

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD.
Petitioner

v.

MOJO MOBILITY INC.
Patent Owner

Patent No. 11,462,942

**DECLARATION OF R. JACOB BAKER, PH.D., P.E.
IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 11,462,942**

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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. 11,462,942 (“the ’942 patent”) (Ex. 1001).¹ I have been asked to consider whether the prior art discloses or suggests the features recited in claims 21-26 (“the challenged claims”) of the ’942 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 ’942 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. 11,462,942
Ex. 1004	Prosecution History of U.S. Patent No. 11,462,942
Ex. 1005	Translation of Japanese Patent Application Publication No. 2006-141170A (“ <i>Okada</i> ”) ²
Ex. 1006	U.S. Patent No. 6,912,137 (“ <i>Berghegger</i> ”)
Ex. 1007	U.S. Patent Application Publication No. 2006/0145660A1 (“ <i>Black</i> ”)
Ex. 1008	U.S. Patent No. 6,960,968 (“ <i>Odendaal</i> ”)
Ex. 1009	U.S. Patent No. 6,489,745 (“ <i>Koreis</i> ”)
Ex. 1010	U.S. Patent No. 6,366,817 (“ <i>Kung</i> ”)
Ex. 1011	Physics, Henry Semat et al., Rinehart & Co., Inc., 1958, Chapters 29-32 (“ <i>Semat</i> ”)

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

Ex. 1012	U.S. Patent No. 5,702,431 (“ <i>Wang</i> ”)
Ex. 1013	International Patent Application Publication No. WO1996040367 (“ <i>WangII</i> ”)
Ex. 1014	Handbook of Radio and Wireless Technology, Stan Gibilisco, McGraw-Hill, 1999 (“ <i>Gibilisco</i> ”)
Ex. 1015	U.S. Patent No. 4,942,352 (“ <i>Sano</i> ”)
Ex. 1016	Fundamentals of Electric Circuits, 2d., Charles Alexander et al., McGraw-Hill, 2004 (“ <i>Alexander</i> ”)
Ex. 1017	International Patent Application Publication No. WO1994/18683 (“ <i>Koehler</i> ”)
Ex. 1019	U.S. Patent Application Publication No. 2005/0068019 (“ <i>Nakamura</i> ”)
Ex. 1020	U.S. Patent Application Publication No. 2007/0109708 (“ <i>Hussman</i> ”)
Ex. 1023	U.S. Patent Application Publication No. 2004/0201988 (“ <i>Allen</i> ”)
Ex. 1024	U.S. Patent No. 7,378,817 (“ <i>Calhoon-817</i> ”)
Ex. 1025	International Patent Application Publication No. WO2003/096361 (“ <i>Cheng</i> ”)
Ex. 1026	International Patent Application Publication No. WO2004/038888 (“ <i>ChengII</i> ”)
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 (“ <i>Lee</i> ”)
Ex. 1028	U.S. Patent Application Publication No. 2001/0055207 (“ <i>Barbeau</i> ”)
Ex. 1029	AN710 Antenna Circuit Design for RFID Applications

Ex. 1030	U.S. Patent No. 6,606,247 (“ <i>Credelle</i> ”)
Ex. 1032	U.S. Patent No. 5,808,587 (“ <i>Shima</i> ”)
Ex. 1033	U.S. Patent Application Publication No. 2005/0134213A1 (“ <i>Takagi</i> ”)
Ex. 1036	International Patent Application Publication No. WO2003/105308A1 (“ <i>Hui</i> ”)
Ex. 1037	U.S. Patent No. 5,780,992 (“ <i>Beard-1</i> ”)
Ex. 1039	U.S. Patent No. 5,631,539 (“ <i>Beard-2</i> ”)
Ex. 1041	U.S. Patent Application Publication No. 2005/0127868A1 (“ <i>Calhoon</i> ”)
Ex. 1043	U.S. Patent No. 7,791,311 (“ <i>Sagoo</i> ”)
Ex. 1044	U.S. Patent Application Publication No. 2007/0145830A1 (“ <i>Lee-II</i> ”)
Ex. 1045	U.S. Patent Application Publication No. 2007/0267718A1 (“ <i>Lee-Via</i> ”)
Ex. 1047	U.S. Patent Application Publication No. 2006/0202665 (“ <i>Hsu</i> ”)
Ex. 1048	International Patent Application Publication No. WO2009155000A2 (“ <i>Lin</i> ”)
Ex. 1049	U.S. Patent Application Publication No. 2008/0067874 (“ <i>Tseng</i> ”)
Ex. 1050	U.S. Patent No. 9,356,473 (“ <i>Ghovanloo</i> ”)
Ex. 1056	U.S. Patent No. 6,459,383 (“ <i>Delatorre</i> ”)
Ex. 1057	International Patent Application Publication No. WO1999050806A1 (“ <i>Cunningham</i> ”)
Ex. 1058	International Patent Application Publication No. WO2004026129A1 (“ <i>Due-Hansen</i> ”)

Ex. 1059	U.S. Patent Application Publication No. 2009/0261778 (“ <i>Kook</i> ”)
Ex. 1060	U.S. Patent Application Publication No. 2003/0195581A1 (“ <i>Meadows</i> ”)
Ex. 1061	International Patent Application Publication No. WO2002/37641 (“ <i>Cho</i> ”)
Ex. 1062	U.S. Patent Application Publication No. 2007/0022058 (“ <i>Labrou</i> ”)
Ex. 1063	ATMEL e5530 Data Sheet (2002)
Ex. 1064	U.S. Patent Application Publication No. 2009/0243799A1 (“ <i>Tetlow</i> ”)
Ex. 1065	U.S. Patent Application Publication No. 2003/0143963A1 (“ <i>Pistor</i> ”)
Ex. 1066	U.S. Patent Application Publication No. 2002/0166073A1 (“ <i>Nguyen</i> ”)
Ex. 1067	U.S. Patent Application Publication No. 2006/0119418A1 (“ <i>Merandat</i> ”)
Ex. 1075	Watson, J., Mastering Electronics, Third Ed., McGraw-Hill, Inc. (1990) (“ <i>Watson</i> ”)
Ex. 1076	Sedra, A., <i>et al.</i> , Microelectronic Circuits, Fourth Ed., Oxford University Press (1998) (“ <i>Sedra</i> ”)
Ex. 1077	GB Patent Application Publication No. 2202414 (“ <i>Logan</i> ”)
Ex. 1078	U.S. Patent No. 7,226,442 (“ <i>Sheppard</i> ”)

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 '942 patent at the time of the alleged invention.

18. I understand that the '942 patent issued from U.S. Patent Application No. 17/728,502, filed on April 25, 2022, 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 '942 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 '942 patent to be around the timeframe from April 2007 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:

- claims 21-24 and 26: around April 30, 2007 to July 30, 2007;
- claim 25: 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 '942 patent, the prior art to the patent, and the state of the art at the time of the alleged invention (e.g., from April 2007 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 '942 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 21-26 of the '942 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 April 2007 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 '942 patent, a person of ordinary skill in the art at the time of the alleged invention of the '942 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 April 2007 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., early-2007 to mid-2007 (claims 21-24 and 26), mid-to-late 2007 (claim 25) 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 '942 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 '942 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 '942 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 '942 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 '942 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. 1075, 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.)

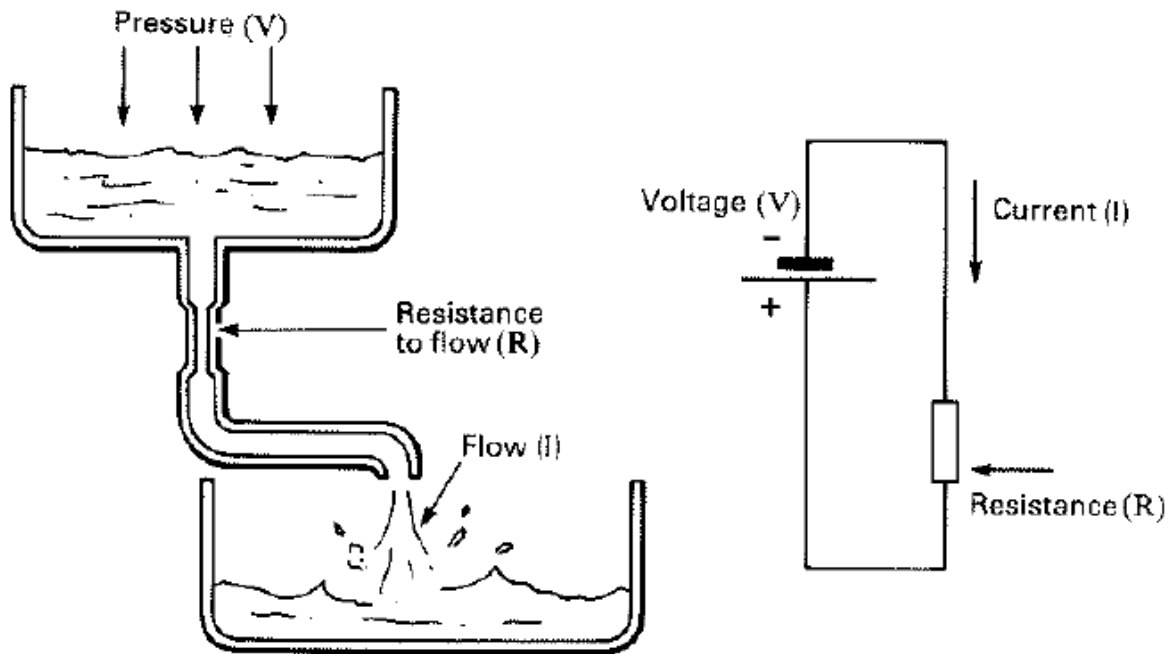
27. Additionally, a person of ordinary skill would have known that resistance is another fundamental concept involved in the flow of electrons. “Resistance is a property of all materials that reduces the flow of electricity through them,” so that “[t]he higher the resistance, the more difficult it is 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.

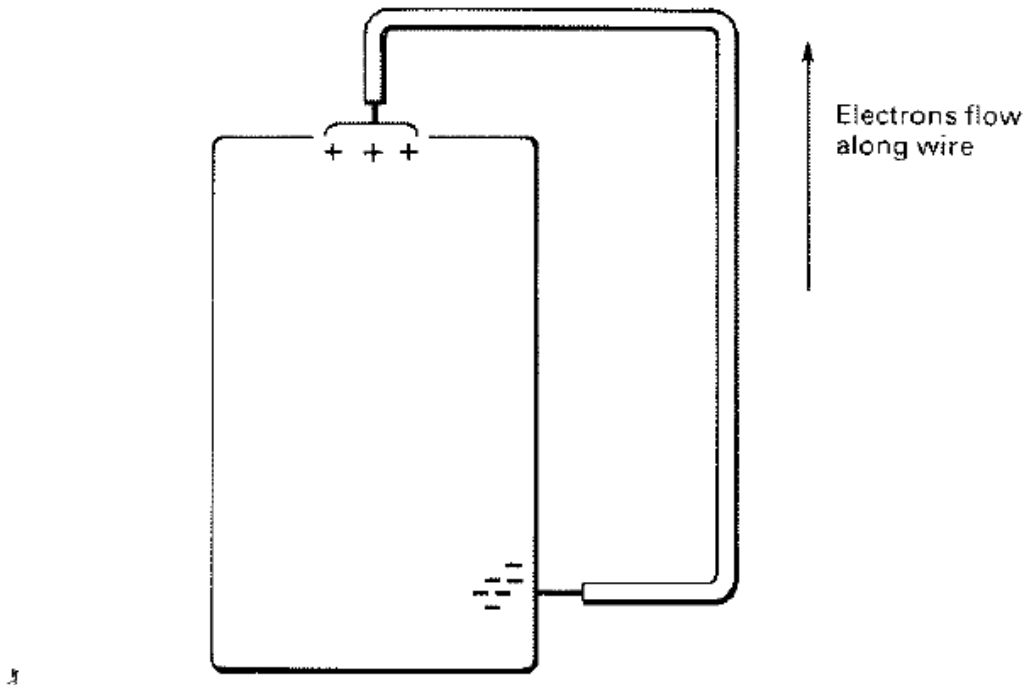
fig 2.5 a plumbing analogy: voltage, current and resistance all have their equivalents in the water system



(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*



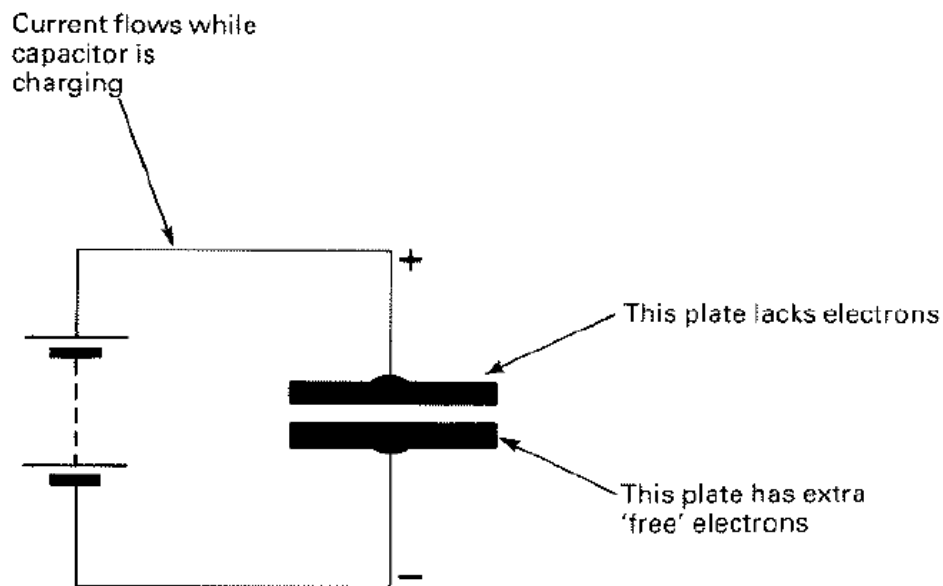
(*Id.*, FIG. 2.3.) A person of ordinary skill would have known that without such a closed path (e.g., as shown above in Figure 2.3), current cannot flow. (*Id.*, 8-11, FIGS. 2.3-2.5.)

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*



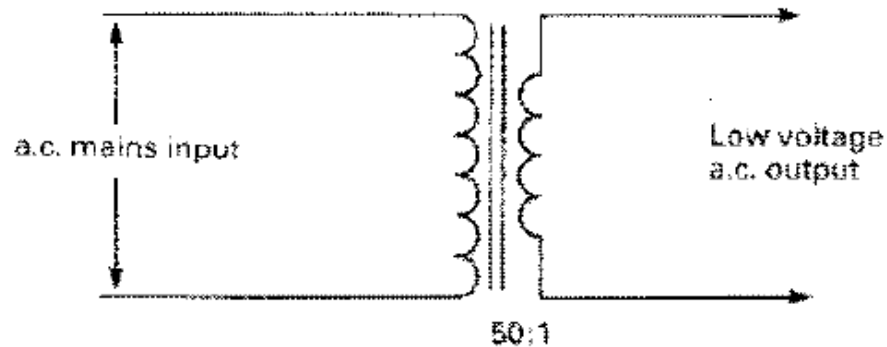
(*Id.*, FIG. 3.8.) A person of ordinary skill would have known that “[i]n this state the capacitor is said to be *charged*,” and [i]f the charged capacitor is connected in a circuit, it will, for a short time, act as a voltage source, just like a battery.” (*Id.*, 27

(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. 1076, 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).)

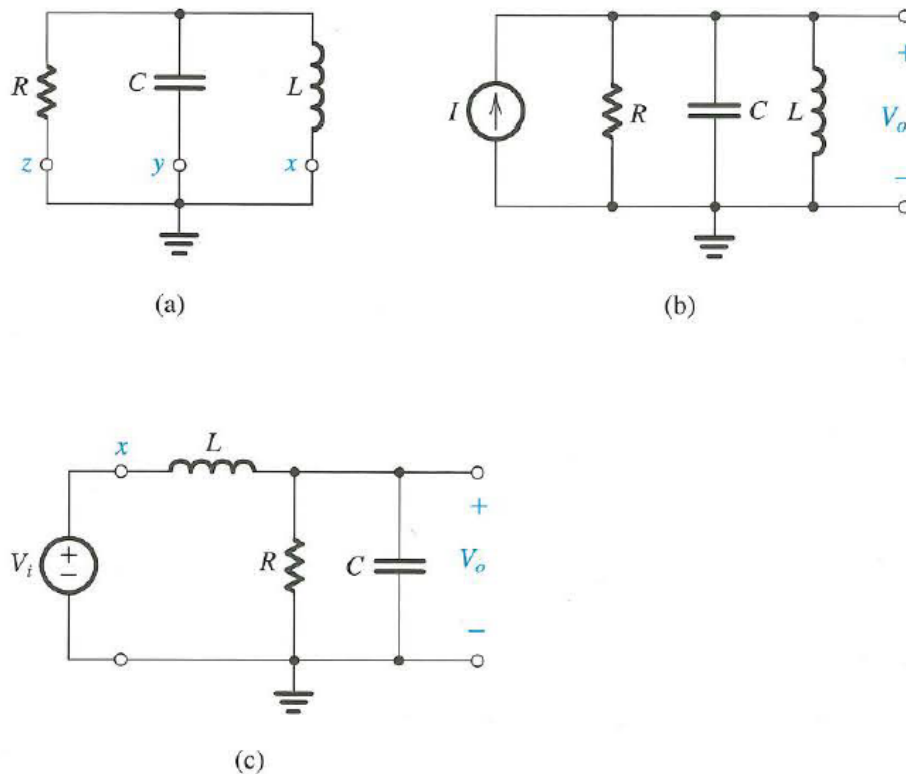


Fig. 11.17 (a) The second-order parallel LCR resonator. (b) and (c) Two ways for exciting the resonator of (a) without changing its *natural structure*. The resonator poles are the poles of V_o/I and V_o/V_i .

(*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.)

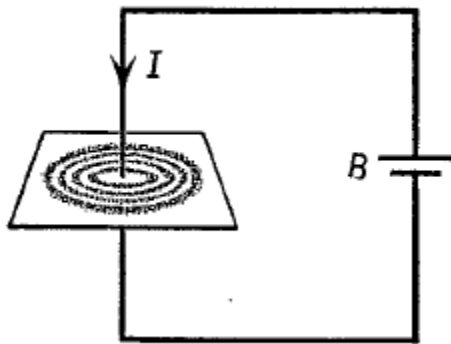


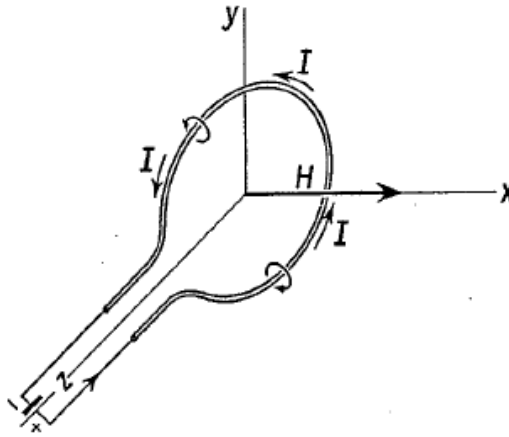
Fig. 30-2 Pattern formed by iron filings showing the circular magnetic field around a wire carrying current.

(*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.)

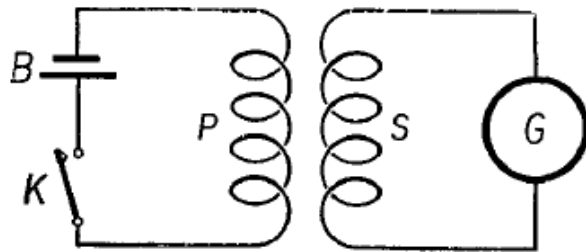


Fig. 32-3 Faraday's experiment on electromagnetic induction.

(*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

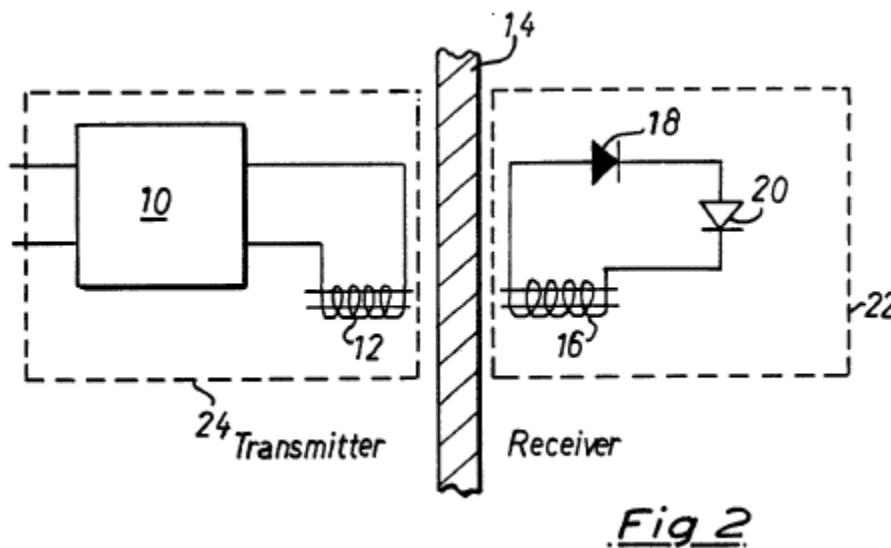
first circuit, the magnetic field (and therefore, magnetic flux) generated by the primary coil P is continuously varied, thereby inducing a corresponding EMF in the secondary circuit based on the inductive coupling between the primary coil P and the secondary coil S.

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. 1077, 1:10-12.) It was well known to use inductor coils to facilitate wireless signal transmission. (Ex. 1078, 5:39-66 (describing “receiv[ing] power from an electromagnetic (EM) energy source” and “a coil for the receipt of electromagnetic energy”); Ex. 1077, 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.

1077, 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. 1078,

5:39-66 (describing “receiv[ing] power from an electromagnetic (EM) energy source” and “a coil for the receipt of electromagnetic energy”); Ex. 1077, Abstract, FIGS. 1-2, 3:19-23, 4:12-14, 6:3-5.) Additionally, *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

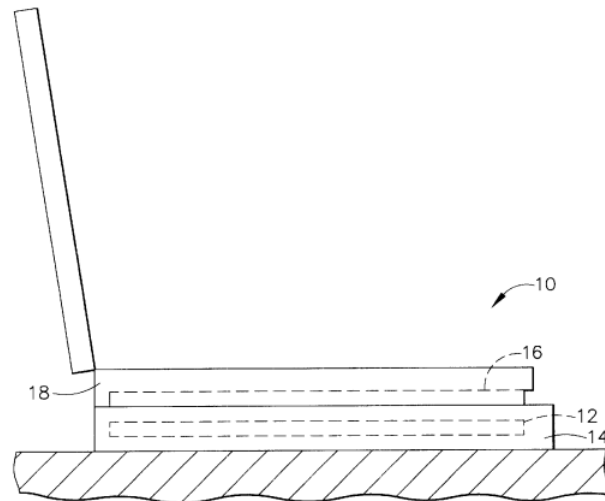


FIG. 1

(*Id.*, FIG. 1.)

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

³ I have added any emphasis herein unless indicated otherwise.

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

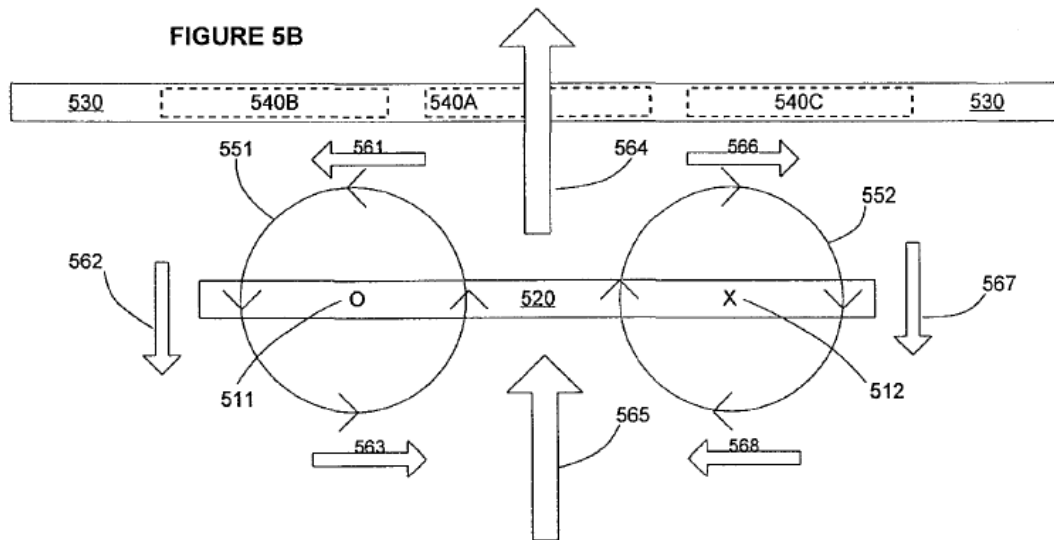
564 and 565 is perpendicular to plane 520 of charger and primary coil 510 and/or plane 540A of secondary coil 230.

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.)

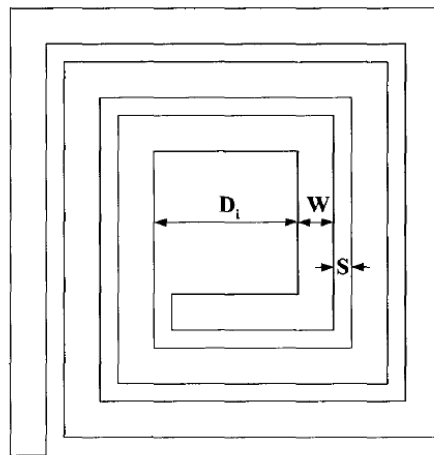


Fig. 1. A planar square spiral inductor structure.

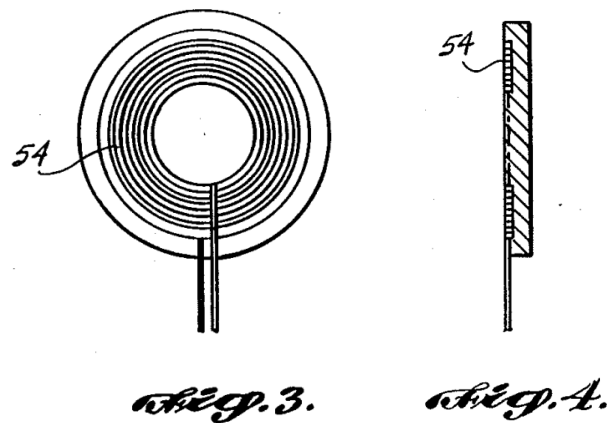
(*Id.*, FIG. 1 (showing a “**planar square spiral inductor** structure”).)

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.)



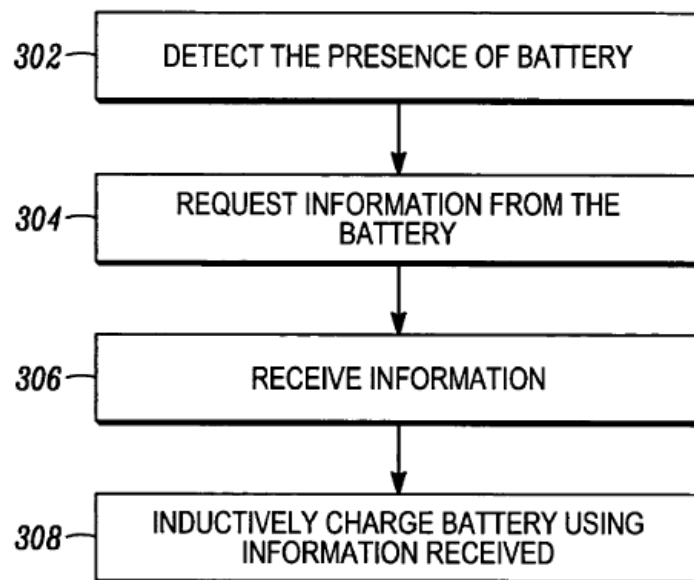
(*Id.*, FIGS. 3-4.)

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. Additionally, 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, $w_1 < w < w_2$ 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.)

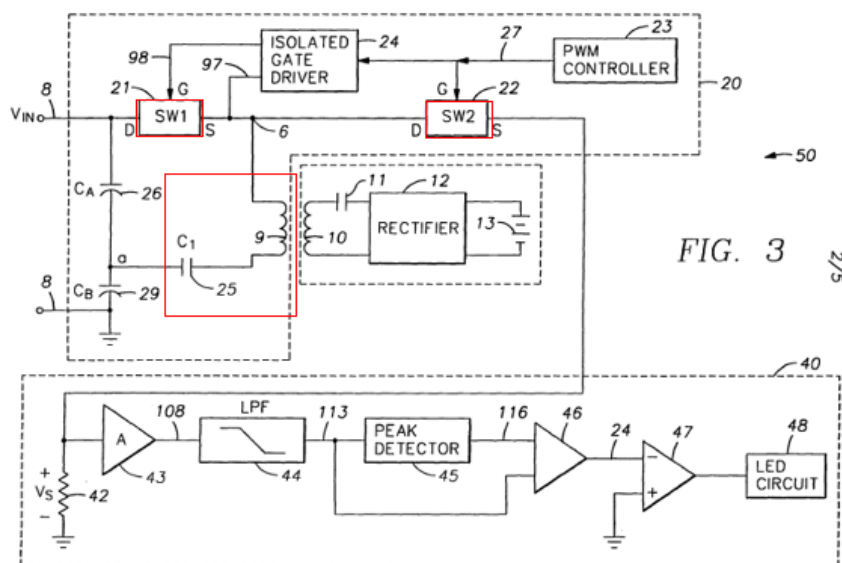
63. Likewise, *Lee-II* explains that:

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’s knowledge 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 trace 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 '942 PATENT

66. The '942 patent relates “generally to power supplies, power sources, and particularly to a system and method for inductive charging of portable devices.” (Ex. 1001, 1:45-47.) For example, the patent explains that “A portable inductive power source, power device, or unit, for use in powering or charging electrical, electronic, battery-operated, mobile, and other devices or rechargeable batteries is disclosed herein. In accordance with an embodiment the system comprises 2 parts: The first part is a pad or similar base unit that contains a primary, which creates an alternating magnetic field by means of applying an alternating current to a winding, coil, or any type of current carrying wire. The second part of the system is a receiver that comprises a means for receiving the energy from the alternating magnetic field from the pad and transferring it to a mobile or other device or rechargeable battery.” (*Id.*, 3:45-56.)

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 '942 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 21-26, 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

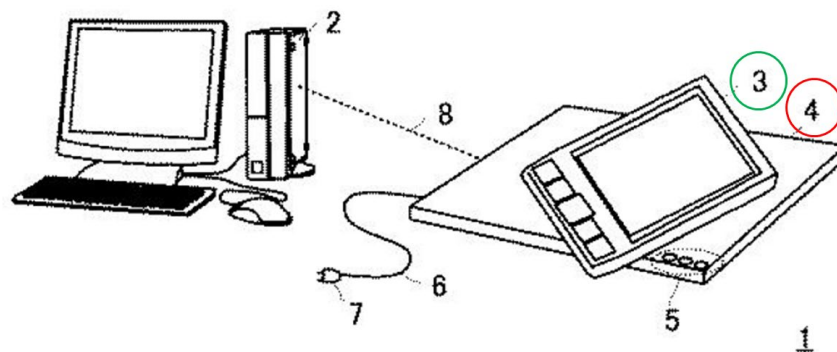
69. I rely on the disclosures and analysis thereof of the prior art discussed in this section VIII for my opinions regarding their respective teachings and suggestions as applied to the challenged claims of the '942 patent below in Section IX. Accordingly, the following discussions are incorporated into 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 '942 patent below in Section IX.

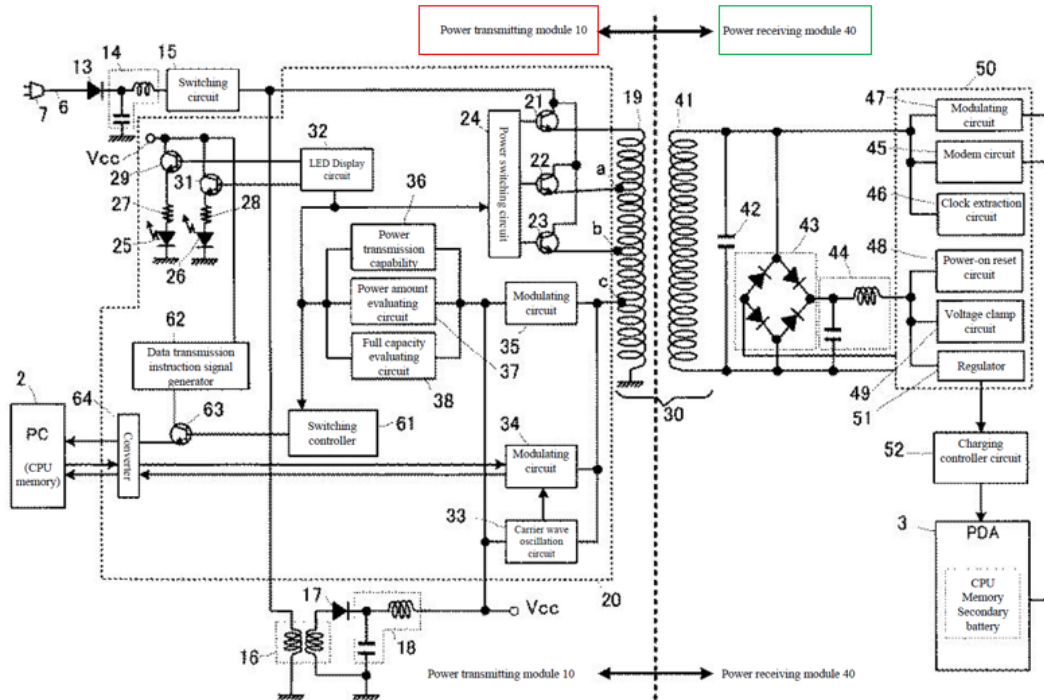
71. *Okada* discloses a system for inductive powering or charging of portable devices such as mobile phones and PDAs with batteries. (Ex. 1005, Abstract, ¶¶0001, 0015, 0047, FIG. 2, claim 4.) *Okada*'s FIG. 1 shows a power supply system 1 including PC 2, PDA 3 (green), and cradle 4 (red), which receives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

FIG. 1



(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.)

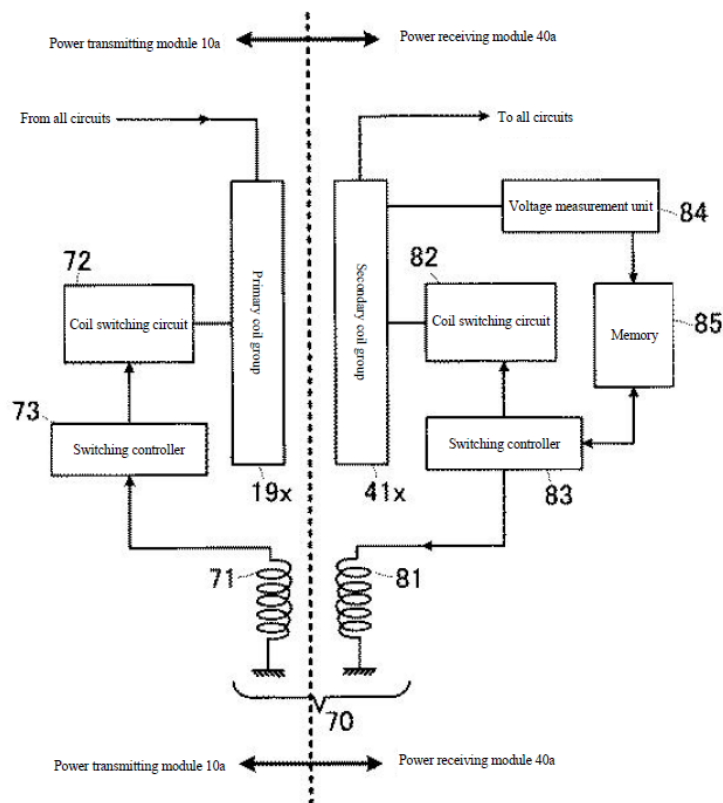


(Ex. 1005, FIG. 2 (annotated).)

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.)

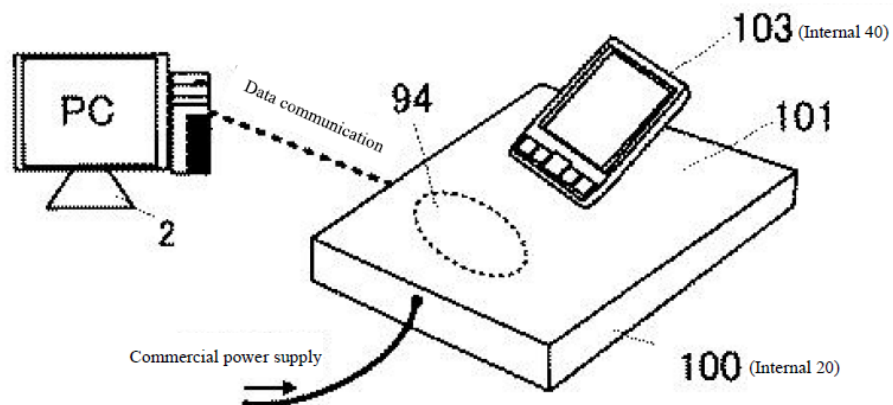
75. A person of ordinary skill in the art would have understood that applications/disclosures of these features of *Okada* (that I discussed above and below in this section) are also described in *Okada* with respect to (and are applicable to) other exemplary system(s)/configuration(s)/figure(s). (Ex. 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 **PTM10**s 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.

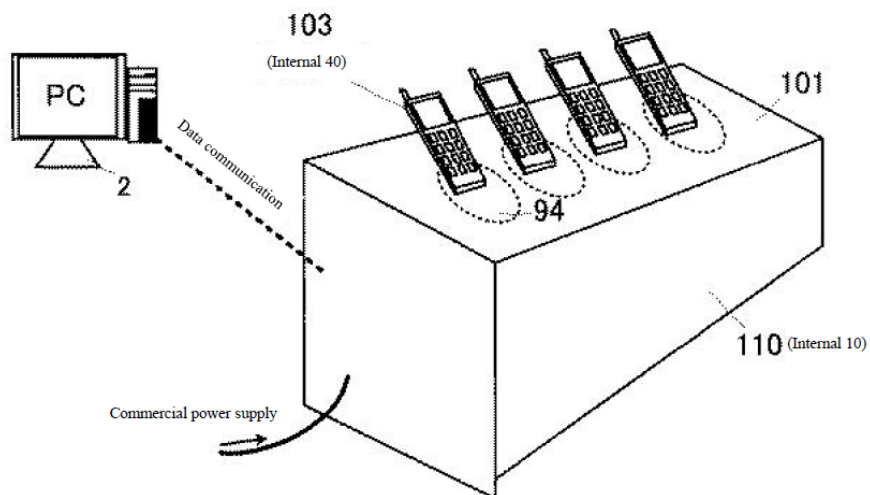
(Ex. 1005, ¶0030.)

FIG. 9



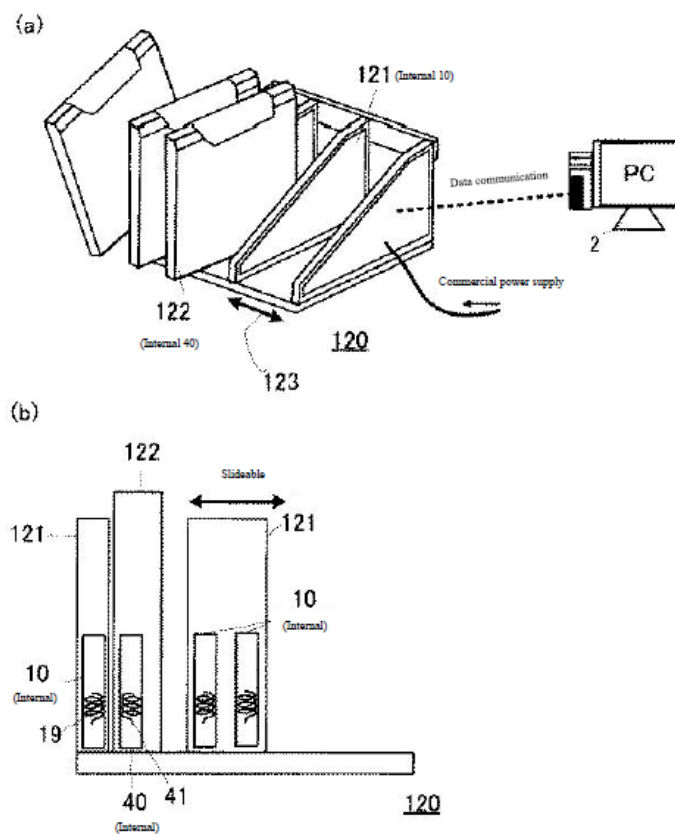
(Ex. 1005, FIG. 9.)

FIG. 10



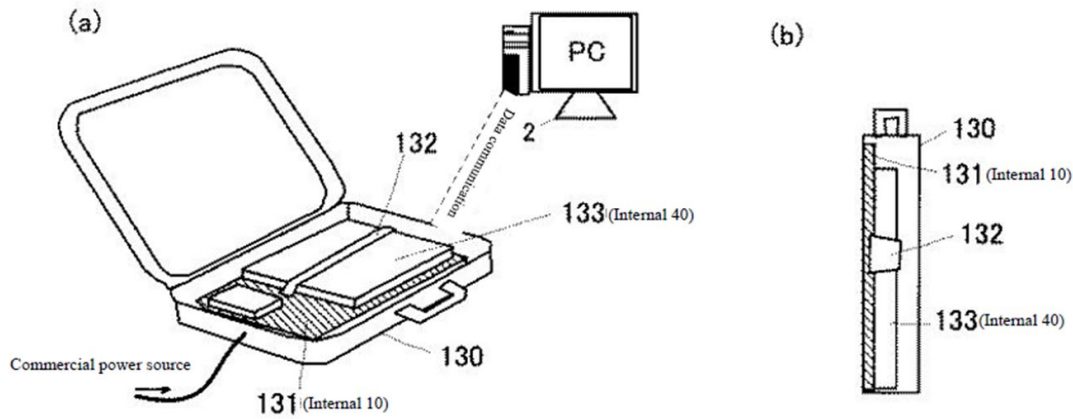
(*Id.*, FIG. 10.)

FIG. 11



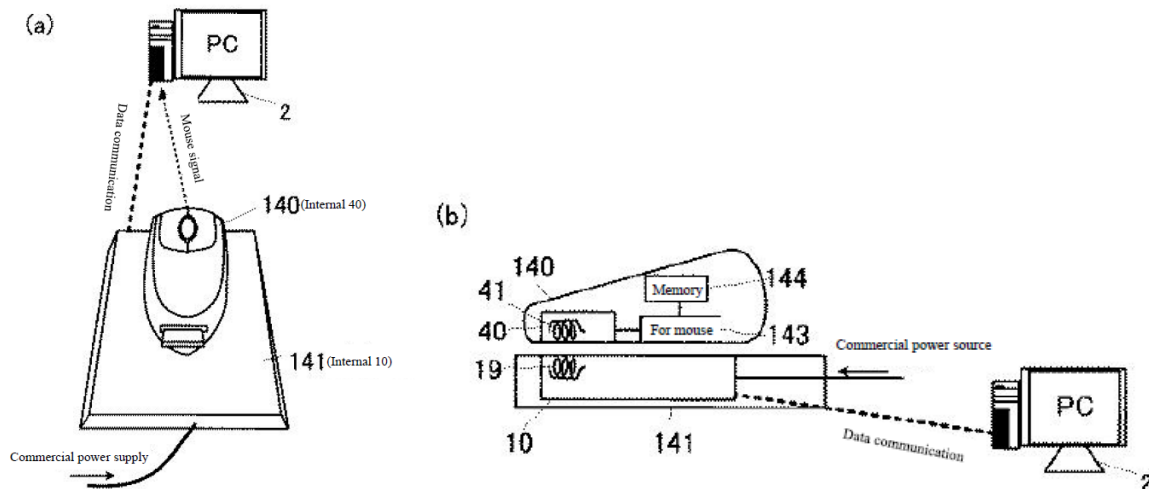
(*Id.*, FIGS. 11(a), 11(b).)

FIG. 12



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

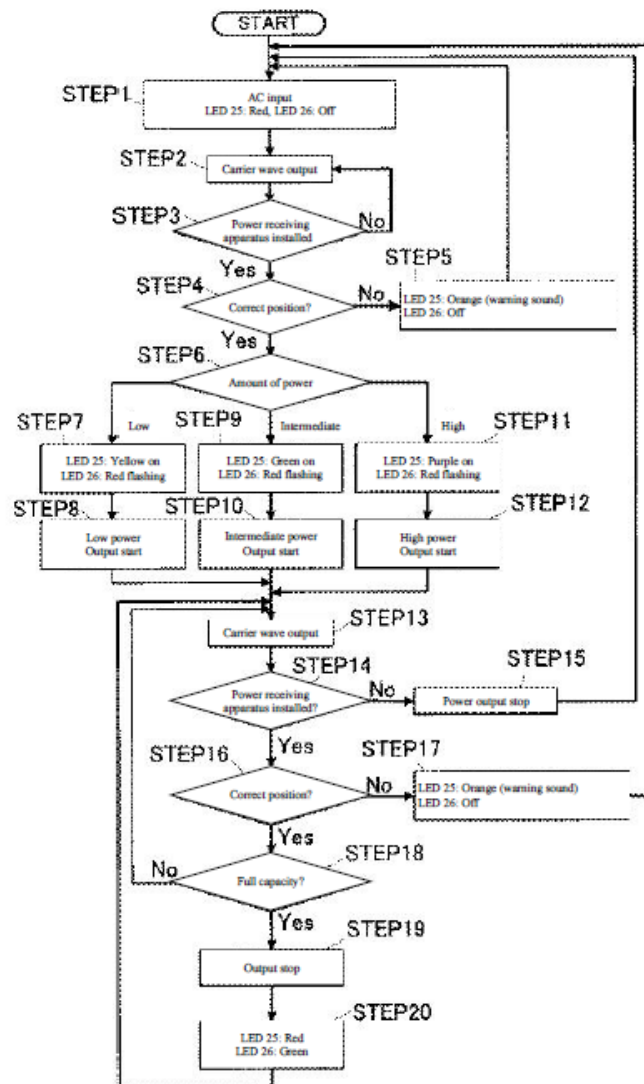
FIG. 13



(*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/wave⁴ 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

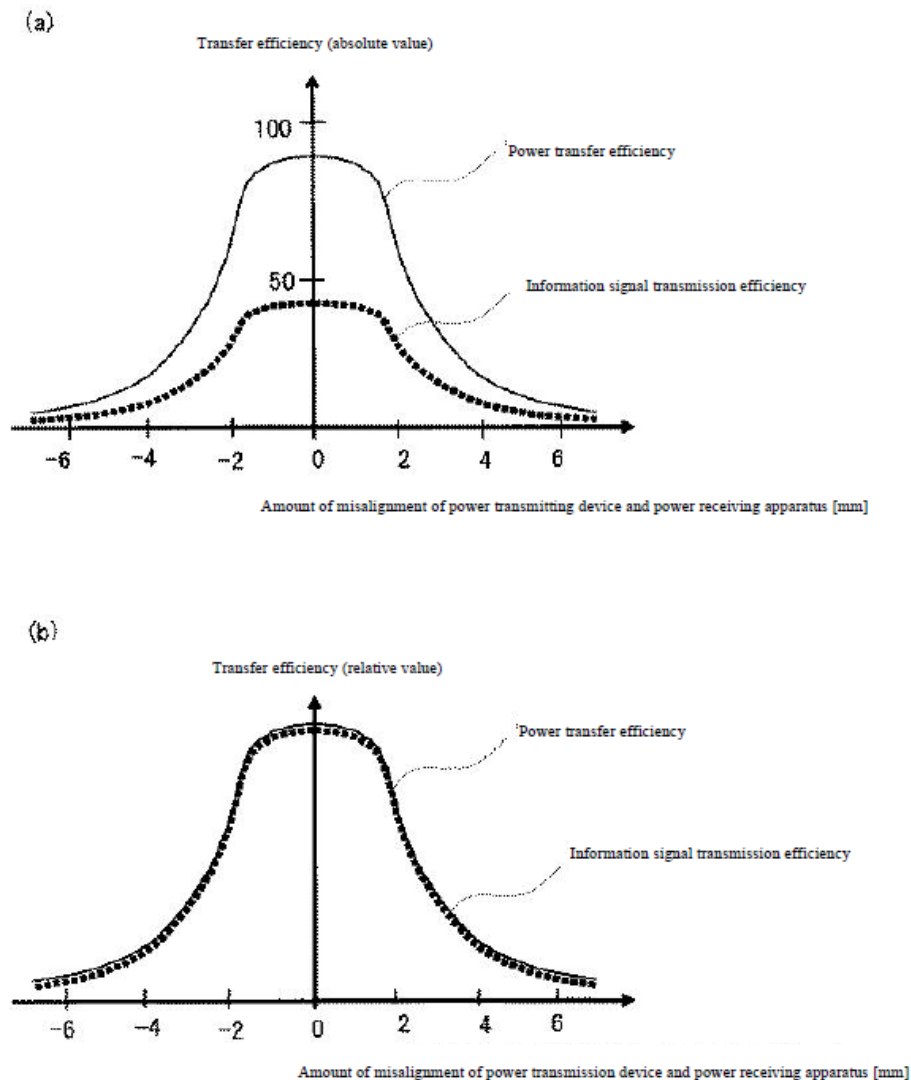
information signal, the amount of positional offset of the common cradle 4 and the PDA 3 can be recognized.

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.

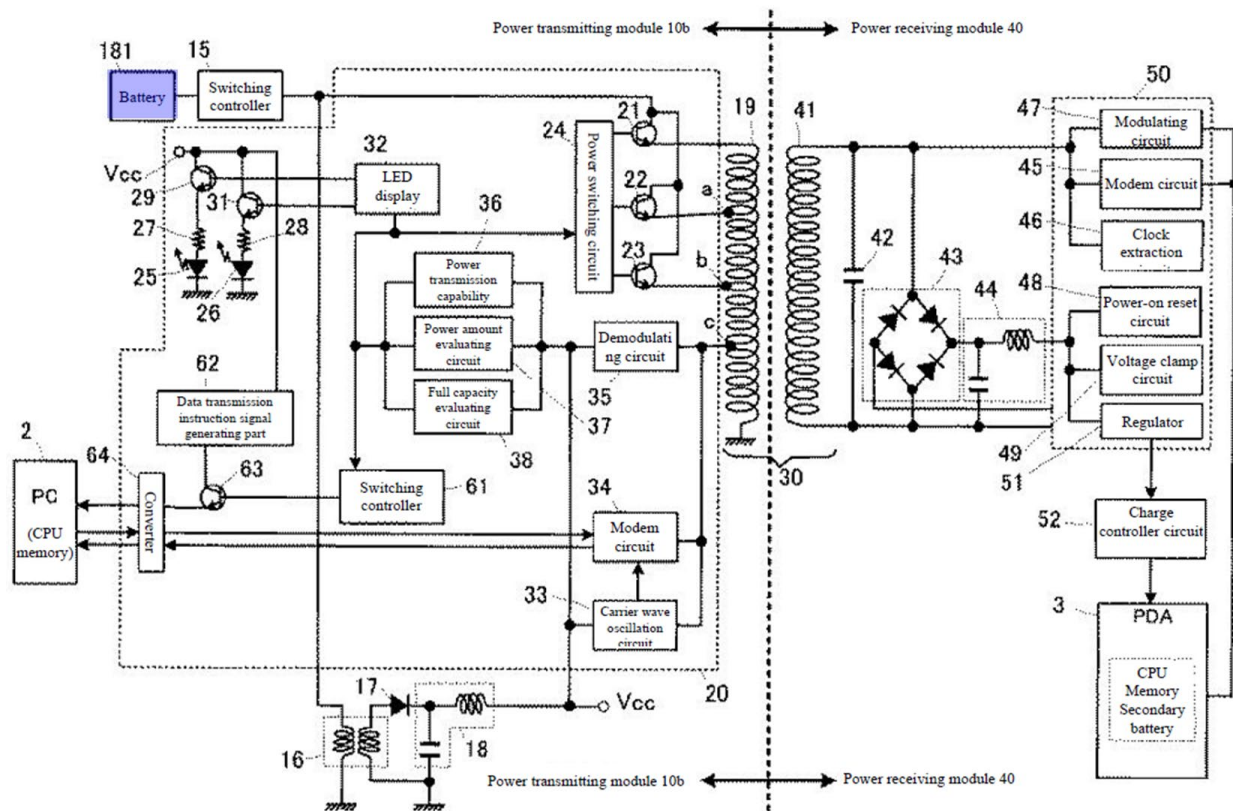
Meanwhile, when the amount of positional offset of the common cradle 4 and the PDA 3 does not exceed the prescribed amount of offset, processing proceeds to evaluating whether a charged state of the PDA 3 is at full capacity (STEP 18). This evaluation process is conducted by the full capacity evaluating 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).) Additionally, *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. *Berghegger* (Ex. 1006)

85. 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 ’942 patent below in Section IX.

86. *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”).)

87. *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.)

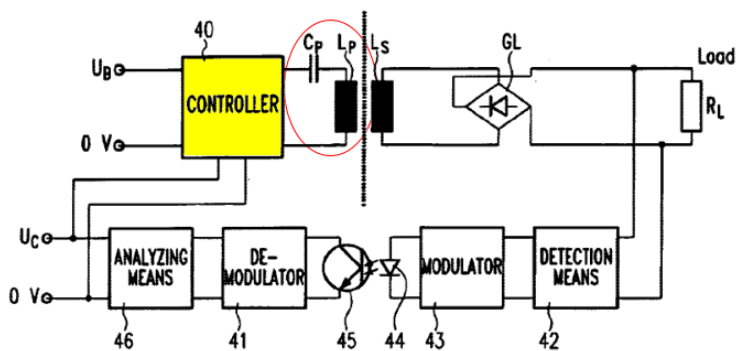


Fig.4

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

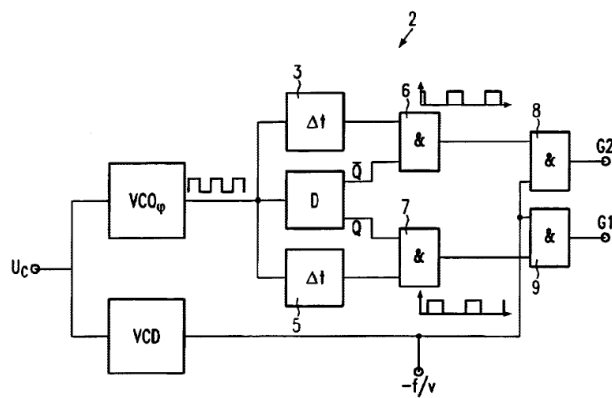
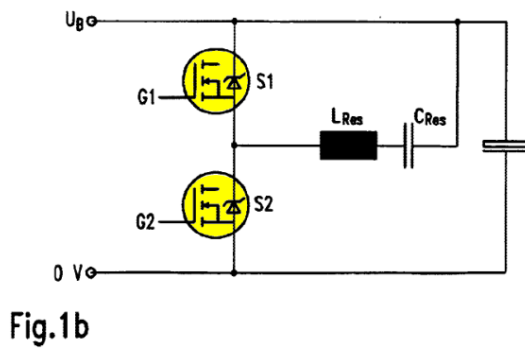


Fig.2

(*Id.*, FIG. 2.)



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

88. *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.)

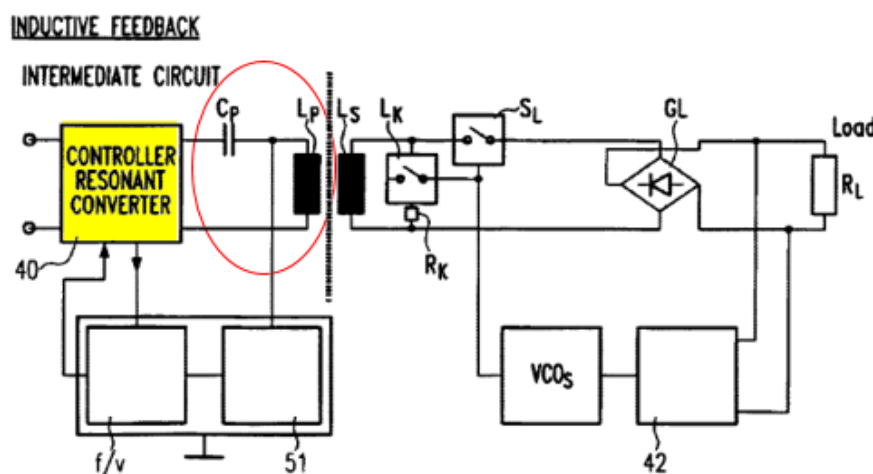


Fig.5

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

89. 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 ”).)

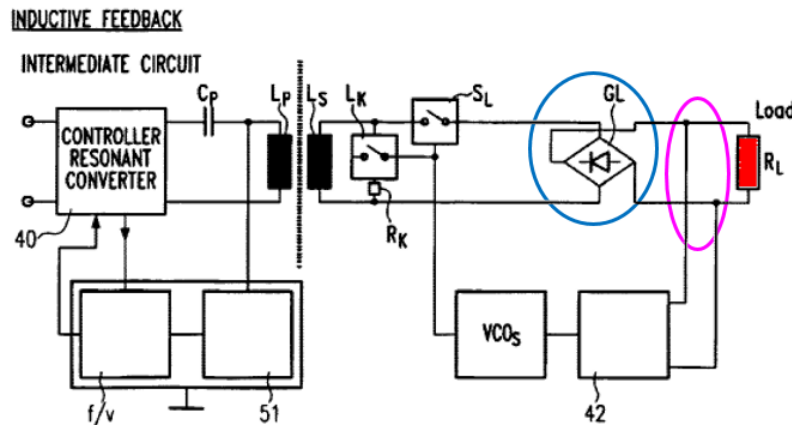
90. *Berghegger* also teaches using a capacitor with the primary-side inductor “to obtain a serial resonant circuit [which] has the advantage that the power transmission from the primary side to the secondary side is improved” (Ex. 1006, 2:58-61) and also choosing the highest frequency produced by the 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 L_P on the primary side forms a resonant circuit with the resonant capacitor C_P .” (*Id.*, 3:58-59; see also *id.*, FIGS. 1a, 4-5.)

91. *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.”).)

92. Additionally, 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).)

93. *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 losses 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.)

C. *Odendaal* (Ex. 1008)

94. 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 '942 patent below in Section IX.

95. *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.)

96. *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).)

97. 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.”).)

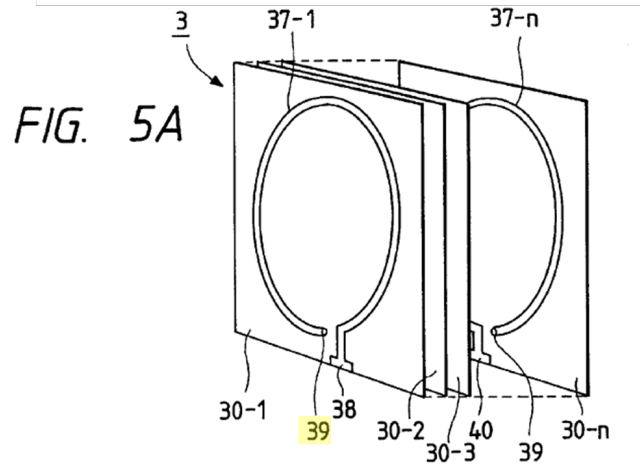
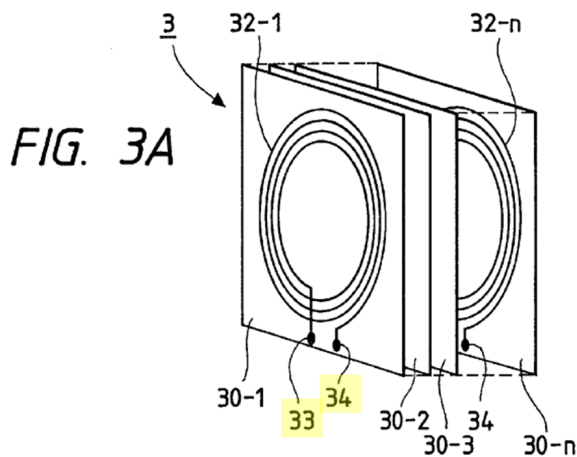
D. *Shima* (Ex. 1032)

98. I understand that *Shima* is an issued United States patent. (Ex. 1032, Cover.) My understanding is that *Shima* was filed March 21, 1997 and issued September 15, 1998. (*Id.*) I rely on the disclosures and analysis thereof of *Shima* that I discuss in this section VIII for my opinions regarding *Shima*'s teachings and suggestions as applied to the challenged claims of the '942 patent below in Section IX.

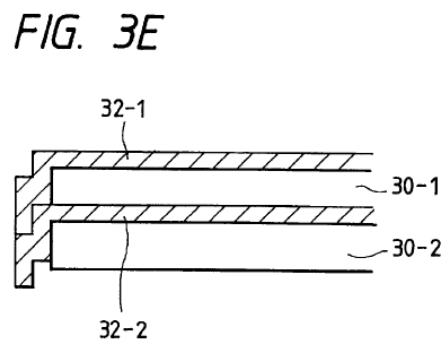
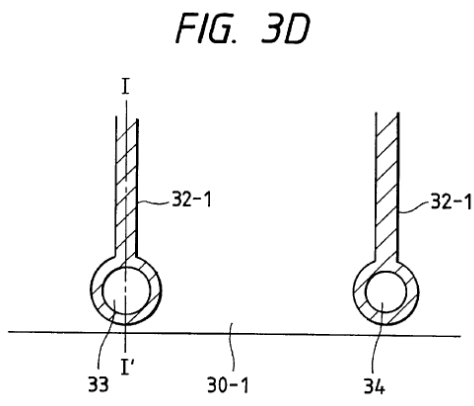
99. *Shima* discloses an inductive power/signal transfer system using primary and secondary coils. (Ex. 1032, Abstract, 1:42-50, 2:12-4:10, 5:62-6:53, 7:17-8:38.)

100. *Shima* discloses connecting different coil patterns residing on different layers of PCBs by using through-holes (vias). For example, FIG. 3A (below) is described having "a plurality of thin printed-circuit substrates 30-1 to 30-n" with similar "coil patterns 32-1 to 32-n." (Ex. 1032, 5:62-6:1, FIGS. 3D-3E (below), 6:13-35.) *Shima* explains that starting and terminating ends of the coil patterns are connected using through-holes 33 and 34, respectively. (*Id.*, 6:4-21.) *Shima* also explains that layers of loop patterns (e.g., 37-1 to 37-n (FIG. 5A (below))) may also "have the respective through-holes [39] connected in such a way that a spiral coil is

formed in the direction in which the printed-circuit substrates 30-1 to 30-n are stacked.” (*Id.*, 7:17-35.)



(Ex. 1032, FIGS. 3A, 5A (annotated).)



(*Id.*, FIGS. 3D, 3E.)

E. *Takagi* (Ex. 1033)

101. I understand that *Takagi* is a published United States patent application.

(Ex. 1033, Cover.) My understanding is that *Takagi* was filed November 4, 2004

and published June 23, 2005. (*Id.*) I rely on the disclosures and analysis thereof of *Takagi* discussed in this section VIII for my opinions regarding *Takagi*'s teachings and suggestions as applied to the challenged claims of the '942 patent below in Section IX.

102. *Takagi* discloses inductive power/signal transfer system configurations using primary and secondary coils. (Ex. 1033, Abstract, FIGS. 1-7, ¶¶0003, 0013-0030, 0041-0078.)

103. *Takagi* discloses a power transmitting/receiving device 12 including a coil 125, power transmitting circuit 121, power receiving circuit 122, secondary battery 123, and other components. (Ex. 1033, FIG. 2 (annotated below), ¶0047.) *Takagi* explains that such features are applicable to portable systems, such as cellular phones and “portable personal computers” (e.g., laptop computers). (*Id.*, ¶¶0026, 0030, 0043, 0058, 0065, 0070.)

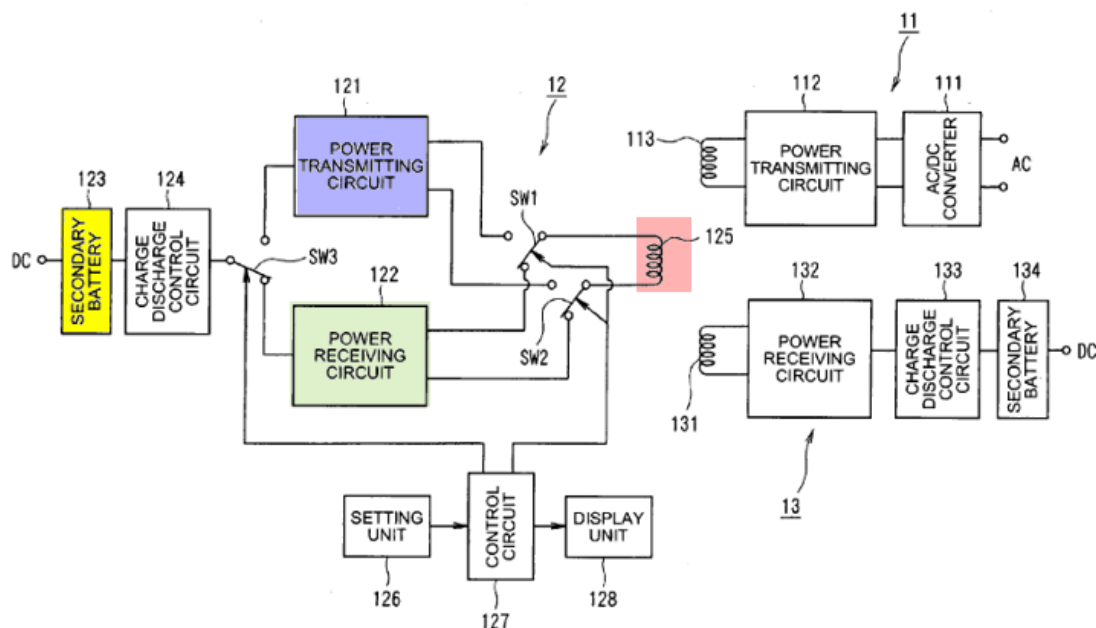


FIG. 2

(Ex. 1033, FIG. 2 (annotated).) *Takagi* explains that transmitting circuit 121 produces an alternating voltage from battery 123, and supplies it to coil 125 for inductively charging other device 13 via coupled secondary coil 131. (*Id.*, ¶¶0048, 0054-0056.) Alternatively, device 12 may also inductively receive power from device 11 (via coils 125 and 113) for recharging battery 123. (*Id.*, ¶¶0048-0053.) Thus, a person of ordinary skill in the art would have understood that when coil 113 approaches coil 125 (and based on switch SW1-SW2 settings), power receiving circuit 122 receives power from device 11 (via the magnetic coupling between coils 125 and 113) to charge battery 123. (*Id.*, ¶¶0048, 0052-0053, 0069-0072; *id.*,

¶¶0057-0068.) Also, *Takagi* explains that battery 123 can be “repeatedly used by charging.” (*Id.*, ¶0049.)

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 ’942 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.)

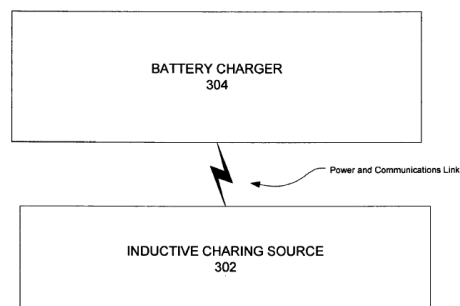


FIGURE 2

(Ex. 1041, FIG. 2.)

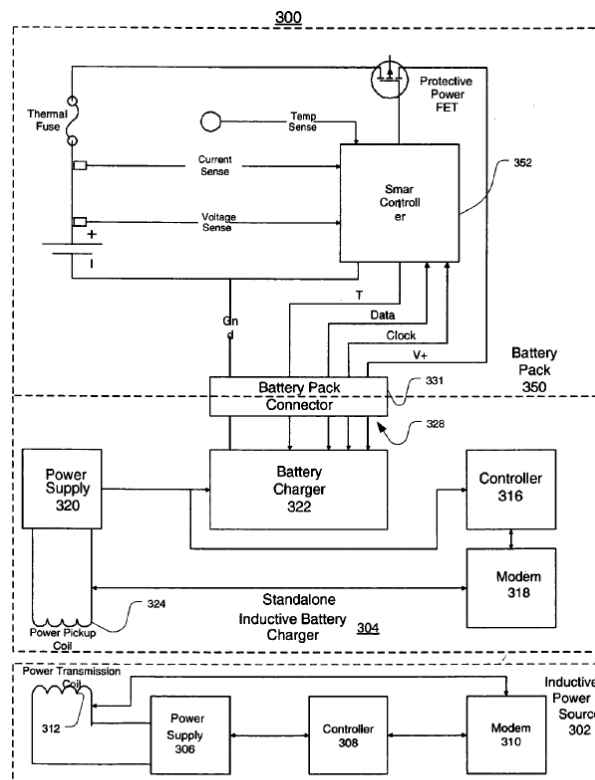


FIGURE 3

(*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. *Cho* (Ex. 1061)

107. I understand that *Cho* is a published International patent application. (Ex. 1061, Cover.) My understanding is that *Cho* was filed November 6, 2001 and published May 10, 2002. (*Id.*) I rely on the disclosures and analysis thereof of *Cho* discussed in this section VIII for my opinions regarding *Cho*'s teachings and suggestions as applied to the challenged claims of the '942 patent below in Section IX.

108. *Cho* discloses designs/materials associated with planar receiver coils used for charging/powering portable devices. (Ex. 1061, 17:10-18 (“a

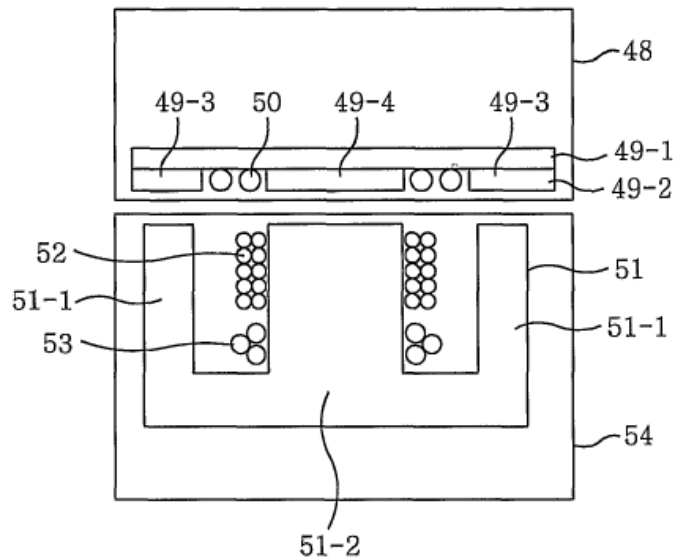
transformer...divided into two parts implemented in a charger 54 and such portable device 48”), 17:18-19:19.) For example, *Cho* explains:

Fig. 8A is a cross sectional view of showing a transformer in accordance with the first preferred embodiment of the present invention, which is divided into two parts implemented in a **charger 54** and such **portable device 48** as a mobile phone, a MP3 player, a MD player, a portable cassette player and a notebook computer. **A primary circuit of a separable type transformer is installed in the charger 54, and a secondary circuit of the separable type transformer is installed in the portable device 48.**

(Ex. 1061, 17:10-18.)

109. Such configurations include using ferrite sheets for implementing planar receiver coils in portable devices. (Ex. 1061, FIG. 8A (below).)

FIG. 8A



110. Portable device 48 includes a “thin film shape winding 50” located in a groove formed by two layers of ferrite sheets 49-1—49-2. (Ex. 1061, 17:10-18:15.)

The secondary circuit of the transformer includes two layers of ferrite sheets 49-1 and 49-2. The first ferrite sheet 49-1 is constructed as a round shape with a diameter corresponding to the ferrite core 51, and the second ferrite sheet 49-2 is formed at a position facing the charger 54. The second ferrite sheet 49-2, which is a ring shape, has a cylindrical part 49-3 whose circumference and thickness are similar to those of the cylindrical part 51-1 of the ferrite core 51, and a circular column 49-4 whose diameter is identical to that of the circular column 51-2 of the ferrite core 51. A winding groove is constructed on the round

shaped ferrite sheet 49-2, and **a thin film shape winding 50** of the secondary circuit of the transformer is formed inside of the winding groove.

(Ex. 1061, 17:36-18:15.)

H. *Meadows* (Ex. 1060)

111. I understand that *Meadows* is an issued United States patent. (Ex. 1060, Cover.) My understanding is that *Meadows* was filed April 18, 2003 and issued October 16, 2003. (*Id.*) I rely on the disclosures and analysis thereof of *Meadows* that I discuss in this section VIII for my opinions regarding *Meadows*'s teachings and suggestions as applied to the challenged claims of the '942 patent below in Section IX.

112. *Meadows* discloses a battery protection IC 686 controlling a FET switch 688 to ensure that battery 180 is not overcharged. (Ex. 1060, ¶¶0086-0087, FIG. 7A (annotated below).)

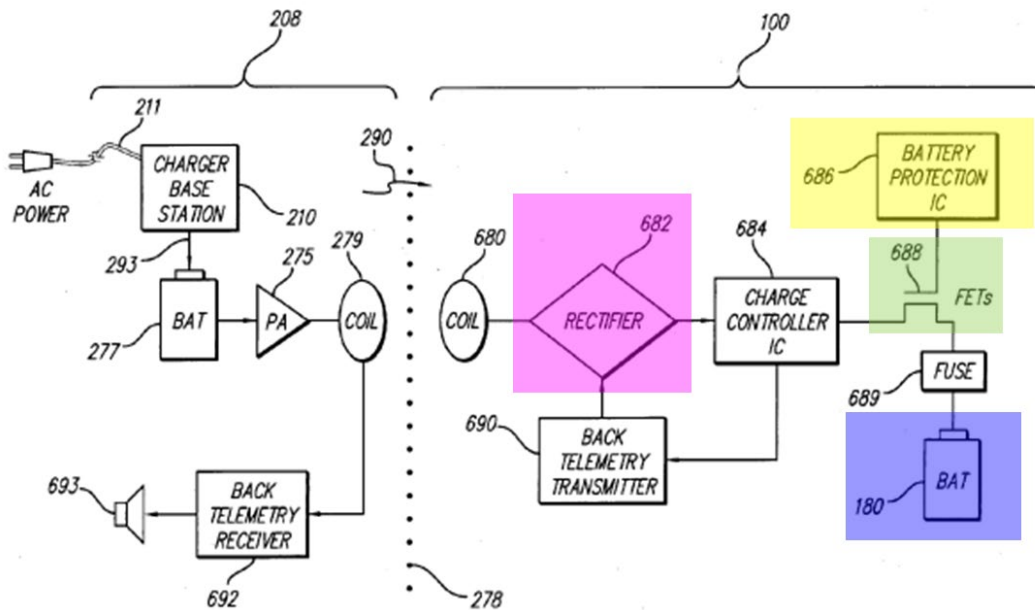


FIG. 7A

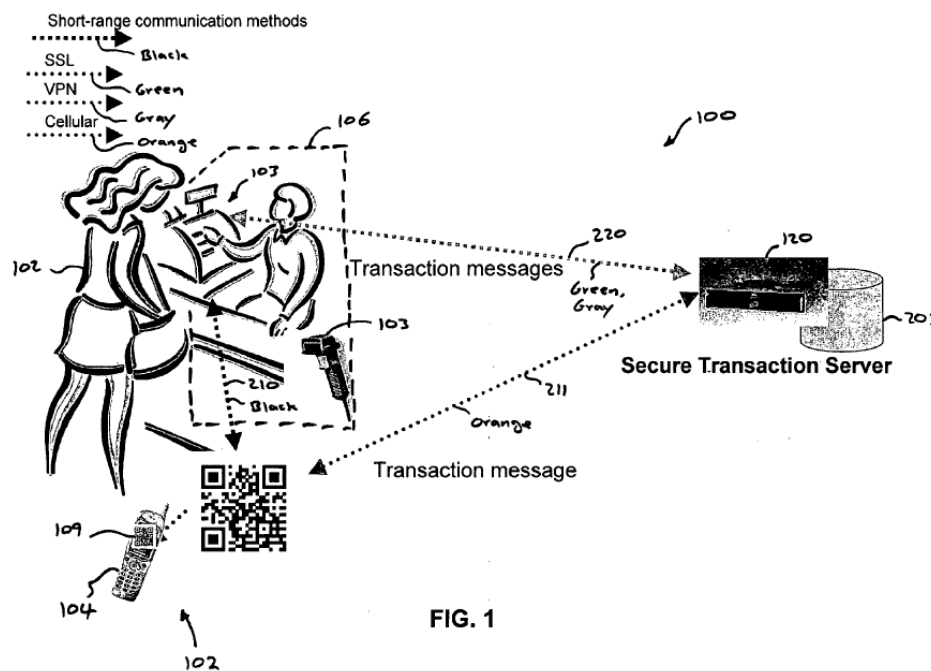
113. Rectifier 682 converts an AC signal from coil 680 to a DC signal for charging battery 180. (*Id.*, ¶0086.) “IC 686, with its FET switch 688...**keeps the battery within safe operating limits.**” (*Id.*, ¶0087.) If abnormality occurs when charging the battery (*e.g.*, overvoltage/undervoltage/short-circuit), “IC 686 **opens...switches 688 to prevent further charging.**” (*Id.*, ¶¶0087-0089; *id.*, ¶0022.)

I. *Labrou* (Ex. 1062)

114. I understand that *Labrou* is a published United States patent application. (Ex. 1062, Cover.) My understanding is that *Labrou* was filed July 18, 2006 and published January 25, 2007. (*Id.*) I rely on the disclosures and analysis thereof of *Labrou* discussed in this section VIII for my opinions regarding *Labrou*’s

teachings and suggestions as applied to the challenged claims of the '942 patent below in Section IX.

115. *Labrou* discloses mobile devices having wireless communication capability. (Ex. 1062, ¶0009.) *Labrou* discloses an NFC chip coupled to a mobile device 104 and being a “part of the circuitry thereof,” allowing software of mobile device 104 to “communicate with the . . . NFC chip.” (*Id.*, ¶0185, FIG. 1.) Mobile device 104 may be used for “physical POS [point of sale] transactions,” where the mobile device sends to a POS device 103 (e.g., cash register) a transaction message for “authentica[ting] and approv[ing] the transaction” via an NFC signal. (*Id.*, ¶¶0021-0026, 0185.)

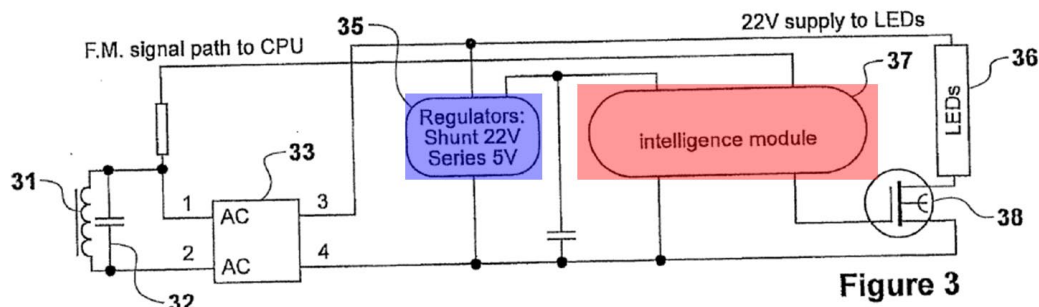


(Ex. 1062, FIG. 1.)

J. *Tetlow* (Ex. 1064)

116. I understand that *Tetlow* is a published International patent application. (Ex. 1064, Cover.) My understanding is that *Tetlow* was filed June 22, 2006 and published October 1, 2009. (*Id.*) I rely on the disclosures and analysis thereof of *Cho* discussed in this section VIII for my opinions regarding *Tetlow*'s teachings and suggestions as applied to the challenged claims of the '942 patent below in Section IX.

117. *Tetlow* discloses a rectifier/control module 33 receives signals inductively generated on a secondary coil 31 and provides rectified signals to regulators 35 (blue below). (Ex. 1064, ¶¶0002 (“secondary...coil in which current is induced”), 0021-0022.) Based on the rectified signal, regulators 35 power “an intelligence module 37 [red below],...typically provided [as] an integrated circuit, such as a microprocessor.” (Ex. 1064, ¶0023; *id.*, ¶0021-0022.) Regulators 35 provide two power levels, *e.g.*, 22V to a load 36, and 5V to the microprocessor. (*Id.*, ¶0023.)

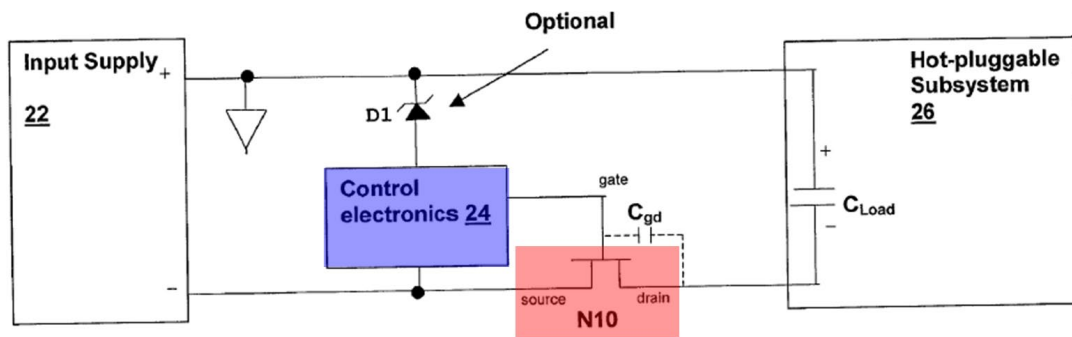


K. *Nguyen* (Ex. 1066)

118. I understand that *Nguyen* is an issued United States patent. (Ex. 1060, Cover.) My understanding is that *Nguyen* was filed May 2, 2001 and issued November 7, 2002. (*Id.*) I rely on the disclosures and analysis thereof of *Nguyen* that I discuss in this section VIII for my opinions regarding *Nguyen*’s teachings and suggestions as applied to the challenged claims of the ’942 patent below in Section IX.

119. In *Nguyen*, a pass device N10 (red below) controls power supplied from supply 22 to subsystem 26, where N10 is controlled by control electronics 24 (blue) and coupled to a voltage regulator or diode D1 to manage the “startup characteristics” of the power transfer. (Ex. 1066, ¶¶0029-0030.) “[C]ontrol electronics 24...determines the **under-voltage lockout voltage level**,” which “may be programmed” to “set” a “minimum” output voltage from supply 22—required to turn on device N10—to “start supplying power to subsystem 26.” (*Id.*, ¶0030.) As

a person of ordinary skill in the art would have understood, given that when N10 (e.g., a MOSFET) is turned off (*id.*, ¶0029) little-to-no current flows through N10, subsystem 26 draws little-to-no current from supply 22. Thus, only when the set minimum output voltage (from supply 22) is reached (which turns on N10), subsystem 26 begins to draw current.



IX. THE PRIOR ART DISCLOSES OR SUGGESTS ALL RECITED FEATURES OF CLAIMS 21-26 OF THE '942 PATENT⁵

A. Ground 1: *Okada* in view of *Odendaal, Cho, Tetlow, Nguyen, Berghegger, and Calhoon* Discloses and/or Suggests the Features of Claims 21 and 24

120. In my opinion, *Okada* in view of *Odendaal, Cho, Tetlow, Nguyen, Berghegger, and Calhoon* discloses and/or suggests all of the features of claims 21 and 24 of the '942 patent.

1. Claim 21

- a) A portable device configured to receive inductive power from an inductive charging system comprising a primary coil and associated circuit, the portable device comprising:**
- a battery;**

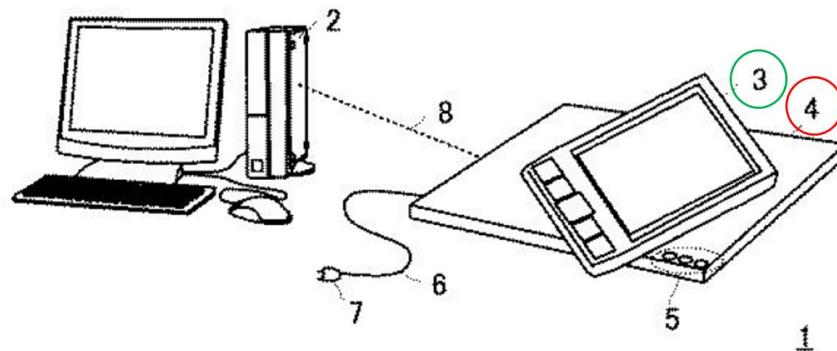
121. I understand that the this phrase “[a] portable device configured to receive inductive power from an inductive charging system comprising a primary coil and associated circuit, the portable device comprising:” (limitation

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.)

21(a) is the preamble of claim 21, and I have been asked to assume that the preamble limits the claim. Under that assumption, it is my opinion that *Okada* discloses the features of limitation 21(a). Additionally, *Okada* discloses that the “portable device” comprises the claimed “**battery**,” recited in limitation 21(b) (*See* my analysis and discussions below for this section; *see also* my analysis and discussions below for Sections IX.A.1(c)-(l).)

122. Namely, *Okada* discloses a “mobile-enabled electronic device[]” (*e.g.*, PDA3) (“**portable device**”) including a rechargeable “**battery**.” (Ex. 1005, Abstract, ¶¶0001, 0009, 0012 (“power receiving device...with a rechargeable secondary battery”), FIG. 2, ¶¶0015, 0034-0037, FIG. 14, ¶¶0134-0136, FIG. 15, ¶¶0138-0140, FIG. 16, ¶¶0142-0144, claim 4.) PDA3 (green (below)) receives inductive power from cradle 4 (with wire/plug 6/7, LEDs 5) (collectively “**inductive charging system**”). (Ex. 1005, ¶¶0034-0036.)

FIG. 1

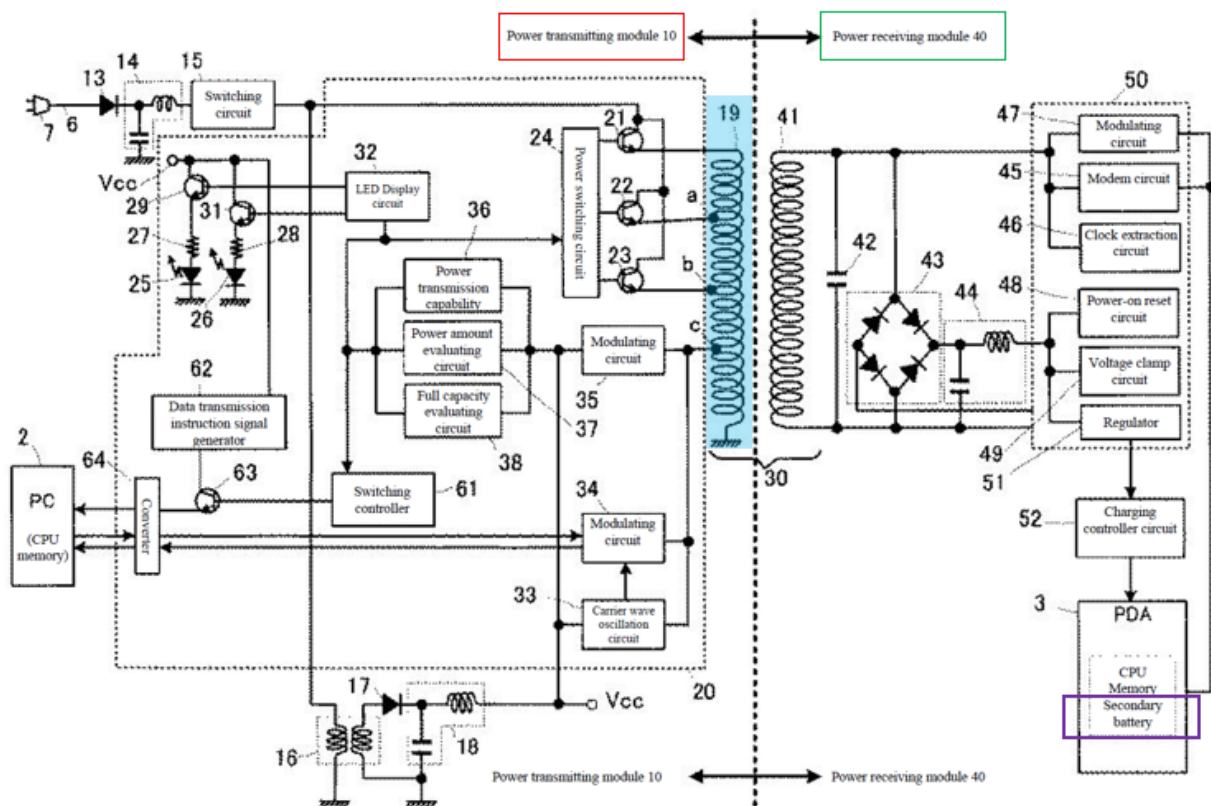


123. As shown below (FIG. 2), cradle 4 includes a **power transmitting module 10** (“PTM10”), and PDA3 includes a **power receiving module 40** (“PRM40”) (“**receiver unit**”) coupled to the battery (purple). (*Id.*, ¶¶0035-0058, FIG. 8, ¶¶0110-0111.) PTM10 includes a primary coil 19 (“**primary coil**” (blue) (*id.*, ¶0040) and various circuits (*e.g.*, one or more of IC 20 (and/or one or more of its components), circuits 13-18 etc.) (“**associated circuit**”) (*id.*, ¶¶0037-0046). “[M]agnetic coupling” occurs via coil 19 and a receiver coil 41 in PRM40, which “induces voltage” in coil 41 to “suppl[y] power” to PDA3/PRM40 and its battery. (*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.)



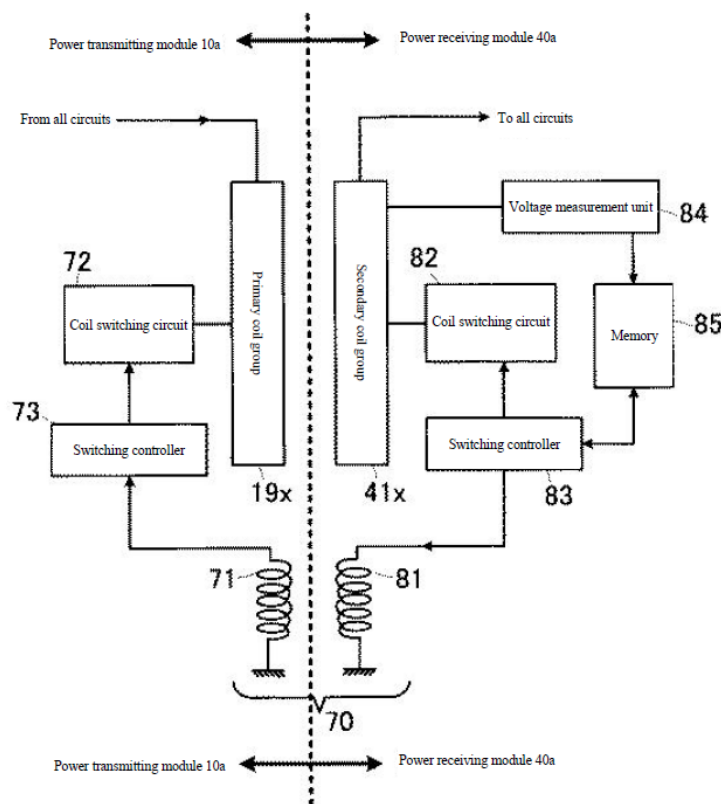
124. Switching circuit 15 in PTM10 receives a DC signal from circuits 13-14 (Ex. 1005, ¶¶0038, 0049) to generate a switching pulse signal that is converted

(Vcc) and used to power components in PTM10 (via circuits 16-18) (*id.*, ¶0039) and is also supplied to coil 19 via switches 21/22/23 under control of power switching circuit 24 (*id.*, ¶¶0040, 0049-0051). Such features allow selected power level(s) to be transferred to PDA3 based on device “power consumption information” provided by PRM40. (*Id.*, ¶¶0040, 0051, 0057, 0063-0073.) 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.

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

125. *Okada* discloses configurations/applications of its power/charging system and portable device configuration having similar functionalities associated with **PTM10** and **PRM40**. (Ex. 1005, FIGS. 2, 7 (below), 8-17, ¶¶0009-0032, 0094-0154 (multiple primary/secondary coil configurations, with switching controller circuitry).)



126. Applications of these features are described with respect to other examples. (Ex. 1005, ¶0107, FIG. 9 (below), ¶¶0116-0118 (multi-coil tabletop charging pad), FIG. 10, ¶0119 (charging multiple portable devices), FIGS. 11(a)-(b) (below), ¶¶0120-0122 (multiple **PTM10**s powering/charging multiple devices with

PRM40s), FIGS. 12(a)-(b) (below) ¶¶0123-0126, FIGS. 13(a)-(b) (below), ¶¶127-132.) Thus, multiple types of “portable device(s)” can operate with different types of “charging systems.” (*Id.*)

FIG. 9

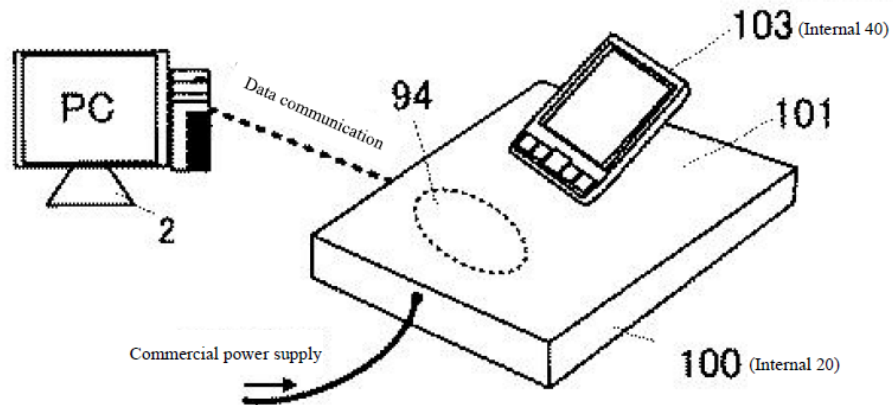


FIG. 10

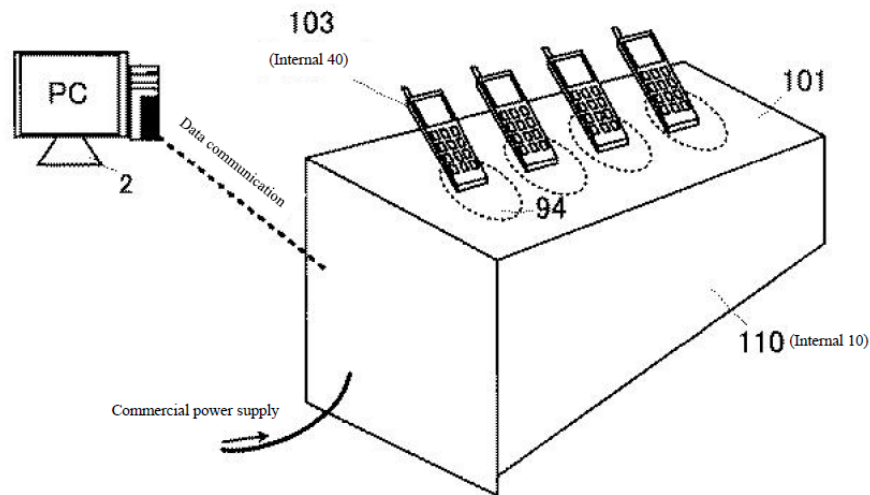


FIG. 11

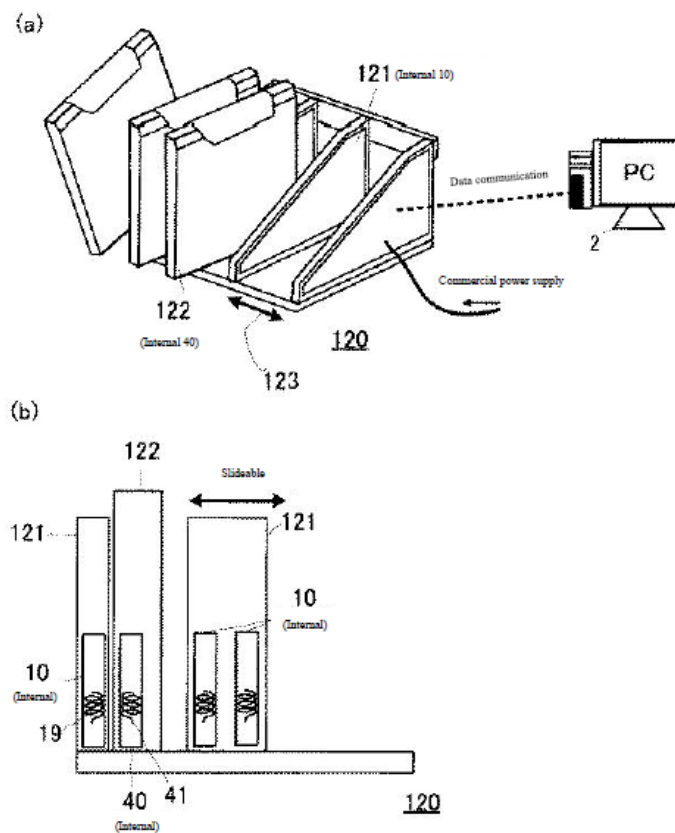


FIG. 12

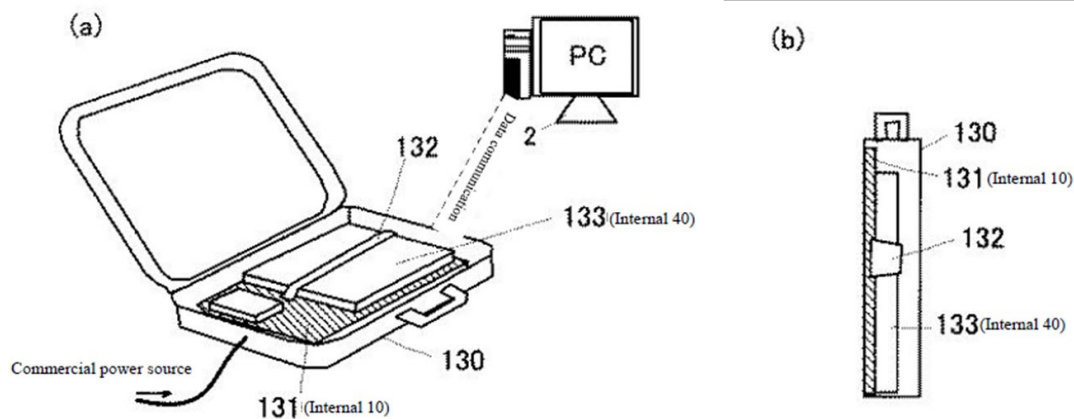
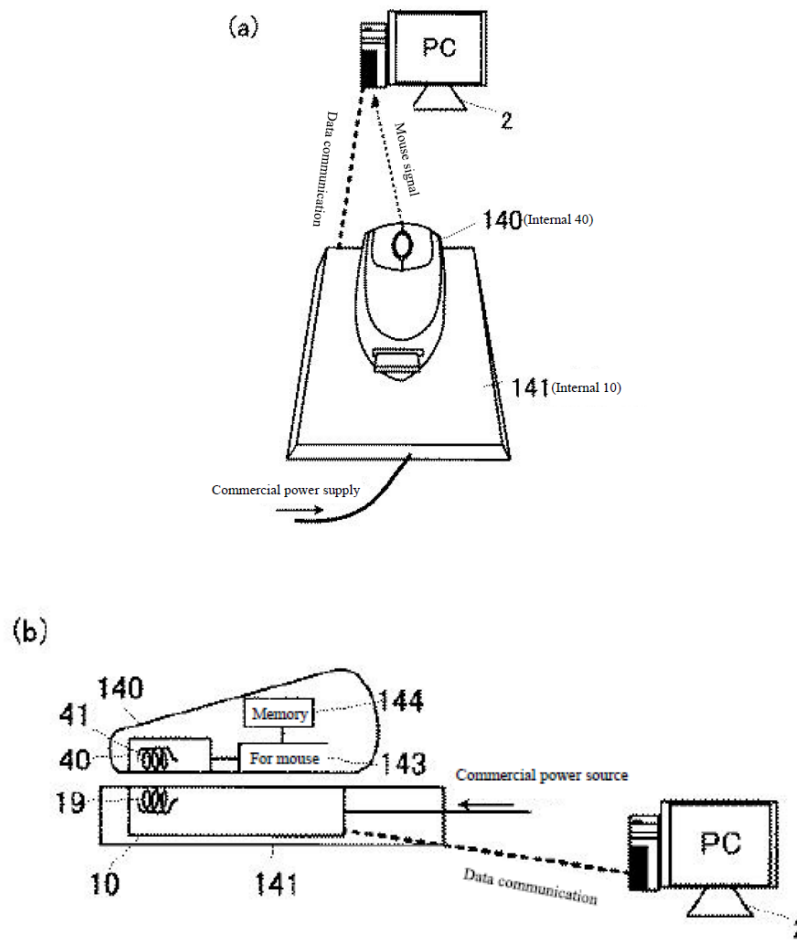
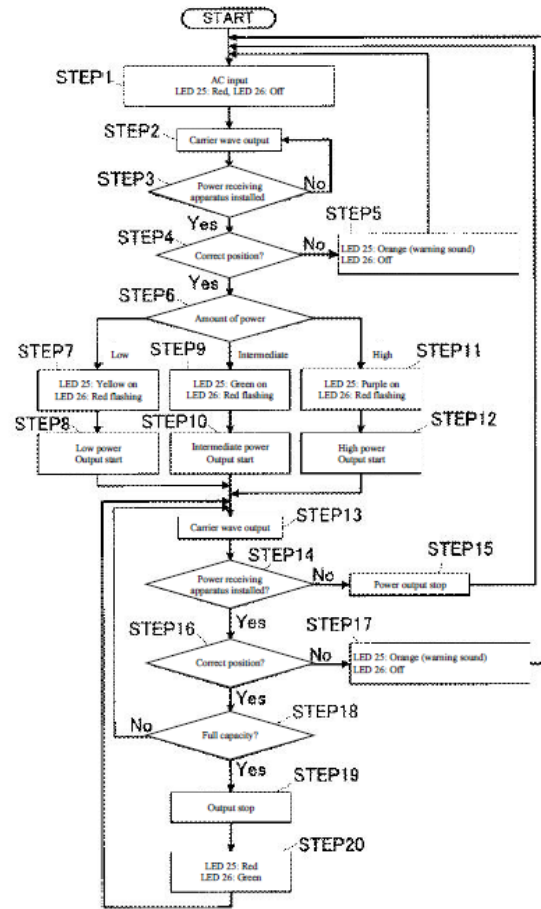


FIG. 13

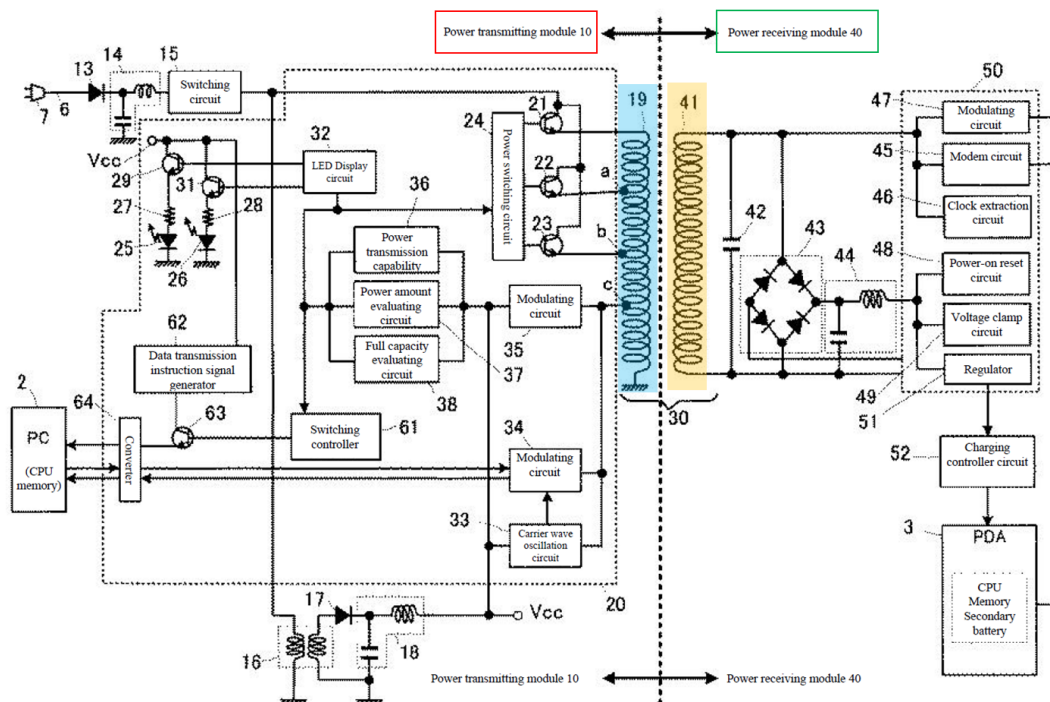


127. FIG. 3 (below) illustrates a flowchart of “power supply operations carried out between [PTM10 and PRM40],” applicable to such configurations. (Ex. 1005, FIG. 3, ¶¶0059-0090; ¶¶0094-0115.)



- b) a coil substantially planar in shape and located parallel to a charging surface of the portable device so that an alternating magnetic field, when received through the charging surface of the portable device from the primary coil of the inductive charging system in a direction substantially perpendicular to the plane of the coil, inductively generates a current in the coil to provide power inductively to the portable device when the portable device is placed on the inductive charging system for charging the battery of the portable device;

128. *Okada* in view of *Odendaal* discloses/suggests this limitation. *Okada* discloses (shown below) that PRM40 includes a coil 41 (orange) (“coil”). (Ex. 1005, ¶¶0035, 0040; Sections IX.A.1(a)-(b).) Primary coil 19 is shown in blue.



129. When PDA3 is properly positioned/aligned on/with cradle 4, “magnetic coupling induces a voltage” (and thus current) on coil 41 to power/charge PDA3. (See my discussions in Section IX.A.1(a); Ex. 1005, ¶¶0051; *id.*, ¶¶0035, 0047 0056, 0066-0068, FIG. 3.) *Okada* explains:

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.

(*Id.*, ¶0051.) The magnetic coupling and inductive power transfer performed in *Okada*’s system results in coil 41 receiving “**an alternating magnetic field**” from primary coil 19, which “**inductively generates a current**” in coil 41 to “**provide power inductively to the portable device,**” as known in the art. (Ex. 1041, ¶¶0022 (“magnetic flux induces an alternating current through the magnetic field and across the receiver coil, completing an energy transfer circuit.”), 0031; Ex. 1009, 2:62-3:8,

1:54-2:18, 3:20-4:11, FIGS. 1-3; 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”), FIGS. 6A-10, 7:21-8:54, 9:53-10:22, 11:27-14:67.).)

130. Power/charging occurs “**when the portable device [PDA3] is placed on the inductive charging system [cradle 4] for charging the battery [secondary battery] of the portable device.**” Consistent with the disclosed feedback loop processes described by *Okada* (Ex. 1005, ¶¶0056-0058, FIG. 3 (below); *see* my discussions below in Sections IX.A.1(i)-(l)), **PTM10** components use information received from **PRM40** to “evaluate whether supplying power to the device via the common cradle 4 is feasible,” and whether the device is properly aligned/positioned to efficiently receive power (*id.*, ¶¶0057-0073, FIG. 3 (*e.g.*, Steps 3-12)), and continuously checks for presence/alignment/position/charge status after onset of power/charge operations (*id.*, FIG. 3 (*e.g.*, Steps 13-20), ¶¶0074-77, 0090). For example, *Okada* explains that:

the modulating circuit 47...modulate[s] 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.

(*Id.*, ¶0058.)

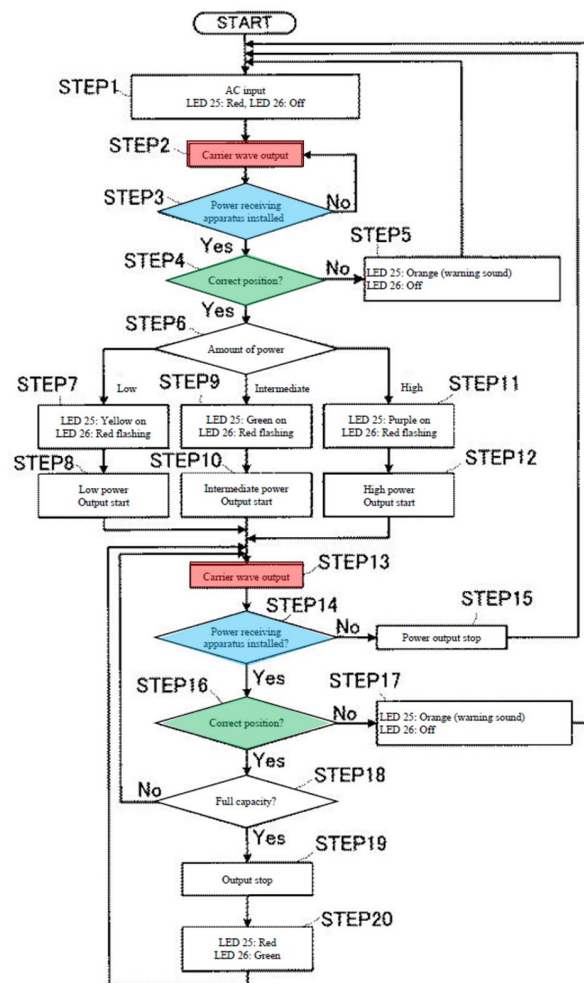
Even after power transmission has begun, a carrier wave is periodically transmitted (STEP 13), and first, based on information included in a modulated wave returned in response to this carrier wave, it is verified whether the PDA 3 has been removed from the common cradle 4 (STEP 14).

(*Id.*, ¶0074.)

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**

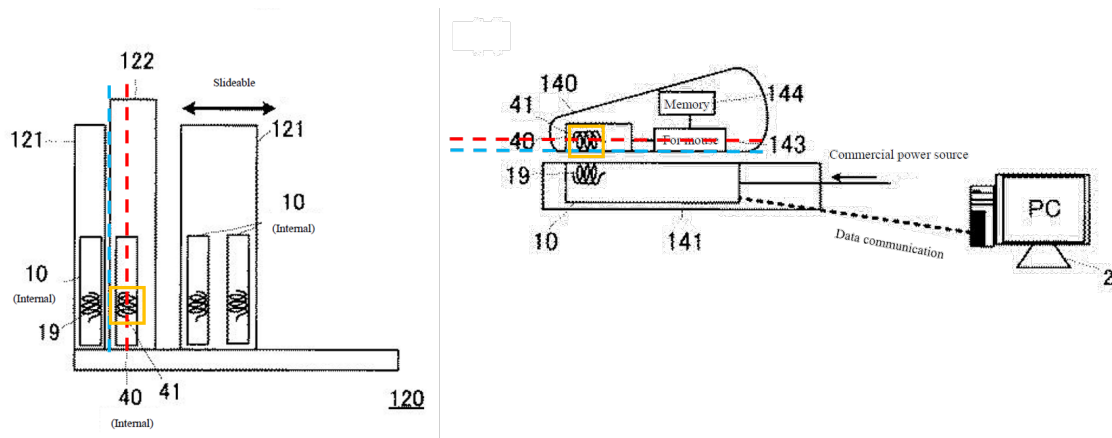
whether the device capable of receiving power is correctly mounted onto the common cradle 4 (STEP 16).

(*Id.*, ¶0075.)



131. PDA3's "coil" is "located parallel to a charging surface of the portable device." For example, Figures 11(b) and 13(b) below exemplify coil 41 (orange) positioned substantially parallel (red) to a surface (blue) of the portable

device. (Ex. 1005, FIGS. 11(b) (left), 13(b) (right).) Similar arrangement/features exists with the other exemplary configurations discussed above and as modified below. (See my discussions in Sections IX.A.1(a)-(b).)



132. In my opinion, while *Okada* does not expressly state the “coil substantially planar in shape and located parallel to a charging surface of the portable device,” it is my opinion that a person of ordinary skill in the art would have been motivated to configure *Okada*’s portable device to implement/use planar coil(s) (and primary coil(s)) in view of *Odendaal*. (See my analysis and discussions in this section and in Sections IX.A.1(a), (c)-(l); see also my analysis and discussions in Sections V.B.3, VIII.A-B.)

133. 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.*)

134. For one example, *Lee* (Ex. 1027)⁶ 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

⁶ 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.)

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.)

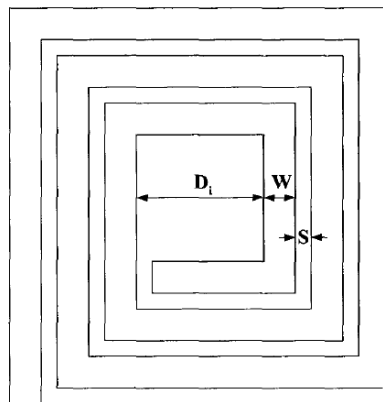


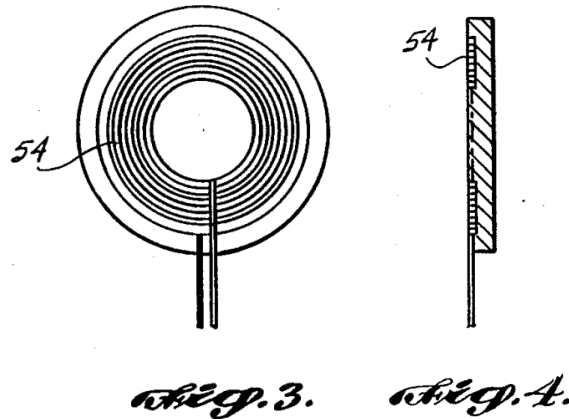
Fig. 1. A planar square spiral inductor structure.

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

135. 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.)

136. 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).

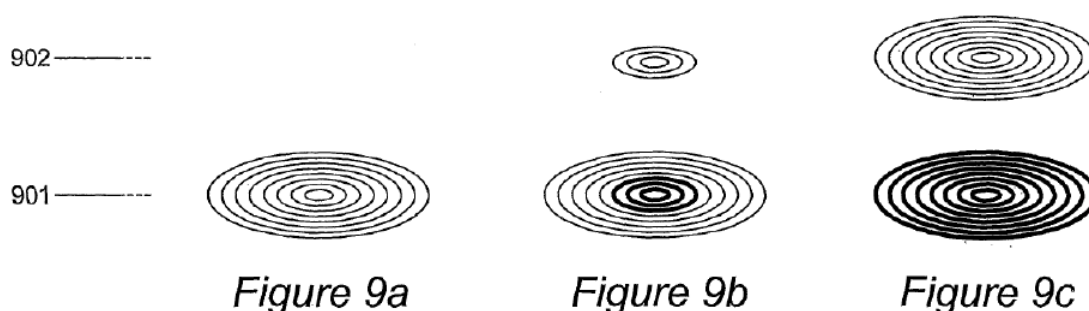
Figure 9 extends these two means of generating a rotational degree of freedom by adding universality. A charger 901 consists of a number of such coils, arranged concentrically, each of which can be driven independently. The charger behaves differently depending on which type of device is present 902.

- 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.)

137. These and other state of art references demonstrate and exemplify the above-discussed knowledge of a person of ordinary skill in the art, that planar coils placed in parallel to device/charger surfaces were known. (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, 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 (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, 3:9-39 (thin/flat coil), 4:18-60); 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, 5:22, 11:18, 23:20-24:8 (“flat surface [] preferably parallel to the plane of the secondary winding within the housing”), 24:19-22 (“*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.”).)

138. 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*.

139. 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)-(k).) 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.)

140. 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 '942 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 '942 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 explained above and do so further 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*. Such a person would have thus been motivated to modify *Okada*'s system to include a planar secondary/receiver coil in the portable device that is parallel to a charging surface of the device to provide features like those discussed herein and claimed (and complemented such a design with corresponding planar primary coil(s) in the charger system). (*Id.*)

141. 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)-(k).) 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.)

142. 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 '942 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 '942 patent discusses and a person of ordinary skill in the art was trying to address. (*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 explained above and do so further 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 secondary/receiver coils that are parallel to a charging surface of the portable device to provide features like those discussed herein and claimed (and complemented such a design with corresponding planar primary coil(s) in an inductive power receiver / portable device). (*Id.*)

143. *Odendaal* discloses known use of **planar-type inductor coils** in an inductive power transfer system, for, *e.g.*, charging a cellphone battery. (Ex. 1008, 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*.

(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.)

144. *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).)

145. Additionally, *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 I explained 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.)

146. Also, 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 portable device and charging device surfaces. (*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).)

147. 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* portable device (e.g., PDA3) to use “**a coil substantially planar in shape and located parallel to a charging surface of the portable device. . .**” (and complemented such a design with corresponding planar primary coil(s) in the charger system) 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.) Additionally, 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).)

148. Further, as I explained above (*see* Section V.B.3), a person of ordinary skill in the art would have understood complementing a secondary-side/primary-side planar coil with a primary-side/secondary-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 receiving coil (or planar primary 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 other side coil (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 portable device (e.g., PDA3) in *Okada*'s system, and also to complement its inductive power transmission features, via use of a planar coil for the charging system (e.g., cradle 4).

149. A person of ordinary skill in the art would have had the skills and rationale given the teachings/suggestions of *Okada*, *Odendaal*, and such a skilled person's state-of-art knowledge, to implement the above modification while considering design tradeoffs and techniques/technologies with a reasonable expectation of success. Especially given such modification would have involved known technologies/techniques (see my discussions above) to foreseeably result in

providing a portable device (and associated charger) with known planar coil designs promoting thin form factor configurations and inductive power transfer, like that contemplated by *Okada-Odendaal*. (See my discussions in Section IX.A.1(a))

150. A person of ordinary skill in the art would have understood implementing a planar receiver coil (along with similar positioned primary planar coil), as I explained above, in the *Okada-Odendaal* device/system would have resulted in the planar receiver coil receiving “**from the [planar] primary coil,**” “**an alternating magnetic field**” “**through the charging surface of the portable device,**” that was “**in a direction substantially perpendicular to the plane of the [receiver] coil,**” when the device is properly positioned/aligned/“**placed**” on the “**charging system,**” consistent with that known in the art and with *Okada*’s teachings. (Ex. 1005, Abstract (coils 19 and 41 are “*internal*” coils (“**through the surface**”), FIGS. 1, 9-16; Ex. 1008, 2:51-52 (“substantially axially aligned” coils); Ex. 1011, 558, 559 (“magnetic field at the center of [a wire] loop is perpendicular to the plane of the loop”), 562-564, 592; Ex. 1048, Abstract, FIGS. 1-6, 1:28-2:4, 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, 0044-0051, 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).) In my opinion, a person of

ordinary skill in the art would have appreciated that implementing planar coils (secondary-side / primary-side) would have promoted efficient energy transmission between the charger and portable device, especially where the coils were aligned to allow the perpendicular magnetic field generated by the primary coil(s) to be efficiently received by the receiving coil(s) **“for charging the battery of the portable device.”**

- c) **a ferrite layer positioned under the coil on a side of the coil opposite to the charging surface of the portable device; and**

151. *Okada-Odendaal* in view of *Cho* discloses/suggests this limitation. (See my discussions in Sections IX.A.1(a)-1(c).) While *Okada-Odendaal* does not expressly disclose a ferrite layer positioned under the coil on a side of the coil 41 opposite to the charging surface of the portable device (*e.g.*, PDA3), it is my opinion that a person of ordinary skill in the art would have been motivated to implement such features in view of *Cho*.

152. *Cho*, like *Okada-Odendaal*, is in the same technical field as the '942 patent. (See my discussions in Sections IX.A.1(a)-(b); Ex. 1061, Abstract, 1:5-18, 1:35-2:14, 17:10-23:13; Ex. 1001, Abstract, 1:50-7:50.) *Cho* discloses features reasonable pertinent to particular problem(s) the '942 patent discusses and a person of ordinary skill in the art was trying to solve. (Ex. 1061, 17:10-23:13; Ex. 1001,

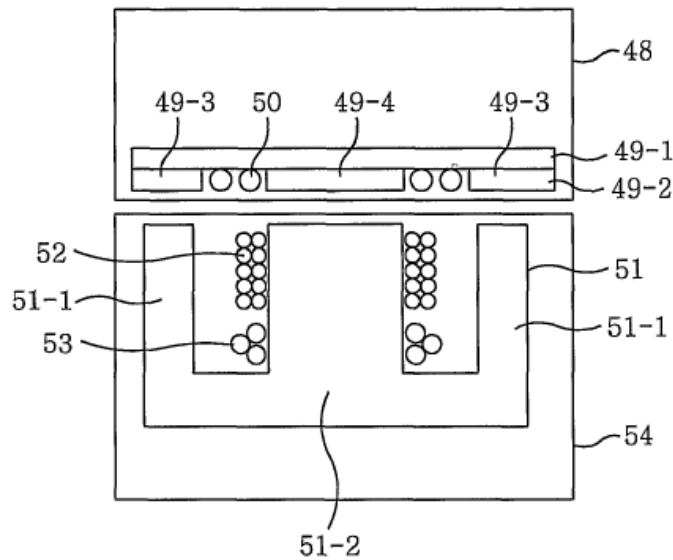
1:50-7:50.) Therefore, a person of ordinary skill in the art had reasons to consider/consult *Cho* when designing/implementing the *Okada-Odendaal* combination that I discussed above.

153. *Cho* discloses designs/materials associated with planar receiver coils used for charging/powering portable devices. (Ex. 1061, 17:10-18 (“a transformer...divided into two parts implemented in a charger 54 and such portable device 48”), 17:18-19:19.) For example, *Cho* explains:

Fig. 8A is a cross sectional view of showing a transformer in accordance with the first preferred embodiment of the present invention, which is divided into two parts implemented in a **charger 54** and such **portable device 48** as a mobile phone, a MP3 player, a MD player, a portable cassette player and a notebook computer. **A primary circuit of a separable type transformer is installed in the charger 54, and a secondary circuit of the separable type transformer is installed in the portable device 48.**

(Ex. 1061, 17:10-18.) Such configurations include using ferrite sheets for implementing planar receiver coils in portable devices. (Ex. 1061, FIG. 8A (below).)

FIG. 8A

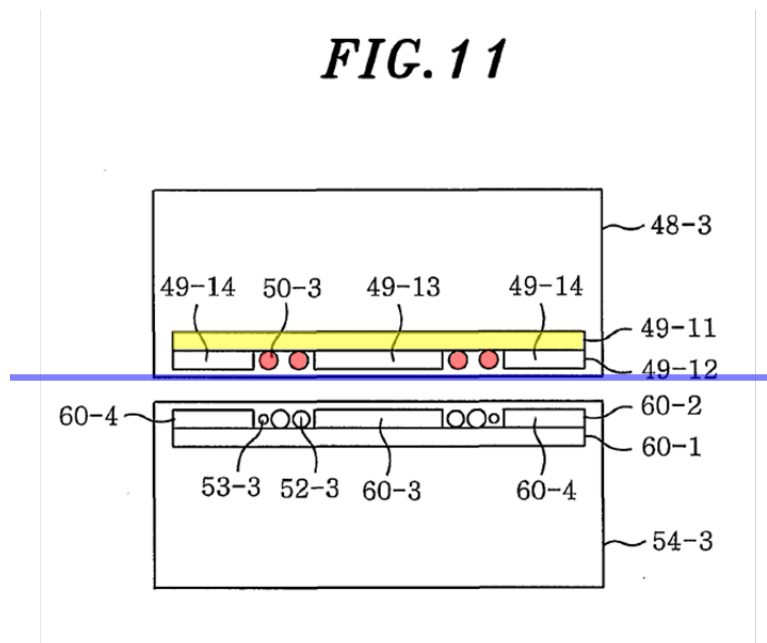


154. Portable device 48 includes a “thin film shape winding 50” located in a groove formed by two layers of ferrite sheets 49-1—49-2. (Ex. 1061, 17:10-18:15.)

The secondary circuit of the transformer includes two layers of ferrite sheets 49-1 and 49-2. The first ferrite sheet 49-1 is constructed as a round shape with a diameter corresponding to the ferrite core 51, and the second ferrite sheet 49-2 is formed at a position facing the charger 54. The second ferrite sheet 49-2, which is a ring shape, has a cylindrical part 49-3 whose circumference and thickness are similar to those of the cylindrical part 51-1 of the ferrite core 51, and a circular column 49-4 whose diameter is identical to that of the circular column 51-2 of the ferrite core 51. A winding groove is constructed on the round

shaped ferrite sheet 49-2, and a **thin film shape winding 50** of the secondary circuit of the transformer is formed inside of the winding groove.

(Ex. 1061, 17:36-18:15.) Charger 54 includes windings 52/53 located around ferrite core 51-2 for transferring energy to device 48. (*Id.*, 17:26-35.) Windings 52/53 may have “a planar shape.” (*Id.*, 22:4-23:13, FIG. 11 (below).) Accordingly, *Cho* discloses use of a ferrite sheet 49-11 (**yellow**) placed behind/under a planar secondary coil 50-3 (**red**) (“**ferrite layer positioned under the coil on a side of the coil opposite to the charging surface of the portable device**” 48 (blue)). (*Id.*, FIGS. 8A and 11.)



155. Given such teachings/suggestions discussed above, a person of ordinary skill in the art would have been motivated to configure the *Okada-Odendaal* modified portable device such that the device includes a ferrite sheet/layer placed under the planar receiver coil on a side of the coil opposite to the device's charging surface in order to, *e.g.*, shield circuitry from electromagnetic waves generated during inductive charging operations. *Cho*'s guidance associated with planar receiver coils with ferrite material/layers/sheets would have motivated a person of ordinary skill in the art to consider/implement similar features in the *Okada-Odendaal* system, and done so with a reasonable expectation of success. *Cho* explains that "[a] ferrite sheet [can be] very soft," "not easily breakable by an impact," though "can be easily shaped." (Ex. 1061, 18:16-20.) Consistent with the *Okada-Odendaal* combination, *Cho* explains that:

Accordingly, by tailoring a thickness of a desired ferrite and a thickness and a width of a wire, a charging device having **a high charging efficiency can be obtained without increasing a volume and a weight of a portable device**. Further, a mass-production of wires and ferrite sheets can also be achieved to **provide planar type thin films and thick ferrite films**.

(*Id.*, 18:20-24.)

156. A person of ordinary skill in the art would have also understood that positioning a ferrite sheet under the planar receiver coil on a side opposite to the charging surface of the portable device,, similar to that discussed in *Cho*, would have shielded the portable device's (PDA3) circuits from the electromagnetic fields, *e.g.*, such as those generated by the primary coil 19. Such a feature would have reduced/minimized the electromagnetic field's detrimental effects on the portable device's circuits, *e.g.*, unwanted radiations and heat on the circuits that may cause faulty signals and reduced reliability and service life.

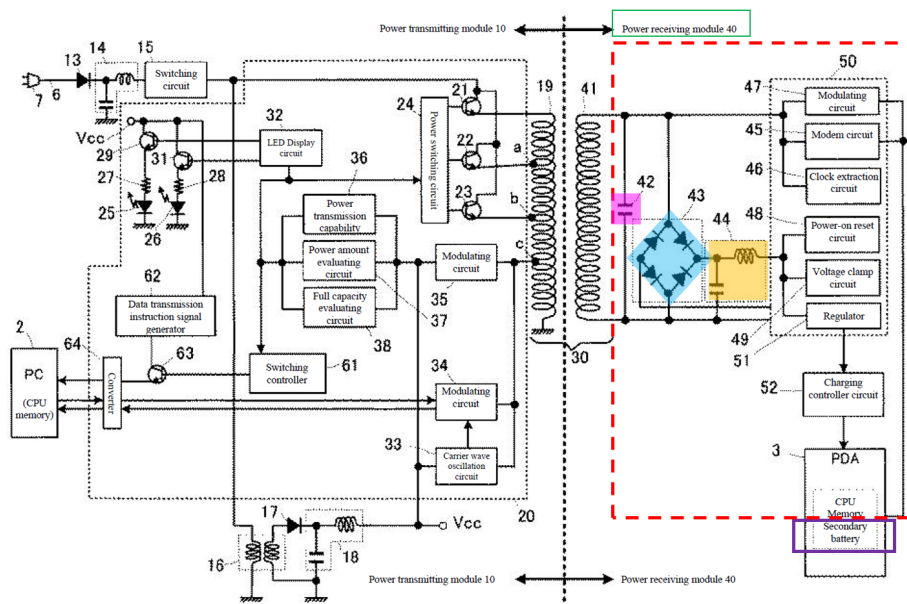
157. A person of ordinary skill in the art would have had the skill and rationale to implement, and reasonable expectation of success in achieving, such modification. As such a skilled person would have recognized, it was known to employ ferrite sheet(s) in portable device receiver coil designs (*Cho*) and that such material as implemented in the modified *Okada-Odendaal* system would have mitigated potential detrimental effects of electromagnetic fields on the portable device. Thus, such modification would have involved applying known technologies/techniques to foreseeably result in the modified combination noted above and consistent with the teachings of *Cho* and known in the art.

- d) a receiver circuit powered by the received inductive power from the inductive charging system, wherein the receiver circuit comprises:
- e) a receiver rectifier circuit including a rectifier and a capacitor;

158. In my opinion, the combination of *Okada-Odendaal-Cho* discloses/suggests the features recited in limitations 21(d)-(e). (See my discussions in Sections IX.A.1(a)-(c) and below in Sections IX.A.(f)-(l).) As illustrated below, and consistent with *Okada*'s teachings, PDA3's **PRM40** ("receiver unit") includes a "receiver circuit" (e.g., **red** below) including, among other things, capacitor 42 (**pink**) and circuit 44 (with capacitor/inductor) (**orange**) (either exemplifying a "capacitor"), rectifying circuit 43 (**blue**) ("receiver rectifier circuit"), clock circuit 46, modulating circuit 47, and/or one or more other components in **PRM40** (other than **battery**), e.g., one or more of circuits 45, 48-49, and 51-52. (Ex. 1005, ¶0047, FIG. 2; See my discussions in Sections IX.A.1(a)-(b).)⁷ In my opinion, circuits

⁷ The annotated figure(s) provided herein are exemplary visual aids and are not intended to limit/constrain the prior art mappings (alone or as modified). For example other components/circuitry, etc. not shown but described/suggested by

42/43, 43/44, or 42/43/44 are each an example of a “**receiver rectifier circuit**” since they smooth/rectify the signal from coil 41 and used for powering/charging PDA3/battery. (Ex. 1005, ¶¶0047, 0057.)



159. *Okada*’s “**receiver circuit**” converts the signals received, via coils 19 and 41, from the “**inductive charging system**” (see my discussions above for limitations 21(a)-(c)) into a DC signal to power the components in the “**receiver circuit**,” PDA3, and charge its battery. For example, *Okada* explains:

Okada (or as modified *Okada*) may be encompassed in such mappings that meet the claimed limitation features as discussed herein.

[T]he power receiving module 40 has a primary-side coil 19 and a secondary-side coil 41 that forms a transformer 30, a smoothing capacitor 42 that smooths the voltage induced at both ends of the secondary-side coil 41, a rectifying circuit 43 that rectifies the voltage smoothed by the smoothing capacitor 42, and a smoothing circuit 44 that smooths the DC voltage output from the rectifier circuit 43.

In addition, a modem circuit 45 that demodulates a superimposed signal by applying a prescribed process to the voltage output from the smoothing capacitor 42 and modulates the data signal from the PDA 3 by applying a prescribed process, a clock extraction signal circuit 46 that extracts a clock signal by applying a prescribed process to the voltage output from the smoothing capacitor 42, and a modulating circuit 47 that applies a prescribed process to the voltage output from the smoothing capacitor 42 and performs modulation are connected to the smoothing capacitor 42.

The power-on reset circuit 48, which receives the output from the smoothing circuit 22 and provides drive instructions to the power receiving control IC 50 described below, and the voltage clamp circuit 49, which receives the output from the smoothing circuit 44 and converts the

output to a prescribed voltage, and a regulator 51 are connected to the smoothing circuit 44. In addition, the charging control circuit 52 is connected to the regulator 51, and the voltage output from the regulator 51 is provided.

The charging control circuit 52 charges the device (PDA 3) to be charged using the voltage provided by the regulator 51. As described above, power is supplied from the common cradle 4 to the PDA 3.

(Ex. 1005, ¶¶0047 (which I separated for readability purposes), 0056-0058, 0062-0063; See my discussions in Sections IX.A.1(a)-(c); Ex. 1041, ¶¶0022, 0031; Ex. 1009, 8:55-9:52.) (See also my discussions in Sections IX.A.1(f)-(o).)

- f) **a receiver communication and control circuit including a microcontroller, wherein the receiver communication and control circuit is configured to modulate the current in the coil to communicate with the inductive charging system while the receiver circuit is being powered by the inductive charging system;**

160. In my opinion, the combination of *Okada-Odendaal-Cho* discloses/suggests this limitation.

161. *Okada* discloses that clock extracting circuit 46 of **PRM40** extracts a clock signal a carrier wave received from oscillating circuit 33 of **PTM10**. (Ex. 1005, ¶¶0056-0057, 0063.) Modulating circuit 47 “uses the clock signal...to

modulate the carrier wave,” based on PDA3’s information (power receiving capability, power consumption, and full capacity, information), and provides the modulated carrier wave to **PTM10** through primary coil 19. (*Id.*, ¶¶0057, 0064.) After demodulation by circuit 35, and based on the information therein, evaluation circuits 36-38 of **PTM10** “perform various decision-making processes” associated with powering/charging PDA3. (Ex. 1005, FIG. 2, ¶¶0042, 0057, 0060-0077, FIG. 3.) These processes determines whether supplying power from cradle 4 to PDA3 is feasible (circuit 36), amount of power to supply to PDA3 (circuit 37), and whether the charging of PDA3 is complete (circuit 38). (*Id.*, FIG. 3, ¶¶0057-0076.)

162. Thus, in my opinion, and as one example, at least one of circuits 46 and 47 (annotated in Figure 2 below) discloses an example of “**a receiver communication and control circuit.**” (Ex. 1005, FIG. 2.) In my opinion, other components may be included in the “**circuit,**” *e.g.*, modem circuit 45, power-on reset circuit 48, voltage clamp circuit 49, and/or switching controller 83 in the multi-coil arrangement of FIG. 7. (Ex. 1005, FIG. 7 (annotated below), ¶¶0047-0048, 0094-0115; *see my discussions in Section IX.A.1(b).*)

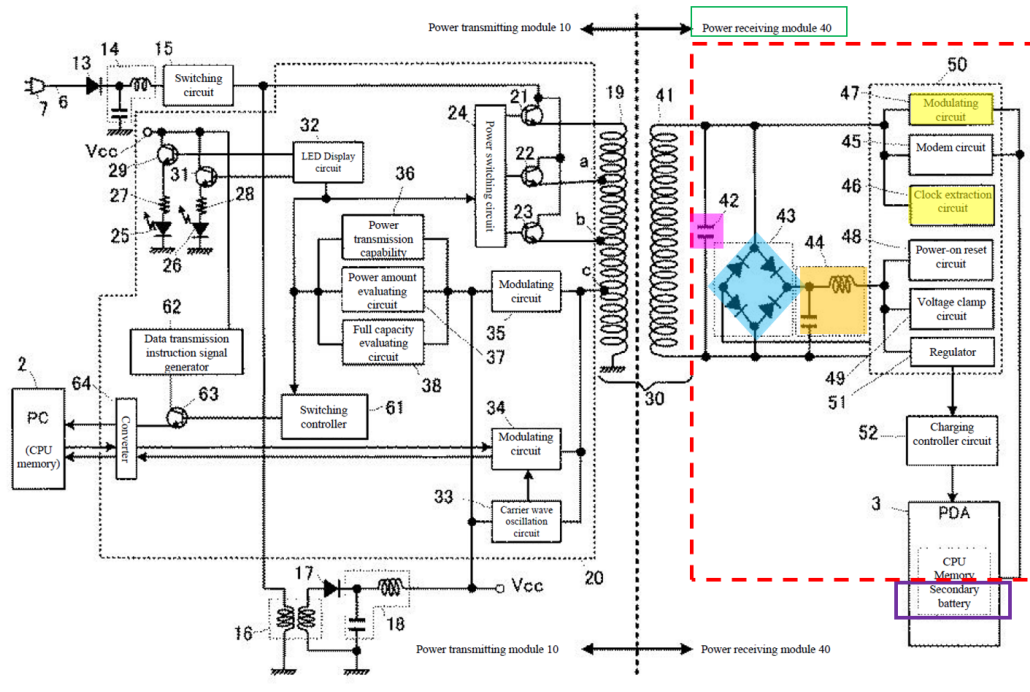
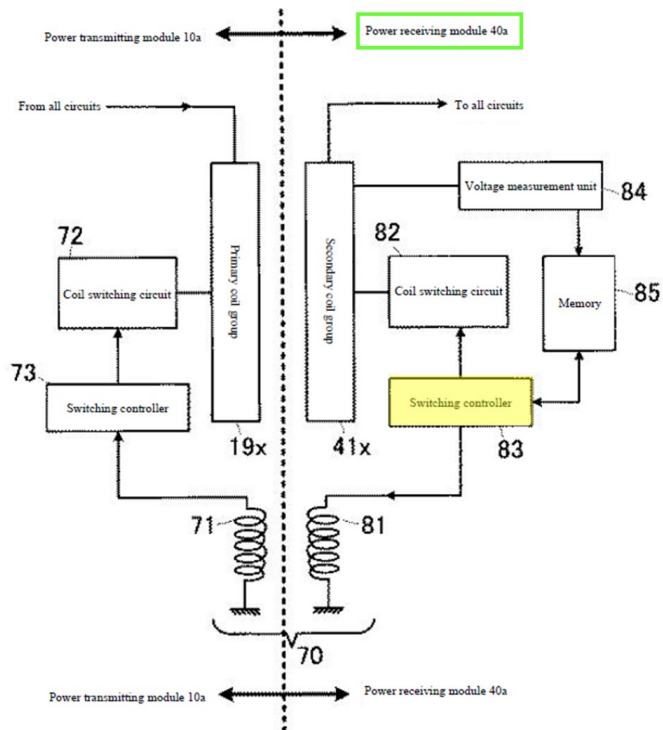


FIG. 7



163. Circuits 46-47 (and circuits 45/48/49) may be “configured on the same IC chip,” *e.g.*, “power receiving control IC 50.” (Ex. 1005, ¶¶0047-0048, 0057, 0063, 0086-0092, FIGS. 2, 7.) Such circuitry would have been understood as compact integrated circuitry designed to perform certain operations in PRM40, which is consistent with a “**microcontroller**” as understood by a person of ordinary skill in the art and in context of the ’942 patent. (Ex. 1001, 27:11-14 and 42:4-6 (exemplifying an “IC” or “chip” as a “microcontroller”); Ex. 1064, ¶0023 (describing a secondary-side module “[as] an *integrated circuit*, such as a *microprocessor*.” (Ex. 1064, ¶0023.) The same is true where switching controller 83 is part of such “**receiver communication and control circuit**” since it sends “instructions” to control the switching to select specific coils (when implemented). (Ex. 1005, ¶¶0096-0097, 0100-0106.) Thus, *Okada-Odendaal-Cho* discloses “**a receiver communication and control circuit including a microcontroller.**”

164. I have been asked to assume that the claimed “microcontroller” requires a processor or the like and *Okada* does not expressly disclose such features. Under such an assumption, a person of ordinary skill in the art would have been motivated to configure the “receiver circuit” in PRM40 to include such features because it would have been a foreseeable application of known technologies/techniques in a portable device/system, which uses ICs to perform “control[er]”-type operations,

consistent with *Okada*. (See my discussions above; Ex. 1006, 5:65-6:59, FIGS. 4-5 (controller 40); Ex. 1024, 6:60-7:14 (“microprocessor controller 308” controlling power-supply operation/modes), FIG. 3; Ex. 1064, ¶0023.) Such a modification would have been a well-known variation/implementation as to how the communication/control circuit (above) performs/provides similar features, while providing known programmable functionalities. A person of ordinary skill in the art would have had the skills and rationale to implement such a modification, and given the known technology and *Okada*’s teachings, would have done so with a reasonable expectation of success.

165. As I explained, modulating circuit 47 (part of “**receiver communication and control circuit**”) modulates the carrier wave based on PDA3’s information that is sent to PTM10 when the “**receiver circuit**” is powered by the “**charging system.**” (See my discussions in Sections IX.A.1(e)-(f); Ex. 1005, ¶¶0047, 0056-0058, 0062-0063.) Circuit 35 then “demodulates modulated signals included with the voltage from” primary coil 19. (Ex. 1005, ¶0042.)

166. *Okada* explains that the 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.) To the extent that *Okada-Odendaal-Kook* does not disclose “**a receiver**

communication and control circuit...configured to modulate the current in the coil to communicate with the inductive charging system while the receiver circuit is being powered by the inductive charging system,” it is my opinion that a person of ordinary skill in the art would have been motivated to implement such features.

167. A person of ordinary skill in the art would have understood that modulating/demodulating a waveform (*Okada*) by using an inherent property thereof (e.g., current) would have been a known and available option for including/encoding/decoding information to facilitate communications between the portable device and base unit in the modified *Okada* system/device (e.g., used to confirm power reception equipment, verify/determine presence/alignment, full charge status, and/or power level, consistent with that disclosed by *Okada*) (Ex. 1005, ¶¶0056-0057, 0062-0064), and consistent with that known in the art by a person of ordinary skill in the art at the time.

168. 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.⁸ (*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 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

⁸ I references Exhibits 1056, 1057, and 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 regarding the use/implementation of “current modulation” for communicating information, which is consistent with how such a person would have understood *Okada*, *Odendaal*, and *Cho*’s teachings.

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.)⁹ In my opinion, in light 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*

⁹ The '942 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, 27:11-18 (describing technologies, such as those found in the ATMEL e5530 or “other inexpensive microcontroller[s]” that “modulates the current in the secondary that can be detected as current modulation in the primary”); Ex. 1063 (ATMEL e5530 Datasheet).)

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.

169. Thus, in my opinion, a person of ordinary skill in the art would have been motivated to configure the modified *Okada* system to provide current modulation/demodulation-type techniques/technologies to facilitate communications of information via the primary/receiver coils, such that the “microcontroller” in the above-described communication/control circuit of the portable device would “**modulate the current in the coil [41] to communicate with the inductive charging system [cradle 4],**” consistent with that known in the art, while the disclosed “**receiver circuit**” (Section IX.A.1(d)) is being powered by the “charging system,” consistent with *Okada*’s operations. (Ex. 1056, Abstract, 2:7-9, 2:38-44, 4:21-34, 5:12-14, 6:12-33; Ex. 1057, 9:20-24, 15:16-21, 21:21-22:3, FIGS. 1-3, 11-13; Ex. 1058, Abstract, FIGS. 1, 3A-8, 3:25-4:35, 5:27-7:23, 10:22-24, 10:25-12:17.) (Ex. 1001, 27:11-18) (discussing “current modulation” in context of conventional technologies—supporting that such features were known); Ex. 1063.)

170. Thus, for reasons I explained, in my opinion, a person of ordinary skill in the art would have been motivated to configure/implement current

modulation/demodulation techniques/features in the *Okada-Odendaal-Cho* device/system such that the communication and control circuit communicates the device information with the charger system (cradle 4) during charging operations consistent with the modulation communication features disclosed by *Okada*. 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., modulation techniques/components, including using signal intensity and sensed current in primary coil 19 for determining/verifying PDA 3 presence/positioning, and the state-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)-(e).)

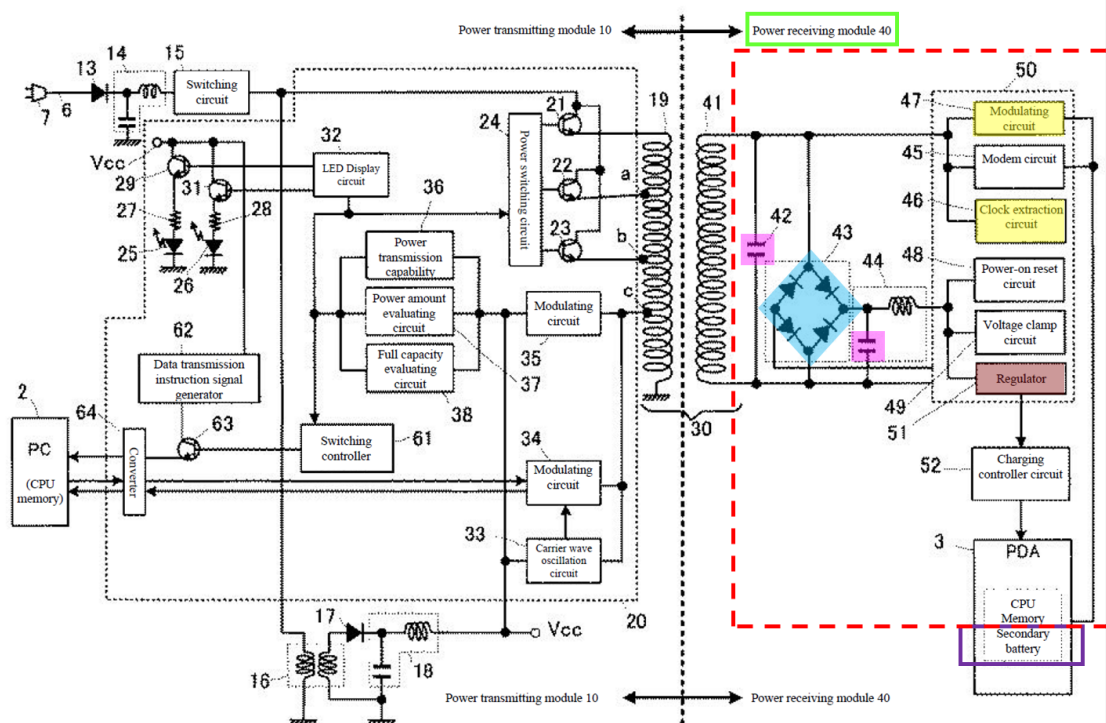
171. In my opinion, a person of ordinary skill in the art would have had the requisite skills, knowledge and capabilities to design/implement such current modulation/demodulation-type features in the above discussed *Okada-Odendaal-Cho* device/system, and would have done so with a reasonable expectation 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, 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 to a inductive/contactless power/data transfer system that uses known modulation techniques to communicate information, consistent with the features taught by *Okada*. (See also my discussions in Sections IX.A.1(g)-(l).)

- g) a voltage regulator coupled to an output of the receiver rectifier circuit and coupled to the microcontroller, wherein the voltage regulator is configured to provide a regulated voltage to power the microcontroller from the received inductive power; and**

172. In my opinion, the combination of *Okada-Odendaal-Cho* in view of *Tetlow* discloses/suggests this limitation.

173. In *Okada*, regulator 51 (**brown** below) (“**voltage regulator**”) is “**coupled to an output**” of the circuit 44 (part of “**receiver rectifier circuit.**” (See my discussions in Section IX.A.1(e)) and provides a voltage output to charging control circuit 52 to charge PDA3. (Ex. 1005, ¶¶0047-0048 (while not required, regulator 51 “may be” configured on IC 50); FIG. 2.)

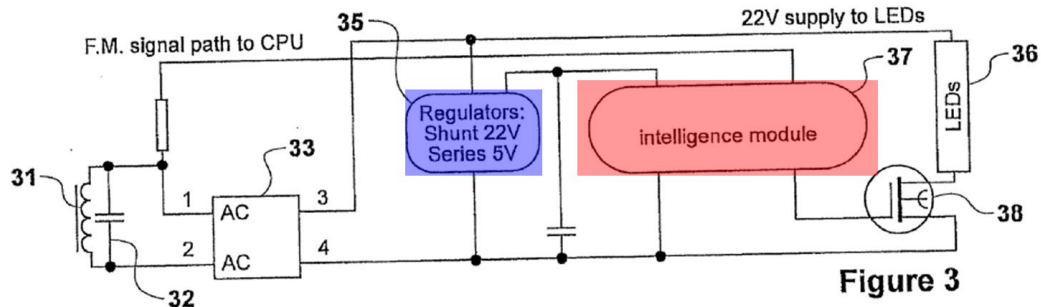


174. Although regulator 51 provides power through circuit 52 to charge PDA3 (containing a battery) (Ex. 1005, ¶10087), *Okada* does not expressly disclose that regulator 51 is “coupled to the microcontroller...to provide a regulated voltage to power the microcontroller from the received inductive power.” A person of ordinary skill in the art, nevertheless, would have been motivated to implement such features in view of *Tetlow*.

175. *Tetlow*, like *Okada* (and other combined art), is in the same technical field as the '942 patent and discloses features reasonable pertinent to particular problem(s) the '942 patent and a person of ordinary skill in the art was trying to

solve. (See my discussions in Sections IX.A.1(a)-IX.A.1(g); Ex. 1064, Abstract, ¶¶0021-0023; Ex. 1001, Abstract, 1:50-7:50, 36:31-41.) Therefore, such a skilled person had reasons to consider/consult *Tetlow* when looking to design/implement the above modified *Okada* combination.

176. *Tetlow* discloses a rectifier/control module 33 receives signals inductively generated on a secondary coil 31 and provides rectified signals to regulators 35 (blue below). (Ex. 1064, ¶¶0002 (“secondary...coil in which current is induced”), 0021-0022.) Based on the rectified signal, regulators 35 power “an intelligence module 37 [red below],...typically provided [as] an integrated circuit, such as a microprocessor.” (Ex. 1064, ¶0023; *id.*, ¶0021-0022.) Regulators 35 provide two power levels, *e.g.*, 22V to a load 36, and 5V to the microprocessor. (*Id.*, ¶0023.) Thus, *Tetlow* discloses “**a voltage regulator coupled to an output of [a] receiver rectifier circuit [e.g., module 33] and coupled to [a] microcontroller [e.g., module 37] to provide a regulated voltage to power the microcontroller from the received inductive power.**”



177. Given such teachings and suggestions that I discussed above, a person of ordinary skill in the art would have been motivated to implement a “**voltage regulator**” in the above-modified *Okada* device that receives the rectified signals from the “**receiver rectifier circuit**” (*see* my discussions in Section IX.A.1(f)) to “**provide a regulated voltage to power the microcontroller** (*see* my discussions in Section IX.A.1(g)) **from the received inductive power output** that was received by the receiver coil 41 (that is rectified/smoothed via circuits 43/44). A person of ordinary skill in the art would have appreciated and recognized, consistent with that known in the art, implementing such configuration/modification would have ensured that the “microcontroller” receives a constant/stable voltage suitable for powering/operating the microcontroller and related circuitry to prevent potential voltage irregularities at the receiver rectifier circuit output, which may damage components during operations. (Ex. 1065, ¶¶0033-0039 (voltage converter/regulator used to avoid “voltage spikes” and increase “operating

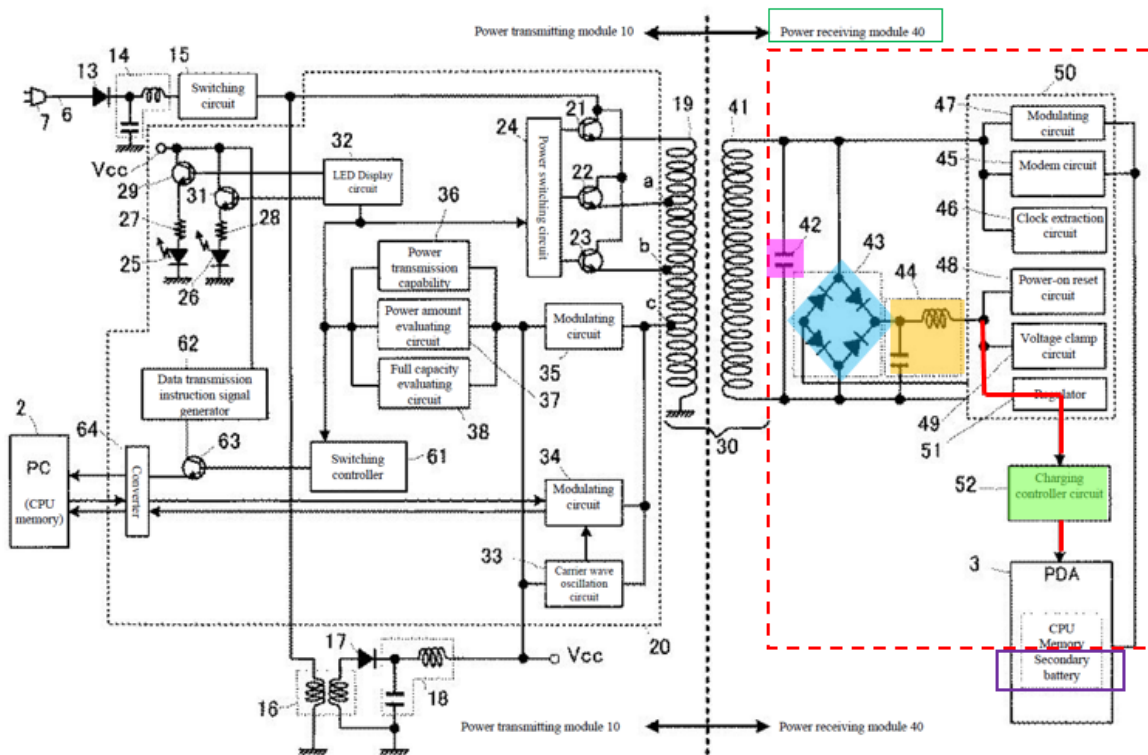
reliability”), claims 1-7, FIG. 1).) A person of ordinary skill in the art would have been motivated to consider/configure such a modification in various ways, including modifying regulator 51 to provide such regulation operations for power the “microcontroller” and supply regulated voltage to charge controller 52, or implementing a complimenting voltage regulator circuit dedicated for regulating voltage for the “microcontroller.”

178. A person of ordinary skill in the art would have had the skill and rationale to implement, and reasonable expectation of success in achieving, such modification. This is so given such a skilled person would have appreciated and known of the benefits of using a voltage regulator to provide stabilized voltage/power to controller circuitry to mitigate issues, *e.g.*, voltage spikes/irregularities, damage to components. (*See my discussions above.*) Additionally, such a skilled person would have understood that such modification would have involved applying known technologies/techniques to foreseeably result in a portable device with conventional voltage regulator mechanisms to provide stabile voltage for powering electrical components in an inductive power transfer system, consistent with that discussed by *Okada, Tetlow*, and known in the art.

- h) a battery charging circuit configured to charge the battery, wherein the battery charging circuit is coupled to the output of the receiver rectifier circuit and coupled to the battery and is configured to begin drawing current when the output of the receiver rectifier circuit reaches a set minimum voltage value;

179. In my opinion, the combination of *Okada-Odendaal-Cho-Tetlow* in view of *Nguyen* discloses/suggests this limitation.

180. As I explained and as shown below, the “**receiver circuit**” (*see* my discussions in Section IX.A.1(d) (red)) includes charging control circuit 52 (“**battery charging circuit**”) (green), which is coupled to the output of the “**receiver rectifier circuit**” (Section IX.A.1(e) (variations of circuits 42/43/44 (magenta/blue/orange))) via regulator 51 and also to the battery (purple). (Ex. 1005, ¶0047, FIG. 2 (below); Sections IX.A.1(a)-(b), (e)-(g).)



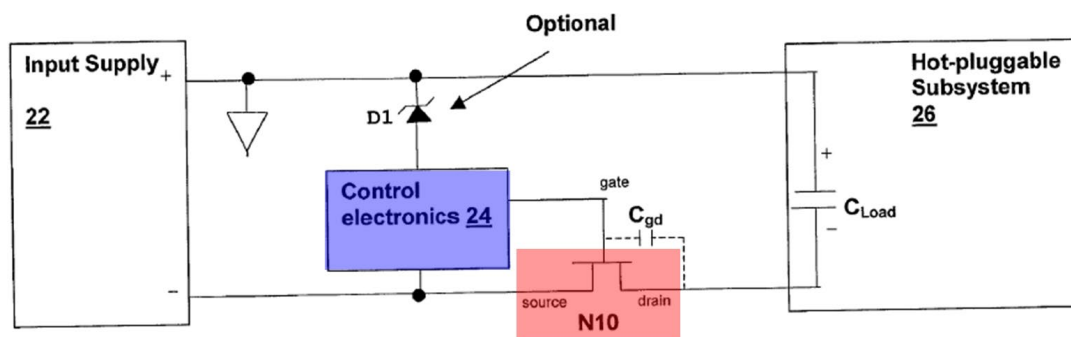
181. To the extent that *Okada* does not disclose that circuit 52 “**begin[s] drawing current when the output of the receiver rectifier circuit reaches a set minimum voltage value,**” it is my opinion that a person of ordinary skill in the art would be motivated to implement such features in view of *Nguyen*.

182. In my opinion, a person of ordinary skill in the art had reasons to consider/consult *Nguyen* when looking to design/implement the above-discussed *Okada* combination. Such a person would have had reasons to consider *Nguyen* given *Nguyen* discloses technologies/techniques for providing/supplying power from one system to another (subsystem), which a person of ordinary skill in the art

would have found relevant/helpful to inductive power transfer system/component designs/implementations, like those disclosed by *Okada* and other asserted prior art (see my discussions in Sections IX.A.1(a)-(g); Ex. 1066, Abstract, ¶¶0002-0004). Thus, *Nguyen* is in the same technical field as the '942 patent and discloses features reasonable pertinent to particular problem(s) the '942 patent and a person of ordinary skill in the art was trying to solve. (*Id.*; Ex. 1001, Abstract, 1:45-46, 12:33-13:8.) Therefore, such a skilled person had reasons to consider/consult *Nguyen* when looking to design/implement the above-discussed *Okada* combination.

183. In *Nguyen*, a pass device N10 (red below) controls power supplied from supply 22 to subsystem 26, where N10 is controlled by control electronics 24 (blue) and coupled to a voltage regulator or diode D1 to manage the “startup characteristics” of the power transfer. (Ex. 1066, ¶¶0029-0030.) “[C]ontrol electronics 24...determines the **under-voltage lockout voltage level**,” which “may be programmed” to “set” a “minimum” output voltage from supply 22—required to turn on device N10—to “start supplying power to subsystem 26.” (*Id.*, ¶0030.) As a person of ordinary skill in the art would have understood, given that when N10 (*e.g.*, a MOSFET) is turned off (*id.*, ¶0029) little-to-no current flows through N10, subsystem 26 draws little-to-no current from supply 22. Thus, only when the set minimum output voltage (from supply 22) is reached (which turns on N10),

subsystem 26 begins to draw current (“**begins drawing current when the output of [a] receiver rectifier circuit reaches a set minimum voltage value**”).



184. Given such teachings/suggestions as I discussed above, a person of ordinary skill in the art would have been motivated to configure/modify the charge control circuit 52 in the “**receiver circuit**” (*see* my discussions in Section IX.A.1(d)) of the modified *Okada* portable device to implement features similar to *Nguyen*’s under-voltage lockout (UVLO) features such that it would begin drawing current when the output of the “**receiver rectifier circuit**” reaches a set minimum voltage value for charging the battery. A person of ordinary skill in the art would have appreciated *Nguyen*’s guidance that such features (e.g., a UVLO circuit) would “keep[] the rest of the circuitry of an integrated circuit disabled until the power supply reaches a specified level,” such that “[the] circuit would *keep the integrated circuit supply current at zero until the specified voltage is reached.*” (Ex. 1066,

¶3:34-41.) Such a person would have also appreciated that that similar features implemented in the modified *Okada* device as I discussed above would have prevented unwanted power/current drawn by PDA3/battery that does not meet its required operating/powering requirements, consistent with *Okada*'s and *Nguyen*'s teachings. (*Id.*; Ex. 1005, ¶¶0057, 0069.) Especially since it was conventional practice to control a battery charging process to prevent over/under-charging the battery, consistent with that described by *Okada*. (Ex. 1005, FIG. 3, ¶¶0074-0077; Ex. 1037, 1:35-2:22.)

185. A person of ordinary skill in the art would have had the skill and rationale to configure/implement, and reasonable expectation of success in achieving, such modification. Especially where, as I discuss above, it was known to employ mechanism/features to control power/current draw when supplying power to a device/battery to mitigate potential damage or undesired operations. Thus, such modification would have involved applying known technologies/techniques to foreseeably result in a portable device having a battery charging circuit that safely draws current when *e.g.*, the receiver rectifier circuit output reaches a set minimum voltage value, consistent with that discussed above by *Nguyen* and known in the art.

- i) **wherein when a current is generated in the coil inductively by the primary coil: the receiver rectifier circuit is configured to rectify and smooth the current, the voltage regulator is configured to use the current to power and activate the microcontroller, and the battery charging circuit is configured to use the current to charge the battery of the portable device; and**

186. In my opinion, the *Okada-Odendaal-Cho-Tetlow-Nguyen* combination discloses/suggests this limitation. As I explained, signal(s) transmitted from coil 19 in the modified system inductively generates a current in coil 41 (“**current is generated in the coil inductively by the primary coil**”). (See my discussions in Sections IX.A.1(a)-(c), IX.A.1(e).) As a person of ordinary skill in the art would have recognized, when PDA3 is placed on cradle 4, circuit 33 of **PTM10** applies a carrier wave to primary coil 19, and a voltage, and thus current, is induced on secondary coil 41. (*Id.*; Ex. 1005, ¶¶0056-0057, 0062-0063.) The induced current is rectified/smoothed by circuits 42/43/44 (“**receiver rectifier circuit is configured to rectify and smooth the current.**”) (Ex. 1005, ¶¶0047, 0057, 0063; Section IX.A.1(e).)

187. My analysis above for limitation 21(g) explains that, in the modified *Okada* device/system, a “**voltage regulator**” would have been implemented/configured such that it “provide[s] a regulated voltage to power the

microcontroller” as implemented in the modified portable device. (See my discussions in Section IX.A.1(g).) For similar reasons, rationale, and with a similar expectation of success as I explained for limitation 21(g), it is my opinion that a person of ordinary skill in the art would have understood and/or been motivated to configure, the above-discussed “**voltage regulator**” such that when it provide(s) “**power**” to the “**microcontroller**,” it “**activate[s]**” it to facilitate the feedback control operations discussed by *Okada* (e.g., activate circuits 46/47 (part of “**microcontroller**” (including as configured/modified) to generate/transmit device information to **PTM10** for controlling power transfer operations). (See my discussions in Sections IX.A.1(a)-(h).) Such a modification would have been consistent with *Okada*’s teachings, which explains that the rectified/smoothed current from the “**rectifier circuit**” is used to power/activate circuits 46/47. (Ex. 1005, ¶0058 (the signal “generated by a carrier wave provided by...circuit 33 can be used as a driving power source for the clock extracting circuit 46 and the modulating circuit 47”), ¶¶0056-0057; Sections IX.A.1(d)-(h).) Thus, for reasons that I discussed above, a person of ordinary skill in the art would have been motivated to configure the “**voltage regulator**” (See my discussions in Section IX.A.1(g)) to use the rectified/smoothed voltage from the “rectifier circuit” (Section IX.A.1(e) “**to power and activate the microcontroller.**”

188. My analysis above for limitation 21(h) also explains how, in the modified *Okada* device/system, a **“battery charging circuit”** is implemented/configured such that it is “coupled to the output of the receiver rectifier circuit and coupled to the battery” such that the **“battery charging circuit”** uses the rectified/smoothed output (including **“current”**) **“to charge the battery of the portable device.”** (See my discussions in Section IX.A.1(h).) For similar reasons, rationale, and with a similar expectation of success as I explained for limitation 21(h), a person of ordinary skill in the art would have understood and/or been motivated to configure, the above-discussed **“battery charging circuit”** such that it uses the **“current [] rectified and smoothed by the receiver rectifier circuit...to charge the battery of the portable device,”** consistent with the teachings of *Okada*. (Ex. 1005, ¶¶0047 (power-on reset circuit 48 receives the rectified/smoothed output signal of circuits 43/44) and provides “drive instructions to the power receiving control IC 50” to power/charge PDA3 using voltage clamp circuit 49, regulator 51, and charging control circuit 52), 0049-0051, 0057-0073, FIG. 3; Sections IX.A.1(a)-(h).)

- j) wherein upon powering and activation of the receiver circuit by the primary coil, the receiver circuit is configured to:
- k) communicate to the inductive charging system information corresponding to a voltage or current value at the output of the receiver rectifier circuit induced by the primary coil, a unique identifier code, and a power requirement; and

189. In my opinion, the combination of *Okada-Odendaal-Cho-Tetlow-Nguyen* in view of *Berghegger* and *Calhoon* discloses/suggests this limitation.

190. My analysis above for limitation 21(i) explains how in the modified *Okada* system/device, the “**microcontroller**” (part of “**receiver circuit**”) is powered and activated via the “**voltage regulator**’s” use of the rectified/smoothed current generated in the receiver coil inductively by the primary coil to facilitate the feedback control power/charge transfer operations discussed by *Okada*. (See my discussions in Section IX.A.1(i).)

191. As I explained, those power/transfer operations include circuit 33 in **PTM10** applying a carrier wave to primary coil 19, which is used (after rectification/smoothing (circuits 42/43/44) to power/activate *e.g.*, circuits 46/47 (See my discussions in Section IX.A.1(g)) and cause power-on reset circuit 48 to “drive instructions” to “control IC 50” to power/charge PDA3/battery. (Section IX.A.1(j).) To configure the system to transfer appropriate power for the specific portable

device (PDA3), circuit 47 modulates a carrier wave, based on PDA3's information, and provides the signals to PTM10 through receiver coil 41 and primary coil 19. (Ex. 1005, ¶¶0057, 0064, FIG. 3.) After demodulation (circuit 35), evaluation circuits 36/37/38 of PTM10 use that information to “perform various decision-making processes” associated with powering/charging PDA3/battery. (Ex. 1005, FIG. 2, ¶¶0042, 0057; *id.*, FIG. 3, ¶¶0060-0077; Sections IX.A.1(b)-(c), IX.A.1(g).) The device information modulated by circuit 47 (part of “**receiver circuit**” (*see my discussions in Section IX.A.1(d)*) includes, *e.g.*, “power consumption information” (“**a power requirement**”) that is used to determine the power requirement/level for PDA3/battery. (Ex. 1005, ¶¶0057, 0063-0064, 0069-0073, FIG. 3.) Thus, for reasons that I explained above, a person of ordinary skill in the art would have been motivated to configure the modified *Okada* system to perform similar features in accordance with the configurations to PTM10/PRM40 components as explained above, such that “**upon powering and activation of the receiver circuit by the primary coil, the receiver circuit is configured to...communicate to the inductive charging system information corresponding to a... a power requirement.**” (*See my discussions in Sections IX.A.1(a)-IX.A.1(i).*)

192. While not expressly stated/disclosed by *Okada*, a person of ordinary skill in the art would have been motivated to configure the modified *Okada*

device/system to include in such communication, “**information corresponding to a voltage or current value at the output of the receiver rectifier circuit induced by the primary coil,**” in view of *Berghegger*.

193. *Berghegger* discloses a system for inductively powering/charging a device/battery. (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* Section VIII.C.) A controller 40 drives 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). (Ex. 1006, FIG. 4 (below), 3:58-61, 4:12-6:4, 6:5-15, 6:38-40 (“charging tray” and “mobile...telephone”).)

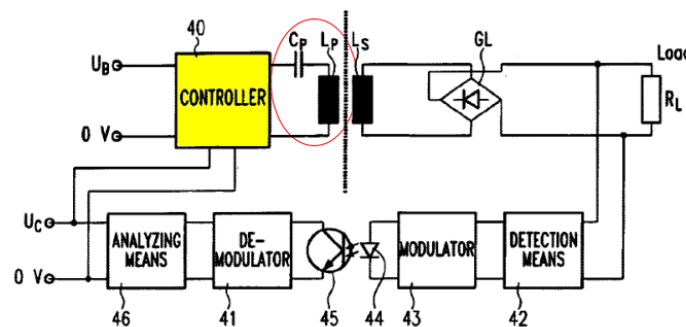


Fig.4

194. As demonstrated above and below, *Berghegger* is in the same technical field as the '942 patent and *Okada* (with the other asserted art), and discloses features reasonable pertinent to particular problem(s) the '942 patent (and a person of

ordinary skill in the art) was trying to solve. (See my discussions in Sections IX.A.1(a)-(k); Ex. 1001, Abstract, 1:50-7:50; Ex. 1006, Abstract, 2:18-20.) Accordingly, a person of ordinary skill in the art would have consulted *Berghegger* when designing/implementing the above-discussed modified *Okada* device/system.

195. A person of ordinary skill in the art would have recognized, similar to *Okada*'s closed-loop feedback power/charging operations (Ex. 1005, ¶¶0057, 0064; see my discussions above), *Berghegger* uses a closed-loop feedback configuration, where controller 40 receives a control signal U_C that "depends on the power demand of the secondary side," e.g., the voltage across the load R_L ***or at the output of a receiver rectifier circuit GL*** to perform charging operations, including regulating/adjusting the output power/voltage provided to the load. (Ex. 1006, Abstract, 3:51-4:50, 4:51-61, 4:62-5:64, 6:16-29, 6:60-61). The FIG. 5 configuration (below) 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.)

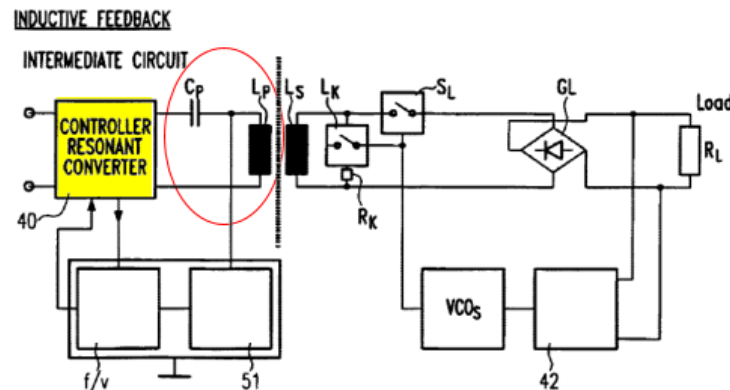


Fig.5

Thus, *Berghegger* discloses providing to a charger “**information corresponding to a voltage or current value at the output of [a] receiver rectifier circuit induced by [a] primary coil.**” (*Id.*) Controller 40 is capable of adjusting power levels **during** charging to provide a more efficient power signal via a closed-loop feedback arrangement based on the voltage across the load R_L or output of rectifier GL . (See my discussions above.)

196. A person of ordinary skill in the art would have appreciated the benefits/advantages *Berghegger*’s techniques/configurations would have provided to the modified *Okada* system/device. (See my discussions in Sections IX.A.1(a)-(j).) Namely, a person of ordinary skill in the art would have recognized that the modified system/device, operating consistent with *Okada*’s teachings, would use device information to control/adjust power delivery in a closed-loop feedback

fashion, but have done so at the **onset** of charging, **not during** charging. (Ex. 1005, ¶¶0069-0076, FIG. 3.) In contrast, *Berghegger* teaches that power required by a load “is **variable in time**” and thus a closed-looped control feature (similar to that described by *Berghegger*) would allow for accurate adjusted power delivery based on a varying power demand **during** powering/charging operations, considered at the output of a rectifier circuit (that supplies rectified signal(s) to the load) (*e.g.*, control signal U_C that “depends on the power demand of the secondary side,” *e.g.*, voltage across the load R_L or output of rectifier GL). (Ex. 1006, 6:12-15, FIG. 5; see my discussions above regarding *Berghegger*.)

197. Thus, *Berghegger*’s teachings would have motivated a person of ordinary skill in the art to configure the modified *Okada* system/device such that **PTM10** components adjusts power delivered to PDA3 based on received device information associated with a “**voltage or current value at the output of the receiver rectifier circuit**” (*see* my discussions in Section IX.A.1(e)) similar to the teachings of *Berghegger*. A person of ordinary skill in the art would have recognized obtaining/including such rectifier output value information in the information communicated in the current modulated signal(s) from the “receiver circuit” in **PRD40** (*see* my discussions in Sections IX.A.1(f) (current modulation), IX.A.1(i), IX.A.1(j)—above) would have improved/complimented the above-modified *Okada*

system/device to allow fine tuning of the determined power level while PDA3/battery is charged. For example, it would ensure “a sufficient amount” of power is “available on the secondary side” **during** power delivery (whether initiated at a low/intermediate/high level as in *Okada*) 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; Ex. 1005, ¶¶0069-0073).

198. In my opinion, a person of ordinary skill in the art would have considered/implemented such modification in various ways. For example, such a skilled person would considered leveraging/modifying *Okada*’s features/components that are used to receive/pass/process device information in **PTM10** for power transfer control (*e.g.*, demodulator 35, circuits 36-38 (Ex. 1005, ¶0064)) to achieve the noted beneficial power delivery features during charging/powering operations. For example, components in circuit 20 would have been configured to process/assess the received rectifier circuit current/voltage output value to provide a signal (like U_C in *Berghegger*) to control the operating frequency

of the charger components/circuits that facilitate the transfer of selected power (*e.g.*, switching circuit 15, etc.) to adjust power delivery during charge operations.¹⁰

199. A person of ordinary skill in the art would have had rationale and skills to implement, and expectation of success in achieving, such modification, especially since it would have involved the use of known technologies/techniques (*e.g.*, as disclosed/suggested by *Okada-Berghegger*) that would have foreseeably result in the modified *Okada* system including in the information communicated from the **“receiver circuit” “information corresponding to a voltage or current value at the output of the receiver rectifier circuit induced by the primary coil”** as claimed.

200. A person of ordinary skill in the art would have also been motivated to consider and implement use of other information to further such power transfer control operations, especially in light of *Calhoon*. As shown below, *Calhoon* is in the same technical field as *Okada* (and the other asserted art) and the '942 patent, and discloses features reasonable pertinent to particular problem(s) the '942 patent

¹⁰ Other successful designs/configurations would have been contemplated/implemented by a person of ordinary skill in the art to achieve the same features/functionalities as discussed.

and a person of ordinary skill in the art was trying to solve. (See my discussions in Section IX.A.1(a); Ex. 1041, FIGS. 3, 5A, 6, ¶¶0003-0010, 0022, 0029, 0034, 0045-0050, 0065; 1005, ¶0110, 0147-0151; Ex. 1001, 1:50-7:50; see my discussions below.) Accordingly, *Calhoon* would have been consulted by a person of ordinary skill in the art looking to design/implement a power/charging apparatus/system like that described by *Okada* (as modified above).

201. *Calhoon* discloses an inductive 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.)

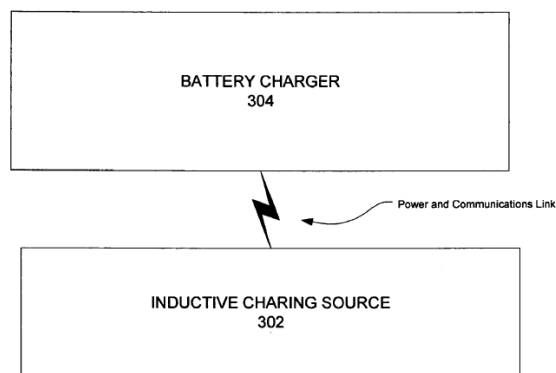


FIGURE 2

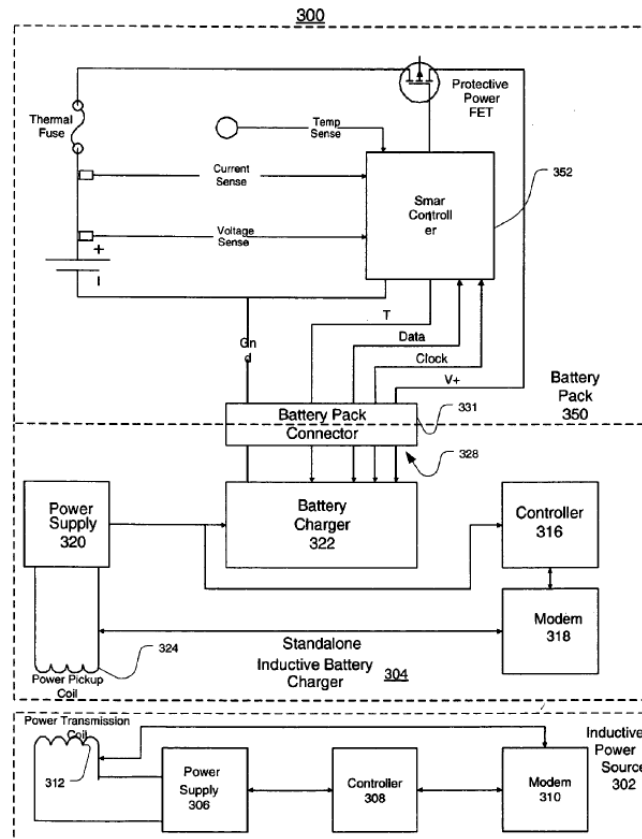


FIGURE 3

202. *Calhoon* describes 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 a power source (*e.g.*, inductive charging source 302). (*Id.*, Abstract, ¶¶0022, 0034, 0046-0048, 0050-0052, 0056, FIGS. 3, 5A, 6.) 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; *id.*, FIGS. 5A-6, ¶¶0034, 0042-0044, 0045-0048, 0049,

0050-0052, 0056.) Charging source 302 “can request other information relevant to the battery charger assembly 304” (e.g., battery charger ID or charger/battery pack serial number), which charger assembly 304 transmits. (*Id.*, ¶0047.) Thus, *Calhoon*’s power receiver includes “**a manufacturer code**” (e.g., serial number and/or manufacturer’s name) and “**a unique identifier code**” (e.g., a battery charger ID number), consistent with *Calhoon*’s disclosure that the information “can be used **for security, data integrity**, or other purposes.” (Ex. 1041, ¶0047; *id.*, FIGS. 3-5A, ¶¶0036-0037, 0040-0043.)

203. Given such teachings/suggestions discussed above, a person of ordinary skill in the art would have been motivated to further configure the above-modified *Okada* system to include in the information communicated by the disclosed “**receiver circuit**” device serial number and/or manufacturer’s name information (“**unique identifier code**”) to verify and/or authenticate each portable device for proper/authorized use. Thus, based on *Calhoon*’s teachings/disclosures, a person of ordinary skill in the art would have been further motivated to configure the above-modified *Okada* system/device to maintain, transmit, and use such identifier information to ensure a properly verified and positioned/aligned portable device receives appropriate power in accordance with the charging/power operations

discussed above. (See my discussions in Sections IX.A.1(a)-IX.A.1(i); see my discussions above (this section).)

204. A person of ordinary skill in the art would have had the skill and rationale in implementing, and reasonable expectation of success in achieving, such modification, especially where implementing it would have involved applying known technologies/techniques (*Okada, Calhoon*)) to verify/authenticate/confirm receiving device(s) to control power transfer in accordance with the modified operations/components discussed above.

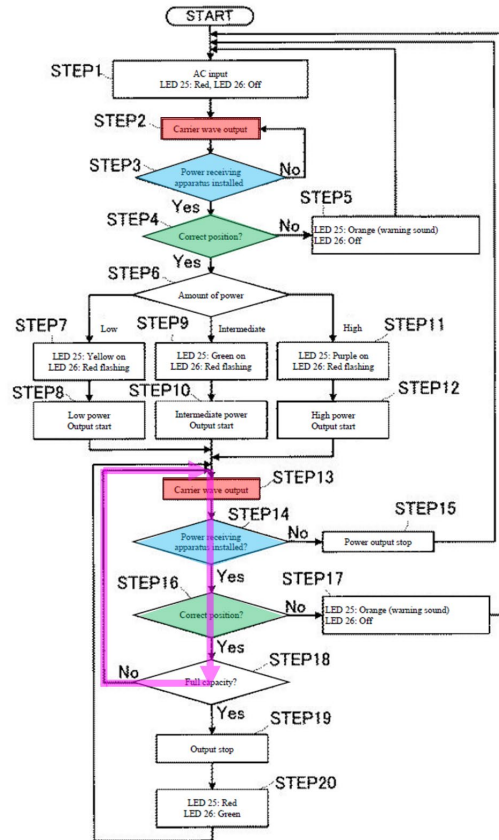
- l) periodically communicate to the inductive charging system additional information corresponding to a presently induced output voltage or current of the receiver rectifier circuit to enable the inductive charging system to regulate in a closed loop feedback manner the output voltage or current of the receiver rectifier circuit during the charging of the portable device.**

205. In my opinion, the *Okada-Odendaal-Cho-Tetlow-Nguyen-Berghegger-Calhoon* combination discloses/suggests this limitation.

206. As I explained for limitation 21(k), the modified *Okada* system would have been configured to communicate information corresponding to a voltage or current value at the output of the receiver rectifier circuit induced by the primary coil upon activation/power of the microprocessor. (See my discussions in Section

IX.A.1(k).) I also explain for *e.g.*, limitations 21(j)-(k), how and why the modified system/device would have been configured to provide a “**closed loop**” feedback operations that allow the system/device to control/regulate the power delivered for charging a specific portable device/battery (*e.g.*, PDA3/battery) by using information associated with a “voltage or current value at the output of the receiver rectifier circuit” induced by the primary coil. (*See* my discussions in Sections IX.A.1(i)-IX.A.1(k).)

207. As *Okada* explains, “[e]ven after power transmission has begun,” device information is periodically/continuously transmitted from PRM40 to PTM10 in response to the periodic/continuous transmission of the carrier wave by circuit 33, to maintain/control power delivery operations. (*See* my discussions in Sections IX.A.1(a)-(b), IX.A.1(f), IX.A.1(i); Ex. 1005, ¶0074-0077, FIG. 3 (below).)



208. Thus, consistent with *Okada*'s teachings (and *Berghegger* (See my discussions in Sections IX.A.1(j)-(k)) in context of the above-discussed modified *Okada*'s system/device, and for similar reasons explained above (including rationale, a person of ordinary skill in the art's skills/knowledge and expectation of success), it is my opinion that a person of ordinary skill in the art would have been motivated to configure the above-discussed modified system/device such that the "receiver circuit" (Section IX.A.1(d)) "periodically communicate[s] to the inductive charging system [cradle 4] additional information corresponding to a

presently induced output voltage or current of the receiver rectifier circuit” (voltage measured at the output of the “rectifier circuit” (Section IX.A.1(g)). (*See* my discussions in Sections IX.A.1(h)-(k).) Such **“information”** would have enabled cradle 4 to **“regulate in a closed loop feedback manner the output voltage or current of the receiver rectifier circuit during the charging of the portable device,”** consistent with what I discussed above for limitations 21(j)-(k). A person of ordinary skill in the art would have understood this because, as I explained, the modified *Okada* system/device would have been configured to provide/adjust power transfer based on the device power demand information, *e.g.*, voltage measured at the output of a rectifier circuit, communicated by PDA3’s “receiver circuit” in a closed loop manner during charging/powering of a portable device, consistent with the periodic/continuous feedback operations described by *Okada-Berghegger*. (*See* my discussions in Sections IX.A.1(i)-(k).) Thus, a person of ordinary skill in the art would have had similar motivation, capability, and expectation of success to implement such features as those explained above for limitations 21(i)-(l).

2. Claim 24

- a) **The portable device of claim 21, wherein the receiver circuit further comprises a limiter to limit the output voltage of the receiver rectifier circuit to a maximum value within a safe operating range of the battery charging circuit.**

209. In my opinion, the *Okada-Odendaal-Cho-Tetlow-Nguyen-Berghegger-Calhoon* combination discloses/suggests this limitation. (See my discussions in Section IX.A.1.)

210. As I discussed for limitation 21(f), voltage clamp circuit 49 (optional part of “**communication and control circuit**” of the “**receiver circuit**”) may further include voltage clamp circuit 49 that “receives the output from the smoothing circuit 44 and converts the output to a prescribed voltage.” (Section IX.A.1(f); Ex. 1005, ¶¶0047-0048.) As a person of ordinary skill in the art would have understood, a clamp circuit (like that disclosed by *Okada*), was known to provide a voltage not exceeding a certain set limit. (Ex. 1067, Abstract, ¶0005 (“voltage supply...*rises to the clamp voltage limit controlled by the high voltage clamp 130.*”), claim 1.) A person of ordinary skill in the art was also aware that excessive voltage to a device/battery can cause damage or undesirable operations, and thus would have considered design options to avoid/mitigate such issues. (Ex. 1065, ¶¶0033-0039 (voltage converter/regulator used to avoid “voltage spikes” and increase “operating

reliability”); Ex. 1060, ¶¶0013, 0016, 0097 (“battery protection circuitry [] necessary to keep the cell in a safe operating region”).) As a person of ordinary skill in the art would have understood, *Okada* provides mechanisms that can prevent overcharging PDA3’s battery. (Ex. 1005, FIG. 3, ¶¶0074-0077.)

211. Recognizing *Okada*’s use of a clamp circuit in context of such knowledge/understandings, a person of ordinary skill in the art would have been motivated to modify the “**receiver circuit**” in the modified *Okada* device to include voltage limiting circuitry/component (“**limiter**”) and/or configure the voltage clamp circuit 49 to include mechanisms/circuitry, to limit the output voltage of the “**receiver rectifier circuit**” (Section IX.A.1(e)) to be within a range that allows safe/proper operation of the “**battery charging circuit**” (Section IX.A.1(h)). A person of ordinary skill in the art understood at the time that different devices/battery components have different power characteristics. (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.) Also that such components have designed/specified maximum operating characteristics (*e.g.*, max current/voltage/power, etc.) to ensure proper and safe operations. (Ex. 1001, 67:26-27 (“electronic devices generally need to satisfy regulatory and safety requirements...”).) A person of ordinary skill in the art would have understood and appreciated that each circuit component, including the “**battery**

charging circuit” and the battery it charges, cannot sustain a signal having an excessively high voltage level, and thus have respective/corresponding finite operating voltage range(s) that the designer/manufacture deemed safe to operate within. Consistent with such knowledge, a person of ordinary skill in the art would thus have been motivated to configure the modified device/system’s “receiver circuit” with **“a limiter to limit the output voltage of the receiver rectifier circuit to a maximum value within a safe operating range of the battery charging circuit”** as claimed.

212. A person of ordinary skill in the art would have had the skill and rationale, and reasonable expectation of success in achieving, such modification, especially since it would have involved use of known technologies/techniques (*e.g.*, voltage clamps, limiter circuitry, overcharging mechanisms/techniques for blocking excessive voltage signals to protected components). (*Okada*, Ex. 1067; Ex. 1060, ¶0087.) Such modification would have foreseeably resulted in an inductive power transfer system with a portable device having a clamp/limiter that ensures the voltage of its receiver rectifier circuit provided to a battery charging circuit (*See my discussions in Sections IX.A.1(g)-(l)*) is within a safe operating range, as discussed.

B. Ground 2: *Okada* in view of *Odendaal*, *Cho*, *Tetlow*, *Nguyen*, *Berghegger*, *Calhoon*, and *Shima* Discloses and/or Suggests the Features of Claim 22

1. Claim 22

- a) **The portable device of claim 21, wherein the coil is formed in a flexible Printed Circuit Board (PCB) of multiple layers of substantially spiral-shaped conductor coil patterns electrically connected with vias.**

213. The *Okada-Odendaal-Cho-Tetlow-Nguyen-Berghegger-Calhoon* combination in view of *Shima* discloses/suggests this limitation. (Section IX.A.1.)

214. In addition to what I explained above for claim 21, *Odendaal* discloses that a receiver coil may be “a set of **spiral coils**...with each spiral being a conductor trace **on a separate substrate**, such as **flex** or **printed circuit board**” (Ex. 1008, 2:19-28, 3:41-48 (multi-layer coils)) and that “number of turns of spirals” may be adjusted (*id.*, 6:59-64) (“**flexible...(PCB) of multiple layers of substantially spiral-shaped conductor coil patterns**”). In addition to reasons discussed above for modifying *Okada* in view of *Odendaal*, in my opinion, a person of ordinary skill in the art would have been motivated to include similar features, *e.g.*, receiver coil 41 made of a flexible PCB having a set of multi-layer spiral-shaped conductor coil patterns, when implementing the *Okada-Odendaal* system. A person of ordinary skill in the art would have appreciated that such a modification/configuration would

have allowed forming flexible coils/substrate to be used in portable devices having different configurations and surfaces (*e.g.*, rigid, curved, flexible) consistent with *Okada*. (Section IX.A.1(a).) Additionally, multi-layer spiral-shaped coils were known to increase the generated magnetic field. (Ex. 1008, 3:41-48.)

215. A person of ordinary skill in the art would have had the motivation, skills and rationale to consider and configure such a modification, and done so with a reasonable expectation of success, given the teachings/suggestions of *Okada-Odendaal*, and state-of-art knowledge, to implement the above-modification while considering design tradeoffs and techniques/technologies with a reasonable expectation of success. Especially given such modification would have involved known technologies/techniques (*e.g.*, flexible PCB having layers of spiral-shaped conductor coil patterns) to foreseeably result in expanding/complementing applications of the portable devices and charging systems contemplated by *Okada-Odendaal*. (Section IX.A.1(a).) A person of ordinary skill in the art would have been further motivated to implement such modification in light of *Shima*, as explained below.

216. To the extent the modified *Okada* combination above does not expressly disclose a receiver coil formed in a flexible PCB coils having “**multiple layers of spiral-shaped conductor coil patterns electrically *connected with vias*,**”

it is my opinion that a person of ordinary skill in the art would have been motivated to do so given that was a common design for interconnecting multi-layer PCB circuit arrangements, as exemplified by *Shima*.

217. *Shima*, like *Okada-Odendaal*, discloses an inductive power/signal transfer system using primary and secondary coils (Ex. 1032, Abstract, 1:42-50, 2:12-4:10, 5:62-6:53, 7:17-8:38), and thus is similarly in the same technical field as the '942 patent, and discloses features reasonably pertinent to particular problem(s) the '942 patent and a person of ordinary skill in the art was trying to solve. (Section IX.A.1; Ex. 1001, Abstract, 1:50-7:50.) Therefore, a person of ordinary skill in the art had reasons to consider/consult *Shima* when looking to design/implement the above-discussed modified *Okada* device/system. (*Id.*)

218. *Shima* discloses the known use of coils having similar spiral patterns that reside on different layers of PCBs (“multiple layers of substantially spiral-shaped conductor coil patterns”), where the patterns are connected by through-holes (which a person of ordinary skill in the art would have known were “vias” consistent with that known in the art). For example, FIG. 3A (below) is described having “a plurality of thin printed-circuit substrates 30-1 to 30-n having similar coil patterns 32-1 to 32-n.” (Ex. 1032, 5:62-6:1, FIGS. 3D-3E (below), 6:13-35.) Starting and terminating ends of the coil patterns are connected using through-holes 33 and 34,

respectively. (*Id.*, 6:4-21.) Layers of loop patterns (*e.g.*, 37-1 to 37-n (FIG. 5A (below))) may also “have the respective through-holes [39] connected in such a way that a spiral coil is formed in the direction in which the printed-circuit substrates 30-1 to 30-n are stacked.” (*Id.*, 7:17-35.)

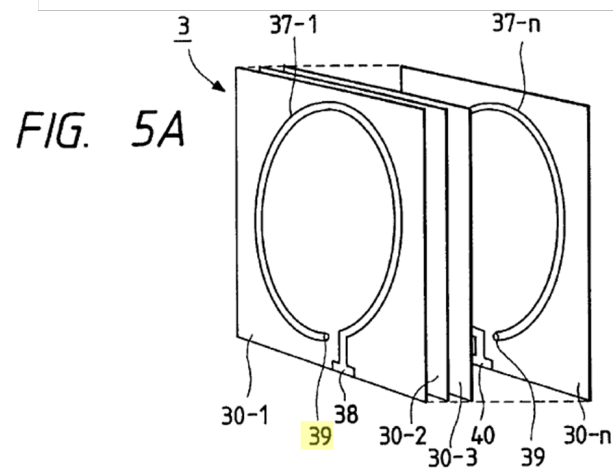
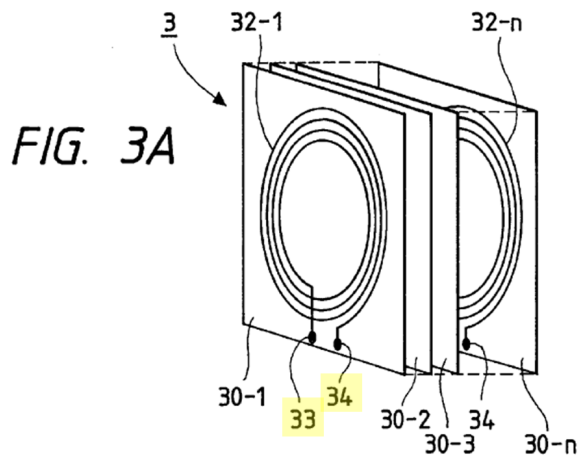


FIG. 3D

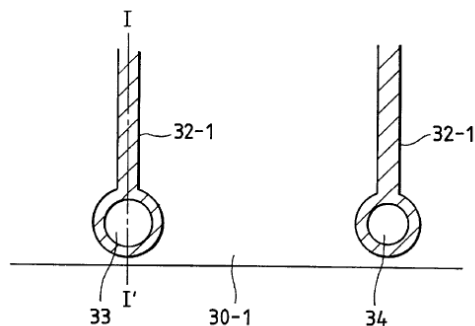
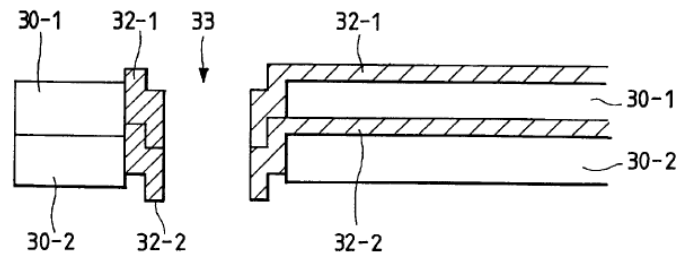


FIG. 3E



219. In view of *Shima* and *Odendaal*, a person of ordinary skill in the art would have been motivated to configure/implement the receiver coil in the modified *Okada* system (Section IX.A.1) as a flexible PCB with layers of substantially spiral-shaped conductor coil patterns electrically connected with vias in to maintain continuity while providing a compact coil configuration with enhanced efficiency and reduced conductor resistance as suggested by *Shima*. (Ex. 1032, 6:47-53, 7:41-44, 8:28-33.) A person of ordinary skill in the art would have appreciated the versatility in applications taught by *Okada* (Section IX.A.1(a)) and known stacked PCB coil designs and ways to interconnect them (vias) (*Shima/Odendaal*), and thus been motivated to design/implement various system designs that were consistent with such applications, including thin form factor configurations consistent with mobile devices (PDAs). Additionally, a person of ordinary skill in the art would have understood (and thus been motivated by such appreciation) that implementing a coil with layers having substantially similar conductor coil patterns would have

reduced the complexity of designing and manufacturing comparing one having different patterns. (*See my discussions above.*)

220. A person of ordinary skill in the art would have had the skill and rationale in implementing, and reasonable expectation of success in achieving, such a modification, especially given it was known to use vias to connect multi-layered flexible PCBs. (Ex. 1045, ¶0026, FIGS. 3A-C; Ex. 1032 (*see my discussions above.*)) Therefore, a person of ordinary skill in the art would have appreciated that such modification would have involved applying known technologies/techniques to foreseeably result in providing a charger with multi-layer flexible PCB primary coils that would have performed power/signal communications consistent with that discussed above for the modified *Okada* system. (Section IX.A.1.)

C. Ground 3: *Okada* in view of *Odendaal, Cho, Tetlow, Nguyen, Berghegger, Calhoon*, and *Labrou* Discloses and/or Suggests the Features of Claim 23

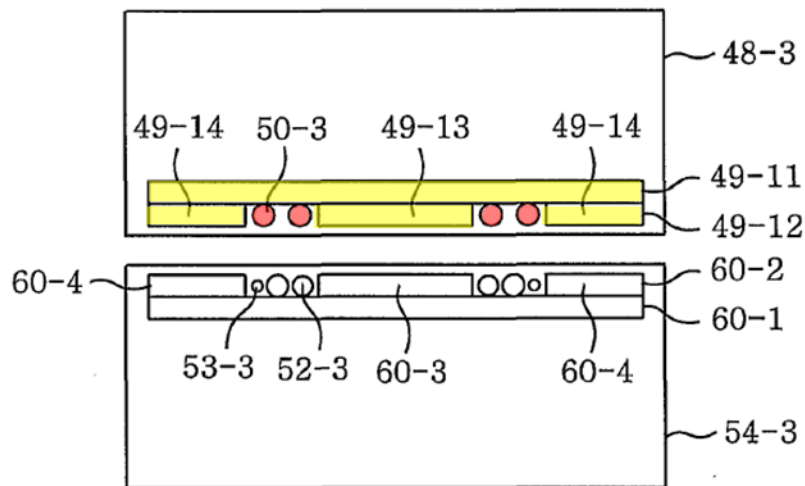
1. Claim 23

- a) **The portable device of claim 21, further comprising a magnetic core of ferromagnetic material within a central area of the coil and a near field communication (NFC) antenna and circuitry for communication of data with other devices.**

221. The *Okada-Odendaal-Cho-Tetlow-Nguyen-Berghegger-Calhoon* combination in view of *Labrou* discloses/suggests this limitation. (Section IX.A.1.)

222. Consistent with the combined teachings above (e.g., Section IX.A.1(c)), *Cho* describes secondary coil 50-3 (“**receiver coil**”) (red below) is formed on two ferrite sheets 49-11/49-12 (yellow) having a **central protrusion part** 49-13 (“**magnetic core**”) and an outer protrusion part 49-14. (Ex. 1061, 22:4-23:3; Section IX.A.1(c).)

FIG. 11



Given such teachings/suggestions (*Odendaal-Cho* in context of a person of ordinary skill in the art’s state-of-art knowledge (Sections IX.A.1(b)-(c)), a person of ordinary skill in the art would have been motivated to configure the receiver coil 41 in the modified *Okada* system/device (Section IX.A.1(c)) to have a central ferrite

protrusion part/core (“**a magnetic core of ferromagnetic material within a central area of the receiver coil**”) for reasons that I discussed for limitation 21(c), including, *e.g.*, improving the charging efficiency, as was known in the art. (Ex. 1061, 18:20-24 (“by tailoring a thickness of a desired ferrite and a thickness and a width of a wire, a charging device having a high charging efficiency can be obtained without increasing a volume and a weight of a portable device.”); Section IX.A.1(c).)

223. 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 because such a skilled person would have appreciated and knew above the use/benefits of a ferrite core/material in secondary coils was known. (Ex. 1059, ¶0012 (secondary coil having a ferrite core); Ex. 1061, 17:10-23:13 (ferrite material/core for inductive coils).) Therefore, in my opinion, a person of ordinary skill in the art had the motivation and skills in configuring, and a reasonable expectation of success in achieving, the above-modification, especially because of the teachings from *Cho*, *Odendaal*, in context of such a person’s state-art-knowledge concerning the use of ferrite material to enhance inductive energy transfer efficiency. (See my discussions in Sections IX.A.1(b)-IX.A.1(c).)

224. Additionally, while the above-modified *Okada* device/system does not disclose the “portable device” using NFC technologies/techniques to communicate

data as claimed, a person of ordinary skill in the art would have been motivated to implement such features in view of *Labrou*.

225. *Labrou*, like *Okada* (and other asserted art), is in the same technical field as the '942 patent, and discloses features reasonable pertinent to particular problem(s) the '942 patent and a person of ordinary skill in the art was trying to solve. (Section IX.A.1; Ex. 1001, Abstract, 1:60-7:50, 42:22-34, 44:21-25; Ex. 1062, ¶¶0009, ¶¶0185.) Therefore, a person of ordinary skill in the art had reasons to consider/consult *Labrou* when looking to design/implement the above-modified *Okada* device/system.

226. *Labrou* discloses use of an NFC chip coupled to a mobile device 104 and being a “part of the circuitry thereof,” allowing software of mobile device 104 to “communicate with the...NFC chip.” (Ex. 1062, ¶¶0185, FIG. 1.) *Labrou* explains that mobile device 104 may be used for “physical POS [point of sale] transactions,” providing a message for “authenticat[ing] and approv[ing] the transaction” via an NFC signal. (*Id.*, ¶¶0022-0026, 0185.) As disclosed, if the NFC chip is “integrated with the circuitry of [the mobile device],” the device may send a confirmation message to the POS upon the consumer entering a PIN on the mobile device. (*Id.*, ¶¶0185.) A person of ordinary skill in the art would have understood that the disclosed NFC chip necessarily includes **“antenna and circuitry for**
200

communication of data with other devices” given it communicates with an RFID reader at the POS. (*Id.*, ¶0185).) Without such an antenna, such wireless (radio frequency) communications would not occur as disclosed. (*Id.*)

227. A person of ordinary skill in the art would have been motivated to implement known NFC technologies/functionalities (NFC antenna/circuitry), similar to that taught by *Labrou* and known in the art, in *e.g.*, PDA3 (“**portable device**”) to provide additional functionalities/techniques for PDA3 to communicate data consistent with that known in the art, and consistent with features taught by *Okada* and *Labrou* (*e.g.*, use of mobile device at a POS for authentication/approval). Such an implementation/modification would have allowed the portable device to perform/provide common communication techniques/technologies (known to be used with mobile devices at the time, as demonstrated by *Labrou*).

228. A person of ordinary skill in the art would have had the skill and rationale in implementing, and reasonable expectation of success in achieving, such modification. This is because such a skilled person would have appreciated that it was known in the art to employ NFC chip(s)/antenna/circuitry with mobile devices circuitry to provide the benefits of such near-field communications (*e.g.*, POS transactions, etc.) Accordingly, a person of ordinary skill in the art would have appreciated and recognized that such modification would have involved applying

known technologies/techniques (e.g., known use of NFC antenna/circuitry) to foreseeably result in providing a mobile device that is capable of providing conventional features, such as NFC-based POS transactions, consistent with that discussed by *Labrou* and known in the art.

D. Ground 4: *Okada* in view of *Odendaal*, *Cho*, *Tetlow*, *Nguyen*, *Berghegger*, *Calhoon*, and *Meadows* Discloses and/or Suggests the Features of Claim 25

1. Claim 25

- a) **The portable device of claim 21, further comprising an output disconnect switch configured to connect and disconnect an output power from the receiver circuit to the battery, wherein the communication and control unit is further configured to control the output disconnect switch to disconnect the battery from the output power from the receiver circuit during at least some of the communication with the inductive charging system.**

229. In my opinion, the *Okada-Odendaal-Cho-Tetlow-Nguyen-Berghegger-Calhoon* combination in view of *Meadows* discloses/suggests this limitation.

230. Although the above-modified *Okada* combination does not expressly disclose “**an output disconnect switch**” as configured and controlled by “**the communication and control unit**” as recited in claim 25, it is my opinion that a person of ordinary skill in the art would have been motivated to implement such features in view of the teachings and suggestions in *Meadows*.

231. *Meadows*, like *Okada* (and other asserted art), is in the same technical field as the '942 patent and discloses features reasonable pertinent to particular problem(s) the '942 patent and a person of ordinary skill in the art was trying to solve. (See my discussions in Sections IX.A.1; Ex. 1001, Abstract, 1:60-5:17, 38:3-6; Ex. 1060, FIG. 7A, Abstract, ¶¶0085-0097.) Therefore, a person of ordinary skill in the art had reasons to consider/consult *Meadows* when looking to design/implement the modified *Okada* system/device discussed above. (Section IX.A.1.)

232. *Meadows* discloses a battery protection IC 686 controlling a FET switch 688 (“**disconnect switch**”) to ensure that battery 180 is not overcharged. (Ex. 1060, ¶¶0086-0087, FIG. 7A (annotated below).)

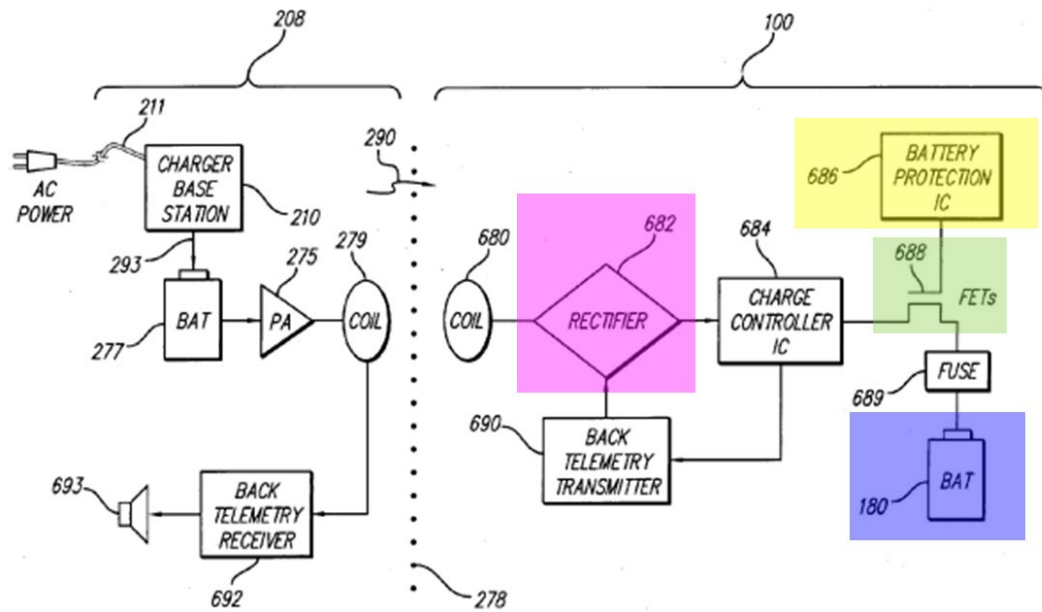


FIG. 7A

Rectifier 682 converts an AC signal from coil 680 to a DC signal for charging battery 180. (*Id.*, ¶0086.) “IC 686, with its FET switch 688...**keeps the battery within safe operating limits.**” (*Id.*, ¶0087.) As disclosed, if abnormality occurs when charging the battery (*e.g.*, overvoltage/undervoltage/short-circuit), “IC 686 **opens...switches 688 to prevent further charging.**” (*Id.*, ¶¶0087-0089; *id.*, ¶0022.) Thus, FET switch 688 is “**an output disconnect switch**” that is “**configured to connect and disconnect an output power from [a] receiver circuit to [a] battery,**” where IC 686 is “**configured to control the output disconnect switch to disconnect the battery from the output power from**” a rectifier 682 (art of receiver circuitry).

233. In light of such teachings in context of a person of ordinary skill in the art's state-of-art knowledge, a person of ordinary skill in the art would have been motivated to configure the "**communication and control circuit**" (Section IX.A.1(f)) (or the "**the communication and control *unit***" (claim 25)) in the above-modified *Okada* system/device (Section IX.A.1) to control a switch-based battery protection mechanism (*e.g.*, features similar to how FET switch 688 is controlled by battery protection IC 686 as taught by *Meadows*) to prevent further supply of power from the "**rectifier circuit**" (of the "**receiver circuit**") to the PDA3 battery if abnormality occurs, *e.g.*, overvoltage/undervoltage/short-circuit (*e.g.*, by disconnecting the battery from the output power from the receiver circuit) during the charging process (which includes when "**the communication**" of information with cradle 4 occurs) (Sections IX.A.1(j)-(l) ("**the communication**" occurring "**during**" the charging process).)

234. A person of ordinary skill in the art would have understood charging abnormality would be detrimental to the battery, and cause potential safety issues. (Ex. 1060, ¶¶0013, 0016, 0097 (overcharging may cause breakdown, gas leakage and thus, cell voltage monitoring is "paramount" and "battery protection circuitry [] necessary to keep the cell in a safe operating region").) A person of ordinary skill in the art would have known that it was advantageous to address overcharging issues

with respect to portable devices/batteries and configure/consider multiple ways to avoid overcharging (in case one fails). (*Id.*) Thus, while *Okada* relies on feedback information at the charging system to control/monitor full charge state (Ex. 1005, ¶¶0057, 0076, FIGS. 2-3), a person of ordinary skill in the art would have found it beneficial to avoid overcharging in case such components/process fail to stop charging (due to disruptions, component/signal failure/issues, etc.)

235. Given the teachings/suggestions of *Meadows* and *Okada*, in context of a person of ordinary skill in the art's state-of-art knowledge, and for reasons that I explained above, a person of ordinary skill in the art would have been motivated to configure the modified *Okada* device with “**an output disconnect switch**” controlled by the “**communication and control unit**” (Section IX.A.1(f)) to disconnect power from the receiver circuit to the battery **during** the charging process, which includes when “the communication(s)” occur with the charger system. (*See* my discussions in Sections IX.A.1(f)-IX.A.1(l).)

236. A person of ordinary skill in the art would have had the skill and rationale in implementing, and reasonable expectation of success in achieving, such modification. Especially where it would have involved applying known technologies/techniques (*e.g.*, known switch-based mechanisms (such as battery protection mechanisms)) to foreseeably result in providing portable device that

minimizes/avoids voltage/power delivery to the device battery at appropriate times, consistent with that discussed above (*Meadows*, state-of-art knowledge).

E. Ground 5: *Okada* in view of *Odendaal*, *Cho*, *Tetlow*, *Nguyen*, *Berghegger*, *Calhoon*, and *Takagi* Discloses and/or Suggests the Features of Claim 26

1. Claim 26

- a) The portable device of claim 21, wherein:
- b) the portable device further comprises a FET driver and a FET switch coupled to the coil and is configured to operate in an inductive power receiving mode and in an inductive power transfer mode,
- c) in the inductive power receiving mode, the portable device is configured to receive power inductively via the coil to charge the battery of the portable device, and
- d) in the inductive power transfer mode, the portable device is configured to operate the FET driver to drive the FET switch to apply an alternating current to the coil for providing power inductively to a second portable device.

237. The *Okada-Odendaal-Cho-Tetlow-Nguyen-Berghegger-Calhoon* combination in view of *Takagi* discloses/suggests this limitation.

238. While the modified *Okada* combination does not expressly disclose the “portable device” includes FET switch/driver and operates in inductive power

receiving/transfer modes as claimed, it is my opinion that a person of ordinary skill in the art would have been motivated to implement such features in view of *Takagi*.

239. *Takagi*, like *Okada-Odendaal-Kook*, discloses inductive power/signal transfer configurations using coils. (Ex. 1033, Abstract, FIGS. 1-7, ¶¶0003, 0013-0030, 0041-0078), and thus is in the same technical field as the '942 patent. (Section IX.A.1; Ex. 1001, 1:50-7:50.) *Takagi* discloses features reasonable pertinent to particular problem(s) the '942 patent and person of ordinary skill in the art was trying to solve. (*Id.*; Ex. 1033, ¶¶0005-0015; Ex. 1001, Abstract, 1:50-7:50.) Therefore, a person of ordinary skill in the art had reasons to consider/consult *Takagi* when looking to design/implement the modified *Okada* device/system.

240. *Takagi* discloses configuring inductive power transfer-based devices to operate as both an inductive power receiver and inductive power transmitters (**“operate in an inductive power receiving mode and in an inductive power transfer mode”**). (Ex. 1033, Abstract, ¶¶0003-0030, 0041-0056.) Power transmitting/receiving device 12 includes coil 125, power **transmitting** circuit 121, power **receiving** circuit 122, and secondary battery 123. (Ex. 1033, FIG. 2 (annotated below), ¶0047.) Such features are applicable to portable systems, e.g., portable/mobile computers/phones. (*Id.*, ¶¶0026, 0030, 0043, 0058, 0065, 0070.)

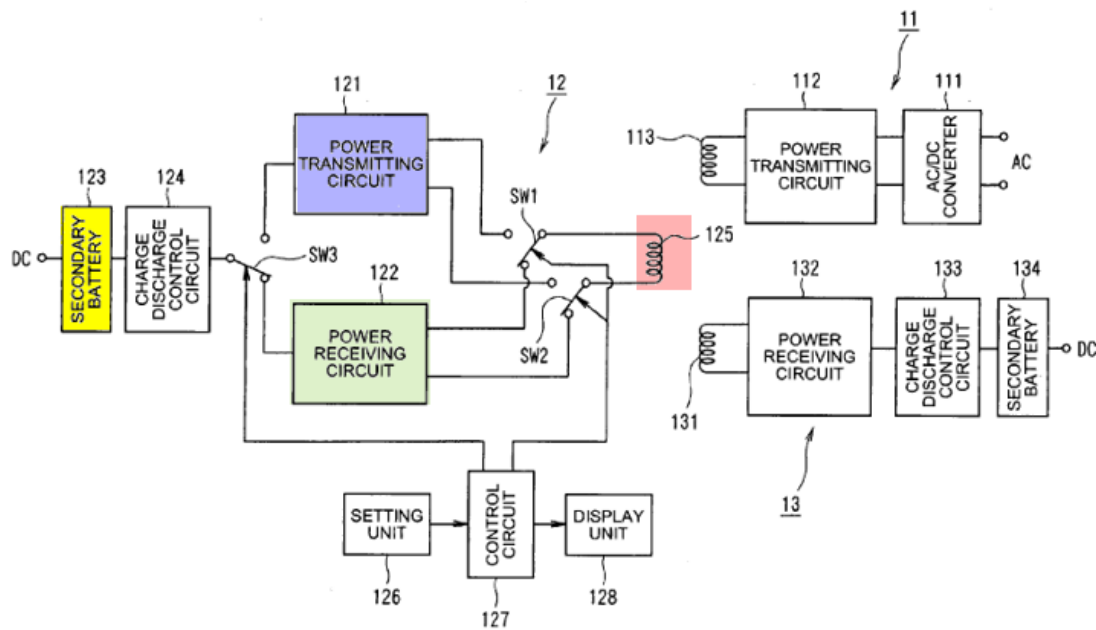


FIG. 2

241. *Takagi* explains that transmitting circuit 121 produces an alternating voltage from battery 123, and supplies it to coil 125 for **charging device 13** via coil 131. (*Id.*, ¶¶0048, 0054-0056.) Alternatively, based on switch SW1/SW2 settings, power receiving circuitry 122 (with control circuit 127 (¶0060)) in device 12 may also **receive power from device 11** via coils 125 and 113 for recharging battery 123. (*Id.*, ¶¶0048-0053, 0057-0072.) Thus, when coil 113 approaches coil 125 (and based on switch SW1-SW2 settings), power receiving circuit 122 receives power from device 11 (via the magnetic coupling between coils 125 and 113) to charge battery 123. (*Id.*, ¶¶0048, 0052-0053, 0069-0072; *id.*, 0057-0068.) Thus, device 12 includes switches (e.g., SW1-SW2) and associated driver circuitry (e.g., circuitry in

transmitting/receiver/control circuits 121-122, 127) to operate in power transmitting/receiving modes to either “receive power inductively via a coil to charge [an internal] battery” or “apply an alternating current to the coil for providing power inductively to a second portable device” [device 13]. (*See* my discussions above.) Also, *Takagi* explains that battery 123 can be “repeatedly used by charging,” and thus a person of ordinary skill in the art would have understood that the battery is periodically recharged. (*Id.*, ¶0049.)

242. In my opinion, in light of *Takagi*’s teachings and suggestions, a person of ordinary skill in the art would have been motivated to configure the portable device in the modified *Okada* combination to provide power transmitting/receiving modes to, via coil 41, inductively provide power to another portable device and inductively receive power to charge the secondary battery therein, similar to features/configurations taught by *Takagi*, and like that recited in claim 26. (*See* my discussions above; Section IX.A.1.) A person of ordinary skill in the art would have appreciated the benefits of such configurations and thus been motivated to enhance the versatility of applications of the modified *Okada* power/charging system, including enhancing/complimenting the mobility aspects of the portable device(s) contemplated by *Okada*. (*Id.*). A person of ordinary skill in the art would have appreciated such a modification would have allowed the portable device to

power/charge other devices (while also being capable of its battery to be recharged), thus expanding the device's functionalities, as taught/suggested by *Takagi*.

243. A person of ordinary skill in the art would have likewise been motivated to configure the above modification with FET driver circuits and FET switch(es) given the teachings/suggestions of *Takagi* in context of the modified *Okada* combination and a person of ordinary skill in the art's state-of-art knowledge (confirming known use of FET switch/driver-circuits in inductive power transfer devices/systems). As explained, *Takagi* discloses using switches and associated drive circuitry to facilitate the above-noted inductive power transmitting/receiving operations. (See my discussions above; e.g., Ex. 1033, FIG. 2, ¶¶0057, 0060, 0066, 0077, 0082-0085, 0092-0093.) Such teachings in context of those by *Okada*, *Berghegger*, *Cho*, *Calhoon* would have motivated a person of ordinary skill in the art to configure the portable device to implement the above power transmitting/receiving features (similar to that taught/suggested by *Takagi* and as-claimed) using FET switch(es) and associated FET driver circuit(s). (Ex. 1005, ¶¶0044, 0049, 0054 (FET switches/control circuits in inductive power transfer device), Ex. 1006, 3:51-4:24 (MOSFET switches in inductive power transfer device) Ex. 1061, 7:3-29, 9:17-29, 11:20-35, 12:20-30 (known use of FET switches in inductive power transfer circuits); Ex. 1041, FIG. 3 (protective power FET in

portable device).) Such a modification would have been a foreseeable application of known technologies/techniques (use of FET switches/driver(s)) to improve *Okada*'s portable device applications/functionalities in a manner consistent with that taught/suggested by *Takagi* and *Okada* (as modified).

244. Thus, consistent with the prior art's teachings/guidance, such modification would have foreseeably resulted in the portable device in the modified *Okada* system (Sections IX.A.1(a)-(l)) to include FET driver circuitry and associated FET switches that enable the device to operate in a power receiving mode where the device receives power inductively via coil 19 to charge the device's battery and also in a power transmitting mode (which operates the FET driver to drive the FET switch(es)) to apply an alternating current to coil 19 (consistent with known inductive power transfer (Sections IX.A.1(a)-(b); Ex. 1041, ¶¶0022), for providing power inductively to a second portable device (e.g., like a laptop/PDA, etc.).

245. A person of ordinary skill in the art would have had the skill and rationale in implementing, and reasonable expectation of success in achieving, such modification, especially since given the guidance by *Takagi* and other prior art (noted above). (See my discussions above and those regarding *Takagi*; *see also* Ex. 1043, 4:34-55, FIG. 3, 5:23-25.) Applying such known technologies/techniques (multi-function portable power transfer device using known inductive power

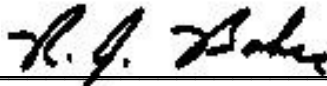
components (FET switches/driver(s)) would have foreseeably led to the modified *Okada* portable device being configured to have dual-mode functionalities (providing power to other devices while also allowing its battery to be wirelessly charged via coil 41), consistent with that discussed above by *Takagi* and the *Okada* combination. (Section IX.A.1).

X. CONCLUSION

246. In summary, it is my opinion that all of the features recited in claims 21-26 of the '942 patent are disclosed and/or suggested by the prior art.

247. 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 27, 2023

By: 

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