.1b

(*Id.*, FIG. 1b (annotated).)

152. *Berghegger* also explains that drive circuit 2 receives a control signal $U_C$ that ultimately determines the frequency of AC signals provided by electrodes G1-G2, where $U_C$ "depends on the power demand of the secondary side." (*Id.*, 4:51-61 ("G1 and G2 are controlled by the drive circuit 2 shown in FIG. 2" and voltage-controlled oscillator ($VCO_p$) and voltage-controlled duty cycle control unit (VCD) both receive $U_C$).) For example, *Berghegger* discloses:

> the control electrodes G1 and G2 are controlled by the drive circuit 2 shown in FIG. 2. The drive circuit 2 comprises a voltage-controlled oscillator ($VCO_P$), two delay elements 3 and 5, a delay flip-flop D and gates 6, 7, 8, 9 as well as a duty cycle control unit VCD. Both the voltage-controlled oscillator $VCO_P$ and the duty cycle control unit VCD have a control signal $U_C$ supplied thereto. ***The control signal $U_C$ depends on the power demand of the secondary side. It will be explained***

***further below with reference to FIGS. 4 and 5 how the control signal is generated.***

(Ex. 1006, 4:51-61; *see also id.*, 4:62-5:64 ($U_C$ determines frequency of ac signal provided by G1-G2).) Signals from G1-G2 control the frequency at which MOSFETs S1/S2 operate to drive inductor $L_P$ and resonant capacitor $C_P$. (*Id.*, 3:51-4:50.) A person of ordinary skill in the art would have understood that the FIG. 5 (below) configuration is similar to FIG. 4 (Ex. 1006, 5:65-6:37), but where $U_C$ is provided using coils $L_S$ and $L_P$. (*Id.*, 6:50-53, 6:53-8:8.)

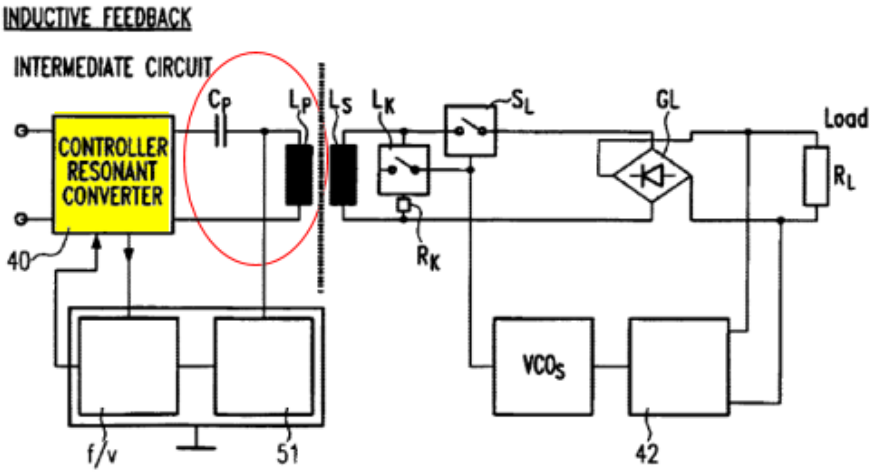



Fig.5

(Ex. 1006, FIG. 5 (annotated).)

153. Thus, in my opinion, a person of ordinary skill in the art would have understood that controller 40 ("**drive circuit**") includes "**FET driver(s)**" (e.g.,

components in circuit 2) controlling the oscillating frequency of "**FET switches**" (S1/S2) for powering a primary coil, and a resonant capacitor (e.g., resonant capacitor $C_P$) coupled to the primary coil (e.g., inductor $L_P$) ("**capacitor[] coupled to the one or more primary coils**"). (*See* my analysis, discussions, and citations regarding *Berghegger* above and below in this section; Ex. 1006, 4:12-19 ("connecting $L_P$ and $C_P$").)

154. In my opinion, in view of *Berghegger*, a person of ordinary skill in the art would have been motivated and found it beneficial to modify the *Okada-Odendaal* system to include a **drive circuit** having **FET driver(s)**, **FET switches**, and a **capacitor** coupled to the primary coil(s) of the system to adjust power levels during charging while providing a more efficient power transfer via capacitive filtering. (*See* my analysis, discussions, and citations regarding *Berghegger* and *Okada* above and below in this section; *see also* my analysis and discussions in Sections VIII.A, VIII.C, IX.A.1(a).) In my opinion, a person of ordinary skill in the art would have appreciated the guidance of *Berghegger*, which describes a closed-loop feedback arrangement, where a drive circuit adjusts the oscillating frequency and thus the power delivery based on device information (e.g., control signal $U_C$ that "depends on the power demand of the secondary side"). (Ex. 1006, 4:51-61; *see*

*also* my analysis, discussions, and citations regarding *Berghegger* above and below in this section.)

155. In my opinion, a person of ordinary skill in the art would have understood that such a configuration would have improved and complemented the *Okada-Odendaal* system, which, as I explained above, also uses device information (e.g., "power consumption information") to control/adjust power delivery in a closed-loop feedback fashion, but does so at the onset of charging, not during charging. (Ex. 1005, ¶¶0057, 0063-0064, 0069-0076, FIG. 3; *see also* my analysis and discussions in Sections VIII.A, IX.A.1(a)-(b).) A person of ordinary skill in the art would have understood that implementing features similar to those described by *Berghegger* would have ensured "a sufficient amount" of power is "available on the secondary side" during a power delivery (whether initiated at a low/intermediate/high level as in *Okada* (*see, e.g.*, Ex. 1005, ¶¶0069-0073, FIG. 3)) while also preventing "an unnecessarily large amount of energy being consumed on the primary side" to achieve a "more energy-efficient continuous operation" as suggested by *Berghegger*. (Ex. 1006, 2:28-44.)

156. In my opinion, a person of ordinary skill in the art would have recognized *Berghegger* teaches that power required by a load "is **variable in time**"

and thus a closed-looped control feature (similar to that described in *Berghegger*) would enable accurately adjusted power delivery based on the time-varying power demand during powering/charging operations. (Ex. 1006, 6:12-15; *see also* my analysis, discussions, and citations regarding *Berghegger* above in this section.) In my opinion, such a skilled person would have thus been motivated to configure/modify the *Okada-Odendaal* system to implement drive circuitry (including FET driver(s), FET switches, and a capacitor (*see* above and below)) to allow fine tuning of the determined power level (e.g., low/intermediate/high) while the mobile device is charged. (*Id.*; *see* my analysis, discussions, and citations regarding *Berghegger* above and below in this section; Ex. 1005, ¶¶0057, 0063-0064, 0069-0076, FIG. 3; *see also* my analysis and discussions in Sections VIII.A, VIII.C, IX.A.1(a).)

157. Moreover, *Berghegger* teaches using a capacitor with the primary-side inductor "to obtain a serial resonant circuit [which] **has the advantage that the power transmission from the primary side to the secondary side is improved**" (Ex. 1006, 2:58-61) and also choosing the highest frequency produced by the VCO to be "equal to the resonant frequency of said serial resonant circuit" (*id.*, 2:61-64). In my opinion, as demonstrated and exemplified by state of art disclosures I cite

below, a person of ordinary skill in the art would have been aware that capacitor circuits provided benefits in improving power transmissions in an inductive-based systems, like *Okada-Berghegger* (e.g., minimizing/reducing unwanted radiations and heat issues caused by harmonics, etc.).

158. For example, *Alexander* (Ex. 1016) explains that "[r]esonance is a condition in an RLC circuit in which the capacitive and inductive reactances are equal in magnitude, thereby resulting in a purely resistive impedance. Resonant circuits (series or parallel) are useful for constructing filters." (Ex. 1016, 631.)[12] *Alexander* also explains that "[a] bandpass filter is designed to pass all frequencies within a band of frequencies, w1 < w < w2. . . . the bandpass filter in Fig. 14.35 is a series resonant circuit." (*Id.*, 641.) *Alexander* also explains regarding "a bandpass filter . . . [i]f the filter is made highly selective . . ., the filter passes only the

[12] As I indicated above, I cite *Alexander* (and other non-asserted prior art references for given grounds) to support my opinions as to the state of the art knowledge of a person of ordinary skill in the art at the time of the alleged invention, which is consistent with how such a person would have understood *Okada*, *Odendaal*, and *Berghegger*'s teachings.

fundamental component (n=1) of the input and **blocks out all higher harmonics**." (*Id.*, 798.)

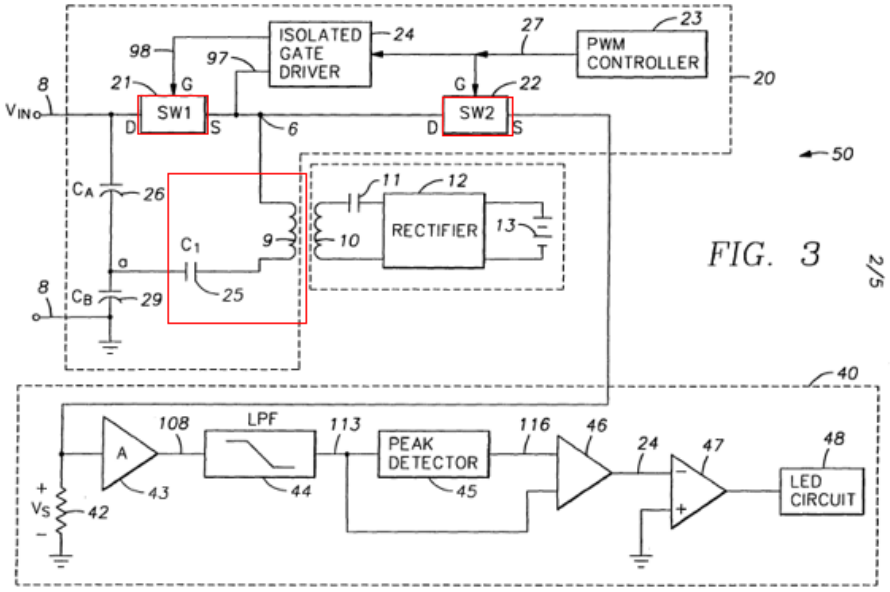
159. Similarly, references such as *WangII* (Ex. 1013) disclose the known use of switch(es) loaded by a capacitor coupled to a primary coil providing wireless power to secondary coil that reduces harmonics in signals generated by a primary coil, consistent with a person of ordinary skill in the art's knowledge at the time. (Ex. 1013, FIGS. 3 (*see* annotated figure below), 6, Abstract, 3:29-4:5 (discussing prior art where primary/secondary coils arrangement using a switching DC voltage across a tuning capacitor where "high frequency harmonic components are present in the waveform," which "induce eddy currents" that increase temperature that is detrimental to operation of the device), 4:19-28 (battery charging device to efficiently charge a battery in device without excessive heat), 4:29-5:7 (use of capacitor-based resonant circuit with switches that provides full sinusoidal wave that "**reduce harmonics and eddy current**" to minimize heat and "without causing excessive energy loss"), 7:24-8:14, 8:17-23 (tuning capacitor 25 designed so that a sinusoidal waveform "flows through the primary coil 9 with **little high order frequency content**"), 8:24-31, 9:26-12:27).) For example, *WangII* explains:

The present invention solves the shortcomings and deficiencies of the prior art by constructing a transcutaneous **energy transmission device with two solid state switches facilitating the production of a substantially sinusoidal power waveform. The generation of the full sinusoidal wave reduces harmonics and eddy currents which otherwise are generated in the housing (or can) of the implanted device. As a result, heating of the can is minimized. The solid state switches connect a regulated DC voltage across an inductor and capacitor resonant circuit. The inductor forms a primary coil of a transformer in which current is induced in a secondary coil attached to an implanted medical device. The medical device receives the induced current for charging rechargeable batteries.**

The present invention can be implemented in a circuit in which a 5 KHz gate signal turns a first MOSFET switch on and off. The gate signal also turns on and off a second MOSFET switch at opposite times than the first MOSFET switch. **In addition to minimizing harmonics, the use of the optimum switching frequency reduces the eddy**

**current in the housing (or can) of the implanted device, without causing excessive energy loss.**

(Ex. 1013, 4:29-5:7; *see also id.*, Abstract ("A current with a sinusoidal waveform is applied to **a resonant circuit comprising a primary coil (9) and a capacitor (25).** Current is induced in a secondary coil (10) attached to the implanted medical device.").)




(Ex. 1013, FIG. 3 (annotated).) (*See also* Ex. 1008, 2:16-19 (resonant tank); Ex. 1001, 21:17-34 (acknowledging harmonics are "undesirable").) (*See also* other state of art disclosures supporting my opinions as to the knowledge of a person of ordinary skill in the art at the relevant timeframe, such as Ex. 1012, FIGS. 2, 5 (C1 25,

inductor 9), 8 (same), 3:30-62, 8:47-9:51; Ex. 1014, 67-68 ("In a narrowband transmitter, a low-pass filter might be built in for ***reduction of harmonic output***"); *id.*, 62-68; Ex. 1015, FIGS. 1-2, 5-12, Abstract, 1:55-2:10, 3:28-51, 4:22-44 (providing a capacitor 20 in parallel with power supply coil "so that [there is] a resonance"), 5:45-6:4 ("the resonant frequency $f_R$" is set to a level as low as approximately 1.5 times of the output frequency f*o* of the frequency converter 16 . . . [and] oscillation at a frequency of 2 f*o* was optimal from the standpoint of maximum circuit efficiency")[13]; Ex. 1020, Abstract (disclosing tuning capacitor 22 in a resonant circuit in an inductively coupled power transfer system that results in reduce harmonics); Ex. 1021, ¶¶0164-0165 ("[i]t was **known in the art to drive coils using parallel or series resonant circuits**" to allow "maximum current flow[] through the primary coil"); Ex. 1029, 19, 22-25; *see also* Section V.)

[13] A person of ordinary skill in the art would have understood that a resonant circuit with a resonant frequency at 1.5 to 2 times the operating frequency of a signal would decrease some of the harmonics of that signal, including, for example, the 4th harmonics and higher.

160. Thus, in light of *Berghegger*'s teachings and a person of ordinary skill in the art's knowledge, such a skilled person would have been motivated to consider and implement a capacitor with the drive circuit(s)/primary coil(s) in PTM10 of *Okada-Odendaal* to improve power transmission and reduce harmonics. (*Id.*; *see also* my analysis, discussions, and citations regarding *Berghegger* and the state of art disclosures above.)

161. In my opinion, a person of ordinary skill in the art would have had the skill, knowledge, and rationale in implementing, and expectation of success in achieving, the above-modification, especially given the use of capacitors and closed-loop feedback control technologies/techniques for adjusting power delivery was known (e.g., as I discussed above with respect to *Okada* and *Berghegger* above). (*See* my analysis, discussions, and citations regarding *Okada* and *Berghegger* above in this section; *see also* my analysis and discussions in Sections V, VIII.A, VIII.C, IX.A.1(a); *see also* my analysis, discussions, and citations regarding the state of art disclosures above.) Such a modification would have involved applying known technologies/techniques (e.g., FET-based drive circuitry in closed-loop feedback power transfer system with capacitive filtering to adjust power delivery (*Okada* and *Berghegger*, a person of ordinary skill in the art's state of art knowledge)) that would

have led a skilled person to provide an inductive power/charging system that ensures sufficient power is available to a portable device during power delivery that achieves energy-efficient, continuous inductive power transfer with reduced heat waste and signal distortion. (*Id.*)

162. In my opinion, a person of ordinary skill in the art would have understood that there were various ways for such a skilled person to implement such modifications. (*Id.*) As a non-limiting example, a person of ordinary skill in the art would have understood that an appropriately designed capacitor-based filter positioned between switches 21/22/23 and primary coil 19, or between switching circuit 15 and the switches would have achieved the above-noted filtering benefits (e.g., reduced harmonics). (*Id.*) Also, another example is where *Okada*'s features/components used to receive/pass/process device information in PTM10 for power transfer control (e.g., demodulator 35, circuits 36-38 (Ex. 1005, ¶0064; *see also* my analysis and discussions in sections IX.A.1(d)-(e))) would have been leveraged to achieve the noted beneficial power delivery features during charging/powering operations (e.g., use received device information (like $U_C$ in *Berghegger*) to control operating frequency of the modified/configured drive circuit (e.g., switching circuit 15, etc.)). (*See* my analysis and discussions above in this

section; *see also* my analysis and discussions in Sections V, VIII.A, VIII.C, IX.A.1(a)-(b), IX.A.1(d)-(l).)[14]

> **(2) 1(c)(2): …that when operated apply an alternating electrical current to the one or more primary coils to generate a magnetic field in a direction substantially perpendicular to the plane of the one or more primary coils and the surface of the system…**

163. In my opinion, *Okada* in view of *Odendaal* and *Berghegger* discloses and/or suggests this limitation. (*See* my analysis and discussions below in this section; *see also* my analysis and discussions in Sections IX.A.1(a)-(c)(1); IX.A.1(c)(3); *see also* my analysis and discussions in Sections VIII.A-C.)

[14] While I provide such exemplary configurations/modifications/implementations, they are not intended to limit the way a person of ordinary skill in the art would have implemented such a modification. Nor are they intended to represent a specific limiting design (e.g., schematic, etc.) of the modified system. In my opinion, other designs/configurations could/would have been contemplated by a person of ordinary skill in the art when designing/implementing such a modification depending on given applications that would have achieved similar results.

164. As I explained above, the above-discussed *Okada-Odendaal-Berghegger* system would have included a drive circuit (with FET driver(s) and switch(es) and associated capacitor) having a closed-loop feedback control. (*See* my analysis and discussions in Section IX.A.1(c)(1).) In my opinion, in light of *Berghegger* and *Okada*'s teachings, a person of ordinary skill in the art would have understood that such a drive circuit in the *Okada-Odendaal-Berghegger* system, during operation, would have provided an alternating signal to primary coil(s) of the system (e.g., similar to *Berghegger*'s inductor/primary coil $L_P$). (Ex. 1006, Abstract ("oscillator for producing an **alternating signal which is supplied to the inductor ($L_P$)** on the primary side"), 4:41-42 ("[w]hen switch S2 is switched off, the current is first maintained by inductor $L_P$"), 6:5-9, 8:13-15 ("producing an **alternating signal which is supplied to said inductor ($L_P$)** on the primary side"); *see also* my analysis and discussions in Section IX.A.1(c)(1); Ex. 1005, ¶¶0110-0111.)

165. In my opinion, consistent with such teachings, a person of ordinary skill in the art would have also understood that the ac signal applied to the primary coils in the modified *Okada* system would have generated "**a magnetic field in a direction substantially perpendicular to the plane of the one or more primary coils and the surface of the system**" as claimed in limitation 1(c)(2), given such a

field would have been the natural result of activating the primary coil to inductively transfer power as described by *Okada*, *Odendaal*, and *Berghegger*. (Ex. 1005, ¶¶0035 ("magnetic coupling occurs between the [coils]"), 0051, 0056 ("magnetic coupling occurs between" coils), 0063, 0066, 0121, ¶¶0127-0132, FIGS. 11(b) and 13(b) (showing parallel coils that would generate a magnetic field perpendicular to the plane of coil 19 and system) (*see* annotated FIGS. 11(b) and 13(b) and my analysis in Section IX.A.1(b)); Ex. 1006, 4:25-27 ("charge mode" where $L_P$ is "magnetically coupled with" $L_S$), 6:5-9; Ex. 1008, 1:17-20, 2:1-29; *see also* my analysis and discussions in Sections V, IX.A.1(a)-(b).) For example, *Koreis* (Ex. 1009) and other references I reference below[15] demonstrate such knowledge of a person of ordinary skill in the art. *Koreis* explains:

[15] I reference *Koreis* (and other prior art references below) only to reflect the state of the art known to a person of ordinary skill in the art at the time of the alleged invention, which is consistent with how such a person would have understood *Okada*, *Odendaal*, and *Berghegger*'s teachings. Thus, I do not rely on such references here to supplement the teachings of *Okada*, *Odendaal*, and *Berghegger*, which as I explained, disclose/suggest the claimed features.

Referring to the drawings, **a contactless power supply** according to the present invention is illustrated and generally indicated by **reference numeral 10 in FIG. 1**. The **contactless power supply comprises an inductive coil 12 disposed within a charging unit 14**, along with a receptor 16 disposed within or on a computing device 18, wherein the computing device 18 is positioned proximate the charging unit 14 as shown. ***When energized, the inductive coil 12 generates magnetic fields to provide electrical current to the receptor 16, which powers the computing device 18.*** Further, the electrical current may also be used to charge batteries (not shown) of the computing device 18 in addition to supplying power. . . .

**More specifically, the contactless power supply 10 comprises** ***a two-part transformer, wherein the transformer has a flat configuration so as to fit within, for example, a seatback tray or a desktop. The first part of the transformer is located within the seatback tray*** **and is coupled to a source of AC power.** The second part of the transformer, hereinafter referred to as receiving coil and core, is located within the computing device 18 and is coupled to a rectifier that converts AC power to DC power. ***When magnetic field lines are approximately 90 degrees***

> ***to the first part of the transformer*** when the receiving coil and core are placed within the field, ***current is induced into the computing device 18.***

(Ex. 1009, 2:46-3:8; *see also id.*, FIG. 1.)

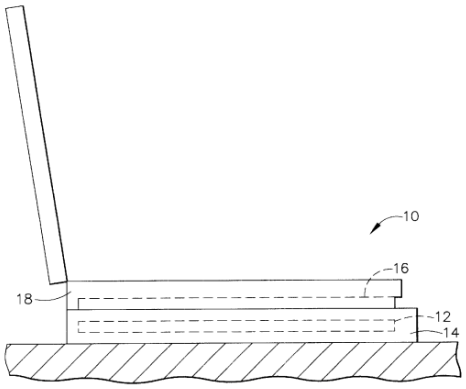


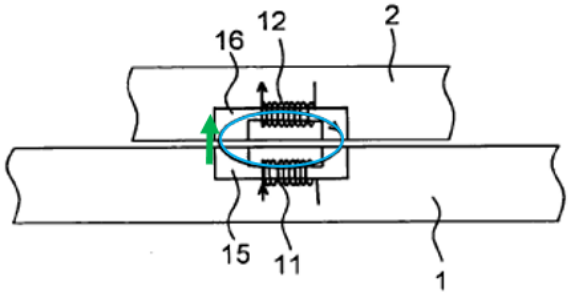

FIG. 1

(*Id.*, FIG. 1.) The above disclosures of *Koreis* show that the above-discussed "magnetic field lines [that] are approximately 90 degrees to the first part of the transformer" are substantially perpendicular to the plane of the activated inductive coil 12 (e.g., activated primary coil), a surface of an inductive power source such as charging unit 14, the plane of the second part of the transformer (e.g., plane of receptor 16 / receiving coil) (*id.*; *see also id.*, 3:9-10 ("Preferably, the **receptor 16 is a thin flat coil** disposed on or within the computing device 18.")), and a surface of an inductive power receiver such as computing device 18. (*Id.*, 2:46-3:8, FIG. 1.) Such teachings are consistent with the above-discussed knowledge of a person of

ordinary skill in the art regarding an activated primary coil of an inductive/contactless power supply system generating a **magnetic field** in a direction **substantially perpendicular** to the plane of the activated primary coil (similar to the activated primary coil of *Okada*) and surfaces of an inductive power source and inductive power receiver (e.g., inductive power system) (similar to the system of *Okada*), which are also consistent with the above-discussed disclosures of *Okada*. (*Id.*; *see also id.*, 1:54-2:18, 3:20-4:11, FIGS. 1-3; *see also* Ex. 1011, 557-562, 593-594, 601; Ex. 1010, FIGS. 1-5B, 8:55-9:52 ("as is well known by those skilled in the relevant art, primary coil 510 induces a current to flow in secondary coil 230" and a magnetic field represented by arrows 564 and 565 is generated that is perpendicular to plane 520 of charger and primary coil 510), FIGS. 6A-10, 7:21-8:54, 9:53-10:22, 11:27-14:67; Ex. 1029, 3-4, 27-50; Ex. 1019, FIG. 2B (annotated below, showing magnetic field (**blue** below) perpendicular (**green**) to charger surface 1), ¶¶0027, 0064, 0065 ("The primary side coil 11 and the secondary side coil 12 constitute a transformer through magnetic coupling between a primary side core (ferrite) 15 and a secondary side core (ferrite) 16, wherein when the pulse voltage obtained by switching is applied across the primary side coil 11, a voltage is

induced across the secondary side coil 12 by magnetic coupling."); *see also* Section V.)

FIG. 2B




(Ex. 1019, FIG. 2B (annotated).)

166. Moreover, *Okada* discloses providing power inductively when primary coil 19 is present and properly aligned with a portable device such as PDA 3 (and its secondary/receiver coil 41) where appropriate magnetic coupling for high power transmission efficiency exists between the primary and secondary coils. (*See, e.g.*, Ex. 1005, ¶¶0064-0069, 0074-0076, FIGS. 3, 4(a)-(b).) For example, *Okada* explains:

> . . . Here, the power transmission capability evaluating circuit 36 determines whether a power receiving apparatus is mounted onto a power transmitting device 1 based on the "code indicating that a device is capable of receiving

power" (STEP 3). If a prescribed "code indicating that a device is capable of receiving power" is received (STEP 3: Yes), it is recognized that a device capable of receiving power is mounted onto the common module 4 [sic]. ***Next it is determined whether the device capable of receiving power (compatible device) is correctly mounted onto the common cradle 4 (STEP 4).*** Meanwhile, if no prescribed "code indicating that a device is capable of receiving power" is received (STEP 3: No), it is determined that no device capable of receiving power is mounted onto the common cradle 4, and a carrier wave is output again (STEP 2).

Next, the determination as to whether a device capable of receiving power is correctly mounted onto the common cradle 4 is described. ***Determining whether a device capable of receiving power is correctly mounted onto the common cradle 4 determines whether the primary-side coil 19 in the power transmitting module 10 and the secondary-side coil 41 in the power receiving module 40 are arranged at positions having high power transmission efficiency, and providing this determination step allows for the selection not to carry***

***out power transmission when the mount position has significantly poor power transmission efficiency.***

***FIG. 4 illustrates the relationship between relative positions of the common cradle 4 and the PDA 3, transmission efficiency of power and an information signal.*** Here, the information signal is the modulated wave described above, returned by the power receiving module 40 in response to a carrier wave transmitted by the power transmitting module 10. In FIG. 4, (a) illustrates an absolute value of a transmission efficiency of power (solid line) and an information signal (dashed line), and (b) illustrates a relative value of the power (solid line) and the information signal (dashed line). In both (a) and (b), the **horizontal axis represents an amount of offset of the common cradle 4 and the PDA 3, with 0 being a case where the common cradle 4 and the PDA 3 are positioned at positions at which magnetic coupling of the primary-side coil 19 of the common cradle 4 and the secondary-side coil 41 of the PDA 3 is highest, illustrating the amount of offset of the PDA 3 from this position either left to right or front to back in units of mm.**

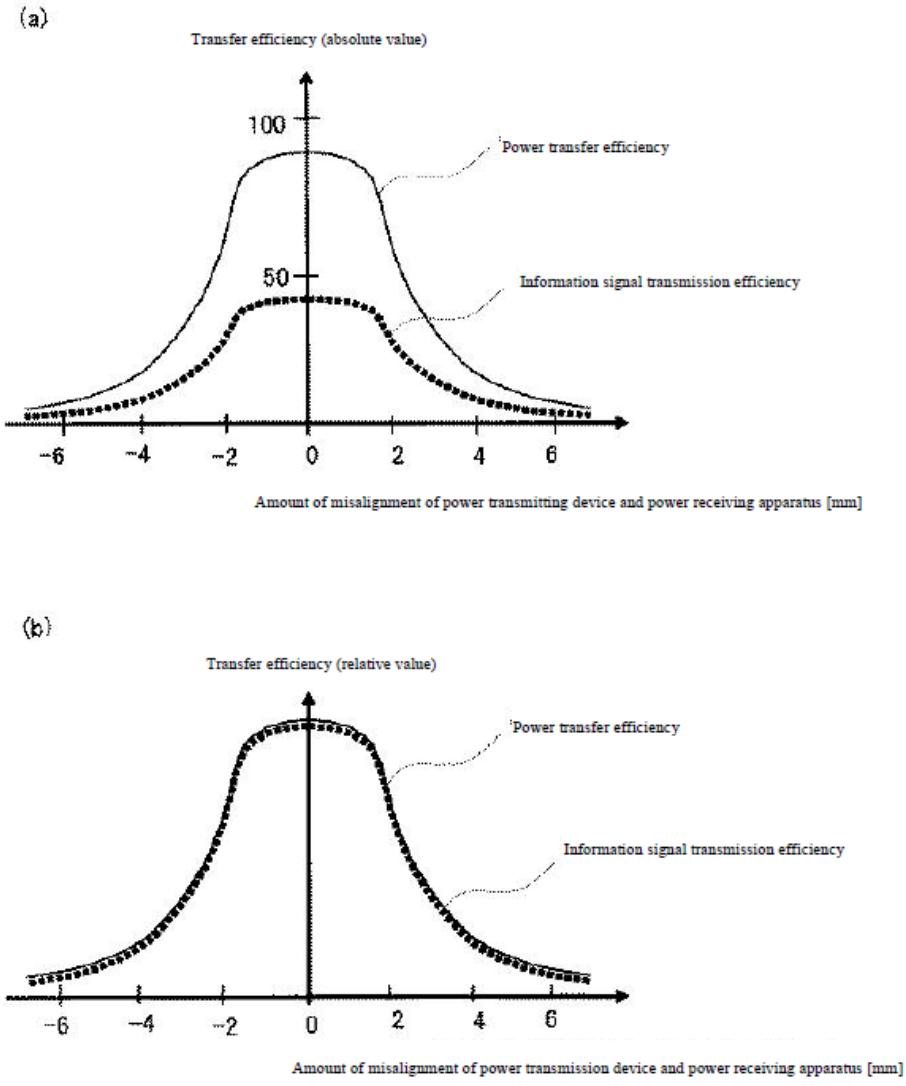
As illustrated in FIG. 4(a), **the greater the amount of offset of the positions of the common cradle 4 and the PDA 3, the worse the power transmission efficiency and information signal transmission efficiency.** As illustrated in FIG. 4(b), this power transmission efficiency and information signal transmission efficiency decrease by the same percentage as the amount of positional offset of the common cradle 4 and the PDA 3, so even when the common cradle 4 is in a state where power is not being transmitted, by measuring a signal intensity of the information signal, the amount of positional offset of the common cradle 4 and the PDA 3 can be recognized.

**The greater the amount of positional offset of the common cradle 4 and the PDA 3, the worse the power transmission efficiency, so when power transmission efficiency is significantly low, the PDA 3 cannot receive power even if power is transmitted from the common cradle 4, which defeats the purpose of transmitting power. Therefore, after evaluating whether an amount of positional offset of the common cradle 4 and the PDA 3 exceeds a prescribed amount of offset (STEP 4), when exceeded (STEP 4: No), power is not transmitted from the power transmitting device 1** . . .

> Meanwhile, **when the amount of positional offset of the common cradle 4 and the PDA 3 does not exceed the prescribed amount of offset (STEP 4: Yes), processing proceeds to evaluating an amount of power to transmit (STEP 6)**. . . .

(Ex. 1005, ¶¶0064-0069; *see also id.*, FIGS. 3, 4(a)-(b), ¶¶0074-0076.)

FIG. 4




(Ex. 1005, FIGS. 4(a) and (b) ("Amount of ***misalignment*** of power transmission device and power receiving apparatus [mm]").) Thus, based on such disclosures of *Okada* that the system provides power inductively when primary coil 19 is present and properly aligned with a portable device such as PDA 3 (and its

secondary/receiver coil 41) where appropriate magnetic coupling for high power transmission efficiency exists between the primary and secondary coils (Ex. 1005, ¶¶0064-0069, 0074-0076, FIGS. 3, 4(a)-(b)), in view of *Okada*'s configurations (discussed above (e.g., parallel primary and secondary coils, etc.)) and a person of ordinary skill in the art's state of art knowledge (also discussed above), such a skilled person would have understood that the ac signal applied to the primary coils in the modified *Okada* system would have generated "**a magnetic field in a direction substantially perpendicular to the plane of the one or more primary coils and the surface of the system**" as claimed in limitation 1(c)(2). (*Id.*; *see also* my analysis and discussions above in this section; *see also* my analysis and discussions in Sections V, VIII.A, IX.A.1(a)-(c)1.)

167. Also, in my opinion, a person of ordinary skill in the art would have understood planar primary coils in the *Okada-Berghegger-Odendaal* system would have likewise generated a magnetic field that was substantially perpendicular to the plane of primary coils 19 and the surface of the system, as known in the art. (*Id.*; *see* my analysis, discussions, and citations above in this section and in Section IX.A.1(b).) For example, consistent with known planar coil designs and how magnetic coupling occurs in such configurations (*see* my discussions above in

Section V.B and those above and below in this section where I reference state of art references supporting such understanding), and also consistent with *Okada*'s teachings that look to detect and confirm coil/device position/alignment where appropriate magnetic coupling for high power transmission efficiency exists based on positional offset (*see* Ex. 1005, ¶¶0064-0069, 0074-0076, FIGS. 3, 4(a)-(b)), a person of ordinary skill in the art would have understood (and been motivated to design/implement a system where) when the primary planar coil(s) is/are aligned with the (planar) secondary coil in the modified *Okada* system to maximize/increase magnetic coupling (energy transfer efficiency), that a ***substantially perpendicular*** magnetic field (relative to the plane of the primary coil(s) and surface of the system) would be generated by the planar primary coil(s) and received by the planar secondary coil. (*Id.*; *see also* my analysis and discussions in this section (including analysis and discussions regarding a person of ordinary skill in the art's state of art knowledge); *see also* my analysis and discussions in Sections V.B, IX.A.1(b); *see also* Ex. 1048, Abstract, FIGS. 1-6, 1:28-2:4 ("spiral coil" with a "high magnetic field strength at the center of the coil"), 2:27-3:14, 4:11-24, 5:23-6:15, claims 1-88; Ex. 1049, Abstract, FIGS. 1, 5-6, 9, 11-12, 24-26, ¶¶0008-0010, 0044-0050, 0051 (peak intensity of magnetic field at center of the inductor), 0065-0066; Ex. 1050,

Abstract, FIGS. 1-5, 9A-9C, 5:22-6:45, 11:22-33, 12:28-38, 16:25-17:23, 17:61-18:3 ("**substantially perpendicular**" magnetic field from planar coils).)

168. In fact, a person of ordinary skill in the art would have understood planar coils like those implemented in the above discussed modification would have generated magnetic field lines substantially perpendicular to the plane of the primary coil(s) and surface of the system, consistent with that known in the art by such a skilled person. (*See id.*) For example, consistent with that discussed in 1958 by *Semat* (Ex. 1011), a person of ordinary skill in the art was aware that the "magnetic field at the center of [a wire] loop is perpendicular to the plane of the loop." (Ex. 1011, 559; *see id.*, 558.)

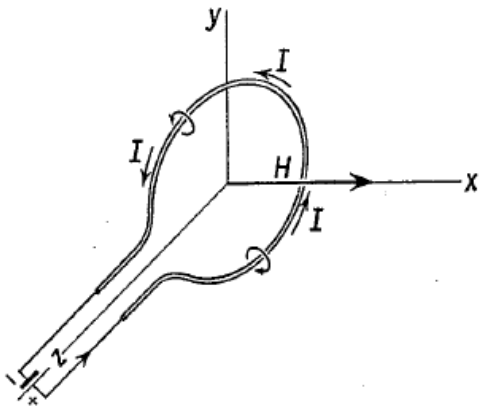



**Fig. 30-4** Magnetic field produced by a current in a circular loop of wire. The magnetic field at the center is at right angles to the plane of the loop.

(Ex. 1011, 559, FIG. 30-4, 562.) A person of ordinary skill in the art knew of, and how to determine, the magnetic field intensity "at the center of a singular circular

loop of wire carrying a current, and likewise, that the magnetic field at center of such a single conductor loop coil in the positive z direction as shown in the figure below (perpendicular to center of loop). (*Id.*, 562.)

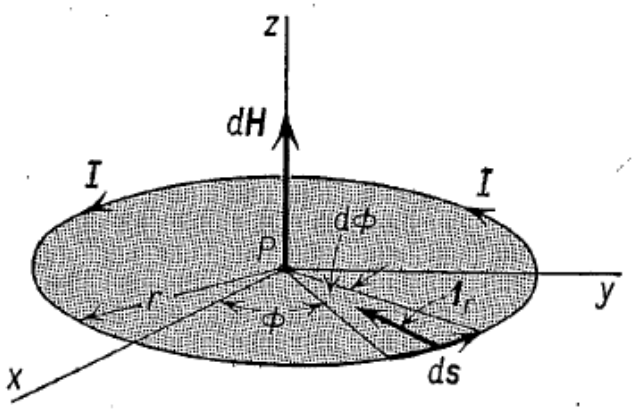



Fig. 30-8

(Ex. 1011, 562 (explaining the "direction of the magnetic field *d*H…is in the positive *z* direction when the current is in the counterclockwise direction, as shown the figure.") The magnetic intensity "at the center of a single circular loop of wire" like that shown is given by equation (30-3). (*Id.*, 563.) Similarly, "[i]n the event we have a coil of *N* turns of wire wound as a flat circular coil rather than a single circular loop, each turn of the coil contributes a magnetic field at the center of the coil" where "the total magnetic field is *N* times that given by Equation (30-3)" given "these field contributions are all in the same direction," and thus "has at its center a magnetic field H" given by equation (30-4) (shown below). (*Id.*, 564.)

$$\mathbf{H} = \frac{NI}{2r}\mathbf{1}_z. \qquad (30\text{-}4)$$

(*Id.*, 564; *see also id.*, 592 (magnetic flux ϕ being total number of lines pass perpendicularly through an element of area).) Accordingly, a person of ordinary skill in the art would have understood that the primary planar coil(s) in the modified *Okada* system above would have **generated a magnetic field in a direction substantially perpendicular** to the primary coil(s) and system surface, like that claimed.

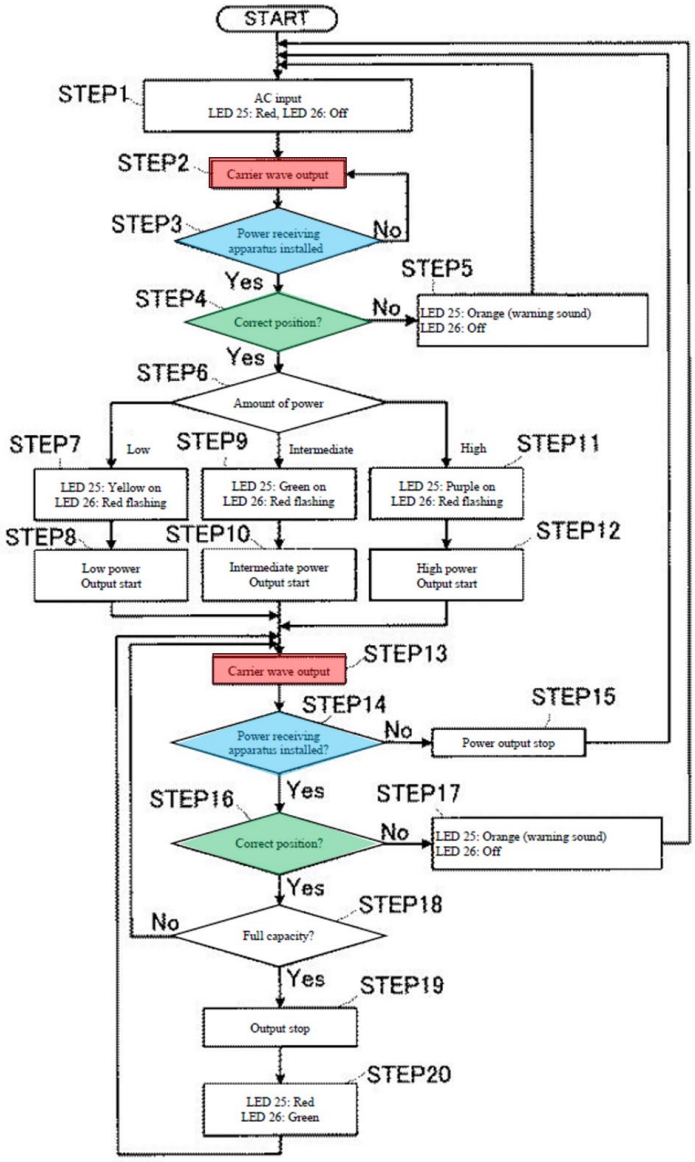
**(3) 1(c)(3): … to provide power to the one or more portable devices capable of being powered or charged by the system when present and near the one or more primary coils;**

169. In my opinion, *Okada* in view of *Odendaal* and *Berghegger* discloses and/or suggests this limitation. (*See* my analysis and discussions below in this section; *see also* my analysis and discussions in Sections IX.A.1(a)-(c)(2); *see also* my analysis and discussions in Sections VIII.A-C.)

170. In my opinion, a person of ordinary skill in the art would have understood that *Okada* discloses detecting the **presence, proximity, and alignment** of a mobile device **capable** of being powered/charged by the system to primary coil

19 before providing power to the device like that claimed in limitation 1(c)(3). (*See* my analysis and discussions above in Sections IX.A.1(a)-1(c)(2); Ex. 1005, ¶¶0056-0058.)

171. For example, PTM10 receives "a code indicating that a device is capable of receiving power" from PRM40 that is used by circuit 36 to "evaluate whether supplying power to the device via the common cradle 4 is **feasible**." (Ex. 1005, ¶0057; *id.*, FIG. 3 (annotated below), ¶¶0059-0064 (circuit 36 determines whether portable device is mounted) (e.g., whether a "**capable**" device is "**present**" over "**the one or more primary coils**"), 0065-0068 (determining whether secondary-side/receiver coil 41 is "arranged at positions having high power transmission efficiency" based on positional offset, i.e., alignment, with primary coil(s)—*see, e.g.*, FIGS. 4(a)-(b) describing detection of "[a]mount of misalignment") ("**near**" primary coils), ¶¶0069, 0073-0076 (provide appropriate power to present and properly positioned/aligned device (FIG. 3, Steps 6-12) and continue to check after onset of power/charge operations (FIG. 3, Steps 13-20)), 0090.)




(Ex. 1005, FIG. 3 (annotated).)

172. In my opinion, a person of ordinary skill in the art would have been motivated to configure the above-discussed *Okada-Odendaal-Berghegger* system to include/implement similar features. (*See* my analysis and discussions above in this

section and in Sections IX.A.1(a)-(c)(2).) Therefore, in my opinion, a person of ordinary skill in the art would have understood that the above-discussed drive circuit(s) in the modified system, when operated as I discussed for limitation 1(c)(2), would have provided power to "**capable**" portable device(s) (that are "**capable of being powered or charged by the system**") "**when present and near the one or more primary coils**." (*Id.*; *see also* my analysis and discussions above in this section; *see also* my analysis and discussions in Sections V, VIII.A-C, IX.A.1(a)-(c)(2), IX.A.1(d)-(l).)

> **d) one or more sense circuits to monitor the current through the one or more primary coils to sense communications from the one or more receiver coils; and**

173. In my opinion, *Okada* in view of *Odendaal* and *Berghegger* discloses and/or suggests this limitation. (*See* my analysis and discussions below in this section; *see also* my analysis and discussions in Sections IX.A.1(a)-(c), IX.A.1(e)-(l); *see also* my analysis and discussions in Sections VIII.A-C.)

174. As I discussed below, limitation 1(g) recites "**sens[ing]** [a response from the receiver circuit(s)] **via the one or more sense circuits as a modulation** of one or more primary coil currents." (*See* my analysis and discussions in Section IX.A.1(g).) A person of ordinary skill in the art would have recognized that PTM10

in *Okada*'s system transmits a carrier wave signal to PRM40, resulting in PDA 3 to generate and send a modulated signal including device information back to PTM10 via magnetically coupled secondary-side coil 41 and primary-side coil(s) 19. Demodulating circuit 35 "demodulates modulated signals included with the voltage from" primary coil 19 (Ex. 1005, ¶0042), and the information is evaluated by power transmission capability evaluating circuit 36, power amount evaluating circuit 37, full capacity evaluating circuit 38 as part of power transfer operations. (Ex. 1005, FIG. 3, ¶¶0060-0077; *see also* my analysis and discussions in Sections IX.A.1(a)-1(c)(3).) For example, *Okada* explains:

> A carrier wave output from the carrier wave oscillating circuit 33 is applied to the tap c of the primary-side coil 19, which, when the PDA 3 is mounted on the common cradle 4, is transmitted to the magnetically coupled secondary-side coil 41. This carrier wave transmitted to the secondary-side coil 41 is rectified, smoothed, and converted to a DC voltage via the smoothing capacitor 42, the rectifying circuit 43, and the smoothing circuit 44 as described above. Furthermore, the power-on reset circuit 48 detects the DC voltage converted from this carrier wave and recognizes that the carrier wave has been transmitted. Furthermore, the clock extracting circuit 46 connected to

the secondary-side coil 41 extracts a clock signal necessary for ***modulation from the carrier wave***, and a ***modulating circuit 47 applies to the secondary-side coil 41 a modulated wave in which the carrier wave is modulated based on information on the PDA 3: such as "the code indicating that a device is capable of receiving power," "power consumption information," and "full capacity information."*** . . .

***The modulated wave provided to the secondary-side coil 41 from the modulating circuit 47 is transmitted to the magnetically coupled primary-side coil 19.***

Furthermore**,** ***a demodulating circuit 35 connected to the tap c of the primary-side coil 19 receives and demodulates the transmitted modulated wave, and provides the "code indicating that a device is capable of receiving power," "power consumption information," and "full capacity information" included in the demodulated information signal*** to the power transmission capability evaluating circuit 36, the power amount evaluating circuit 37, and full capacity evaluating circuit 38. . . .

(Ex. 1005, ¶¶0063-0064.) Thus, in my opinion, demodulating circuit 35 is an example of "**one or more sense circuits**" given it receives and demodulates (e.g., "**monitor[s] the current through the one or more primary coils to sense**") a modulated response signal containing device information (e.g., "code indicating that a device is capable of receiving power," "power consumption information," "full capacity information") ("**communication**") from PRM40's secondary-side coil 41 ("**one or more receiver coils**") received via primary-side coil 19 ("**one or more primary coils**"). (*Id.*; Ex. 1005, FIG. 2, ¶¶0050, 0064, 0069, 0076; *see also* my analysis and discussions in Sections VIII.A, IX.A.1(a).)

175. *Okada* explains that the above-discussed modulation method may be based on "periodic intensity modulation of a carrier wave and may use a phase modulation method to express 0/1 information via phase change information of a signal." (Ex. 1005, ¶0058.) However, to the extent such sense circuit and current monitoring features like that claimed is not disclosed, it is my opinion that a person of ordinary skill in the art would have been motivated to modify/use demodulating circuit 35 or the charging/power system to include sense circuit(s) and current modulation/demodulation-type techniques/technologies such that the sense circuitry monitors/detects the current of the waveform through the primary coil(s) to

sense/detect communications from the receiver coil(s), which can be detected as current modulation in the primary coil(s) for subsequent demodulation and use consistent with the power/charge operations described by *Okada*.

176. In my opinion, a person of ordinary skill in the art would have understood that modulating/demodulating a waveform (as described in *Okada*) and sensing communications based on an inherent property of the waveform (e.g., current) in order to detect/sense/process information contained in the waveform was a known and predictable technique, approach, and/or solution used in, e.g., contactless/inductive power/data transfer systems to transfer, communicate, and/or process information/data relevant for such power transfer operations. In light of the teachings of *Okada* in context of a person of ordinary skill in the art's state-of-art knowledge, it is my opinion that such a skilled person would have been motivated to configure the modified *Okada* system (as I discussed above) to provide current modulation/demodulation-type techniques/technologies, including use of current sense circuitry/circuit(s), to facilitate (and sense) the communication of information from the secondary side in the modified *Okada* system, consistent with that known in the art by such a person.

177. For example, state-of-the art references to *Delatorre* (Ex. 1056), *Cunningham* (Ex. 1057), and *Due-Hansen* (Ex. 1058) describe use of current modulation/demodulation at receiver and primary side devices/circuits for communicating data in inductively coupled systems, and sensing such communications.[16] (*See e.g.*, Ex. 1056, Abstract ("Data from the instrument is translated by current modulation (60) which is demodulated at the one location (50, 64, 66, 68, 70)"), 2:7-9, 2:38-44 ("Data transmission is effected by a well tool current modulation means which modules the power current as function of the data being transmitted by the well tool in response to the address signal. At the surface location, a current demodulation transforms the current signals into digital signals representative of the well tool signals"), 4:21-34 ("current modulation means 60"), 5:12-14, 6:12-33; Ex. 1057, 9:20-24, 15:16-21 ("Each power supply can be provided with a signal transceiver 14A employing a standardized format and protocol to send

[16] I cite Exs. 1056-1058 to support my opinions as to a person of ordinary skill in the art's state of the art knowledge at the time of the alleged invention, which is consistent with how such a person would have understood *Okada*, *Odendaal*, and *Berghegger*'s teachings.

data along the inductive loop in a compatible way, such as by modulating the 20 kHz current in the loop (See Figs. 12 and 13). This will also be transferred inductively across the gap to reach the ferrite-cored pickups at the receivers"), 21:21-22:3 ("the circulating resonant current is halted or quenched (1303) in a relatively complete manner" and the set period "becomes the data bit time 1304 and the length of the data bit (short or long) comprises one binary bit of transmitted information. More preferably, the presence of a quenched period can be considered as a binary '1' and the absence of a quenched period as a '0'"), FIGS. 1-3, 11-13; Ex. 1058, Abstract, FIGS. 1, 3A-8, 3:25-4:35, 5:27-7:23, 10:22-24 ("the pressure data signal transmission will be implemented by a current modulation" which is "explained more fully by means for figures 3 and 4"), 10:25-12:17.)[17] In my opinion, in light

[17] The '500 patent also describes conventional technologies that used current modulation for communications, which is consistent with my opinion that a person of ordinary skill in the art would have been aware of, and capable of implementing with a reasonable expectation of success, such features in the modified *Okada* system. (Ex. 1001, 23:38-45 (describing technologies, such as those found in the ATMEL e5530 or "other inexpensive microcontroller[s]" that "modulates the

of such knowledge, coupled with the teachings of *Okada* (*see* above), a person of ordinary skill in the art would have been motivated to configure the above-discussed modified *Okada* system such that the powering/charging system includes sense circuit(s) and current modulation/demodulation-type techniques such that the sense circuit(s) monitor current through the primary coil(s) to sense the responsive communication from the receiver coil(s), consistent with the operations of *Okada* as modified herein.

178. Therefore, in my opinion, a person of ordinary skill in the art would have been motivated to configure *Okada*'s modified system such that the "inductive powering or charging" system (*see* Section IX.A.1(a)) would include/implement one or more sense circuits to monitor the current through the one or more primary coils to sense communications from the one or more receiver coils in the mobile device, via current modulation/demodulation-type techniques/technologies in light of *Okada*'s teachings/suggestions in context of such a person's state of art knowledge. (*See* my analysis and discussions above and below in this section.) For example,

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current in the secondary that can be detected as current modulation in the primary"); Ex. 1063 (ATMEL e5530 Datasheet).)

*Okada* discloses verifying PDA 3's presence by measuring intensity of the signal(s) communicated via primary coil(s) 19 and secondary coil 41. (Ex. 1005, FIGS. 4(a)-4(b), ¶¶0066 ("transmission efficiency of power and the information signal"), 0067-0068, 0074-0076, FIG. 8 (current sensor 91), ¶¶0110 ("**current measuring sensor**" measuring current "through the primary-side coil 19" when PDA 3 "is in proximity" of cradle 4), 0111.) Thus, for reasons I explained, in my opinion, a person of ordinary skill in the art would have been motivated to configure/implement such current sensing and modulation/demodulation features in the *Okada-Odendaal-Berghegger* system for detecting communications of the information signal (e.g., device information such as "code indicating that a device is capable of receiving power," etc.) from secondary/receiver coil 41 when received via primary coil 19, so that it is timely/properly recognized, demodulated, and used, e.g., to verify that PDA 3 is "placed in a correct position" and "capable of data transmission and reception," etc. (*Id.*, ¶0080, FIGS. 3, 8, 4(a)-4(b), ¶¶0081-0082.) In my opinion, a person of ordinary skill in the art would have been motivated to implement such a modification in light of *Okada*'s teachings, e.g., using signal intensity and sensed current in primary coil 19 for determining/verifying PDA 3 presence/positioning, and the stte-of-art knowledge relating to current modulation/demodulation

techniques/technologies, as I explained above. (*Id.*; *see also* my analysis, discussions, and citations above in this section; *see also* my analysis and discussions in Sections VIII.A, IX.A.1(a), (c)(3).) In my opinion, such a skilled person would have considered various ways of configuring the modification, such as configuring the "sense circuit(s)" associated with current sensor 91, demodulation circuit 35, and/or other components to allow PTM10 to monitor the current through primary coil(s) 19 to sense communications from PRM40's secondary/receiver coil 41, and demodulate the current-modulated information signals, consistent with known current modulation/demodulation techniques. (*Id.*; *see also* my analysis, discussions, and citations above in this section; *see also* my analysis and discussions in Sections VIII.A, IX.A.1(a), (c)(3), IX.A.1(g).)

179. In my opinion, a person of ordinary skill in the art would have had the requisite skills, knowledge and capabilities to design/implement such "**sensor circuit(s) . . .**" and related current modulation/demodulation-type features in the *Okada-Odendaal-Berghegger* system, and would have done so with a reasonable expectation of success given the teachings of *Okada* and the knowledge of such a skilled person at the time (*see* my analysis and discussions above in this section; *see also* my analysis and discussions in Sections VIII.A, IX.A.1(a), (c)(3))—e.g.,

especially since implementing such features/modification would have involved applying known technologies/techniques (as described by *Okada* and state of the art) that would have led a skilled person to provide an inductive/contactless power/data transfer system that senses communications (e.g., device information relevant for and used by *Okada-Odendaal-Berghegger*'s inductive power transfer operations) from secondary/receiver coil 41 of PRM40 are received by primary coil(s) 19 of PTM10 in the *Okada-Odendaal-Berghegger* system. (*See* my analysis and discussions above in this section; *see also* my analysis and discussions in Sections VIII.A, IX.A.1(a), (c)(3), IX.A.1(e)-(l); *see also* my analysis and discussions in Sections IX.A.1(b)-(c).)

**e) one or more communication and control circuits including one or more microcontrollers coupled to the one or more drive circuits and the one or more sense circuits that detect communications through the one or more sense circuits via the one or more primary coils and control the one or more drive circuits to control the powering or charging of the one or more compatible portable devices;**

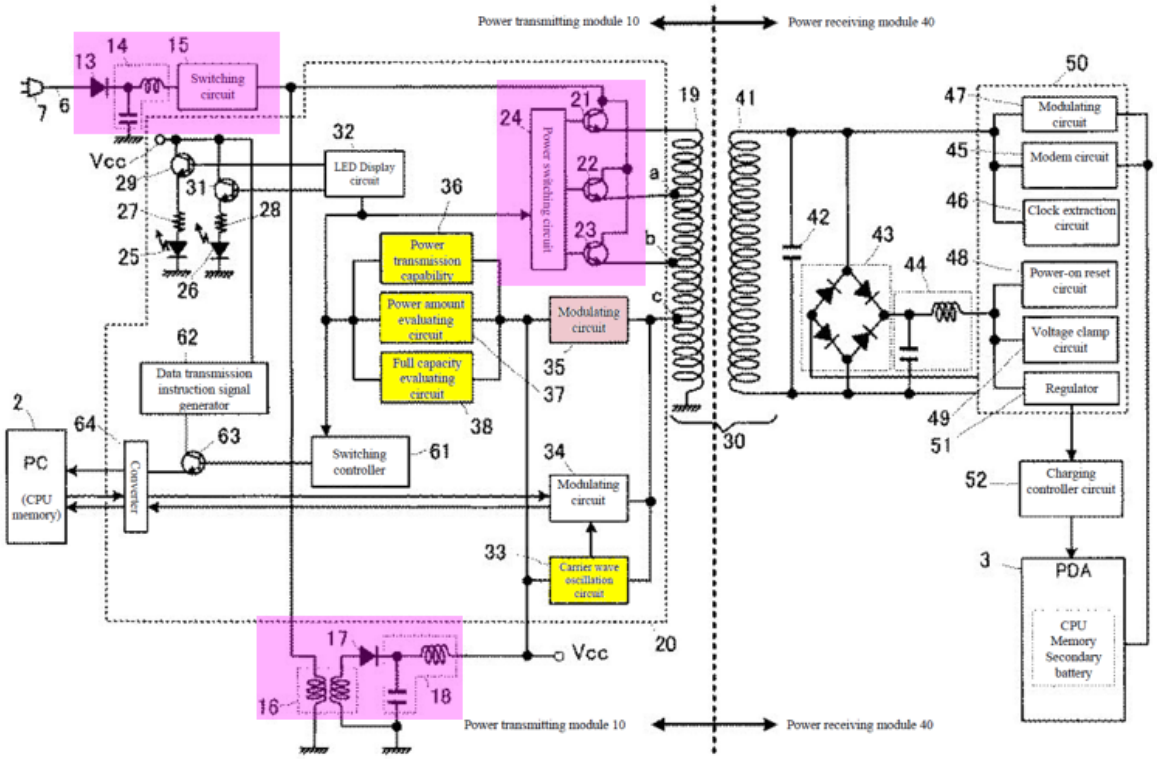
180. In my opinion, *Okada* in view of *Odendaal* and *Berghegger* discloses and/or suggests this limitation. (*See* my analysis and discussions below in this section; *see also* my analysis and discussions in Sections IX.A.1(a)-(d), IX.A.1(f)-(l); *see also* my analysis and discussions in Sections VIII.A-C.)

181. For example, as I explained above, carrier wave oscillating circuit 33 provides a carrier wave to PRM40 that causes responsive device information from modulating circuit 47 of PRM40 via coils 41 and 19 to be received/processed by demodulator 35. (*See* my analysis and discussions in Sections IX.A.1(c)-(d); Ex. 1005, ¶¶0056-0057, 0062-0064.) PTM10's evaluation circuits 36-38 (power transmission capability evaluating circuit 36, power amount evaluating circuit 37, full capacity evaluating circuit 38) "perform various decision-making processes based on information included in the signal demodulated by the demodulating circuit 35." (Ex. 1005, FIG. 2, ¶0042, FIG. 3, ¶¶0060-0077.) *Okada* explains that the circuits 36-38 control power transmission processes in accordance with FIG. 3 by providing signals to power switching circuit 24 that controls/selects switches 21/22/23 (part of the "**drive circuit[]**"). (Ex. 1005, FIG. 3, ¶¶0057-0076; *see also* my analysis and discussions in Sections IX.A.1(a)-(c).) *Okada* also explains that the circuits 36-38 also provide a signal to switching control unit 61 (Ex. 1005, ¶0045) that determines whether "data can be **transmitted and received**" (*id.*, ¶0081, ¶¶0082-0085) and determines whether PDA 3's charge capacity exceeds a "minimum capacity" for it to transmit/receive data (*id.*, ¶¶0082-0089, FIG. 6). The

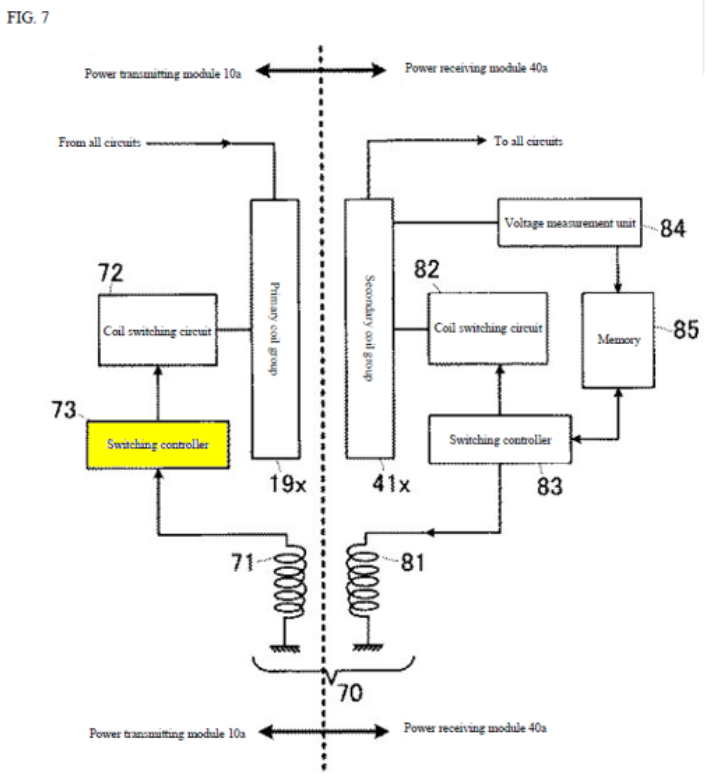
circuits 36-38 additionally control LEDs 25-26 that communicate charging status to a user. (*Id.*, ¶¶0041, 0053-0055, 0061, 0069-0072, 0077, FIG. 5.)

182. Thus, in my opinion, a person of ordinary skill in the art would have understood that one or more circuits 36/37/38 and oscillation circuit 33 collectively disclose one example of "**one or more communication and control circuits** [yellow below] . . . **coupled to the one or more drive circuits** [e.g., Section IX.A.1(c)(1)] **and the one or more sense circuits** [Section IX.A.1(d), pink below]" that "**detect communications through the one or more sense circuits** [magenta] **via the one or more primary coils** [e.g., Section IX.A.1(d)]" and "**control the one or more drive circuits** [e.g., Section IX.A.1(c)(1)] **to control the powering or charging of the one or more compatible portable devices** [e.g., Sections IX.A.1(a)-(d)]" as claimed. (*See* my analysis and discussions above and below in this section; *see also* my analysis and discussions in Sections IX.A.1(a)-(d); Ex. 1005, FIG. 2 (annotated below).) In my opinion, a person of ordinary skill in the art would have understood that other components may also be included in such claimed "**communication and control circuit(s)** . . . ," e.g., switching controller 61, and/or "switching controller 73" in the multi-coil arrangement of FIG. 7 "system." (Ex.

1005, FIG. 7 (annotated below), ¶¶0094-0115; *see also* my analysis and discussions in Section IX.A.1(i).)




(Ex. 1005, FIG. 2 (annotated).)




(*Id.*, FIG. 7 (annotated).)

183. In my opinion, a person of ordinary skill in the art would have understood that such inter-relationships would have enabled the "**communication and control circuit(s)**" implemented in the modified *Okada-Odendaal-Berghegger* system to "**detect communications through the one or more sense circuits via the one or more primary coils**" and "**control the one or more drive circuits to control**" the powering/charging of compatible portable devices such as PDA 3, like that claimed and explained above. (*See* my analysis and discussions above and below in this section; *see also* my analysis and discussions in Sections IX.A.1(c)(1),

(d).) In my opinion, such a skilled person would have been motivated to configure the above-identified "**communication and control circuits**" in the *Okada-Odendaal-Berghegger* system to convert the power demand information received from demodulator 35 into a control signal for controlling the operating frequency of the modified "**drive circuit(s)**" (*see, e.g.*, Section IX.A.1(c)(1)) to adjust power delivery during charging/powering operations, as I explained. (*See* my analysis and discussions above and below in this section; *see also* my analysis and discussions in Section IX.A.1(c).)

184. In my opinion, a person of ordinary skill in the art would have understood, based on *Okada*'s disclosures, that carrier wave oscillating circuit 33 and the circuits 36-38 may be "configured on the same **IC chip**," e.g., "power transmission control **IC** 20," which includes other components such as "controller" 61, 73. (Ex. 1005, ¶¶0046, 0081-0084, FIGS. 2, 7.) In my opinion, a person of ordinary skill in the art would have understood such circuitry as compact integrated circuitry designed to perform certain operations in PTM10, which is consistent with a "**microcontroller**" as understood by such a skilled person in context of the '500 patent. (Ex. 1001, 23:28-43, 38:29-34 (exemplifying an "IC" or "chip" as a "microcontroller").) In my opinion, a person of ordinary skill in the art would have

understood the same where "switching controller 73" is part of such "**communication and control circuit(s)**" because it sends "instructions" to control the switching to select specific primary coils. (Ex. 1005, ¶¶0095, 0101; *see also* my analysis and discussions in Section IX.A.1(i).)

185. I have been asked to consider the scenario where the claimed "**microcontroller**" requires a processor or the like. Under that scenario, it is my opinion that a person of ordinary skill in the art would have been motivated to configure PTM10 in the *Okada-Odendaal-Berghegger* system to include such feature(s)/component(s) because it would have been a foreseeable and straightforward application of known technologies/techniques to use in PTM10, which uses integrated circuit(s) to perform "control[ler]"-type operations. (*See* my analysis and discussions above in this section; Ex. 1006, 5:65-6:59, FIGS. 4-5 (controller 40); Ex. 1024, 6:60-7:14 (inductive power source including "microprocessor controller 308" for controlling modes of power supply operation),

FIG. 3.)[18] In my opinion, a person of ordinary skill in the art would have appreciated that implementing well-known processor-based microcontroller technology with PTM10 would have been a foreseeable variation to how the module can perform similar functionalities, while providing known programmable functionalities. (*Id.*) In my opinion, a person of ordinary skill in the art would have had the skills, knowledge, and rationale to implement such a modification, and given the known technologies/techniques and *Okada*'s teachings, would have done so with a reasonable expectation of success that the resulting system would operate as intended consistent with *Okada-Odendaal-Berghegger*'s teachings. (*Id.*; *see also* my analysis and discussions in Sections VIII.A-C, IX.A.1(a)-(d), IX.A.1(f)-(l).)

[18] I cite Ex. 1024 to reflect the state of the art known to a person of ordinary skill in the art at the time of the alleged invention, which is consistent with how such a person would have understood *Okada*, *Odendaal*, and *Berghegger*'s teachings.

**f) wherein the one or more communication and control circuits: operate the one or more drive circuits near a first resonant frequency of a circuit formed by a primary coil and a drive circuit and a receiver coil and a receiver circuit of a compatible portable device when nearby;**

186. In my opinion, *Okada* in view of *Odendaal* and *Berghegger* discloses and/or suggests this limitation. (*See* my analysis and discussions below in this section; *see also* my analysis and discussions in Sections IX.A.1(a)-(e), IX.A.1(g)-(l); *see also* my analysis and discussions in Sections VIII.A-C.)

187. For example, as I explained above for limitation 1(b), *Okada* discloses a secondary/receiver coil 41 ("**receiver coil**") and "**receiver circuit[s]**." (*See* my analysis and discussions in Section IX.A.1(b).) Also, as I explained above for limitations 1(c) and 1(e), the above-discussed "**communication and control circuit(s)**" in the *Okada-Odendaal-Berghegger* system would have "**operate[d] the one or more drive circuit(s)**" by e.g., providing control signals to power switching circuit 24 for selecting one of switches 21/22/23 at the **onset** of a charging process, and/or by providing control signal(s) based on received/demodulated device power demand information to control the operation frequency of the "**drive circuit(s)**" (e.g., reconfigured switching circuit 15, etc.) **during** the charging process in the modified system. (*See* my analysis and discussions in Sections IX.A.1(c)-(e).) In

my opinion, for similar reasons, and in view of *Berghegger*'s teachings, a person of ordinary skill in the art would have been motivated to configure the "**communication and control circuit(s)**" to operate the drive circuit(s) "**near a first resonant frequency**" of a circuit formed by primary coil 19 and the drive circuit components, and receiver coil 41 and the identified "**receiver circuit**" of a compatible portable device such as PDA 3, like that claimed. (*Id.*; *see also* my analysis and discussions below in this section.)

188. *Berghegger* explains that when a load is placed on the secondary side (e.g., PDA 3 placed on cradle 4), "the oscillation frequency [of drive circuit 40] **approaches the resonant frequency**, whereby the transmitted power increases." (Ex. 1006, 4:32-40.) In my opinion, a person of ordinary skill in the art would have understood that such "resonant frequency" is that of a circuit formed by primary-side components (including primary coil and drive circuitry (including resonant capacitor)) and secondary-side components (including secondary/receiver coil and receiver circuitry). (*Id.*; *see also* my analysis and discussions in Sections VIII.A, VIII.C, IX.A.1(c)-(e).) *Berghegger* explains that **when there is no load** to the secondary side, the resonance frequency is that of a circuit "formed by the inductor $L_P$ on the primary side and the resonant capacitor $C_P$." (Ex. 1006, 4:27-32.)

*Berghegger* also explains that **when a load exists on the secondary side**, the resonant frequency factors into the impedance of the components on the secondary side. (*Id.*, 4:32-35 ("A load on the coil on the secondary side results in a change in impedance of the coil $L_S$ on the secondary side and thus in an off-resonance setting of the resonant circuit towards higher frequencies.").) In my opinion, a person of ordinary skill in the art would have understood the above-discussed modified *Okada* system (*see* Sections IX.A.1(b)-(e)) would have included similar features/functionalities (e.g., frequency adjustment to drive circuits for adjusting power delivery based on power demand information) and thus predictably resulted in the "**communication and control circuit(s)**" being configured to operate the "**drive circuit(s)**" of the *Okada-Odendaal-Berghegger* system (*see* Section IX.A.1(c)) "**near a first resonant frequency . . .**" like that claimed. (*See* my analysis and discussions regarding *Okada* and *Berghegger* in this section; *see also* my analysis and discussions in Sections VIII.A, VIII.C, IX.A.1(c)-(e).) In my opinion, a person of ordinary skill in the art would have had the same rationale, skills, knowledge, and expectation of success as I explained above for limitations 1(c) and 1(e) to configure the "**communication and control circuit(s)**" as discussed above. (*Id.*; *see also* my analysis and discussions in Sections IX.A.1(c), 1(e).)

189. Moreover, as I discussed above for limitation 1(c)(3), *Okada* discloses that power is delivered only when a "compatible" portable device is present and properly placed/proximate/aligned to cradle 4 and its primary coil 19. (*See* my analysis and discussions in Section IX.A.1(c)(3).) For similar reasons, in my opinion, a person of ordinary skill in the art would have understood that the "**communication and control circuit(s)**" in the above-discussed *Okada-Odendaal-Berghegger* system would have operated the "**drive circuit(s)**" when a compatible portable device is "**nearby**," as claimed. (*Id.*; *see also* my analysis and discussions in Sections VIII.A-C, IX.A.1(a)-(e), IX.A.1(g)-(l).)

> **g) switch the one or more primary coils at a frequency and power level sufficient to transfer power to one or more of the receiver units when near the one or more primary coils for a sufficiently long period of time to activate the one or more receiver circuits and to receive a response from the one or more receiver circuits via the one or more receiver coils which the one or more primary coils sense via the one or more sense circuits as a modulation of one or more primary coil currents;**

190. In my opinion, *Okada* in view of *Odendaal* and *Berghegger* discloses and/or suggests this limitation. (*See* my analysis and discussions below in this section; *see also* my analysis and discussions in Sections IX.A.1(a)-(f), IX.A.1(h)-(l); *see also* my analysis and discussions in Sections VIII.A-C.)

191. For example, as I explained above, the *Okada-Odendaal-Berghegger* system discloses/suggests that "**the one or more communication and control circuits**" (e.g., circuits 36-38) "**operate the one or more drive circuits near a first resonant frequency of a circuit . . . when nearby**." (*See* my analysis and discussions in Sections IX.A.1(e)-(f); *see also* my analysis and discussions in Section IX.A.1(c)(1).) Also, as I explained above, *Berghegger* teaches using a control signal ($U_C$) provided to a drive circuit to adjust the switching frequency of switches (S1-S2) that drive a primary coil based on device power demand to ensure "a sufficient amount of electrical power is always available on the secondary side." (*See* my analysis and discussions in Section IX.A.1(c)(1); Ex. 1006, 2:28-34, 3:51-6:37, FIGS. 1(b), 2, 4.)

192. In my opinion, for reasons similar to that I explained above, a person of ordinary skill in the art would have understood that the *Okada-Odendaal-Berghegger* system would have been configured to provide a control signal to the modified switching circuitry 15 (part of the "**drive circuit(s)**") (*see, e.g.*, Section IX.A.1(c)(1)) to adjust the switching frequency of FET switches, as modified and similar to that disclosed in *Berghegger* (e.g., switches S1/S2), to drive primary coil(s) 19 (at the switched frequency and power level) based on received PDA 3

power demand information (e.g., part of the information sent by PRM40 as discussed by *Okada* (e.g., "power consumption information")) to ensure sufficient power is provided to PDA 3 (and its "**receiver units**" (Section IX.A.1(b)) as its load changes during power/charge operations, when present and properly positioned with cradle 4 and its primary coil(s). (*See* my analysis and discussions in Sections IX.A.1(c)(1), IX.A.1(e); *see also* my analysis and discussions in Sections IX.A.1(a)-(b), (c)(2)-(c)(3), (d), (f).) Thus, in my opinion, a person of ordinary skill in the art would have understood that the above-discussed *Okada-Odendaal-Berghegger* combination discloses and/or suggests "**the one or more communication and control circuits**" "**switch[ing] the one or more primary coils at a frequency and power level sufficient to transfer power to one or more of the receiver units when near the one or more primary coils**." (*Id.*)

193. In addition, *Okada* explains that the switching signal from switching circuit 15 is converted to a DC signal, $V_{CC}$, to power components in PTM10, including carrier wave oscillating circuit 33, which generates "a prescribed carrier wave at a certain interval" that is sent to PRM40. (Ex. 1005, ¶¶0039, 0056-0057; *see also* my analysis and discussions in Sections IX.A.1(a)-(c).) *Okada* also explains that a DC signal "generated by a carrier wave provided by the carrier wave

oscillating circuit 33 can be **used as a driving power source for the clock extracting circuit 46 and the modulating circuit 47**" in the "**receiver circuit(s)**" of PRM40. (Ex. 1005, ¶0058.) As I explained, even during power transmission, the carrier wave is periodically transmitted to PRM40, and based on the device information transmitted back from PRM40 in response to the carrier wave, PTM10 determines whether PDA 3 remains present and/or properly positioned. (Ex. 1005, FIG. 3, ¶¶0074-0075; *see also* my analysis and discussions in Section IX.A.1(c)(3).) Only when present and properly positioned does PDA 3 receive power until, e.g., fully charged, which is determined using the "periodically transmitted" carrier wave. (Ex. 1005, FIG. 3, ¶¶0074, 0076; *see also* my analysis and discussions in Section IX.A.1(c)(3).) For example, *Okada* explains:

> **Even after power transmission has begun, a carrier wave is periodically transmitted (STEP 13), and first, based on information included in a modulated wave returned in response to this carrier wave, it is verified whether the PDA 3 has been removed from the common cradle 4 (STEP 14).** As in STEP 3, for this verification, the power transmission capability evaluating circuit 36 **determines whether a device capable of receiving power is mounted onto the common cradle 4**

**based on the "code indicating that a device is capable of receiving power." Furthermore, if no prescribed "code indicating that a device is capable of receiving power" is received (STEP 14: No), it is determined that the device capable of receiving power has been removed from off of the common cradle 4, the power switching circuit 24 controls all of the transistors including the transistor 21, the transistor 22, and the transistor 23 into an OFF state and stops power transmission (STEP 15).**

Meanwhile, **if a prescribed "code indicating that a device is capable of receiving power" is received (STEP 14: Yes), it is recognized that a device capable of receiving power is mounted on the common cradle 4. Next it is determined whether the device capable of receiving power is correctly mounted onto the common cradle 4 (STEP 16). As in STEP 4, this determination is conducted by evaluating whether an amount of positional offset of the common cradle 4 and the PDA 3 exceeds a prescribed amount of offset. Furthermore, if this amount of offset exceeds the prescribed amount of offset (STEP 16: No), no power is transmitted from the common cradle 4**, the light emitting diode 25 is turned

ON orange and the light emitting diode 26 is turned OFF as a warning display similar to STEP 5 (STEP 17). A warning sound may also be generated at this time.

Meanwhile, **when the amount of positional offset of the common cradle 4 and the PDA 3 does not exceed the prescribed amount of offset, processing proceeds to evaluating whether a charged state of the PDA 3 is at full capacity (STEP 18).** This evaluation process is conducted by the full capacity evaluating circuit 38 evaluating whether the PDA 3 is at full capacity **based on "full capacity information" included in the information signal demodulated by the demodulating circuit 35.** Furthermore, if at full capacity (STEP 18: Yes), the power switching circuit 24 controls all of the transistors including the transistor 21, the transistor 22, and the transistor 23 into an OFF state, ends power output (STEP 19), meaning that the power transmission is stopped because the power receiving apparatus is a full capacity state, turns ON the light emitting diode 25 red, turns ON the light emitting diode 26 green (STEP 20), and **continues to confirm the state of the power receiving apparatus by outputting carrier waves (STEP 13)**. On the other hand, if not at full capacity (STEP 18: No), **the**

> **state of the power receiving apparatus continues to be verified while power is transmitted** (STEP 13). As described above, power is supplied from the common cradle 4 to the PDA 3.

(Ex. 1005, ¶¶0074-0076; *see also id.*, FIG. 3.) In my opinion, a person of ordinary skill in the art would have thus understood that PDA 3 has to be present and properly placed near primary coil 19 for at least a sufficient period of time to allow the periodic carrier wave and responsive device information to be communicated/received/processed, etc. in order to facilitate the powering/charging of the device. (*Id.*)

194. In my opinion, a person of ordinary skill in the art would have been motivated to modify the above-discussed *Okada-Odendaal-Berghegger* system to have similar features, where the above-discussed carrier wave and device information (modulated wave) communications, and resulting switching of primary coil(s) 19 at a frequency and sufficient power level transferred to PRM40's receiver unit would have been performed at "**a sufficiently long period of time to activate the one or more receiver circuits**" and to receive responsive device information from modulating circuit 47 of PRM40 via coil secondary/receiver 41 ("**to receive a response from the one or more receiver circuits via the one or more receiver**

**coils**"). (*See* my analysis and discussions in Sections IX.A.1(b)-(e); Ex. 1005, ¶¶0056-0057, 0062-0064, 0074-0075, FIGS. 2-3.) Moreover, my discussions and analysis above for limitation1(d) explains how and why a person of ordinary skill in the art would have been motivated to configure the modified system to use known current modulation/demodulation-type techniques/technologies and sense circuit(s) designs, such that sense circuit(s) would sense communications (e.g., device information signal(s)) on coil 19 from PRM40, thus resulting in the "primary coil(s)" sensing the "response" from the receiver circuits/coils via "sense circuit(s)" as a modulation of current in the primary coil(s), like that recited in limitation 1(g). (*See* my discussions above in Section IX.A.1(d); Exs. 1056-1058, 1063.)

195. Thus, for the above reasons, and those I discussed in Section IX.A.1(d), the modified *Okada-Odendaal-Berghegger* system discloses/suggests the primary coil(s) 19 in the system "**receive a response**" (device information) "**from the one or more receiver circuits via the one or more receiver coils**" (e.g., circuits/coil(s) in PDA3/PRM40) "**which the one or more primary coils sense via the one or more sense circuits as a modulation of one or more primary coil currents**" (e.g., demodulating the current modulated device information signal(s) received/sensed by primary coil(s) 19 for subsequent use by the circuit(s) in PTM10). (*See* my analysis

and discussions in Sections IX.A.1(b)-(e); Ex. 1005, ¶¶0039, 0056-0058, 0062-0064, 0074-0075, FIGS. 2-3; *see also* my analysis and discussions in Sections VIII.A-C, IX.A.1(a), (f), (h)-(l).)

> **h) detect, through the one or more sense circuits, communications from the one or more receiver units through the one or more receiver coils including information corresponding to one or more voltages at one or more outputs of the one or more receiver rectifier circuits induced by the one or more primary coils and the one or more receiver coils and information associated with the one or more portable devices and/or receiver units to enable the one or more communication and control circuits to identify the one or more portable devices and/or receiver units and to determine any one or more appropriate charging or powering algorithm profiles therefor;**

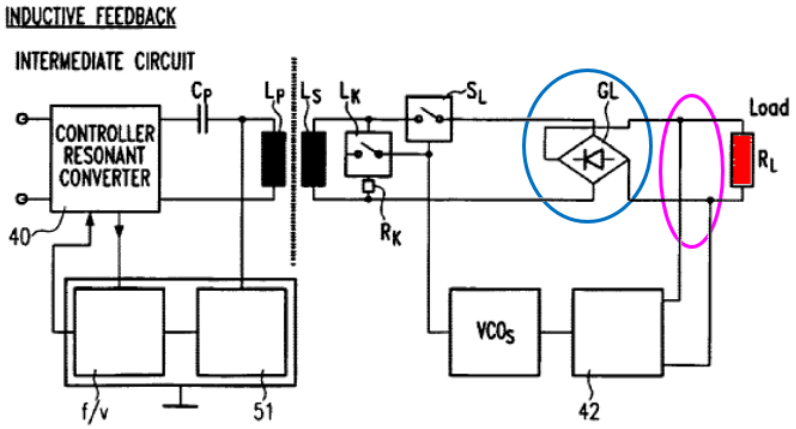
196. In my opinion, *Okada* in view of *Odendaal*, *Berghegger*, and *Black* discloses and/or suggests this limitation. (*See* my analysis and discussions below in this section; *see also* my analysis and discussions in Sections IX.A.1(a)-(g), IX.A.1(i)-(l); *see also* my analysis and discussions in Sections VIII.A-D.)

197. As I discussed for limitation 1(c), a person of ordinary skill in the art would have been motivated to configure the *Okada-Odendaal-Berghegger* system to implement closed-loop feedback controlled frequency switching power delivery based on device information to provide appropriate power to accommodate changes

in PDA 3's load during power/charging operations. (*See* my analysis and discussions in Section IX.A.1(c)(1).) For reasons I explained, a person of ordinary skill in the art would have understood that the *Okada-Odendaal-Berghegger* system would have "**detected, through . . . sense circuit(s), communications**" from the "**receiver unit**" through "**receiver coil**" 41 (Section IX.A.1(b)) that includes information corresponding to PDA 3 (e.g., device compatibility/capability, power level, and charge status information) ("**information associated with the one or more portable devices and/or receiver units**") used to facilitate power/charge operations, like that described by *Okada*. (*See* my analysis and discussions in Sections IX.A.1(d)-(g); *see also* my analysis and discussions in Sections IX.A.1(a)-(c); Ex. 1005, FIG. 3, ¶¶0056-0057, 0059-0077.) As I also explained above, and consistent with *Okada*'s operations, a person of ordinary skill in the art would have understood that "code indicating that a device is capable of receiving power" processed by PTM10 would have been used by ("**enable**[d]") circuit 36 in the "**communication and control circuit(s)**" of the *Okada-Odendaal-Berghegger* system (Section IX.A.1(e)) "**to identify**" PDA 3 (or its "**receiver unit**" (Section IX.A.1(b)) because circuit 36 uses such information to determine whether a portable device capable of receiving power (e.g., PDA 3) is present and properly positioned

with the charger (e.g., cradle 4) and its primary coil(s) to maintain or initiate power delivery. (*See* my analysis and discussions in Sections IX.A.1(c)-(g); Ex. 1005, ¶¶0064-0077, FIG. 3.)

198. As I also explained above, similar to *Okada*, *Berghegger* describes communicating power demand information associated with a receiving device load. (*See* my analysis and discussions in Section IX.A.1(c).) For example, *Berghegger* explains how power demand information at the load can be **measured as a voltage at the output of a receiver rectifier circuit**, which is induced by the signals communicated from the primary coil to the secondary coil. For example, a detection means 42 measures the voltage (**pink** below) rectified by rectifier GL (**blue** below) across the load $R_L$ or batteries (**red** below) that is fed back to the primary-side and used as a control signal $U_C$ to allow controller 40 to adjust the switching frequency of the primary coil via switches S1-S2 (FIG. 1(b)). (Ex. 1006, FIGS. 1(b), 2, 4-5, 5:65-6:37.) As shown in FIG. 5 (below), the "**signal about the power demand on the secondary side [may be] transmitted via the two inductors $L_P$ and $L_S$ to the primary side**," e.g., a voltage signal measured by detection means 42 at the output of rectifier GL or across the battery/load. (*Id.*, 6:16-20, 6:50-53; *see also* my analysis and discussions in Section IX.A.1(c)(1).)




(Ex. 1006, FIG. 5 (annotated).)

199. In my opinion, in light of such teachings, in addition to the reasons I explained above (*see* my analysis and discussions in Sections IX.A.1(c)-(g)), a person of ordinary skill in the art would have been motivated to configure the *Okada-Odendaal-Berghegger* system such that the information communicated from PRM40 to PTM10 includes information corresponding to a portable device such as PDA 3 (e.g., *Okada*'s device capability/compatibility, charge status) and power demand information reflecting the **voltage at the output of the rectifying circuit/rectifier** 43 (which provides the DC signal to charge/power PDA 3) (similar to that taught/suggested by *Berghegger*) to facilitate the power adjustment features I discussed above. (*See* my analysis and discussions in Sections IX.A.1(c)-(g).) In my opinion, a person of ordinary skill in the art would have had similar rationale,

skills, knowledge, and expectation of success as that I discussed above for the modifications involving *Berghegger*'s teachings. (*See* my analysis and discussions in Sections IX.A.1(c)-(g).) In my opinion, like above, configuring the *Okada-Odendaal-Berghegger* system (as I discussed above) would have involved the use of known technologies and techniques (e.g., voltage detection and measuring mechanism and inductive power/data transfer mechanism to adjust power delivery based on device power information), like those taught/suggested by *Okada* and *Berghegger*. (*See* my analysis and discussions above in this section; *see also* my analysis and discussions in Sections IX.A.1(c)-(g).)

200. Although *Okada* and *Berghegger* disclose communicating device information for adjusting charging/powering operations (as I explained above), neither expressly discloses "**determin[ing] any charging or powering algorithm profile(s)**" based on such information. However, in my opinion, a person of ordinary skill in the art would have been motivated to configure the *Okada-Odendaal-Berghegger* system such that PTM10 uses the device information from PRM40 to determine a charging/powering algorithm profile to improve and/or complement the power delivery control features I discussed above. (*Id.*; *see also* my analysis and discussions below in this in Section.)

201. In my opinion, a person of ordinary skill in the art would have been motivated to implement such a modification given *Okada* discloses using the device information such as power requirements of the portable device to determine a power level (low/intermediate/high) to inductively transmit to the portable device. (Ex. 1005, FIGS. 3, 5, ¶¶0069, 0073-0076, 0090; *see also* my analysis and discussions in Sections VIII.A, IX.A.1(a).) Also, in my opinion, a person of ordinary skill in the art would have been aware of using charging algorithm profile(s) to control battery charging in mobile devices (e.g., to avoid overcharging). (*See* my analysis and discussions below in this section.) The '500 patent acknowledges that "[m]ost mobile devices today already include a Charge Management IC . . . to control charging of their internal battery." (Ex. 1001, 37:19-17.) *Black*, consistent with such knowledge of a person of ordinary skill in the art, teaches communicating charging profile information for controlling charging operations in an inductive power transfer system having features similar to those of *Okada-Odendaal-Berghegger*.

202. For example, *Black* discloses inductively charging a portable device battery, where the battery includes a transceiver for communications with a charger. (Ex. 1007, Abstract, FIGS. 1-2, ¶¶0002, 0013-0017.) As *Black*'s FIGS. 1-2 (below)

show, a battery 100/200 includes a charging coupler 108/208 coupled to cell 104/204 through a charging circuit 110/210, and a communications coupler 112/212. (*Id.*, ¶¶0015, 0017.)

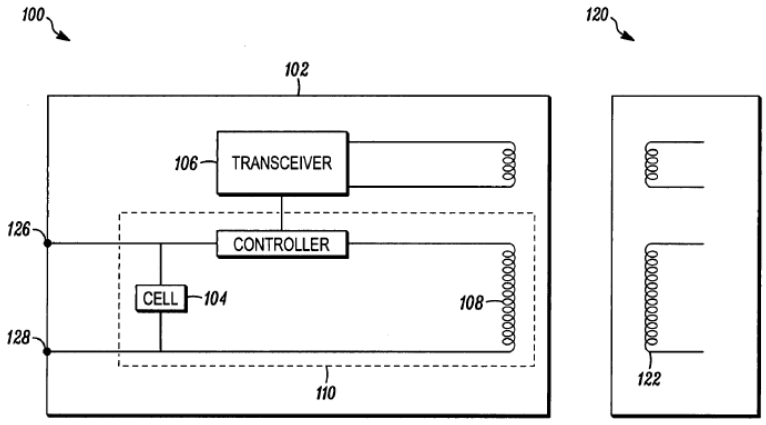
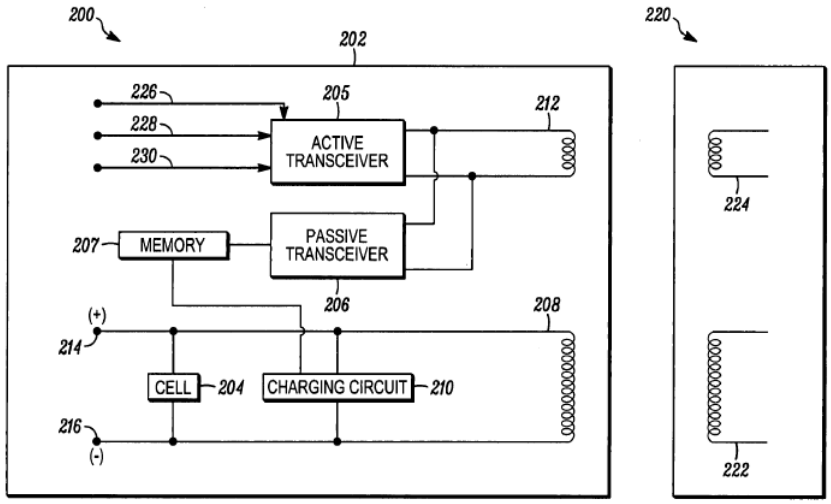



*FIG. 1*

(Ex. 1007, FIG. 1.)

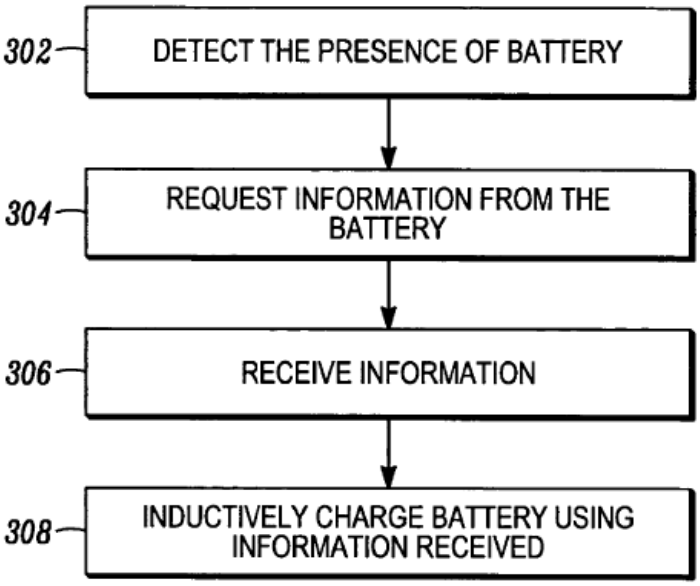


(*Id.*, FIG. 2.) Black explains that "[t]he **first coil 212 may be a portion of the second coil 208**." (*Id.*, FIG. 2, ¶0018.) Black also explains that when the battery is placed in range of the inductive charger, communications between them "may take place and inductive charging can occur." (*Id.*, ¶0019.)

203. In my opinion, a person of ordinary skill in the art would have understood that *Black* is in the same technical field as *Okada-Odendaal-Berghegger* and the '500 patent, given it describes an inductive power transfer system where information is communicated between a primary side (e.g., inductive power charger) and secondary side (e.g., inductive power receiver (e.g., mobile device / battery)). (*See* my analysis and discussions in Sections VIII.A-D, IX.A.1(a)-(c); Ex. 1007, FIGS. 1-4, ¶¶0002, 0005, 0012-0028.) Similar to *Okada-Odendaal-Berghegger*, *Black* also discloses features that were reasonably pertinent to one or more particular problems the'500 patent describes (and a person of ordinary skill in the art was trying to solve). (Ex. 1001, 10:43-51; Ex. 1007, Abstract, ¶0021; *see also* my analysis and discussions regarding *Okada*, *Odendaal*, and *Berghegger* in Sections VIII.A-D, IX.A.1(a)-(c).) Therefore, in my opinion, a person of ordinary skill in the art would have considered the teachings of *Black* in the context of the *Okada-Odendaal-Berghegger* combination, and such teachings thus would have been consulted by

such a skilled person, looking to design and implement the *Okada-Odendaal-Berghegger* system. (*Id.*)

204. *Black* also discloses a procedure for "device identification and charging," where battery information is requested/received upon detecting the presence of the battery. (Ex. 1007, FIG. 3 (below), ¶0020.)




(Ex. 1007, FIG. 3.) *Black* explains:

> . . . In step 302 the charger 120 detects the presence of a near field communication (NFC) device. In this exemplary embodiment the NFC device is the battery 100, 200. The charger 120 requests, in step 304, information from the device 100. The battery may respond with information, the device ID for example.

> If the battery has the capacity to provide power, more information may be transmitted to the charger 120, such as the type of device the battery 100 is coupled to, encryption information, battery characteristics or charging profile or the like. The information may come from the battery memory 207 or memory in the device. The battery may also only send a Device ID, charging profile or the like, particularly when only the passive transceiver can operate because, for example the battery has been depleted and no other power source is available.
>
> The charger receives, in step 306 the information and based thereon, inductively charges, in step 308, the battery 100. To determine how to inductively charge the battery 100, the charger 120, in one exemplary embodiment, may use a lookup table or database to compare the information sent by the battery to that in the charger 120, such as device ID to indicate a valid battery, to determine the charger profile or settings for that particular battery 100. If more information is sent by the battery 100, the charger 120 may use that information to set the charging parameters.

(Ex. 1007, ¶¶0020-0022.) Thus, *Black* explains that such device/battery information may include, e.g., device ID and additional information, e.g., "the type of device the

battery 100 is coupled to, encryption information, **battery characteristics** or **charging profile**." (*Id.*, ¶0021.) Charger 120 inductively charges the battery based on the received battery information. (*Id.*, ¶0022 ("[t]o determine how to inductively charge the battery 100, . . . determine the charger profile or settings for that particular battery 100" and "more information" to "set the charging parameters.").)

205. In my opinion, in view of *Black*, a person of ordinary skill in the art would have been motivated to modify the *Okada-Odendaal-Berghegger* system to include charging algorithm profiles associated with PDA 3's battery ("**appropriate charging or powering algorithm profiles**") with the device information communicated by PRM40 ("**communications from the one or more receiver units**") and used by circuits 36-38 (part of the "**communication and control circuit(s)**") to enhance the control of power to PDA 3 as described by *Okada* and *Berghegger*. (*See* my analysis and discussions in Sections IX.A.1(c)-(g); *see also* my analysis and discussions above in this section.) In my opinion, a person of ordinary skill in the art would have appreciated having charging algorithm profile information would have allowed the modified PTM10 to accurately and properly adjust the power suitable for each specific battery or portable device that has been

determined to be capable of, and present and properly positioned, to receive such power, as I discussed above. (*Id.*)

206. In my opinion, a person of ordinary skill in the art would have had reasons to consider and implement such features given it was known that different types of batteries and portable devices have different power/charge characteristics/algorithm-profiles. (*See* my analysis and discussions above in this section; Ex. 1007, ¶0003; Ex. 1037, 1:56-2:6, 2:18-19, 6:51-7:2, 7:36-53, FIGS. 4A-4C; Ex. 1039, Abstract, 3:23-35, FIG. 1, 5:20-34.)[19] In my opinion, a person of ordinary skill in the art had the requisite motivation, skills, and knowledge to implement, and reasonable expectation of success in achieving, the above-discussed modification, especially because such a modification would have involved applying

[19] I cite Ex. 1037 and Ex. 1039 to reflect the state of the art known to a person of ordinary skill in the art at the time of the alleged invention, which is consistent with how such a person would have understood *Okada*, *Odendaal*, *Berghegger*, and *Black*'s teachings. Thus, I do not rely on such references here to supplement the teachings of *Okada*, *Odendaal*, *Berghegger*, and *Black*, which as I explained, disclose and/or suggest the claimed features.

known technologies/techniques (e.g., use of charging algorithms profiles by a charger to control device charging (*Okada/Berghegger/Black*)) that would have led a skilled person to provide an inductive power/charging system that uses specific device information to control power transfer, consistent with the features disclosed by *Okada*, *Odendaal*, *Berghegger*, and *Black*. (*Id.*; *see also* my analysis and discussions in Sections VIII.A-D, IX.A.1(a)-(g), (i)-(l).)

**i) for each portable device, determine the primary coil electromagnetically most aligned with the receiver coil of the portable device;[20]**

207. In my opinion, *Okada* in view of *Odendaal*, *Berghegger*, and *Black* discloses and/or suggests this limitation. (*See* my analysis and discussions below in this section; *see also* my analysis and discussions in Sections IX.A.1(a)-(h), IX.A.1(j)-(l); *see also* my analysis and discussions in Sections VIII.A-D.)

[20] In my opinion, because limitation 1(b) recites "**one or** more **primary coils**" (*see* Section IX.A.1(b)), a person of ordinary skill in the art would have understood that the modified *Okada* system when implemented with a single primary coil magnetically coupled to a receiver coil of a properly aligned PDA 3 (as I discussed above) meets this limitation as I explained herein.

208. For example, *Okada* discloses providing power inductively when primary coil 19 is present and properly aligned with a portable device such as PDA 3 (and its secondary/receiver coil 41) where appropriate magnetic coupling for high power transmission efficiency exists between the primary and secondary coils. (*See, e.g.*, my analysis, discussions, and citations in Section IX.A.1(g); *see also* my analysis and discussions in Sections IX.A.1(a)-(h); Ex. 1005, ¶¶0064-0069, 0074-0076, FIGS. 3, 4(a)-(b).) For example, *Okada* explains:

> . . . Here, the power transmission capability evaluating circuit 36 determines whether a power receiving apparatus is mounted onto a power transmitting device 1 based on the "code indicating that a device is capable of receiving power" (STEP 3). If a prescribed "code indicating that a device is capable of receiving power" is received (STEP 3: Yes), it is recognized that a device capable of receiving power is mounted onto the common module 4 [sic]. **Next it is determined whether the device capable of receiving power (compatible device) is correctly mounted onto the common cradle 4 (STEP 4).** Meanwhile, if no prescribed "code indicating that a device is capable of receiving power" is received (STEP 3: No), it is determined that no device capable of receiving power

is mounted onto the common cradle 4, and a carrier wave is output again (STEP 2).

Next, the determination as to whether a device capable of receiving power is correctly mounted onto the common cradle 4 is described. **Determining whether a device capable of receiving power is correctly mounted onto the common cradle 4 determines whether the primary-side coil 19 in the power transmitting module 10 and the secondary-side coil 41 in the power receiving module 40 are arranged at positions having high power transmission efficiency, and providing this determination step allows for the selection not to carry out power transmission when the mount position has significantly poor power transmission efficiency.**

**FIG. 4 illustrates the relationship between relative positions of the common cradle 4 and the PDA 3, transmission efficiency of power and an information signal**. Here, the information signal is the modulated wave described above, returned by the power receiving module 40 in response to a carrier wave transmitted by the power transmitting module 10. In FIG. 4, (a) illustrates an absolute value of a transmission efficiency of power (solid line) and an information signal (dashed line), and (b)

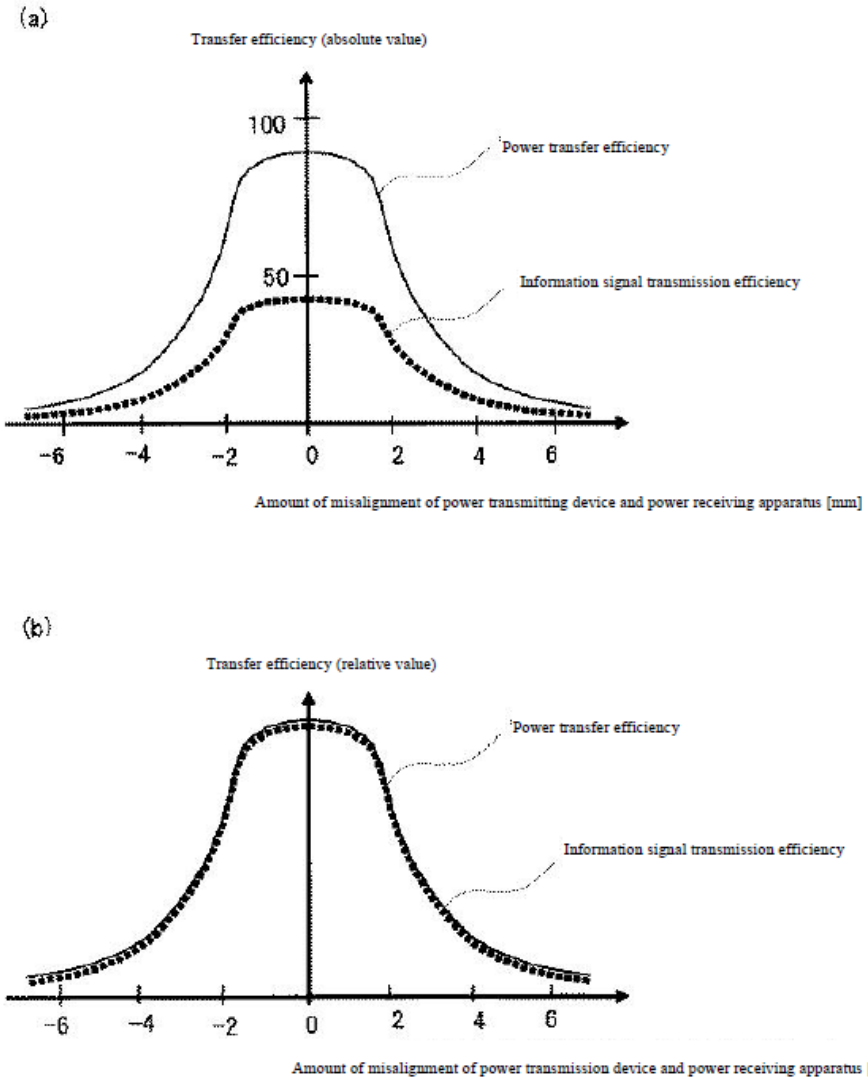
illustrates a relative value of the power (solid line) and the information signal (dashed line). In both (a) and (b), the **horizontal axis represents an amount of offset of the common cradle 4 and the PDA 3, with 0 being a case where the common cradle 4 and the PDA 3 are positioned at positions at which magnetic coupling of the primary-side coil 19 of the common cradle 4 and the secondary-side coil 41 of the PDA 3 is highest, illustrating the amount of offset of the PDA 3 from this position either left to right or front to back in units of mm.**

As illustrated in FIG. 4(a), **the greater the amount of offset of the positions of the common cradle 4 and the PDA 3, the worse the power transmission efficiency and information signal transmission efficiency.** As illustrated in FIG. 4(b), this power transmission efficiency and information signal transmission efficiency decrease by the same percentage as the amount of positional offset of the common cradle 4 and the PDA 3, so even when the common cradle 4 is in a state where power is not being transmitted, by measuring a signal intensity of the information signal, the amount of positional offset of the common cradle 4 and the PDA 3 can be recognized.

> **The greater the amount of positional offset of the common cradle 4 and the PDA 3, the worse the power transmission efficiency, so when power transmission efficiency is significantly low, the PDA 3 cannot receive power even if power is transmitted from the common cradle 4, which defeats the purpose of transmitting power. Therefore, after evaluating whether an amount of positional offset of the common cradle 4 and the PDA 3 exceeds a prescribed amount of offset (STEP 4), when exceeded (STEP 4: No), power is not transmitted from the power transmitting device 1** . . .
>
> Meanwhile, **when the amount of positional offset of the common cradle 4 and the PDA 3 does not exceed the prescribed amount of offset (STEP 4: Yes), processing proceeds to evaluating an amount of power to transmit (STEP 6)**. . . .

(Ex. 1005, ¶¶0064-0069; *see also id.*, FIGS. 3, 4(a)-(b), ¶¶0074-0076.)

FIG. 4




(Ex. 1005, FIGS. 4(a), (b) ("Amount of ***misalignment*** of power transmission device and power receiving apparatus [mm]").)

209. In my opinion, a person of ordinary skill in the art would have understood that, like in *Okada*, power transfer would only occur when such

presence/alignment occurs in the *Okada-Odendaal-Berghegger-Black* system. (*Id.*) Thus, the "**communication and control circuit(s)**" in the system (*see* my analysis and discussions in Sections IX.A.1(e)-(h)) would have likewise been configured to "**determine the primary coil electromagnetically most aligned with the receiver coil of the portable device**" in order to drive the primary coil 19 (and FET switches, etc.) to transfer power consistent with that disclosed by *Okada* (where, as I discussed above, power transmission efficiency is proportional to coil alignment). (*Id.*; Ex. 1005, FIGS. 4(a)-(b), ¶¶0066, 0067 (greater positional offset results in worse power/information transmission efficiency), 0068-0069 (evaluating whether positional offset amount exceeds a prescribed offset amount); *see also* my analysis and discussions in Section IX.A.1(c)(3).)

210. Similarly, in the multi-coil "system" configuration (e.g., FIG. 7 (with primary coil group 19x and secondary coil group 41x)) I discussed above for limitation 1(a), *Okada* explains how switching controller circuitry (e.g., 73) in PTM10 can select a coil from primary coils group 19x based on detected voltage values so that a pair of primary and secondary coils "having a highest power transmission efficiency" (e.g., least misalignment) is used for power transfer. (*See* my analysis and discussions in Section IX.A.1(a); Ex. 1005, ¶0105; *id.*, ¶¶0017,

0094-0115, Claims 9-10.) Therefore, for similar reasons I explained above, the "**communications and control circuit(s)**" in the above-discussed *Okada-Odendaal-Berghegger-Black* system (*see* Sections IX.A.1(e)-(h)) employing coil groups like that contemplated by *Okada* (*see, e.g.*, FIG. 7) would have similarly been configured with switching controller circuitry with the "**communications and control circuit(s)**" (*see* Section IX.A.1(e)) that "**determine[s] the primary coil electromagnetically most aligned with the receiver coil of the portable device**." (*See* my analysis and discussions above in this section; *see also* my analysis and discussions in Sections IX.A.1(e)-(h); *see also* my analysis and discussions in Sections VIII.A-D, IX.A.1(a)-(d), (j)-(l).)

**j) drive the one or more FET switches associated with the most aligned one or more primary coils;**

211. In my opinion, *Okada* in view of *Odendaal*, *Berghegger*, and *Black* discloses and/or suggests this limitation. (*See* my analysis and discussions below in this section; *see also* my analysis and discussions in Sections IX.A.1(a)-(i), IX.A.1(k)-(l); *see also* my analysis and discussions in Sections VIII.A-D.)

212. As I explained, the modified *Okada* system would have been configured to provide power when the present and most aligned primary coil 19 with the receiver coil 41 is determined (whether in a single primary coil 19 (e.g., Ex.

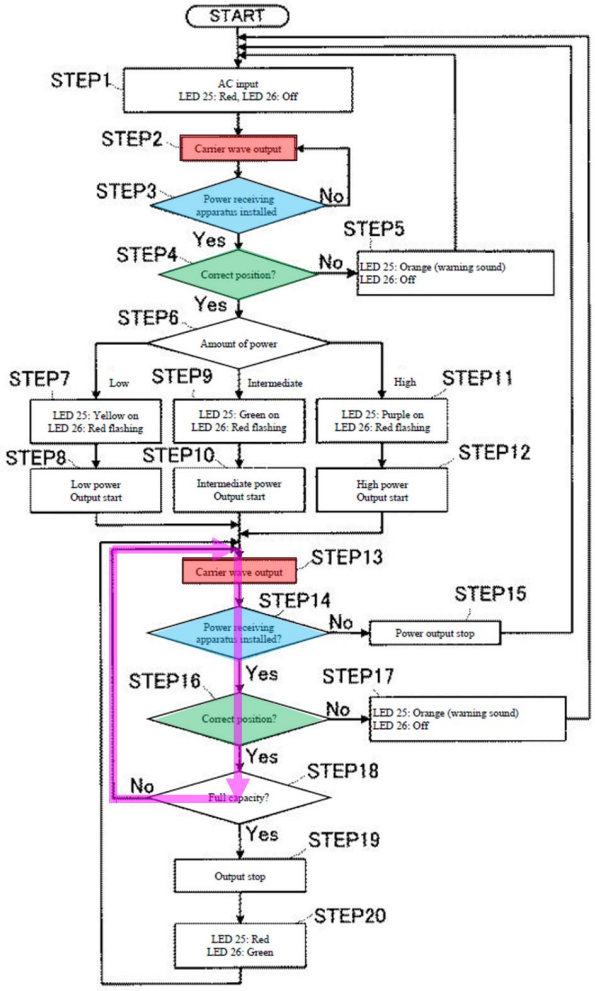
1005, FIG. 2) system arrangement or group of primary coils 19x (*id.*, FIG. 7) system arrangement). (*See* my analysis and discussions in Section IX.A.1(i); Ex. 1005, ¶¶0069-0073, 0094-0115, FIGS. 2-4(b), 7.) In my opinion, consistent with that I discussed for limitations 1(c) and 1(i) (and limitations 1(d)-1(h)), the *Okada-Odendaal-Berghegger-Black* system would have been configured such that, once proper coil alignment was determined ("**most aligned one or more primary coil(s)**"), power transfer operations would proceed, where the FET switches, as modified and similar to that disclosed in *Berghegger* (e.g., switches S1/S2), associated with such aligned primary coil(s) would have been driven according to the switching frequency I discussed above for limitation 1(g). (*See* my analysis and discussions in Sections IX.A.1(c), (g), (i); *see also* my analysis and discussions in Sections IX.A.1(d)-(f), (h).) Therefore, in my opinion, for reasons similar to that I explained above regarding the modifications of *Okada*'s system in light of *Odendaal*, *Berghegger*, and *Black* (*see* Sections IX.A.1(c)-(i)), a person of ordinary skill in the art would have been motivated, had the requisite skills, rationale, knowledge, and expectation of success, to configure and implement the modified system such that the system (e.g., "**communications and control circuit(s)**") drive the FET switches as claimed. (*See* my analysis and discussions above in this section;

*see also* my analysis and discussions in Sections IX.A.1(c)-(i); *see also* my analysis and discussions in Sections VIII.A-D, IX.A.1(a)-(b), (k)-(l).)

**k) periodically receive information corresponding to one or more output voltages or currents of the one or more receiver rectifier circuits via the one or more primary coils and the one or more sense circuits; and**

213. In my opinion, *Okada* in view of *Odendaal*, *Berghegger*, and *Black* discloses and/or suggests this limitation. (*See* my analysis and discussions below in this section; *see also* my analysis and discussions in Sections IX.A.1(a)-(j), IX.A.1(l); *see also* my analysis and discussions in Sections VIII.A-D.)

214. For example, as I explained above for limitation 1(c)(3), "[e]ven after power transmission has begun," the carrier wave is "periodically transmitted" from PTM10 to PRM40 (e.g., to receive the above-discussed device information in return (as a modulated signal) from PRM40) to determine whether PDA 3 is present and properly positioned and whether it is fully charged. (Ex. 1005, ¶¶0074-0076, FIG. 3 (annotated below); *see also* my analysis and discussions in Section IX.A.1(c)(3).)




(Ex. 1005, FIG. 3 (annotated).)

215. Similarly, a person of ordinary skill in the art would have understood that consistent with *Okada*'s system (as modified above), the above-discussed "**communication and control circuit(s)**" in the *Okada-Odendaal-Berghegger-Black* system (*see* Sections IX.A.1(e)-(j)) would "**periodically receive**" the responsive device information provided by PRM40 via "**primary coil**" 19 (whether

in a single coil 19 or in group of primary coils 19x configuration (*see* Sections IX.A.1(i)-(j)) and demodulator 35 (e.g., "**sense circuit(s)**" (*see* Section IX.A.1(d)) ("**via the one or more primary coils and the one or more sense circuits**"). (*See* my analysis and discussions in Sections IX.A.1(d)-(j); Ex. 1005, ¶¶0064-0077, 0094-0115.)

216. Also, as I explained, the received responsive device information (from PRM40) in the modified *Okada* system would have included e.g., "power consumption information." (*See* my analysis and discussions in Sections IX.A.1(a)-(j); Ex. 1005, ¶0057).) In my opinion, a person of ordinary skill in the art would have understood that "power consumption information" "**corresponds to the output voltage or current of the receiver rectifier circuit**" (e.g., rectifying circuit/rectifier 43) because such "information" is used by PTM10 to determine the level of power for charging the portable device, which when received, corresponds to the level of voltage or current at the output of the rectifying circuit/rectifier 43 (that converts the received ac power signal to a DC signal used for powering/charging the device/battery). (*Id.*; Ex. 1005, FIG. 3, ¶¶0057, 0069-0072.) In my opinion, for similar reasons I explained, a person of ordinary skill in the art would have understood that such information would have been received by PTM10

/ cradle 4 (via the primary coil(s) and sense circuit(s)) in the *Okada-Odendaal-Berghegger-Black* system. (*Id.*)

217. Moreover, consistent with that I explained for limitation 1(h), in the *Okada-Odendaal-Berghegger-Black* system, the periodically received information would have also included power demand information similar to that determined by *Berghegger*, such as voltages at output(s) of receiver rectifier circuit (rectifying circuit/rectifier 43) that would have been used to generate a control signal used to adjust the frequency of the signal applied to the primary coil(s) 19 (and thus power transmission). (*See* my analysis and discussions in Section IX.A.1(h); *see also* my analysis and discussions in Sections IX.A.1(g), IX.A.1(i)-(j); Ex. 1006, 4:58-59, 5:65-6:29; *see also* my analysis and discussions in Sections VIII.A-D, IX.A.1(a)-(l).)

**l) regulate in a closed loop feedback manner the one or more output voltages or currents of the one or more receiver rectifier circuits by adjusting the frequency or duty cycle of the one or more drive circuits during the charging or powering of the one or more portable devices.**

218. In my opinion, *Okada* in view of *Odendaal*, *Berghegger*, and *Black* discloses and/or suggests this limitation. (*See* my analysis and discussions below in

this section; *see also* my analysis and discussions in Sections IX.A.1(a)-(k); *see also* my analysis and discussions in Sections VIII.A-D.)

219. For example, my analysis above demonstrates how and why a person of ordinary skill in the art would have configured the *Okada-Odendaal-Berghegger* system to implement a closed-loop feedback control process ("**regulate in a closed loop feedback manner . . .**") where the "**one or more communication and control circuits**" (*see* my analysis and discussions in Sections IX.A.1(e)-(f)) use device information received from PRM40 to control the disclosed "**drive circuit(s)**" during charging/powering by adjusting the frequency and/or duty cycle of the waveform applied to primary coil(s) 19 based on load variation information. (*See* my analysis and discussions in Sections IX.A.1(c), (e)-(f), (g).) Moreover, for reasons I explained above for limitations 1(h) and 1(k), in the *Okada-Odendaal-Berghegger-Black* system, the load variation would have been measured as a voltage at the output of the receiver rectifier circuit(s) (*see* Section IX.A.1(b)) in PRM40, which is fed back to PTM10 with the power demand information for adjusting the frequency and/or duty cycle of the "**drive circuit(s)**" during charging/powering of the portable device (e.g., PDA 3). (*Id.*; *see also* my analysis and discussions in Sections IX.A.1(h), (k); Ex. 1006, 4:58-59, 5:65-6:29.) Thus, for the reasons I explained

above, a person of ordinary skill in the art would have understood that the *Okada-Odendaal-Berghegger-Black* combination discloses/suggests "**regulate in a closed loop feedback manner the one or more output voltages or currents of the one or more receiver rectifier circuits by adjusting the frequency or duty cycle of the one or more drive circuits during the charging or powering of the one or more portable devices**" (limitation 1(l)). (*Id.*; *see also* my analysis and discussions in Sections IX.A.1(a)-(g), (i)-(j); *see also* my analysis and discussions in Sections VIII.A-D.)

**2. Claim 2**

**a) The system of claim 1, further comprising one or more voltage regulator circuits that can change input voltages to the one or more drive circuits between two or more levels to accommodate different powers required by the portable devices.**

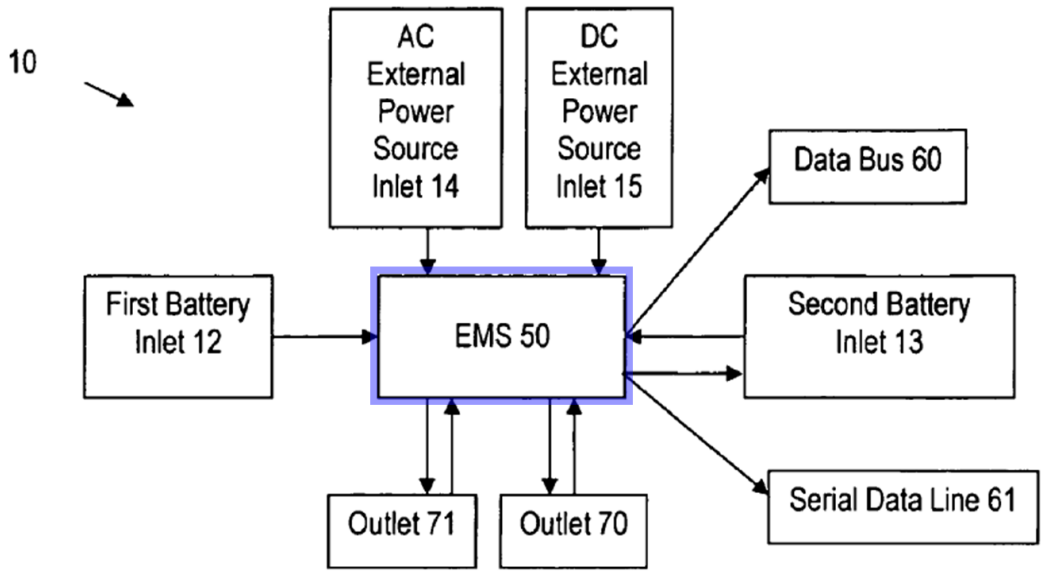
220. In my opinion, *Okada* in view of *Odendaal*, *Berghegger*, *Black*, and *Masias* discloses and/or suggests this limitation. (*See* my analysis and discussions below in this section; *see also* my analysis and discussions in Section IX.A.1; *see also* my analysis and discussions in Sections VIII.A-E.)

221. As I explained above for claim 1, *Okada* discloses adjusting the level of power to be transmitted to a portable/mobile device (e.g., PDA 3) based on the

portable device's "power consumption information." (*See* my analysis and discussions in Section IX.A.1; Ex. 1005, ¶¶0057, 0063-0064, 0069-0073, FIG. 3; *see also* my analysis and discussions in Sections VIII.A.) However, to the extent the modified *Okada* combination does not expressly disclose "**one or more voltage regulator circuits that can change input voltages to the one or more drive circuits between two or more levels to accommodate different powers required by the portable devices**," it is my opinion that a person of ordinary skill in the art would have been motivated to configure the modified *Okada* system (that I explained above in Section IX.A.1) in view of *Masias* to implement such features. (*See* my analysis and discussions below in this section; *see also* my analysis and discussions in Sections VIII.A-E, IX.A.1.)

222. *Masias* discloses "[a] power source system including a power distribution apparatus." (Ex. 1031, Abstract.) *Masias* discloses that the "power distribution apparatus has an energy management system for managing the provision of power from multiple power sources to multiple electrical devices." (*Id.*) With respect to FIG. 1, *Masias* explains that a power distribution apparatus 10 includes an energy management system (EMS) 50 having first and second battery inlets (12 and 13, respectively), AC and DC external power source inlets (14 and 15,

respectively), outlets 70 and 71, among other things. (*Id.*, 4:5-9.) *Masias* discloses that EMS 50 manages "allocation of power from one or more power sources connected at the inlets," and also manages "the supply of power to a plurality of outlets at multiple and customizable voltage levels." (*Id.*, 4:9-13.) *Masias* explains that the inlet and outlet couplings can involve "inductive" connections. (*Id.*, 2:8-12, 3:26-29, 4:9-24, 7:9-41 (recharging done "**inductively**").)




(Ex. 1031, FIG. 1 (annotated).) For example, *Masias* explains:

> The inlets may connect the various power sources to the EMS 50 by continuous conductive paths, or by conductive paths that include **inductive** sections, or both. Similarly, the outlets may connect the various devices to the EMS 50 by continuous conductive paths, or by conductive paths

> that include **inductive** sections, or both. Inductive power source coupling is taught, for example, in . . . .

(Ex. 1031, 4:13-24.)

223. Therefore, in my opinion, a person of ordinary skill in the art would have understood that *Masias* is similar to *Okada-Odendaal-Berghegger-Black* (and the '500 patent) as it discloses a power transfer system (with inductive couplings) that provides power to a device based on its level of power consumption. (*Id.*; Ex. 1031, Abstract, 2:8-12, 3:26-29, 4:5-24, 7:9-41, FIG. 1; Ex. 1005, ¶¶0057, 0034-0038, 148-151; *see also* my analysis and discussions in this section and in Sections IX.A.1(a)-(c); *see also* my analysis and discussions in Sections VIII.A-E, IX.A.1.) Thus, in my opinion, a person of ordinary skill in the art would have understood that *Masias* is in a related technical field as the '500 patent and *Okada-Odendaal-Berghegger-Black* and discloses features reasonably pertinent to one or more particular problems the '500 patent discusses (and a person of ordinary skill in the art was trying to solve). (Ex. 1001, Abstract, 2:15-4:29; Ex. 1031, 6:5-37; *see also* my analysis and discussions in Sections IX.A.1(a)-(c); *see also* my analysis and discussions in Sections VIII.A-E, IX.A.1; Ex. 1005, ¶¶0037-0058, 0094-0109, 0116-0126.) Accordingly, in my opinion, a person of ordinary skill in the art would have

considered *Masias* in the context of *Okada* (and *Okada-Odendaal-Berghegger-Black*) when looking to design and implement an inductive charging/powering system like that described by *Okada* (as modified above, as I explained in Section IX.A.1 (the *Okada-Odendaal-Berghegger-Black* system)). (*Id.*)

224. *Masias* discloses that EMS 50 (e.g., as shown in FIG. 4) may "include **a voltage regulator device** or process to **provide multiple, constant, preprogrammed output voltages in any range . . . dependent on power needs of various equipment**." (Ex. 1031, 6:5-13; *see also id.*, 6:3-5 ("devices can be operated concurrently by connection at outlets 70 and 71"), FIG. 4.)

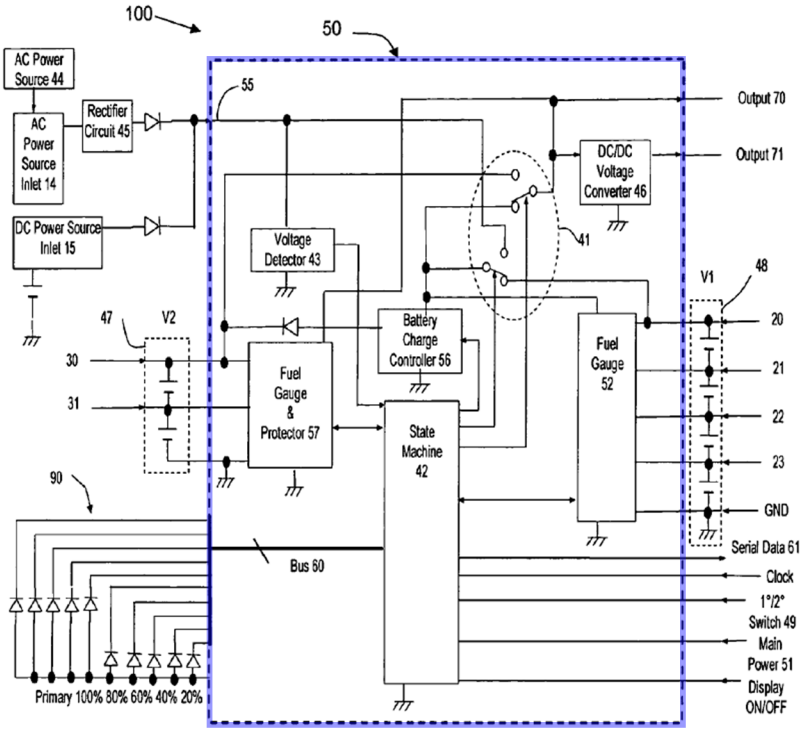



FIG. 4

(Ex. 1031, FIG. 4 (annotated).) *Masias* states:

> In the power source system 100 of FIG. 4, devices can be operated concurrently by connection at outlets 70 and 71. **The EMS 50 may include a voltage regulator device or process to provide multiple, constant, preprogrammed output voltages in any range**, preferably ranging from 15 V to 18 V, **dependent on power needs of various equipment.** Additionally or alternatively, a high voltage may be provided by the EMS 50 internally switching its circuitry to put a greater number of its available energy

> storage devices in series. A high current may be supplied by the EMS placing a greater number of energy storage devices in parallel.

(Ex. 1031, 6:3-13.) *Masias* also explains that the power source system 100 uses various available power sources based on power criteria such as "output power requirements" and monitors/displays charge state, capacity, voltage, current, recharging status, etc. (*See id.*, 6:14-8:14; *see also id.*, 9:7-62 (mobile power source system), 10:56-12:65.)

225. In my opinion, in view of the teachings of *Masias*, a person of ordinary skill in the art would have been motivated to modify the *Okada-Odendaal-Berghegger-Black* system to include power management features with one or more voltage regulator circuits that change input voltages to the "**drive circuit(s)**" (*see* my analysis and discussions in Section IX.A.1(c)), similar to the features provided by EMS 50 in *Masias*, to enhance and complement the *Okada-Odendaal-Berghegger-Black* system's ability to accommodate different levels of voltages supplied to different portable/mobile devices based on their respective power requirements. (*See* my analysis, discussions, and citations regarding *Masias* in this

section; *see also* my analysis and discussions in Sections VIII.A, IX.A.1(a), (c)(1), (g); *see also* my analysis and discussions in Section IX.A.1.)

226. As I explained above for claim 1, the *Okada-Odendaal-Berghegger-Black* system (through, for example, *Okada/Berghegger*) accounts for and accommodate portable/mobile devices having different power requirements and variances in power demand during operation. (*See* my analysis and discussions in Section IX.A.1; *see, e.g.*, Ex. 1005, ¶¶0057, 0063-0064, 0069-0073; Ex. 1006, 6:12-15 ("power required by the batteries decreases with an increasing load").) Therefore, in my opinion, a person of ordinary skill in the art would have found it beneficial to (and would have been motivated to) implement such regulator circuitry capable of providing different levels of constant voltages to the "**drive circuit(s)**" based on the power requirement/demand of a detected, present, and properly aligned portable/mobile device to accommodate different types of electronic devices having different charging/power requirements (and variances in power demand during operation). (Ex. 1031, 6:5-13; *see also* my analysis, discussions, and citations regarding *Masias* in this section; *see also* my analysis and discussions in Sections VIII.A, VIII.C, IX.A.1.)

227. In my opinion, while the *Okada-Odendaal-Berghegger-Black* system includes ways to adjust power level delivery to a portable/mobile device by selecting the transformation ratio (e.g., of the primary coil 19 and secondary/receiver coil 41) using switching elements 21/22/23 and/or adjusting the operating frequency of the "**drive circuit(s)**" (*see* my analysis and discussions in Section IX.A.1(c)), a person of ordinary skill in the art would have understood that implementing the above-discussed modification based on *Masias*'s teachings would have enhanced and complemented the *Okada-Odendaal-Berghegger-Black* system. (*Id.*; *see also* my analysis and discussions above in this section; *see also* my analysis and discussions in Sections VIII.A-E, IX.A.1.) For example, in my opinion, a person of ordinary skill in the art would have understood that implementing power management circuitry (e.g., including regulator circuit(s)) at the input of the "**drive circuit(s)**" (*see* my analysis and discussions in Section IX.A.1(c)) would have improved the flexibility of the modified *Okada* system in terms of, e.g., the types of external power source(s) that the system may use at the charger, consistent with *Masias*'s teachings. (*See* my analysis, discussions, and citations regarding *Masias* in this section; *see also* my analysis and discussions in Sections VIII.A-E, IX.A.1.) In my opinion, a person of ordinary skill in the art would have recognized and understood how *Masias*

discloses that EMS 50 is capable of receiving power from different types of power sources (e.g., AC, DC, and multiple battery sources) to provide a "constant" output voltage at different levels based on such source(s), consistent with known voltage regulation technologies/techniques. (*Id.*; Ex. 1031, 5:37-13, 6:5-8, 8:15-22; *see also* my analysis, discussions, and citations regarding *Masias* in this section.) Moreover, a person of ordinary skill in the art would have understood that, consistent with that described by *Masias*, such a modification would have provided redundancy to ensure "uninterrupted power" is provided to the charger of the modified *Okada* system for facilitating the inductive power transfer features of the system I explained above for claim 1. (*See* my analysis and discussions in Section IX.A.1; Ex. 1031, 6:48-52 ("Redundancy is provided by the power source system 100, resulting in uninterrupted power even when changing batteries.").)

228. Therefore, in my opinion, a person of ordinary skill in the art would have been motivated by *Masias*'s teachings of using a "**voltage regulator**" in a power/charging source system to provide a "**regulat[ed]**" and "**constant**" output at one of "**multiple**" voltage levels. (Ex. 1031, 6:5-13, 8:15-22.) Such a skilled person would have understood the benefits of implementing power source/management components/circuitry at the input of the modified *Okada* system's "**drive circuit(s)**"

given the *Okada* system (as modified) uses power provided to such "drive circuit(s)" to not only drive the primary coil(s) but also covert it into an internal power source Vcc to power circuitry on the primary side. (*See* my analysis and discussions in Section IX.A.1.) Thus, a person of ordinary skill in the art would have been motivated to implement the above-discussed modification because such a skilled person would have understood that providing a regulated, constant, and uninterrupted power at one of the multiple voltage levels based on the power requirement/demand of the portable/mobile device in the modified *Okada* "system" would have enhanced overall stability of system operations while providing flexibility for powering/charging mobile devices of different power requirements/demands. (*See* my analysis, discussions, and citations above in this section; *see also* my analysis and discussions in Sections VIII.A-E, IX.A.1.)

229. In my opinion, a person of ordinary skill in the art would have had the skill, rationale, and knowledge in implementing, and reasonable expectation of success in achieving, the above-discussed modification, especially given the modification would have involved applying known technologies/techniques (e.g., voltage regulator technologies/techniques for providing stable power at different voltage levels to operate charger system components and drive the primary coil for

inductive charging/power operations as I explained above (*Masias*)) that would have led a skilled person to configure a charging system to provide uninterrupted and stable/regulated voltage levels depending on power demand/requirement of a portable/mobile device, consistent with the teachings of *Masias* and *Okada-Odendaal-Berghegger-Black* (e.g., *Okada*, *Berghegger*). (*See* my analysis, discussions, and citations above in this section; *see also* my analysis and discussions in Sections VIII.A-E, IX.A.1.)

### B. Ground 2: *Okada* in view of *Odendaal*, *Berghegger*, *Black*, and *Calhoon* Discloses and/or Suggests the Features of Claim 4

230. In my opinion, *Okada* in view of *Odendaal*, *Berghegger*, *Black*, and *Calhoon* discloses and/or suggests all of the features of claim 4 of the '500 patent.

#### 1. Claim 4

**a) The system of claim 1, wherein the one or more communication and control circuits are designed to receive from a receiver unit of a portable device identification information including one or more codes identifying the manufacturer of the portable device and/or receiver unit, a unique portable device and/or receiver ID code, a charge algorithm profile, and a power requirement of the portable device and/or receiver unit.**

231. In my opinion, *Okada* in view of *Odendaal*, *Berghegger*, *Black*, and *Calhoon* discloses and/or suggests this limitation. (*See* my analysis and discussions below in this section; *see also* my analysis and discussions in Section IX.A.1; *see also* my analysis and discussions in Sections VIII.A-D, F.)

232. As I explained above for limitations 1(e)-(h), *Okada* discloses that power transmission capability evaluating circuit 36 (part of "**communication and control circuit[s]**") receives and uses "code indicating that a device is capable of receiving power" ("**a portable device identification information**") to identify whether a device capable of receiving power is placed and aligned with the charger.

(*See* my analysis and discussions in Sections IX.A.1(e)-(h); Ex. 1005, ¶0064; *see also* my analysis and discussions in Sections VIII.A, IX.A.1.) As I also explained above, *Okada* also discloses that power amount evaluating circuit 37 (part of "**communication and control circuit[s]**") receives and uses "power consumption information" ("**power requirement**") to determine the power amount/level to deliver to the portable/mobile device. (*See* my analysis and discussions in Section IX.A.1(h); Ex. 1005, ¶¶0057, 0067, 0069-0073; *see also* my analysis and discussions in Sections VIII.A, IX.A.1.) The code/information is provided by modulating circuit 47 of power receiving module 40 ("**receiver unit**"). (*Id.*; *see also* my analysis and discussions in Sections IX.A.1(b), (g).) Moreover, as I also explained above for limitation 1(h), a person of ordinary skill in the art would have configured the modified *Okada* system in view of *Black* to configure the system to determine "**charging or powering algorithm profile**(s)" / "**charge algorithm profile**(s)." (*See* my analysis and discussions in Section IX.A.1(h).) Therefore, in my opinion, a person of ordinary skill in the art would have understood that *Okada-Odendaal-Berghegger-Black* discloses/suggests the "**one or more communication and control circuits**" (*see* Section IX.A.1(e)) configured to receive from a "**receiver unit**" of the mobile device ("**portable device**"), "**identification information**,"

identification information relating to "**power requirement**(s)" of the "**portable device**" or its "**receiver unit**," and information used to determine appropriate charge algorithm profile(s) ("**charge algorithm profile(s)**") for the device/receiver unit (*see* my analysis and discussions in Section IX.A.1(h)). (*See also* my analysis and discussions in Sections VIII.A, IX.A.1.)

233. To the extent the *Okada-Odendaal-Berghegger-Black* combination (discussed above for claim 1) does not expressly disclose that "**communication and control unit(s)**" of the modified *Okada* system are configured to receive information, such as charge algorithm profile(s), manufacturer ID code(s), and unique ID code(s) of the device/receiver unit (as recited in claim 4), it is my opinion that a person of ordinary skill in the art would have been motivated to include these features in view of *Calhoon*. (*See* my analysis and discussions below in this section.)

234. *Calhoon* discloses an inductive powering/charging system for a mobile device's battery charger/battery pack. (Ex. 1041, Abstract, FIGS. 2-3 (below), ¶¶0002, 0008-0010, 0022-0029, 0045, 0065.)

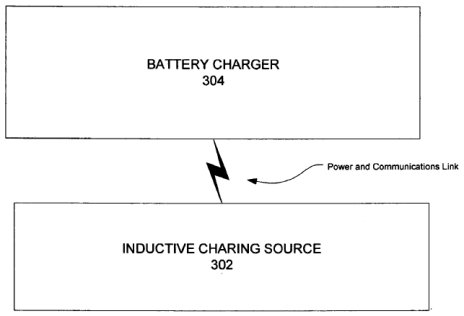



FIGURE 2

(Ex. 1041, FIG. 2.)

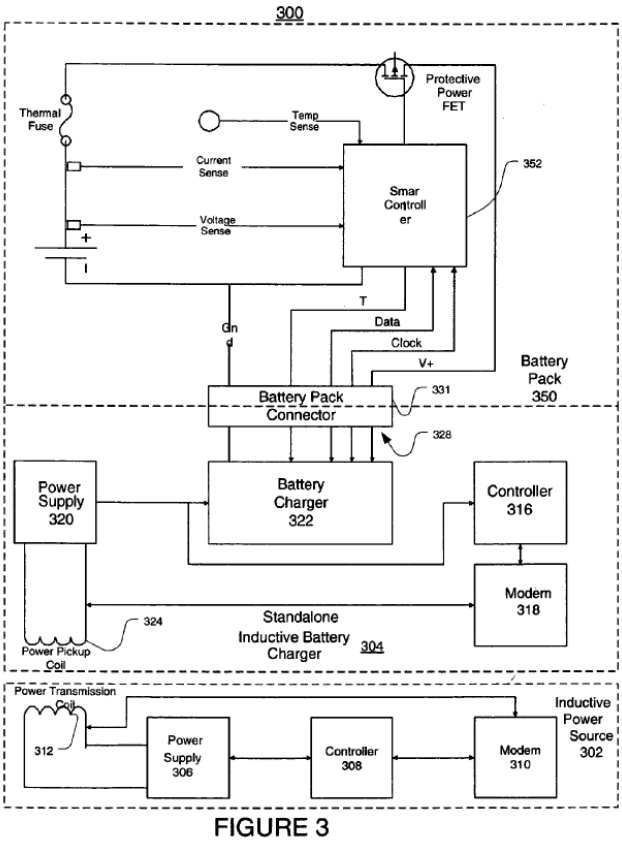



FIGURE 3

(Ex. 1041, FIG. 3.) *Calhoon* discloses obtaining an **ID/serial number of a power receiver**, e.g., a battery charger (charger assembly 304) or a battery (battery pack

350) and wirelessly communicating that information to an inductive power source (e.g., inductive charging source 302). (Ex. 1041, Abstract, ¶¶0022, 0034, 0046-0048, 0050-0052, 0056, FIGS. 3, 5A, 6.) Moreover, *Calhoon* also explains that controller 316 in battery charger 304 may include data, "such as **a battery charger ID number**, **serial number**, **manufacturer's name**," which can be used "for novel power operations . . . such as shown in FIGS. 5A, 5B, and 6." (*Id*., ¶0038; *see also id.*, FIGS. 5A-6, ¶¶0034, 0042-0044, 0045-0048, 0049, 0050-0052, 0056.) *Calhoon* explains:

> the **inductive charging source 302** can request other information relevant to the **battery charger assembly 304**, such as a **battery charger identification (ID) number** . . . **serial number of the battery charger** or the **serial number of the battery pack**. *This information can be used for* **security, data integrity, or other purposes**. In process block 508, the **battery charger assembly 304 transmits the requested information**. In process block 510, the source 302, via controller 308, determines if it can supply the requested voltage and power to battery charger assembly 304. . . . if the source 302 can provide the voltage and/or power, then the process flows to process block 514 for the charging mode.

> After the negotiation process, in process block 514, when the battery charger assembly 304 begins to receive its requested voltage and power, the controller 316 may turn on the battery charger 322 in order to charge the battery pack 350.

(Ex. 1041, ¶¶0047-0048; *see also id.*, ¶¶0034 ("[M]odem 310, 318 may be adapted to modulate and demodulate signals appropriate to the frequency supplied by the power supply 306, 320 to **receive and transmit data**. Thus, **the power transmission coil 312 of the charging source 302 and the power pickup coil 324 of battery charger assembly 304 are used to provide inductive data communications over an inductive pathway**."), 0050 ("[I]nductive charging source 302 and battery charger assembly 304 may be configured for **wireless data communications**.").)

235. Thus, in my opinion, a person of ordinary skill in the art would have understood that *Calhoon*'s inductive power receiver includes "**a portable device identification information**" that includes "**one or more codes identifying the manufacturer of the portable device and/or receiver unit**" (e.g., manufacturer's name) and "**a unique portable device and/or receiver ID code**" (e.g., a battery charger ID number, serial number) that is wirelessly communicated/transmitted to

an inductive power source (e.g., inductive charging source 302) and "can be used **for security, data integrity**, or other purposes." (Ex. 1041, ¶0047; *see also id.*, FIGS. 3-5A, ¶¶0034, 0036-0037, 0040-0043, 0050, FIGS. 2-3, 5A-6; *see also* my analysis and discussions above in this section.) In my opinion, a person of ordinary skill in the art would have understood that these information are "identification" information given the information can be wirelessly transmitted and "used for security, data integrity, or other purposes." (*Id.*)

236. In my opinion, a person of ordinary skill in the art would have understood that *Calhoon* is in the same technical field as the '500 patent (and *Okada-Odendaal-Berghegger-Black*) given, for example, they describe a system and processes for inductive power/data transfer between an inductive power source and an inductive power receiver such as a portable device/battery. (*See, e.g.*, Ex. 1041, Abstract, FIGS. 2-3, 5A-6, ¶¶0002, 0008-0010, 0022-0029, 0034, 0038, 0042-0044, 0045-0048, 0049, 0050-0052, 0056, 0065; *see also* my analysis, discussions, and citations regarding *Calhoon* in this section; Ex. 1001, Abstract, 4:13-14; *see also* my analysis and discussions in Sections VIII.A-D, F, IX.A.1.) Moreover, *Okada* and *Calhoon* both describe transmitting information used by a base unit/inductive power source to control power transfer operations (based on, e.g., device power

requirements, etc.). (*See* my analysis and discussions in Section IX.A.1; Ex. 1041, ¶¶0034, 0047-0048, 0050, FIGS. 3, 5A, 6; *see also* my analysis, discussions, and citations regarding *Calhoon* in this section; *see also* my analysis and discussions in Sections VIII.A, F.) In my opinion, a person of ordinary skill in the art would have understood that, like *Okada-Odendaal-Berghegger-Black*, *Calhoon* also discloses features reasonably pertinent to one or more particular problems the '500 patent discusses (and a person of ordinary skill in the art was trying to solve). (Ex. 1001, Abstract, 1:19-42, 2:15-4:29; Ex. 1041, ¶¶0003-0010, 0022, 0029, 0034, 0045-0048, 0050, 0065, FIGS. 3, 5A, 6; Ex. 1005, ¶¶0110, 0147-0151; *see also* my analysis, discussions, and citations in Sections VIII.A-D, F, IX.A.1.) Thus, in my opinion, *Calhoon*'s teachings would have been consulted by a person of ordinary skill in the art, looking to design and implement contactless/inductive power/data transfer/reception system/processes, like that described by *Okada*. (*Id.*)

237. In my opinion, in view of such teachings/suggestions, a person of ordinary skill in the art would have been motivated to configure the modified *Okada* system to include in the information received by the disclosed "communication and control circuit[s]" (*see* my analysis and discussions in Section IX.A.1(e)) "**code(s) identifying the manufacturer of the portable device** [e.g., PDA 3] **and/or**

**receiver unit**" (*see also* my analysis and discussions in Section IX.A.1(b), IX.A.1(g)-IX.A.1(h)), "**a unique portable device and/or receiver ID code**," "**a charge algorithm profile**" for the device (*see also* my analysis and discussions in Section IX.A.1(h)), and "**a power requirement of the portable device and/or receiver unit**" (*see* my analysis and discussions in Section IX.A.1). (*See* my analysis, discussions, and citations regarding *Calhoon* in this section; *see also* my analysis and discussions in Sections VIII.A-D, F, IX.A.1.) In my opinion, such a modification would have allowed the charger (e.g., cradle 4) to verify and/or authenticate each portable/mobile device by using the device's manufacturer's name and/or serial number or ID associated with the device, and also receive charging algorithm profile information specific to the device, and thus obtain such data/information directly from the device that is present and positioned/aligned to receive the appropriate power. (*Id.*; *see also* my analysis and discussions in Sections IX.A.1.)

238. In my opinion, a person of ordinary skill in the art would have recognized the benefits of such features and thus would have been motivated to implement the above-modification, especially in light of the guidance provided by *Calhoon*. (*See* my analysis, discussions, and citations regarding *Calhoon* in this

section.) For example, in my opinion, a person of ordinary skill in the art would have recognized that such a modification would have beneficially allowed the charger (cradle 4) to verify and/or authenticate each portable/mobile device using the device's manufacturer's name and/or serial number/ID associated with the device—in addition to determining whether the device is present and properly positioned/aligned to receive appropriate power in accordance with the power requirement and charging capacity of the device based on the "code indicating that a device is capable of receiving power," "power consumption information," and "full capacity information" cradle 4 already receives from PRM40. (*Id.*; Ex. 1005, ¶¶0057-0076; Ex. 1041, Abstract, ¶¶0022, 0034, 0046-0048, 0050-0052, FIGS. 3, 5A, 6; *see also* my analysis and discussions in Sections VIII.A, F, IX.A.1.) In my opinion, a person of ordinary skill in the art would have understood that such modification would have allowed for verification/tracking purposes to deter improper use, thus improving security, data protection/integrity, and confirming alignment/presence of authorized/verified devices consistent with that disclosed/suggested by *Okada* and *Calhoon*. (*Id.*; *see also* Ex. 1041, ¶0050; Ex. 1005, ¶¶0034, 0078-0093.) Furthermore, in my opinion, receiving the device's charging algorithm profile with such communicated information would have

allowed the charger (cradle 4) to have such information to "determine" how to appropriately charge/power the device (*see* my analysis and discussions in Section IX.A.1(h)), while also providing versatility to the overall system's applications by enabling providers of the compatible portable/mobile devices to store such device-specific information so it can be updated and shared with the charger for proper charging. (*Id.*; *see also* my analysis, discussions, and citations regarding *Calhoon* in this section; *see also* my analysis and discussions in Sections VIII.A-D, F, IX.A.1.)

239. In my opinion, a person of ordinary skill in the art would have had the skill, rationale, and knowledge in implementing, and reasonable expectation of success in achieving, such modification, especially where it would have involved applying known technologies (e.g., use of identifier information and charging algorithm data (e.g., *Okada*, *Calhoon*) to verify/authenticate/confirm device(s) (receiver/battery) receiving power from an inductive power source (*Okada*, *Calhoon*)) according to known methods/techniques (e.g., control power transfer operations using device/identifier/algorithm-profile information (*Okada*, *Calhoon*)) that would have led a skilled person to provide an inductive power/data transfer system that wirelessly receives device identifying/charging profile information that

can be used to monitor and facilitate proper use and device charging consistent with the teachings of *Okada* and *Calhoon*. (*See* my analysis, discussions, and citations regarding *Calhoon* and *Okada* in this section; *see also* my analysis and discussions in Sections VIII.A-D, F, IX.A.1.)

### C. Ground 3: *Okada* in view of *Odendaal*, *Berghegger*, *Black*, and *Kazutoshi* Discloses and/or Suggests the Features of Claim 18

240. In my opinion, *Okada* in view of *Odendaal*, *Berghegger*, *Black*, and *Kazutoshi* discloses and/or suggests all of the features of claim 18 of the '500 patent.

#### 1. Claim 18

**a) The system of claim 1, further wherein the one or more communication and control circuits use a Proportional-Integral-Derivative control technique to regulate one or more outputs of the one or more receiver rectifier circuits.**

241. In my opinion, *Okada* in view of *Odendaal*, *Berghegger*, *Black*, and *Kazutoshi* discloses and/or suggests this limitation. (*See* my analysis and discussions below in this section; *see also* my analysis and discussions in Section IX.A.1; *see also* my analysis and discussions in Sections VIII.A-D, G.)

242. As I discussed above for limitation 1(l), the "**communication and control circuit(s)**" in the modified *Okada* system (*see, e.g.*, Section IX.A.1(e)) would have been configured to regulate in a "closed loop feedback manner" the one or more output voltages/currents of the "**receiver rectifier circuit(s)**" (*see, e.g.*, Sections IX.A.1(b), (h), (k)-(l)). (*See* my analysis and discussions in Section IX.A.1(l).) Thus, in my opinion, a person of ordinary skill in the art would have understood that the *Okada-Odendaal-Berghegger-Black* combination

discloses/suggests that "**the one or more communication and control circuits . . . regulate[s] one or more outputs of the one or more receiver rectifier circuits**." (*Id.*; *see also* my analysis and discussions in Section IX.A.1.)

243. To the extent the *Okada-Odendaal-Berghegger-Black* combination does not expressly disclose that such a closed loop feedback process "**use[s] a Proportional-Integral-Derivative control technique**," it is my opinion that a person of ordinary skill in the art would have been motivated to implement such features in view of *Kazutoshi*. (*See* my analysis and discussions below in this section.)

244. *Kazutoshi* discloses "[a] contactless power supply system" with a power supply device 21 providing power to portable object (cart 3). (Ex. 1034, Abstract, FIG. 1, ¶¶0001, 0005-0014, 0024-0030.) With respect to FIG. 3 (below), *Kazutoshi* explains that power supply device 21 provides power through inductive wires 19, where power is induced on a signal pickup coil 20A used to operate a load (motor 15) in the portable object. (Ex. 1034, FIG. 3, ¶0029.)

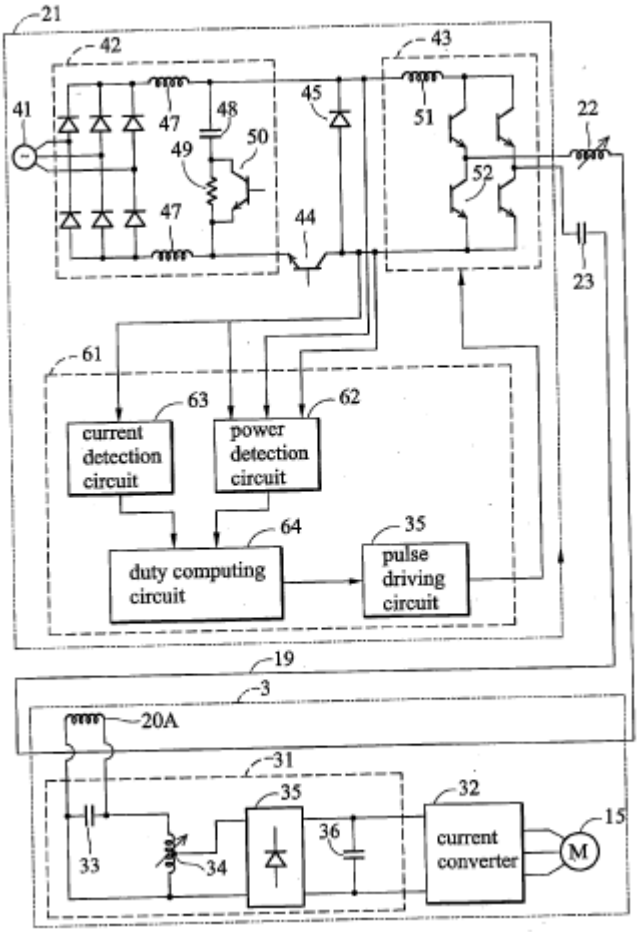



FIG. 3

(Ex. 1034, FIG. 3.)

245. *Kazutoshi* discloses that power supply device 21 includes a controller 61, which comprises power detection circuit 62, current detection circuit 63, duty computing circuit 64, and pulse driving circuit 65. (*Id.*, ¶¶0037-0038.) *Kazutoshi* explains that duty computing circuit 64 receives signals (associated with the output of current converter 42 and current alternator 43, and output power of power

supplying inductive wires 19) from power detection circuit 62 and current detection circuit 63. (*Id.*) Duty computing circuit 64 "employs the output current of the current detection circuit 63 as a reference, [] evaluates the duty of the square wave driving the transistor 52 in the current alternator 43," and provides an output signal to pulse generating circuit 65 to drive transistor 52 and inductive wires 19 in order to power cart 3. (*Id.*, ¶¶0038, 0043.) *Kazutoshi* states:

> The controller 61 comprises a power detection circuit 62, a current detection circuit 63, and a controller circuit. The power detection circuit 62 monitors the output voltage and the output current of the current alternator 42, evaluates the output power flowing from the current converter 42 to the current alternator 43 by sensing output power of power supplying inductive wires 19. The current detection circuit 63 detects an output current from the current converter 42 to the power supplying inductive wires 19. The controller circuit constitutes a duty computing circuit 64 and a pulse generating circuit 65. The duty computing circuit 64 employs the output current of the current detection circuit 63 as a reference, and evaluates the duty of the square wave driving the transistor 52 in the current alternator 43. The pulse generating circuit 65 incorporates a pulse width

> modulation (PWM) circuit using the duty from the duty computing circuit 64 and a gate driving circuit 65.

(*Id.*, ¶0038; *see also id.*, ¶0043.)

246. Thus, in my opinion, a person of ordinary skill in the art would have understood that *Kazutoshi* is in the same technical field as *Okada* (including as modified) and the '500 patent, and also discloses features that were reasonably pertinent to one or more particular problems the '500 patent describes (and a person of ordinary skill in the art was trying to solve). (*See* my analysis and discussions in Sections IX.A.1(a)-(c); Ex. 1001, Abstract, 4:13-29, 32:39-34:3; Ex. 1034, Abstract, ¶¶0029, 0036-0039; *see also* my analysis and discussions in Sections VIII.A-D, G, IX.A.1.) Thus, in my opinion, a person of ordinary skill in the art would have considered *Kazutoshi* in context of the modified *Okada* system when looking to design and implement an inductive charging/powering system like that described by the modified *Okada* system (the *Okada-Odendaal-Berghegger-Black* system I explained above in Section IX.A.1). (*See* my analysis and discussions in Section IX.A.1; *see also* my analysis, discussions, and citations regarding *Kazutoshi* in this section; *see also* my analysis and discussions in Sections VIII.A-D, G.)

247. In addition to the above-discussed disclosures, *Kazutoshi* also discloses that duty computing circuit 64 (e.g., shown in FIG. 5 below) "comprises a subtractor 71, a multiplier 72, an integrator 73, a differentiator 74, an adder 75, and a gain configurator 76," where "[t]he multiplier 72, the integrator 73, and the differentiator 74 make up a ***proportional integral derivative (PID)*** controller." (Ex. 1034, ¶0039.) In my opinion, a person of ordinary skill in the art would have understood that the controller uses the difference between the output current (current detection circuit 63) and a reference value to determine an output signal to pulse generating circuit 65 for driving transistor 52 and inductive wires 19 to inductively power cart 3. (*Id.*; *id.*, ¶¶0040-0043.) In my opinion, such a skilled person would have understood that the proportional integral derivative (PID) controller provides "an output voltage for load resistance R and an output current within the range of the reference current." (*Id.*, ¶0043; *see also id.*, ¶0044.)

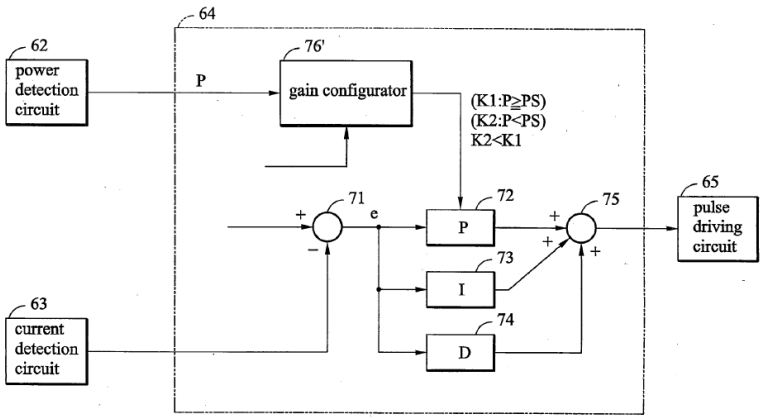



FIG. 5

(Ex. 1034, FIG. 5.)

248. In my opinion, in view of such teachings/suggestions of *Kazutoshi*, a person of ordinary skill in the art would have been motivated to configure the "**communication and control circuit(s)**" in the modified *Okada* system (*see, e.g.*, my analysis and discussions in Sections IX.A.1(e), IX.A.1(l)) to use a proportional integral derivative (PID) control technique to regulate one or more outputs of the one or more "**receiver rectifier circuit(s)**" in the system, similar to features described by *Kazutoshi*, for regulating the output of the "**receiver rectifier circuit(s)**." (*See* my analysis and discussions in Section IX.A.1(l); *see also* my analysis and discussions in Sections VIII.A-D, G, IX.A.1; *see also* my analysis, discussions, and citations regarding *Kazutoshi* in this section.) In my opinion, a person of ordinary skill in the art would have recognized that use of PID control

techniques/technologies in a controller of a powering/charging system and to regulate a rectified DC voltage was known, as demonstrated by *Kazutoshi* and known in the art. (*See* my analysis, discussions, and citations regarding *Kazutoshi* in this section; *see also* my analysis and discussions in Section IX.A.1; Ex. 1044, ¶¶0031, 0078; Ex. 1046, ¶0073 ("Persons of ordinary skill in the art will be aware that many different algorithms may be employed to enable the aforementioned tuning of the device. For example . . . the algorithm may implement PID (proportional, integral, differential) processing.").)[21]

249. In my opinion, a person of ordinary skill in the art would have had the skill, rationale, and knowledge in implementing, and reasonable expectation of success in achieving, such modification, especially where it would have involved applying known technologies (e.g., PID control technologies) (*Kazutoshi* and a person of ordinary skill in the art's state of art knowledge) with wireless power

[21] I cite Exs. 1044 and 1046 to support my opinions as to a person of ordinary skill in the art's state of the art knowledge at the time of the alleged invention, which is consistent with how such a person would have understood *Okada*, *Odendaal*, *Berghegger*, *Black*, and *Kazutoshi*'s teachings.

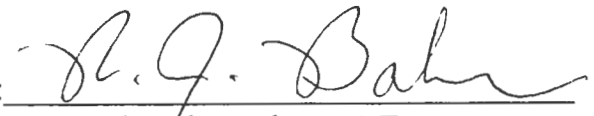
transfer/charging systems (*Okada-Odendaal-Berghegger-Black*) according to known techniques (e.g., regulating an output signal of a powering/charging system) that would have led a skilled person to provide an inductive power/charging system with a regulated output signal at the receiver rectifier circuit, consistent with the teachings of *Kazutoshi* and *Okada* and the features of the modified *Okada* system I discussed above. (*See* my analysis, discussions, and citations above in this section; *see also* my analysis and discussions in Sections VIII.A-D, G, IX.A.1.)

transfer/charging systems (*Okada-Odendaal-Berghegger-Black*) according to known techniques (e.g., regulating an output signal of a powering/charging system) that would have led a skilled person to provide an inductive power/charging system with a regulated output signal at the receiver rectifier circuit, consistent with the teachings of *Kazutoshi* and *Okada* and the features of the modified *Okada* system I discussed above. (*See* my analysis, discussions, and citations above in this section; *see also* my analysis and discussions in Sections VIII.A-D, G, IX.A.1.)

## X. CONCLUSION

250. In summary, it is my opinion that all of the features recited in claims 2, 4, and 18 of the '500 patent are disclosed and/or suggested by the prior art.

251. I declare that all statements made herein of my knowledge are true, and that all statements made on information and belief are believed to be true, and 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 Title 18 of the United States Code.

Dated: June 19, 2023 By: 

R. Jacob Baker, Ph.D., P.E.