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. 11,316,371

DECLARATION OF R. JACOB BAKER, PH.D., P.E.
IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 11,316,371

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a) An apparatus comprising:.....115
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c) a first primary coil that is substantially planar and substantially parallel to a surface of the system for providing power inductively to the portable device;...131
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(2) 1(d)(2): wherein during operation the first drive circuit is configured to apply an alternating electrical current to the first primary coil at an operating frequency and duty cycle to generate an alternating magnetic field in a direction substantially perpendicular to the plane of the first primary coil and the surface of the system to provide power inductively to the portable device, ...173

(3) 1(d)(3): wherein the operating frequency is within a range of frequencies (i) that are near a resonance frequency of a circuit comprising the first primary coil and the capacitor, (ii) such that increasing values of the operating frequency within the range of frequencies would correspond to a lower voltage or current induced in an output of the receiver circuit and (iii) that allow activation and powering of the receiver unit and charging the battery of the portable device; 189

e) a first sense circuit to monitor current flow through the first primary coil during operation of the first drive circuit, wherein the first sense circuit includes a low pass filter and an amplifier to assist in detecting and amplifying a signal corresponding to a current modulation in the first primary coil induced by modulation of current in the receiver coil; and 195

f) a communication and control circuit, including a microcontroller coupled to the first drive circuit and the first sense circuit, configured to: 206

g) detect, through the first sense circuit, a received communication of information in the current modulation in the first primary coil; 212

h) operate the first drive circuit to inductively transfer power from the first primary coil to the receiver coil to activate and power the receiver unit to enable the receiver circuit to communicate the information detected in the current modulation in the first primary coil, wherein the communication of information includes information to enable the communication and control circuit to configure the inductive transfer of power to the portable device, ...214

i) wherein the received communication of information includes: information corresponding to a voltage or current induced by the first primary coil at the output of the receiver circuit; a unique identification code; a manufacturer code; a charge algorithm profile; and a power requirement; and.....219

j) operate the first drive circuit according to the power requirement and charge algorithm profile to provide the power from the first primary coil to the receiver coil to power the receiver unit and charge the battery of the portable device, ...235

k) wherein to charge the battery of the portable device the communication and control circuit is further configured to: receive additional information in the current modulation in the first primary coil from the modulation of the current in the receiver coil corresponding to the voltage or current at the output of the receiver circuit while charging the battery of the portable device;.....236

l) regulate in a closed loop feedback manner the voltage or current at the output of the receiver circuit in accordance with the received additional information corresponding to the voltage or current at the output of the receiver circuit by adjusting at least one of the operating frequency and the duty cycle of the first drive circuit while charging the battery of the portable device; 240

m) monitor for continued presence of the portable device and completion of the charging of the battery of the portable device based on the communication from the receiver circuit and detected by the communication and control circuit through the first sense circuit; and.....241

n) if the portable device is no longer present or charging is complete, stop operation of the first drive circuit for the provision of power inductively to the portable device. 244

2. Claim 4 246

a) The apparatus of claim 1 wherein: the DC voltage input is configured to connect to and receive a DC voltage from a DC power supply via a universal serial bus (USB); and the communication and control circuit is further configured to communicate with the DC power supply via the USB. 246

B. Ground 2: *Okada* in view of *Odendaal*, *Kook*, *Calhoon*, *Black*, and *Kazutoshi* Discloses and/or Suggests the Features of Claim 2 255

1. Claim 2 255

a) The apparatus of claim 1, wherein the closed loop feedback manner comprises a Proportional-Integral-Derivative (PID) control technique for regulating the voltage or current at the output of the receiver circuit. 255

C. Ground 3: *Okada* in view of *Odendaal*, *Kook*, *Calhoon*, *Black*, and *Masias* Discloses and/or Suggests the Features of Claim 3 263

1. Claim 3 263

a) The apparatus of claim 1, wherein the DC voltage input is configured to receive a DC voltage and the system further comprises: a voltage regulator circuit coupled to the DC voltage input and to the microcontroller, wherein the microcontroller is configured to control the voltage regulator circuit to switch a level of the DC voltage between multiple discrete values based on the received communication of information and the additional information received by the communication and control circuit from the portable device. 263

D. Ground 4: *Okada* in view of *Odendaal*, *Kook*, *Calhoon*, *Black*, and *Chen* Discloses and/or Suggests the Features of Claim 8 273

1. Claim 8 273

a) The apparatus of claim 1, wherein the system further comprises a high heat conductivity layer positioned proximate to the first primary coil and at least covering an area surrounding the first primary coil to disperse any heat generated during provision of power inductively. 273

E. Ground 5: *Okada* in view of *Odendaal*, *Kook*, *Calhoon*, *Black*, *Kazutoshi*, *Takagi,* and *Masias* Discloses and/or Suggests the Features of Claim 11 279

1. Claim 11 279

a) The apparatus of claim 1, wherein the closed loop feedback manner comprises a Proportional-Integral-Derivative (PID) control technique for regulating the voltage or current at the output of the receiver circuit, the portable device is a first portable device, and the receiver unit of the first portable device is a first receiver unit, the apparatus further comprises: 279

b) a second portable device;.....281

c) the system is incorporated into the second portable device; and 282

d) the second portable device further comprises: 287

(1) an internal, rechargeable battery and a DC-to-DC voltage converter to provide power to the system to inductively power the first receiver unit of the first portable device and charge the battery of the first portable device; 287

(2) a second receiver unit coupled to the first primary coil to enable the internal, rechargeable battery to be recharged inductively through the first primary coil; and 290

(3) the communication and control circuit is further configured to control whether the second portable device is receiving power inductively or charging the first portable device inductively. 292

F. Ground 6: *Okada* in view of *Odendaal*, *Kook*, *Calhoon*, *Black*, and *Labrou* Discloses and/or Suggests the Features of Claim 12....296

1. Claim 12.....296

a) The apparatus of claim 1 wherein the first primary coil includes a magnetic core of ferromagnetic material within a central area of the first primary coil and the apparatus further comprises a Near Field Communication (NFC) antenna and circuitry for communication of data.....296

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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. 11,316,371 ("the '371 patent") (Ex. 1001).[1] I have been asked to consider whether the prior art discloses or suggests the features recited in claims 1-4, 8, and 11-12 ("the challenged claims") of the '371 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 '371 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. 11,316,371
Ex. 1004	Prosecution History of U.S. Patent No. 11,316,371
Ex. 1005	Translation of Japanese Patent Application Publication No. 2006-141170A ("*Okada*")[2]
Ex. 1006	U.S. Patent No. 6,912,137 ("*Berghegger*")
Ex. 1007	U.S. Patent Application Publication No. 2006/0145660A1 ("*Black*")
Ex. 1008	U.S. Patent No. 6,960,968 ("*Odendaal*")
Ex. 1009	U.S. Patent No. 6,489,745 ("*Koreis*")
Ex. 1010	U.S. Patent No. 6,366,817 ("*Kung*")

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

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

Ex. 1027	Spiral Inductor Design for Quality Factor, Sang-Gug Lee et al., Journal of Semiconductor Technology and Science, Vol. 2. No. 1, March 2002 ("*Lee*")
Ex. 1028	U.S. Patent Application Publication No. 2001/0055207 ("*Barbeau*")
Ex. 1029	AN710 Antenna Circuit Design for RFID Applications
Ex. 1030	U.S. Patent No. 6,606,247 ("*Credelle*")
Ex. 1031	U.S. Patent No. 7,339,353 ("*Masias*")
Ex. 1033	U.S. Patent Application Publication No. 2005/0134213A1 ("*Takagi*")
Ex. 1034	U.S. Patent Application Publication No. 2005/0135129A1 ("*Kazutoshi*")
Ex. 1035	U.S. Patent Application Publication No. 2005/0270745A1 ("*Chen*")
Ex. 1036	International Patent Application Publication No. WO2003/105308A1 ("*Hui*")
Ex. 1037	U.S. Patent No. 5,780,992 ("*Beard-1*")
Ex. 1039	U.S. Patent No. 5,631,539 ("*Beard-2*")
Ex. 1041	U.S. Patent Application Publication No. 2005/0127868A1 ("*Calhoon*")
Ex. 1042	U.S. Patent No. 8,005,547 ("*Forsberg*")
Ex. 1043	U.S. Patent No. 7,791,311 ("*Sagoo*")
Ex. 1044	U.S. Patent Application Publication No. 2007/0145830A1 ("*Lee-II*")

Ex. 1046	U.S. Patent Application Publication No. 2007/0026826A1 ("*Wilson*")
Ex. 1047	U.S. Patent Application Publication No. 2006/0202665 ("*Hsu*")
Ex. 1048	International Patent Application Publication No. WO2009155000A2 ("*Lin*")
Ex. 1049	U.S. Patent Application Publication No. 2008/0067874 ("*Tseng*")
Ex. 1050	U.S. Patent No. 9,356,473 ("*Ghovanloo*")
Ex. 1054	U.S. Patent Application Publication No. 2011/0193484 ("*Harbers*")
Ex. 1055	U.S. Patent Application Publication No. 2005/0057187 ("*Catalano*")
Ex. 1056	U.S. Patent No. 6,459,383 ("*Delatorre*")
Ex. 1057	International Patent Application Publication No. WO1999050806A1 ("*Cunningham*")
Ex. 1058	International Patent Application Publication No. WO2004026129A1 ("*Due-Hansen*")
Ex. 1059	U.S. Patent Application Publication No. 2009/0261778 ("*Kook*")
Ex. 1061	International Patent Application Publication No. WO2002/37641 ("*Cho*")
Ex. 1062	U.S. Patent Application Publication No. 2007/0022058 ("*Labrou*")
Ex. 1063	ATMEL e5530 Data Sheet (2002)

Ex. 1075	Watson, J., Mastering Electronics, Third Ed., McGraw-Hill, Inc. (1990) ("*Watson*")
Ex. 1076	Sedra, A., *et al.*, Microelectronic Circuits, Fourth Ed., Oxford University Press (1998) ("*Sedra*")
Ex. 1077	GB Patent Application Publication No. 2202414 ("*Logan*")
Ex. 1078	U.S. Patent No. 7,226,442 ("*Sheppard*")

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 '371 patent at the time of the alleged invention.

18. I understand that the '371 patent issued from U.S. Patent Application No. 17/507,323, filed on October 21, 2021, 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 '371 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 ’371 patent to be around the timeframe from April 2007 to April 2008. In particular, I have been asked to consider the following dates as representative of the alleged inventions for the following challenged claims:

- claims 1 and 12: around April 30, 2007 to July 30, 2007;
- 2-4, and 11: around September 12, 2007 to December 12, 2007;
- claim 8: around January 7, 2008 to April 7, 2008.

My opinions reflect how one of ordinary skill in the art (which I described below) would have understood the ’371 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 April 2008) 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 ’371 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 1-4, 8, and 11-12 of the ’371 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 April 2008 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 '371 patent, a person of ordinary skill in the art at the time of the alleged invention of the '371 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 April 2008 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., late 2006 to late 2007 (claims 1 and 12), mid-2007 to early 2008 (claims 2-4, and 11), and late 2007 to mid-2008 (claim 8) 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 '371 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 '371 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 '371 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 '371 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 '371 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.)

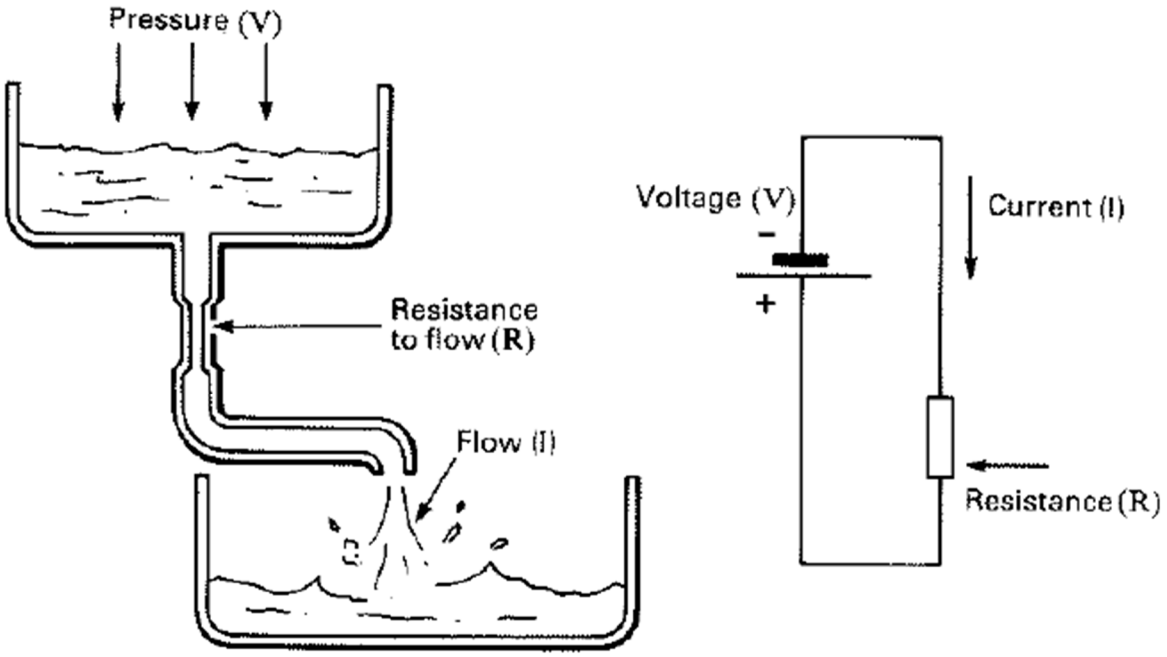
27. Additionally, a person of ordinary skill would have known that resistance is another fundamental concept involved in the flow of electrons. "Resistance is a property of all materials that reduces the flow of electricity through them," so that "[t]he higher the resistance, the more difficult it is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

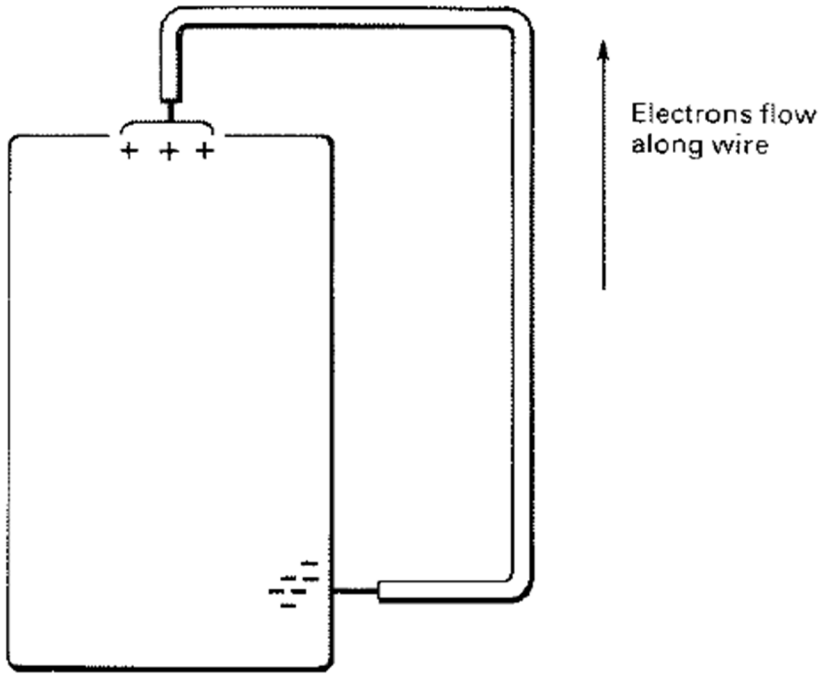
fig 2.5 *a plumbing analogy: voltage, current and resistance all have their equivalents in the water system*



(*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*



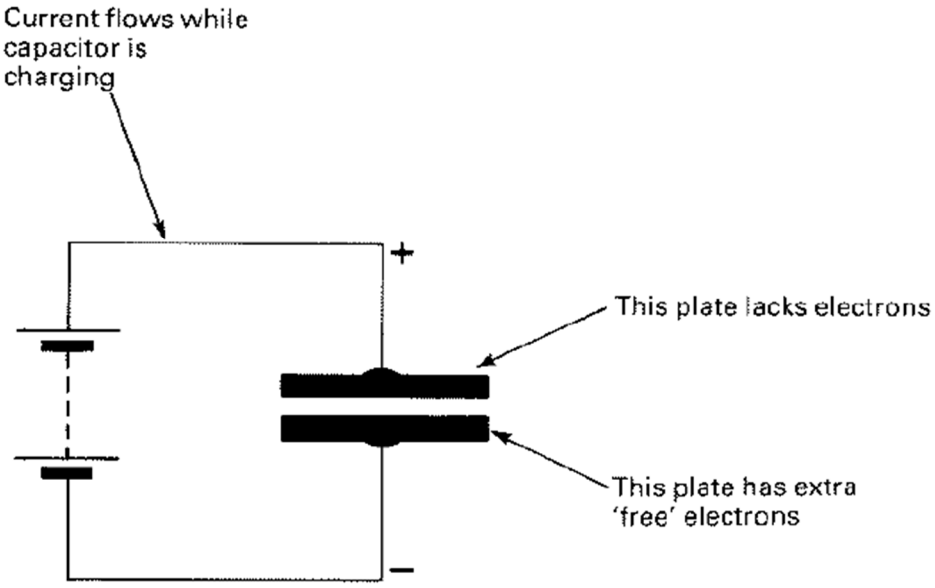
(*Id.*, FIG. 2.3.) A person of ordinary skill would have known that without such a closed path (e.g., as shown above in Figure 2.3), current cannot flow. (*Id.*, 8-11, FIGS. 2.3-2.5.)

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*



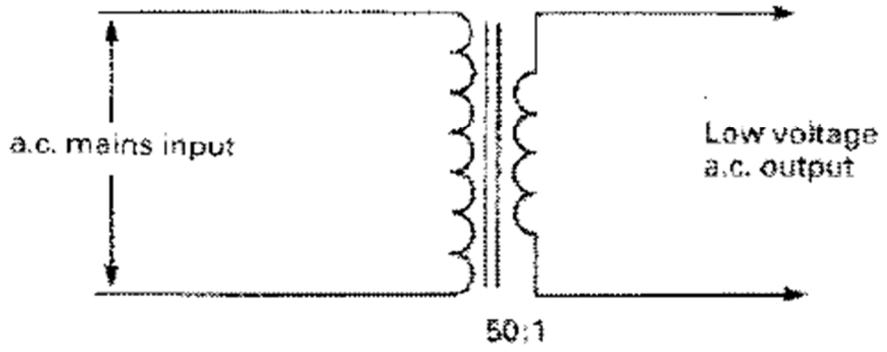
(*Id.*, FIG. 3.8.) A person of ordinary skill would have known that "[i]n this state the capacitor is said to be *charged*," and [i]f the charged capacitor is connected in a

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).)

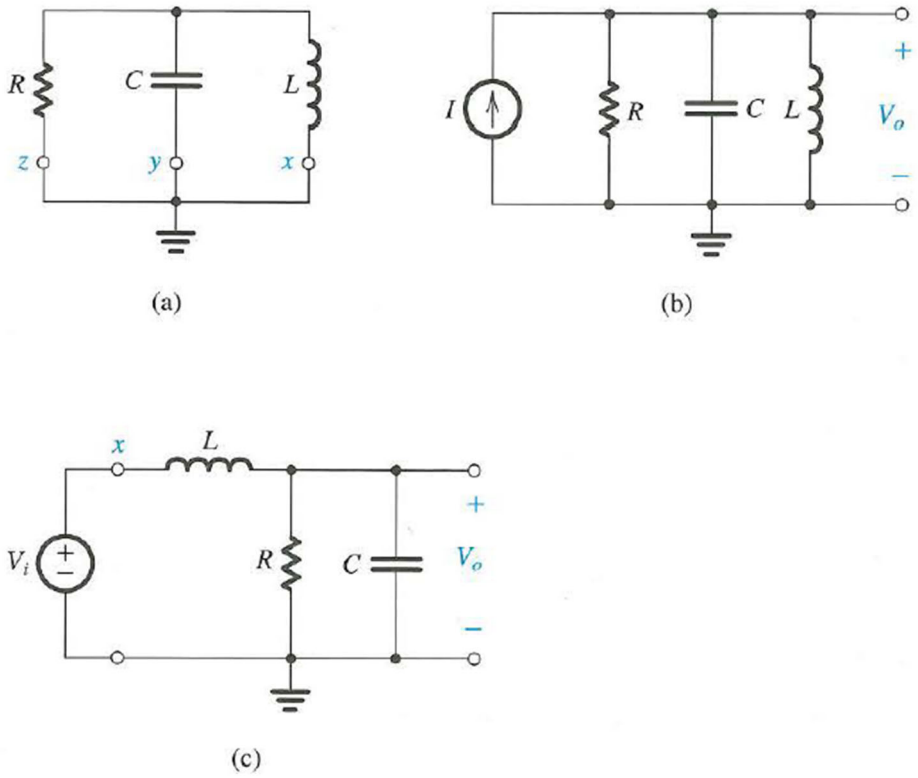


Fig. 11.17 **(a)** The second-order parallel LCR resonator. **(b)** and **(c)** Two ways for exciting the resonator of (a) without changing its *natural structure*. The resonator poles are the poles of V_o/I and V_o/V_i.

(*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.)

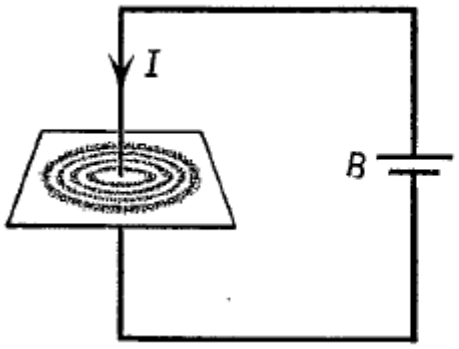


Fig. 30-2 Pattern formed by iron filings showing the circular magnetic field around a wire carrying current.

(*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.").)

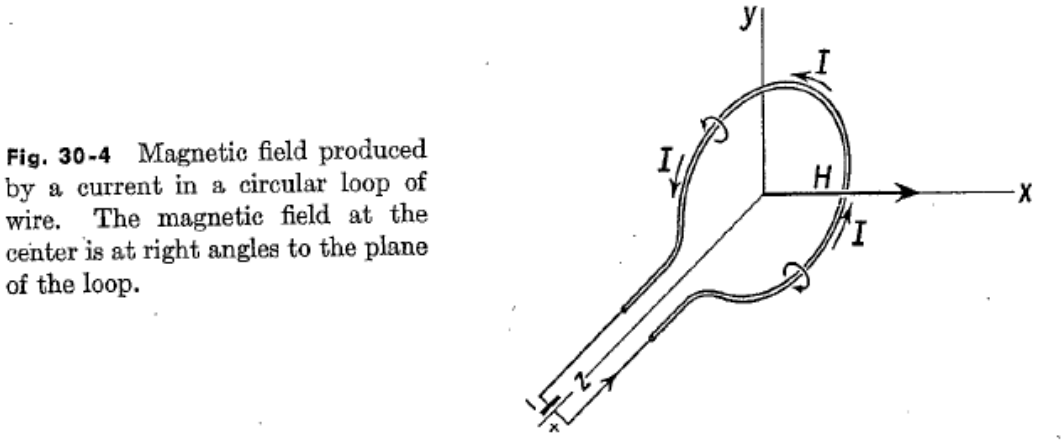


Fig. 30-4 Magnetic field produced by a current in a circular loop of wire. The magnetic field at the center is at right angles to the plane of the loop.

(*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.)

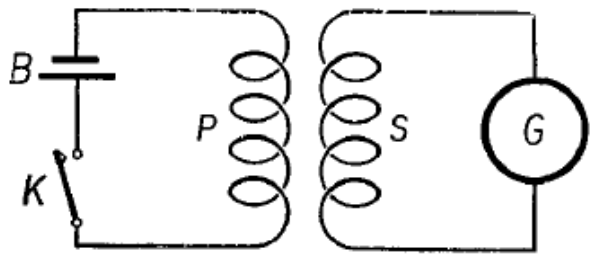


Fig. 32-3 Faraday's experiment on electromagnetic induction.

(*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).

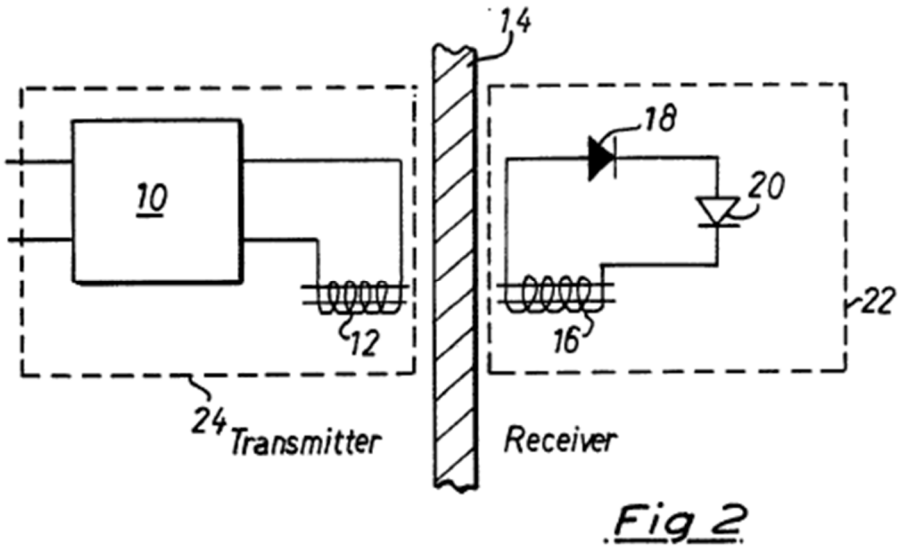


Fig 2

(*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]

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

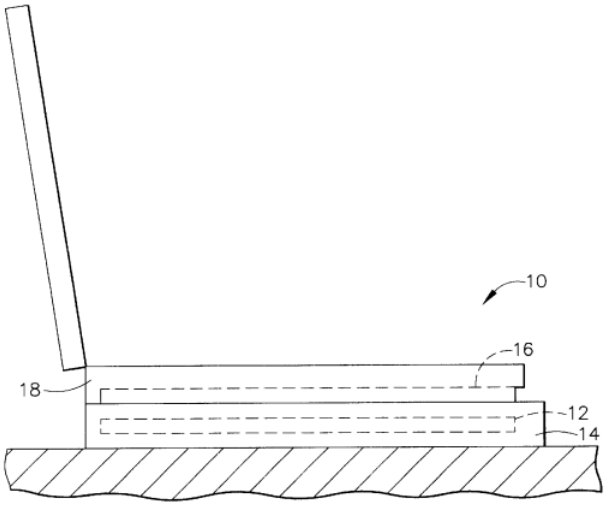


FIG. 1

(*Id.*, FIG. 1.)

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

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

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

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

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

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

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

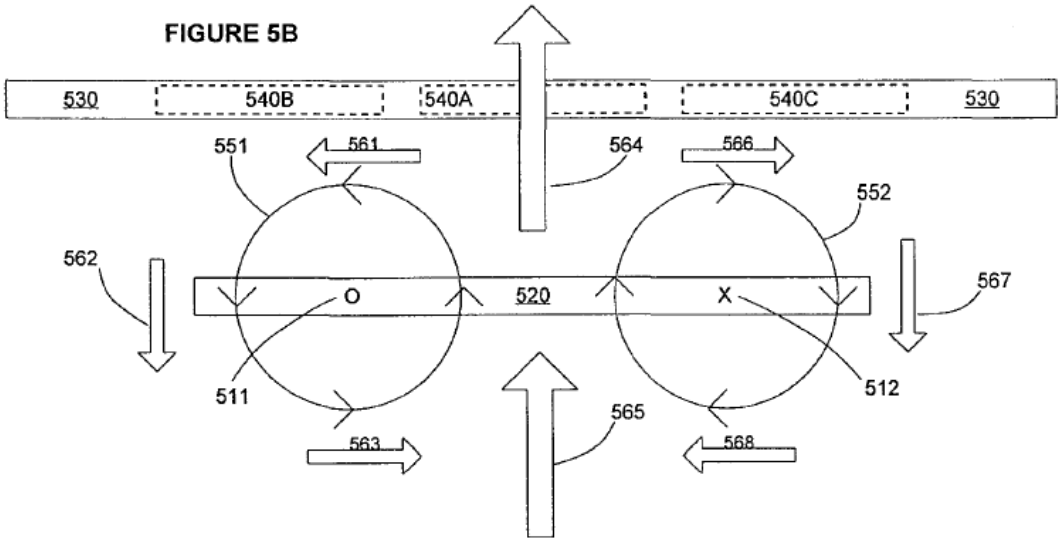
(Ex. 1010, Abstract.)

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

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

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

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



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

3. Use of Planar Coils

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

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

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

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

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

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

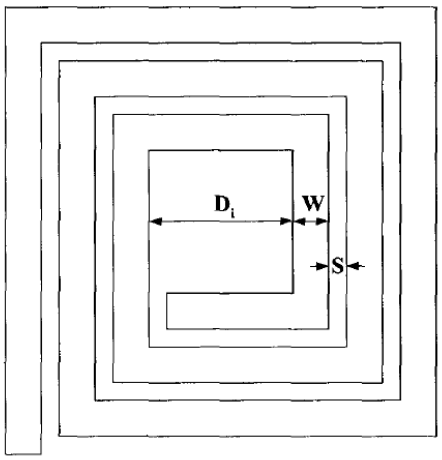


Fig. 1. A planar square spiral inductor structure.

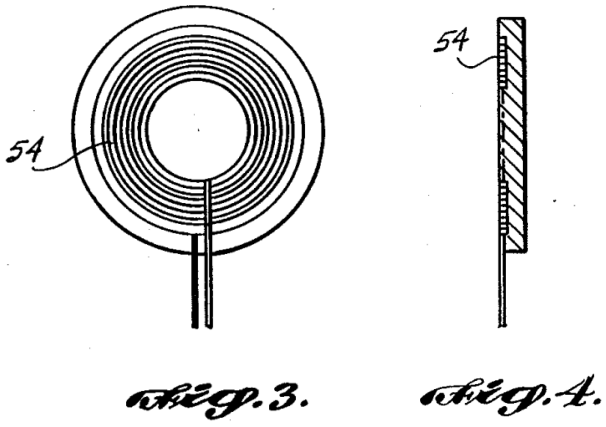
(*Id.*, FIG. 1 (showing a "**planar square spiral inductor** structure").)

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

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

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

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



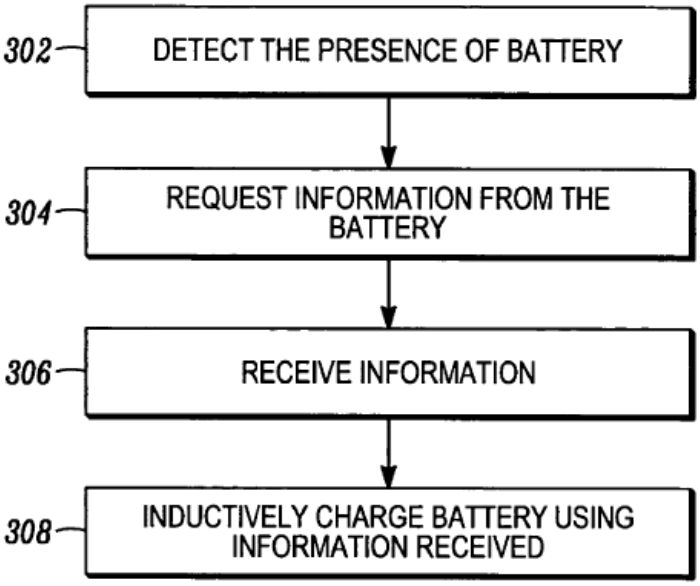
(*Id.*, FIGS. 3-4.)

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, w1 < w < w2. . . . the bandpass filter in Fig. 14.35 is a series resonant circuit.

(*Id.*, 641.)

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

(*Id.*, 798.)

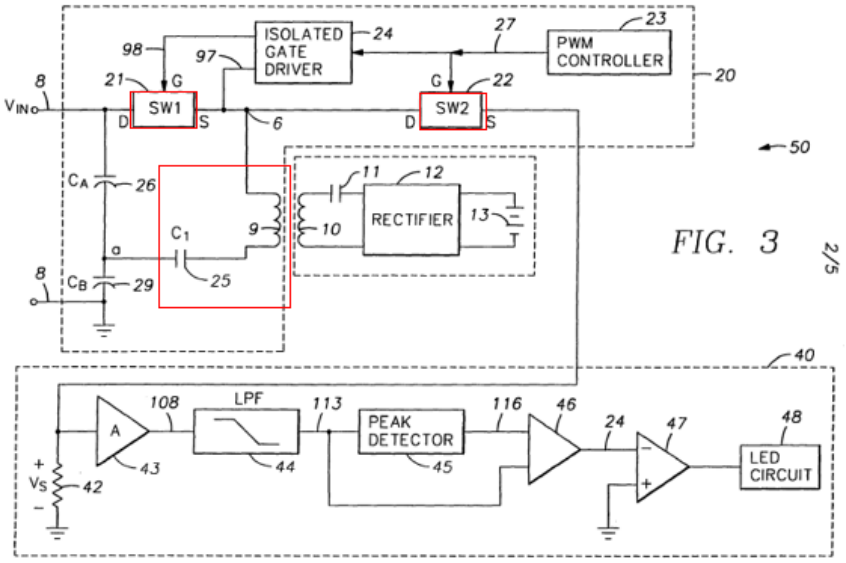
63. Likewise, *Lee-II* explains that:

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

(Ex. 1044, ¶0083.)

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

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



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

65. Other references provide similar disclosures consistent with a person of ordinary skill in the art'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 trance on PCB board or on flexible substrate"), 22-25; Ex. 1017, 1:9-8:22 (discussing known issues with harmonics and conventional and revised ways to reduce harmonics in AC-DC/DC-AC conversion power systems with application to "battery chargers"); Ex. 1023, FIGS. 1-4, 6A-6C, 14, Abstract, ¶¶0007-0024, 0027, 0032-34, 0074-0078 (describing mechanisms/techniques to reduce harmonics in AC and DC driven lighting systems and benefits for doing so).)

VI. OVERVIEW OF THE '371 PATENT

66. The '371 patent relates "generally to power supplies, power sources, and particularly to a system and method for inductive charging of portable devices." (Ex. 1001, 1:54-55.) For example, the patent explains that "a portable device includes a battery and a receiver unit coupled to the battery. The receiver unit is configured to receive inductive power from an inductive charging system. The receiver unit includes a receiver coil, a ferromagnetic layer, and a receiver circuit powered by the inductive charging system. The receiver circuit includes a receiver rectifier circuit, a receiver communication and control circuit, a voltage regulator, and a battery charging circuit. When a current is generated in the receiver coil inductively by the primary coil in the base unit, the current is rectified and smoothed by the receiver rectifier circuit and is used by the voltage regulator to power and activate the microcontroller and used by the battery charging circuit to charge the battery of the portable device." (*Id.*, 3:55-4:1.) "In another embodiment, an apparatus includes a system for providing power inductively to a portable device comprising a battery and an inductive receiver unit including a receiver coil and a receiver circuit. The system includes a first primary coil, a first drive circuit, a first sense circuit, and a communication and control circuit. The communication and

control circuit is configured to detect, through the first sense circuit, a received communication of information in the current modulation in the first primary coil. The communication and control circuit is also configured to operate the first drive circuit to inductively transfer power from the first primary coil to the receiver coil to activate and power the receiver unit to enable the receiver circuit to communicate information detected in the current modulation in the first primary coil." (*Id.*, 4:45-59.)

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 '371 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 1-4, 8, and 11-12, 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

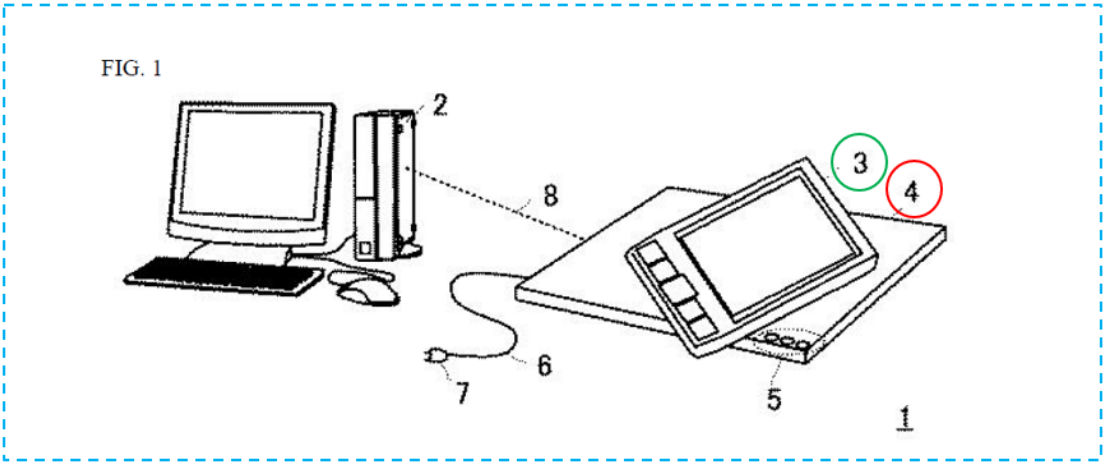
69. I rely on the disclosures and analysis thereof of the prior art discussed in this section VIII for my opinions regarding their respective teachings and suggestions as applied to the challenged claims of the '371 patent below in Section IX. Accordingly, the following discussions are incorporated into 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 '371 patent below in Section IX.

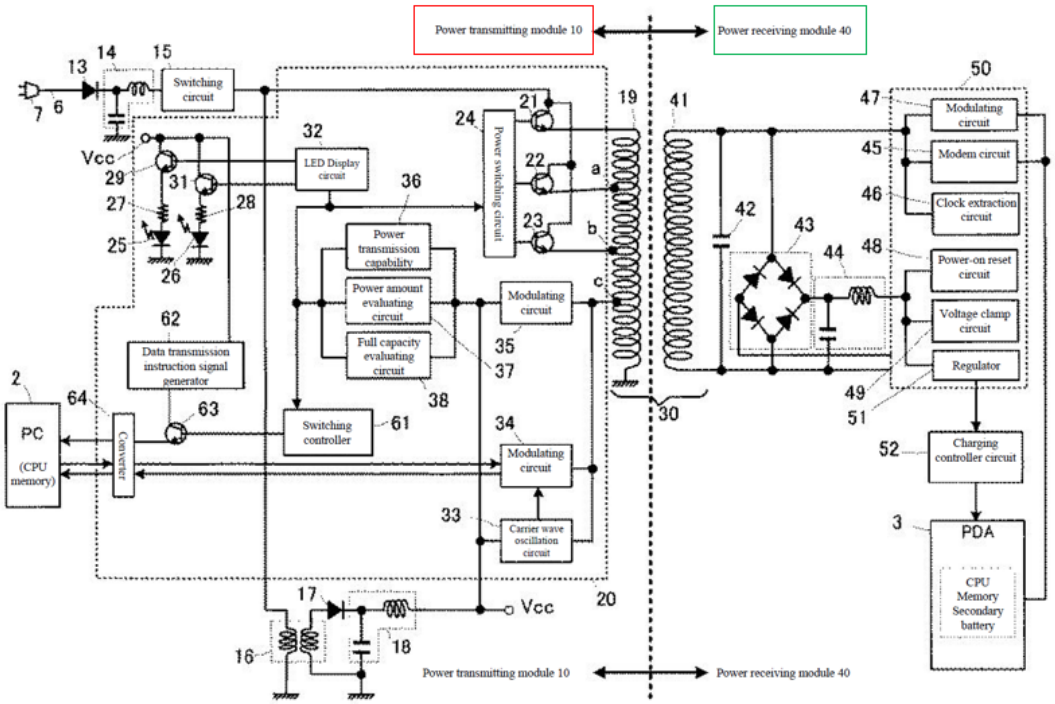
71. *Okada* discloses a system for inductive powering or charging of portable devices such as mobile phones and PDAs with batteries. (Ex. 1005, Abstract, ¶¶0001, 0015, 0047, FIG. 2, claim 4.) *Okada*'s FIG. 1 shows a power supply system 1 (**blue**) including PC 2, PDA 3 (**green**), and cradle 4 (**red**),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



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

the PDA." (*Id.*, ¶0035; *see also id.*, ¶0051 ("The primary-side coil 19 together with the secondary-side coil 41 constitute the transformer 30 and magnetic coupling induces a voltage on both ends of the secondary-side coil 41.").)

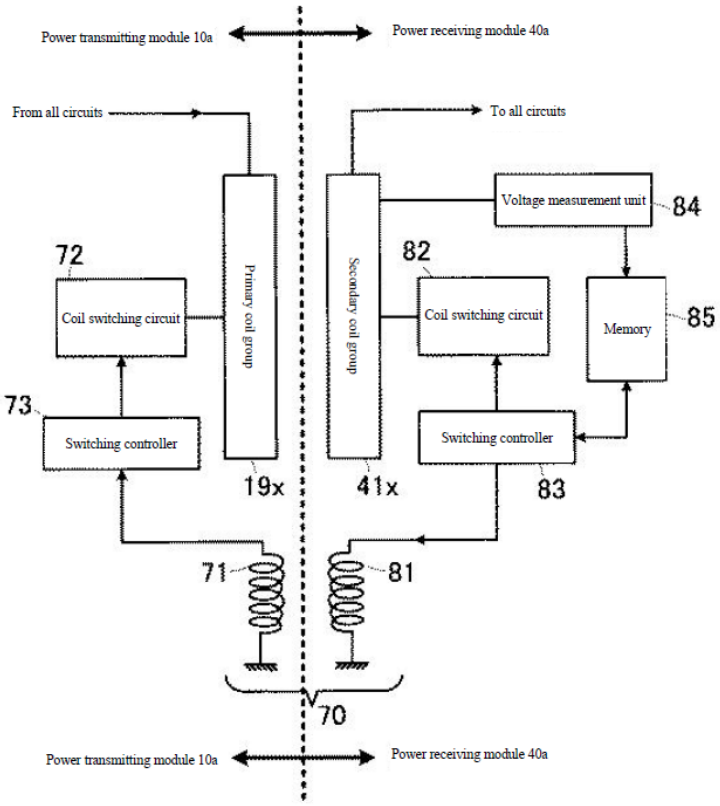
72. *Okada*'s FIG. 2 describes an exemplary system, where each of cradle 4 and PDA 3 includes circuitry/components and at least one coil. (Ex. 1005, ¶¶0035, 0037 ("PDA equipped with the power receiving module 40"), FIG. 2.) Cradle 4 includes a **power transmitting module 10** ("PTM10"), and PDA 3 includes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



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

73. *Okada* explains that PTM10 converts received power (e.g., via cord/plug 6/7) to a DC signal via circuits 13-14. (Ex. 1005, ¶¶0038, 0049.) Switching circuit 15 generates a switching pulse signal using the DC signal (*id.*), which is converted to a DC signal (V_{CC}) powering PTM10 components (via circuits 16-18). (*Id.*, ¶0039.) *Okada* also explains that the switching pulse signal is also supplied to primary coil 19 via one of switches 21/22/23 respectively connected to different coil taps. (*Id.*, ¶¶0040, 0049-0051.) A power switching circuit 24 selects a switch 21/22/23 to allow the switching pulse signal to traverse selected turns of coil 19, enabling the system to select/adjust the power level inductively transmitted from PTM10 (e.g., cradle 4) to PRM40 (e.g., PDA 3). (*Id.*, ¶¶0040, 0051, 0057, 0069-0073, FIG. 2.)

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



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

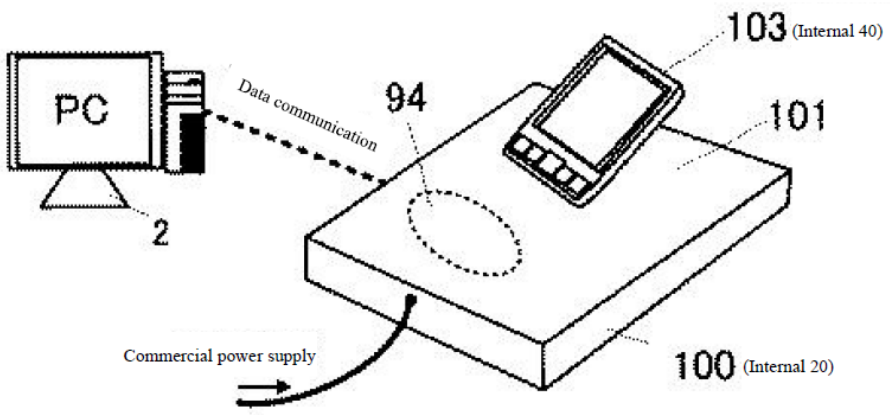
75. A person of ordinary skill in the art would have understood that applications/disclosures of these features of *Okada* (that I discussed above and below in this section) are also described in *Okada* with respect to (and are applicable to) other exemplary system(s)/configuration(s)/figure(s). (Ex.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

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

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

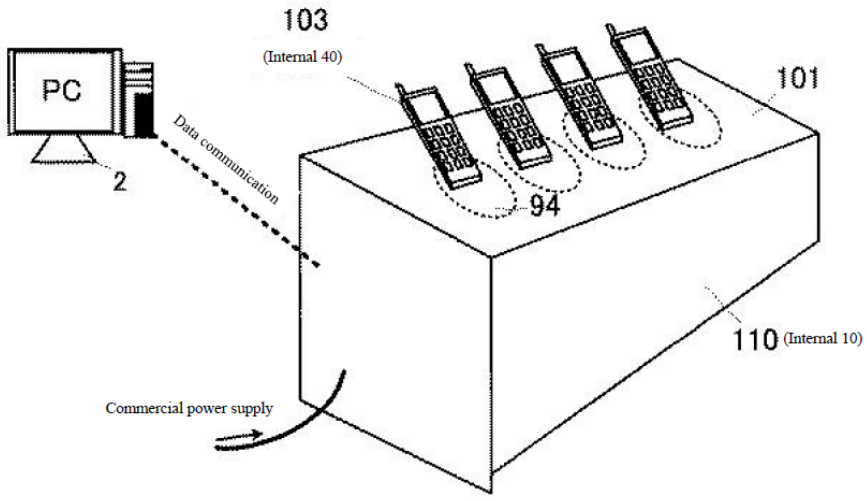
(Ex. 1005, ¶0030.)

FIG. 9



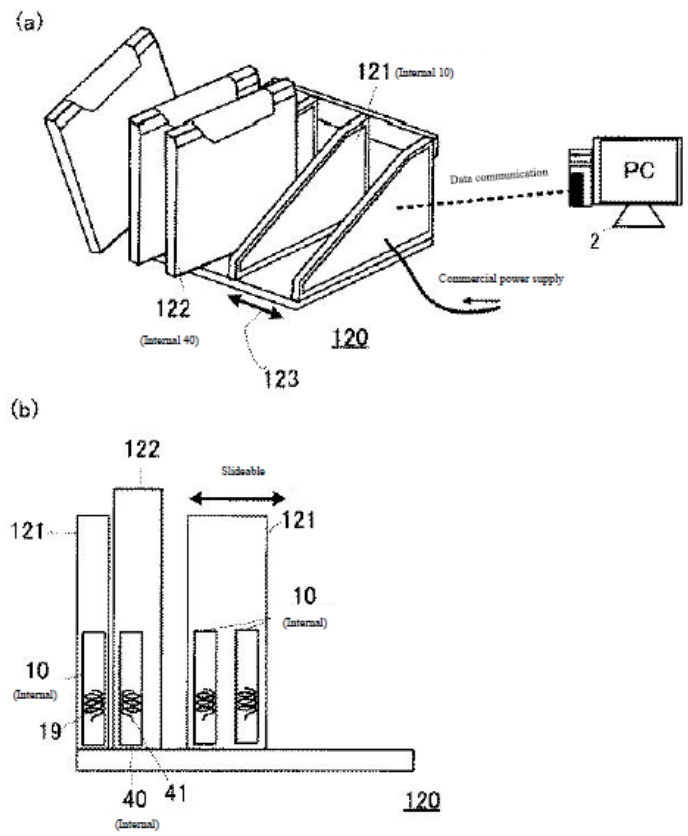
(Ex. 1005, FIG. 9.)

FIG. 10



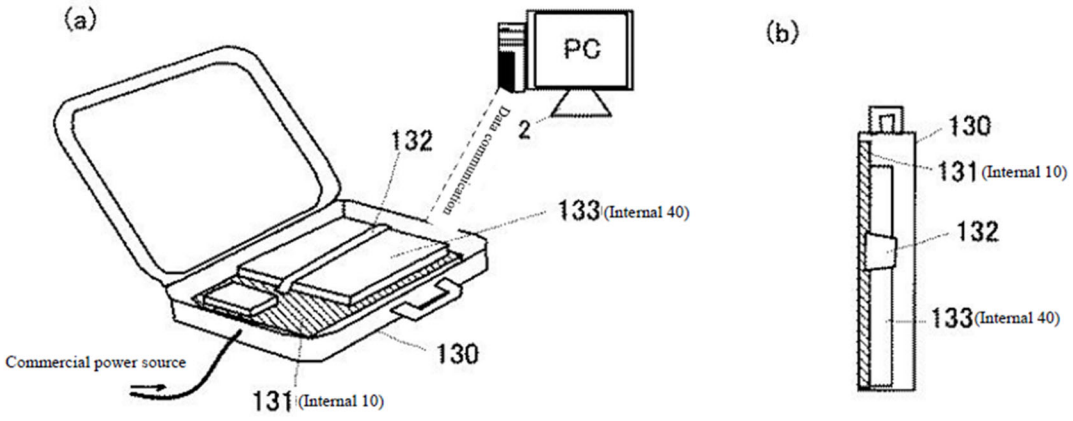
(*Id.*, FIG. 10.)

FIG. 11

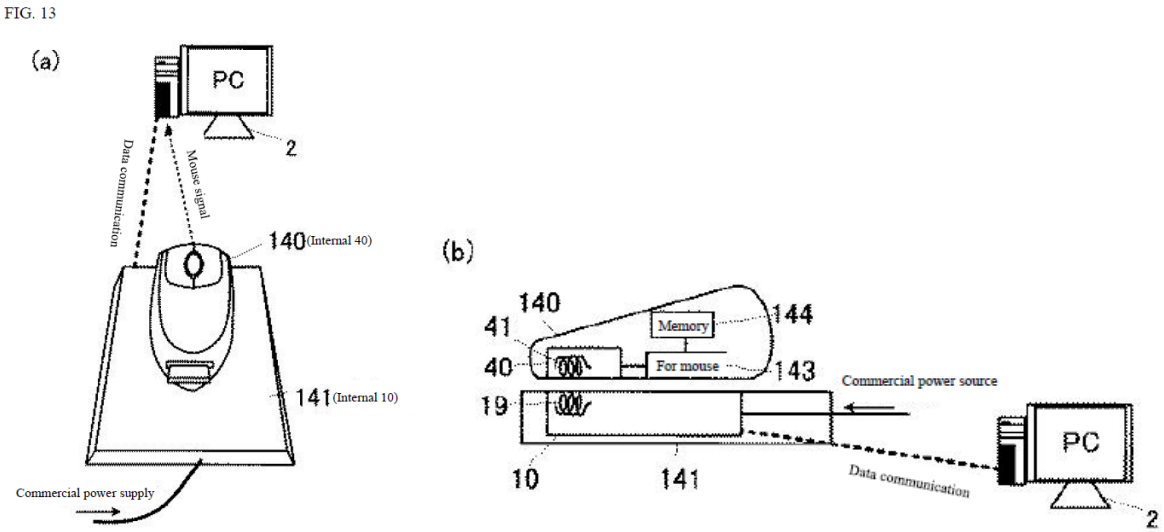


(*Id.*, FIGS. 11(a), 11(b).)

FIG. 12

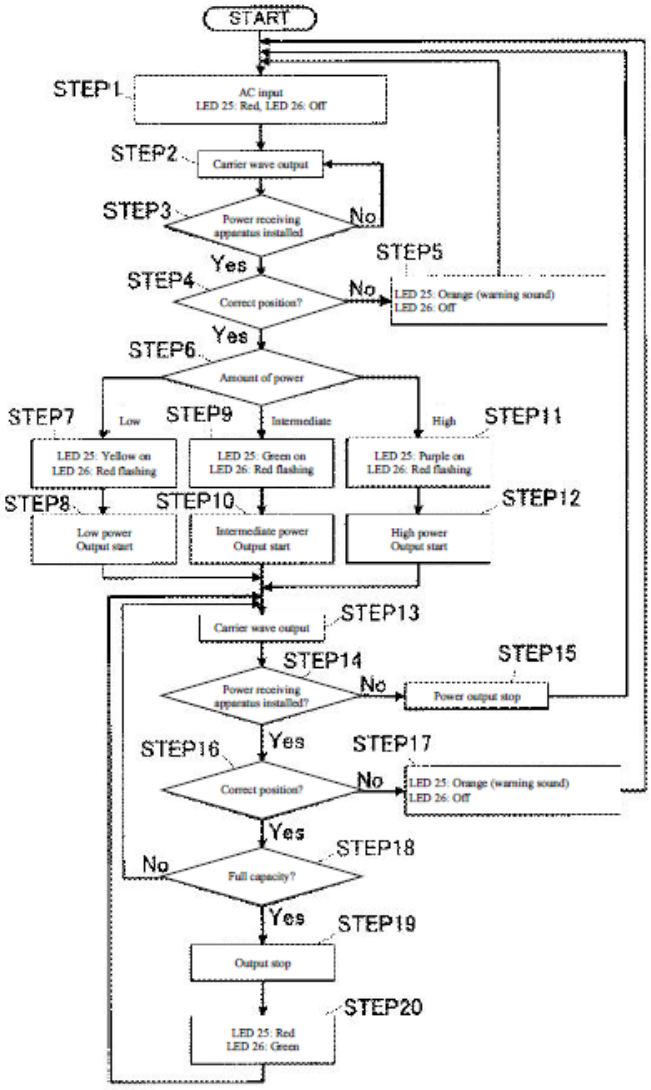


(*Id.*, FIGS. 12(a), 12(b).)



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

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



(Ex. 1005, FIG. 3.)

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

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

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

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

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

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

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

(Ex. 1005, ¶¶0063-0064.)

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

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

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

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

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

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

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

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

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

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

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

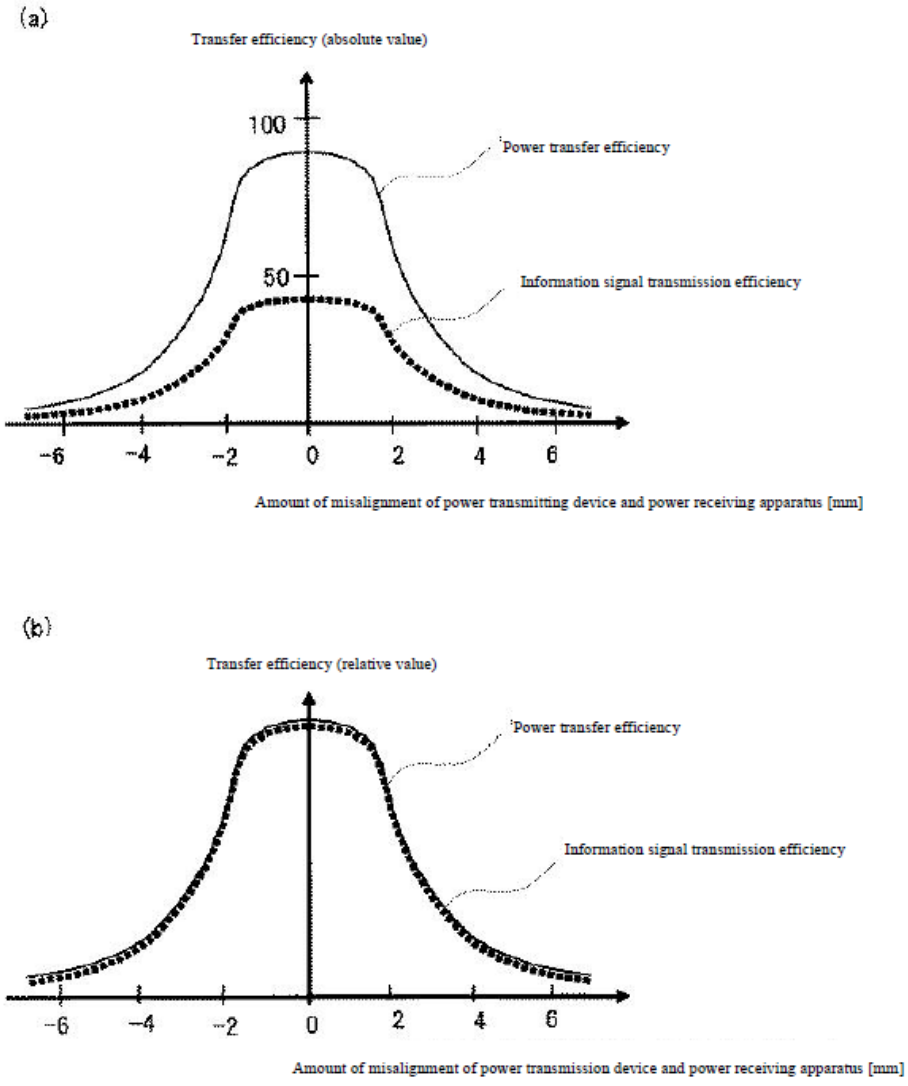
As illustrated in FIG. 4(a), **the greater the amount of offset of the positions of the common cradle 4 and the PDA 3, the worse the power transmission efficiency and information signal transmission efficiency.** As illustrated in FIG. 4(b), this power transmission efficiency and information signal transmission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

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

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

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

FIG. 4



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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

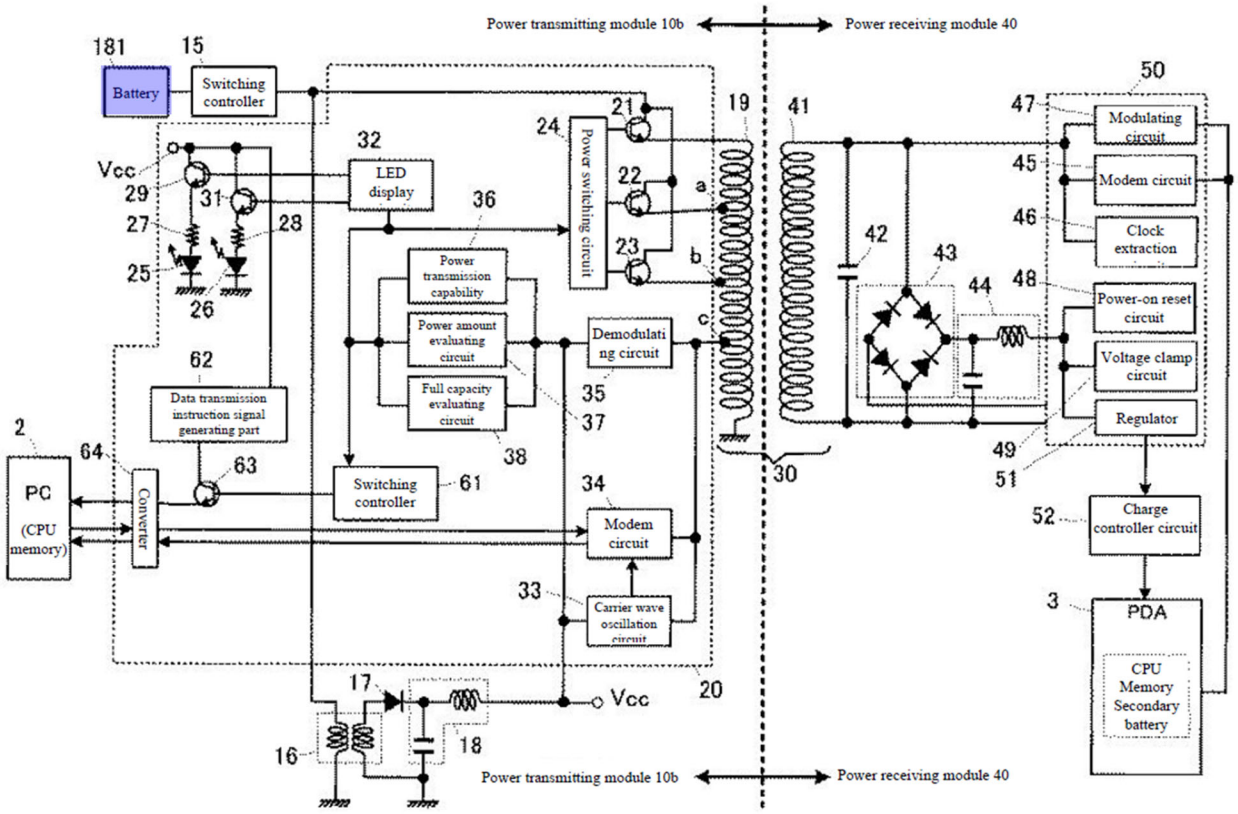
orange and the light emitting diode 26 is turned OFF as a warning display similar to STEP 5 (STEP 17). A warning sound may also be generated at this time.

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

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

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

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



(Ex. 1005, FIG. 17 (annotated).) 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. *Odendaal* (Ex. 1008)

85. I understand that *Odendaal* is an issued United States patent. (Ex. 1008, Cover.) My understanding is that *Odendaal* was filed June 26, 2002 and issued November 1, 2005. (*Id.*) I rely on the disclosures and analysis thereof of *Odendaal* discussed in this section VIII for my opinions regarding *Odendaal*'s teachings and suggestions as applied to the challenged claims of the '371 patent below in Section IX.

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

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

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

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

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

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

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

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

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

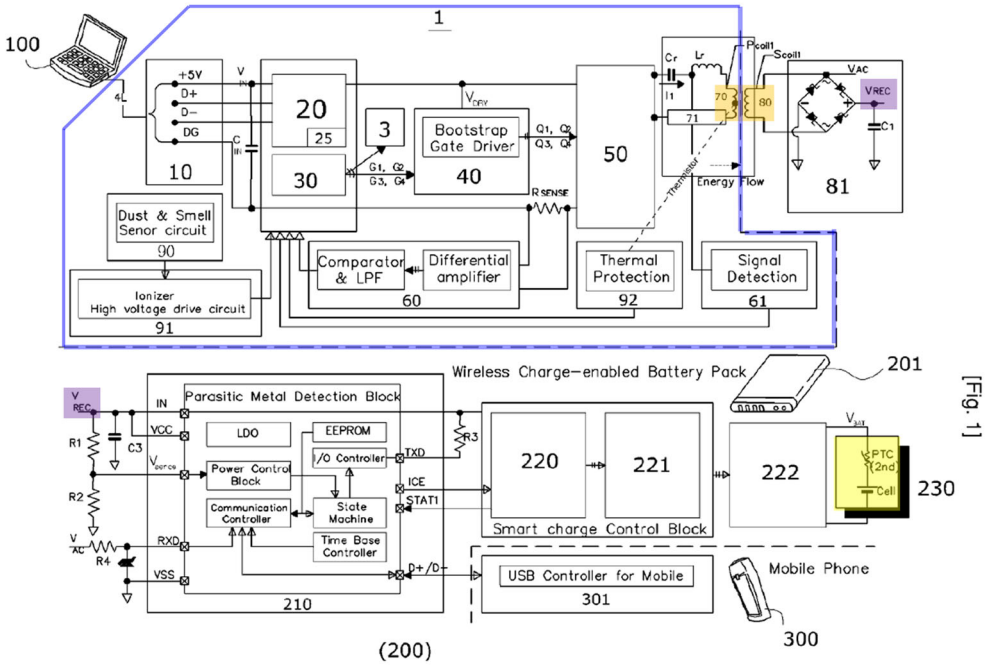
88. As noted in the quote above, *Odendaal* explains that in addition to charging "a radio, cellphone, and/or computer," etc. (Ex. 1008, 2:30-41), its system can also transmit "**digital**" signals through the IOET (e.g., between the primary side and the secondary side) for uploading/downloading "**digital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

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

C. *Kook* (Ex. 1059)

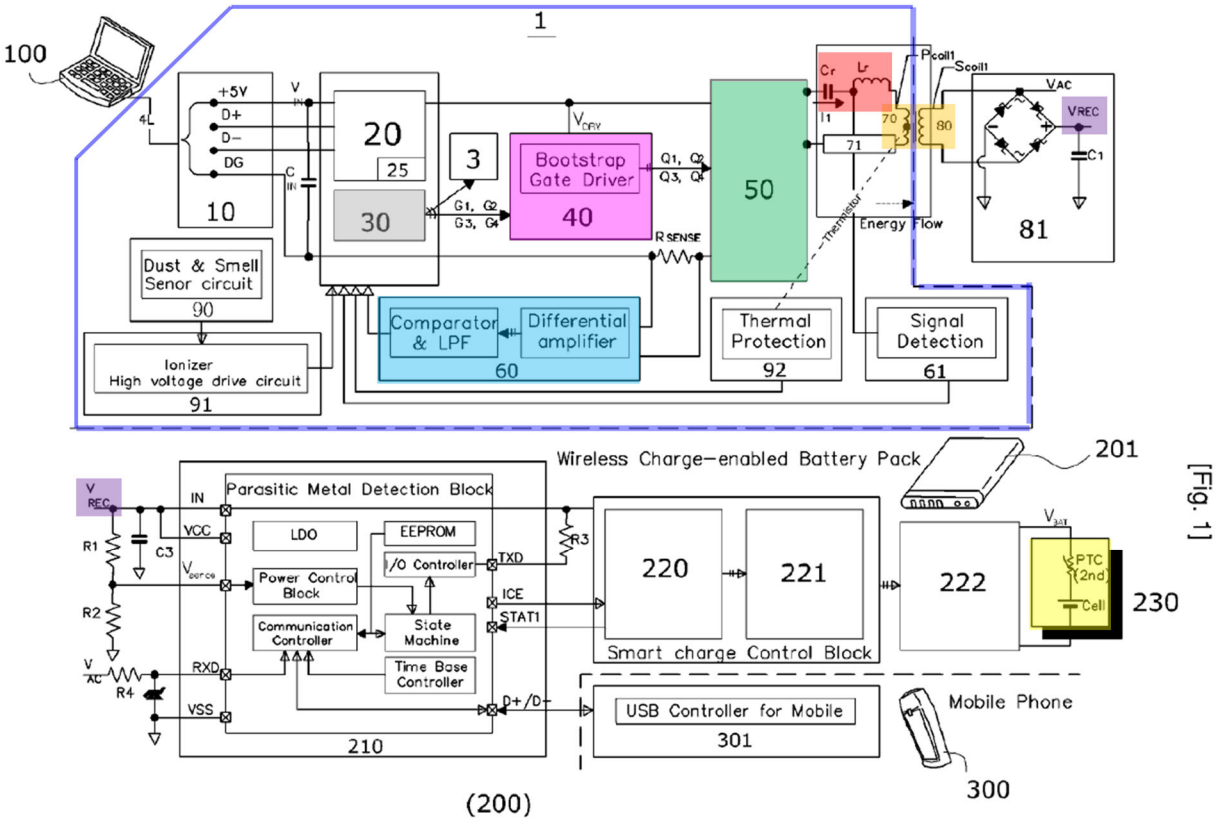
89. I understand that *Kook* is a published United States patent application. (Ex. 1059, Cover.) My understanding is that *Kook* was filed October 25, 2006 and issued October 22, 2009. (*Id.*) I rely on the disclosures and analysis thereof of *Kook* that I discuss in this section VIII for my opinions regarding *Kook's* teachings and suggestions as applied to the challenged claims of the '371 patent below in Section IX.

90. *Kook* discloses "a non-contact charger capable of wireless data communication and…charging battery-pack of a mobile device." (Ex. 1059, Abstract, ¶¶0001, 0006, 0037-0042.) *Kook* explains that charger 1 (blue below) receives power from computer 100 to power/charge mobile device 300 having a battery pack 200 (containing battery 230 (yellow)), via primary coil 70 and secondary coil 80 (both orange). (Ex. 1059, ¶¶0015 (mobile device has battery-pack 200), 0032, 0036-0037, FIG. 1 (below (rectification block 81 of battery pack 200 providing VREC (purple) to charger controller 210 of the same).)



[Fig. 1]

(Ex. 1059, FIG. 1 (annotated).) *Kook* explains that charger 1 includes an MPU 30 "for controlling internal elements" of charger 1. (Ex. 1059, ¶0041.) *Kook* further explains that charger 1 also includes gate drive block 40 (magenta below) and serial resonator converter 50 (*e.g.*, a LLC full/half wave type serial resonator converter, green), a "C-**L resonator**" (red (**Cr**/Lr), coupled to primary coil 70, and current sensing block 60 (blue). (*Id.*, ¶¶0032-0035, 0041.)



[Fig. 1]

(Ex. 1059, FIG. 1 (annotated).)

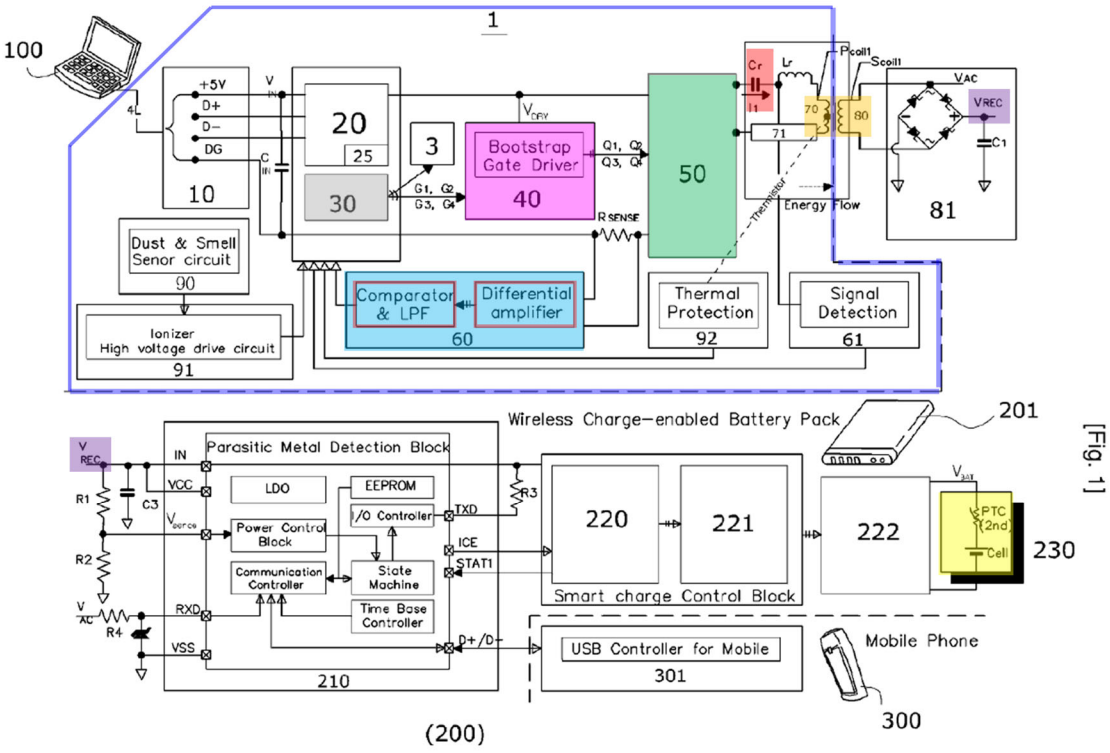
91. *Kook* explains that the "C-L resonator" coupled to primary coil 70, including capacitor Cr. (Ex. 1059, FIG. 1, ¶0041.) *Kook* further explains that by using a "resonator converter to induce LC resonance," it "make[s] an electric current into a sine wave and transmit[s] an electric power to the secondary side by means of the inductive coupling." (*Id.*, ¶0049.) *Kook* describes bootstrap ***gate*** drive block 40" providing four signals Q1-Q4 to serial resonator converter 50. (Ex. 1059, FIG. 1, ¶¶0009, 0032-0035, 0041.)

92. In addition to that described above, *Kook* describes feedback controlled type functionalities that allow the charger to adjust the operating frequency of the charger circuit, to control charging power/voltage to the portable device **during** charge/power transfer operations. For example, in connection with FIG. 1 (annotated above) *Kook* explains that current sensing block 60 "stably control[s] an electric power through a current **feedback** using an automatic variation algorithm of **primary** frequency so as…to control a voltage of a **secondary** rectification terminal in the charging battery-pack 200." (Ex. 1059, ¶¶0041.) *Kook* also explains that current sensing block 60 analyzes "a signal of the secondary coil 80 to recognize the mobile device 300, monitor the primary coil 70 and the secondary coil 80 to control a charge voltage to a stable voltage." (*Id*., ¶0033; *see also id.*, ¶0047 ("voltage of the secondary rectification terminal…is controlled to a constant voltage" via coils 70/80, which "may control the secondary charging power…using an automatic variation algorithm of primary frequency of the non-contact charger 1"), ¶0083 ("adjusting a voltage of the secondary side to the stable voltage…using a parameter (frequency).").)

93. Further, *Kook* discloses that "a voltage of the secondary rectification terminal in [the battery/device] is controlled to a **constant voltage**" via coils 70/80

by "using an automatic variation algorithm of primary frequency of the non-contact charger 1." (Ex. 1059, ¶0047; *id.*, ¶0041 (current sensing block 60 "**stably controlling**" power "through a current feedback using an automatic variation algorithm of primary frequency").)

94. In addition to what I explained above, *Kook* discloses that charger 1 includes **current sensing block 60** (blue in FIG. 1 below) that **monitors primary coil 70** to receive signals and associated information. (Ex. 1059, ¶¶0008, 0010, 0032-0033, 0041 ("a current sensing block 60 for stably controlling an electric power through a current feedback"), 0045 ("current sensing block 60 receives a signal").) *Kook* explains that current sensing block 60 includes a differential "**amplifier**" and a "LPF" ("**Low Pass Filter**" (red below)).



[Fig. 1]

(Ex. 1059, FIG. 1 (annotated).)

D. *Calhoon* (Ex. 1041)

95. 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 '371 patent below in Section IX.

96. *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.)

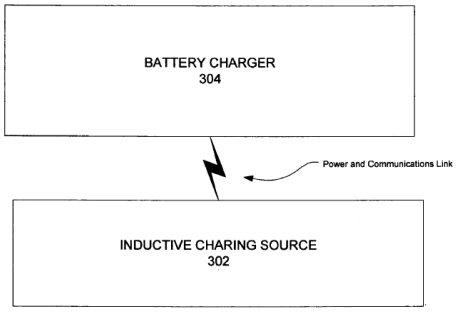


FIGURE 2

(Ex. 1041, FIG. 2.)

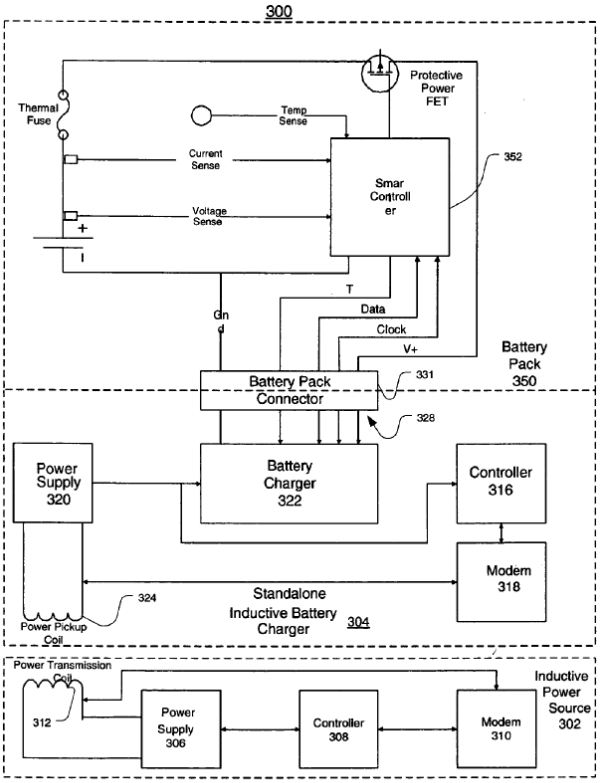


FIGURE 3

(*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.)

97. *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.)

E. *Black* (Ex. 1007)

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

suggestions as applied to the challenged claims of the ’371 patent below in Section IX.

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

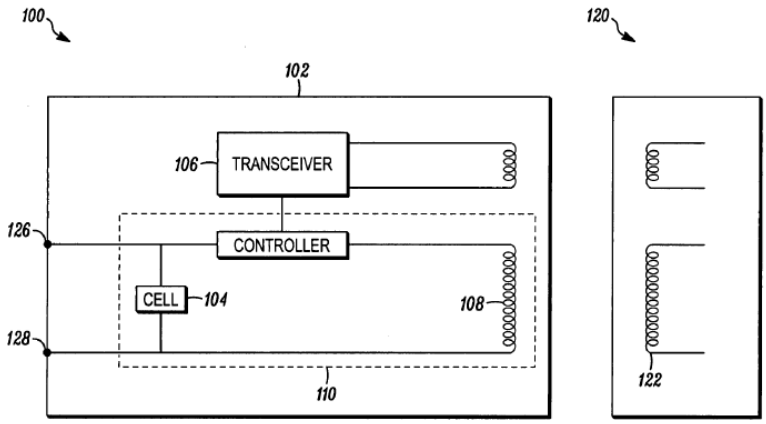
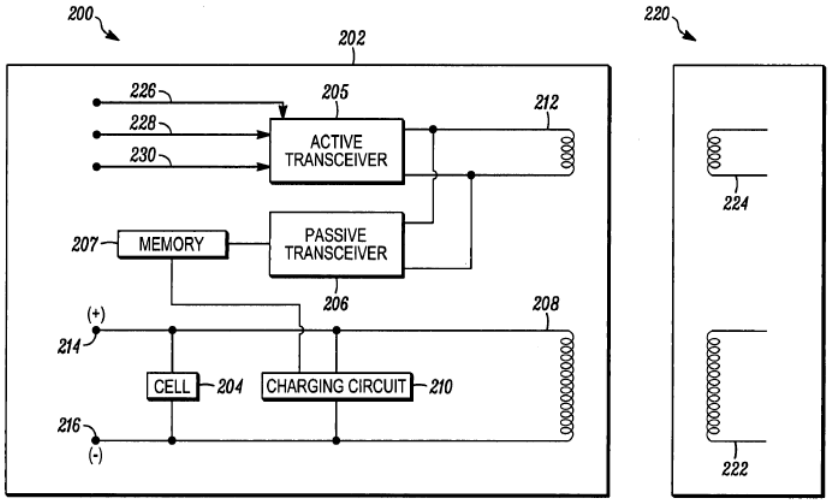


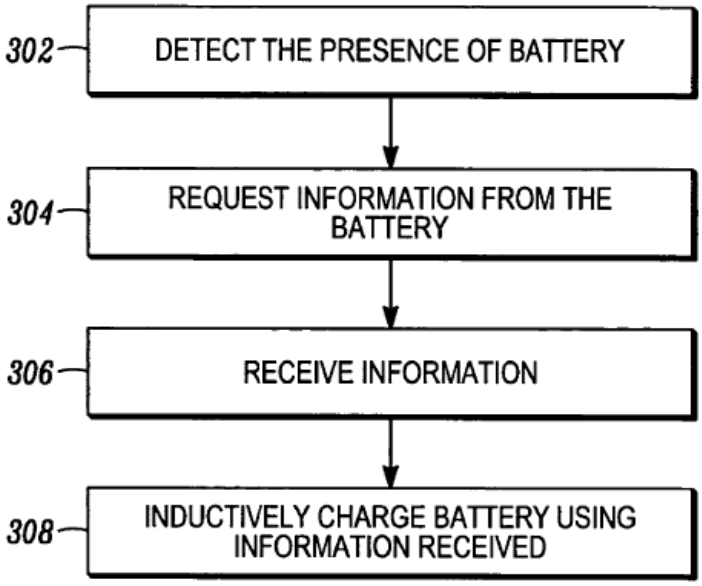
FIG. 1

(Ex. 1007, FIG. 1.)



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

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



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

> . . . In step 302 the charger 120 detects the presence of a near field communication (NFC) device. In this exemplary embodiment the NFC device is the battery 100, 200. The charger 120 requests, in step 304, information from the device 100. The battery may respond with information, the device ID for example.
>
> If the battery has the capacity to provide power, more information may be transmitted to the charger 120, such as the type of device the battery 100 is coupled to, encryption information, battery characteristics or charging profile or the like. The information may come from the battery memory 207 or memory in the device. The battery

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

(Ex. 1007, ¶¶0020-0022.) Thus, *Black* explains that such device/battery information may include, e.g., device ID and additional information, e.g., "the type of device the battery 100 is coupled to, encryption information, **battery characteristics** or **charging profile**." (*Id.*, ¶0021.) Charger 120 inductively charges the battery based on the received battery information. (*Id.*, ¶0022 ("[t]o determine how to inductively

charge the battery 100, . . . determine the charger profile or settings for that particular battery 100" and "more information" to "set the charging parameters.").)

F. *Kazutoshi* (Ex. 1034)

101. I understand that *Kazutoshi* is a published United States patent application. (Ex. 1034, Cover.) My understanding is that *Kazutoshi* was filed December 3, 2004 and published June 23, 2005. (*Id.*) I rely on the disclosures and analysis thereof of *Kazutoshi* discussed in this section VIII for my opinions regarding *Kazutoshi*'s teachings and suggestions as applied to the challenged claims of the '371 patent below in Section IX.

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

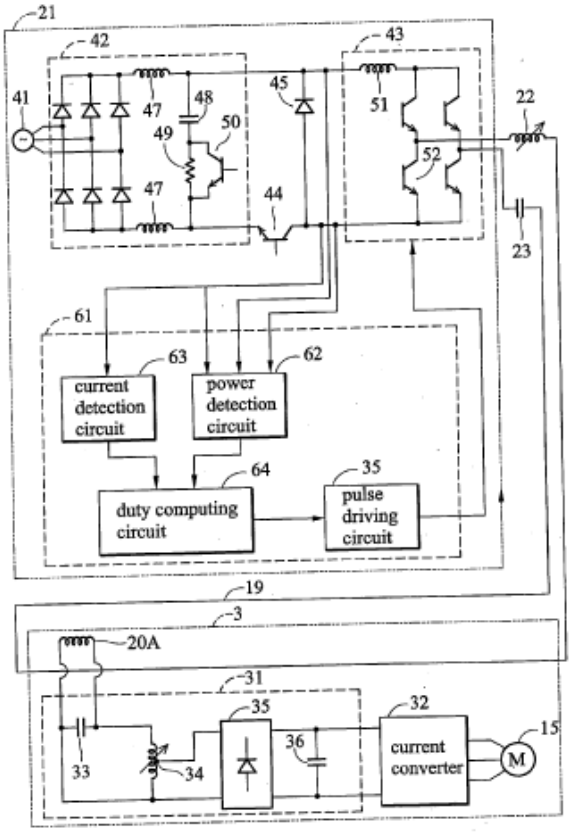


FIG. 3

(Ex. 1034, FIG. 3.)

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

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

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

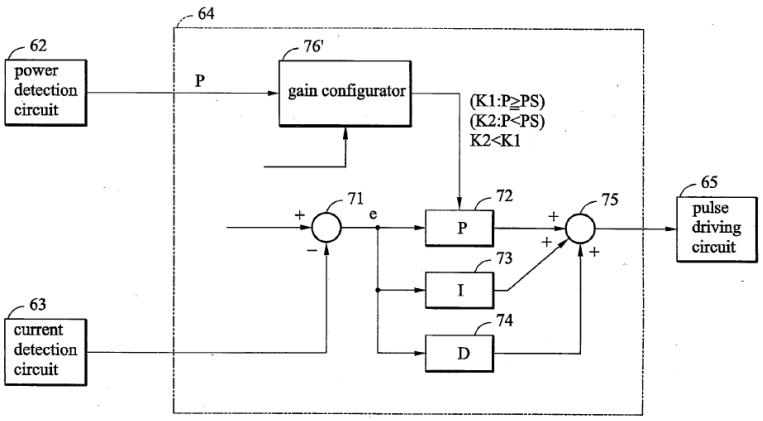


FIG. 5

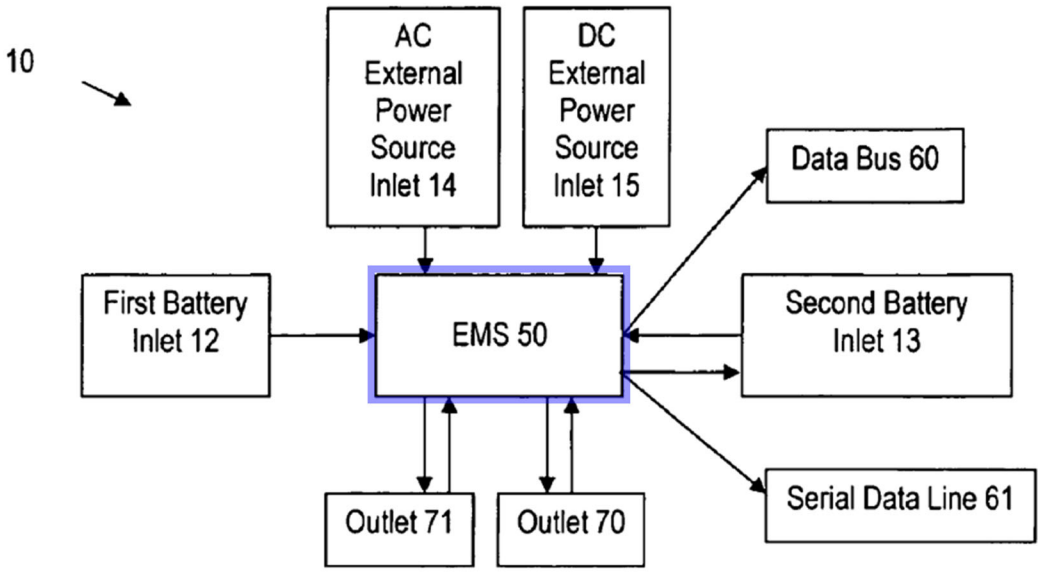
(Ex. 1034, FIG. 5.)

G. *Masias* (Ex. 1031)

105. I understand that *Masias* is an issued United States patent. (Ex. 1031, Cover.) My understanding is that *Masias* was filed March 10, 2004 and issued March 4, 2008. (*Id.*) I rely on the disclosures and analysis thereof of *Masias* discussed in this section VIII for my opinions regarding *Masias*'s teachings and suggestions as applied to the challenged claims of the '371 patent below in Section IX.

106. *Masias* discloses "[a] power source system including a power distribution apparatus." (Ex. 1031, Abstract.) The "power distribution apparatus has an energy management system for managing the provision of power from multiple power sources to multiple electrical devices." (*Id.*) *Masias* explains that a

power distribution apparatus 10 (*see* FIG. 1 below) includes an energy management system (EMS) 50 having first and second battery inlets (12/13), AC and DC external power source inlets (14/15), outlets (70/71), among other things. (*Id.*, 4:5-9.) EMS 50 manages "allocation of power from one or more power sources connected at the inlets," and also manages "the supply of power to a plurality of outlets at multiple and customizable voltage levels." (*Id.*, 4:9-13.) *Masias* explains that the inlet and outlet couplings can involve "inductive" connections. (*Id.*, 2:8-12, 3:26-29, 4:9-24, 7:9-41 (recharging done "inductively").)



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

107. *Masias* discloses that EMS 50 (e.g., as shown in FIG. 4) may "include a voltage regulator device or process to provide multiple, constant, preprogrammed

output voltages in any range . . . dependent on power needs of various equipment." (Ex. 1031, 6:5-13; *see also id.*, 6:3-5 ("devices can be operated concurrently by connection at outlets 70 and 71"), FIG. 4.)

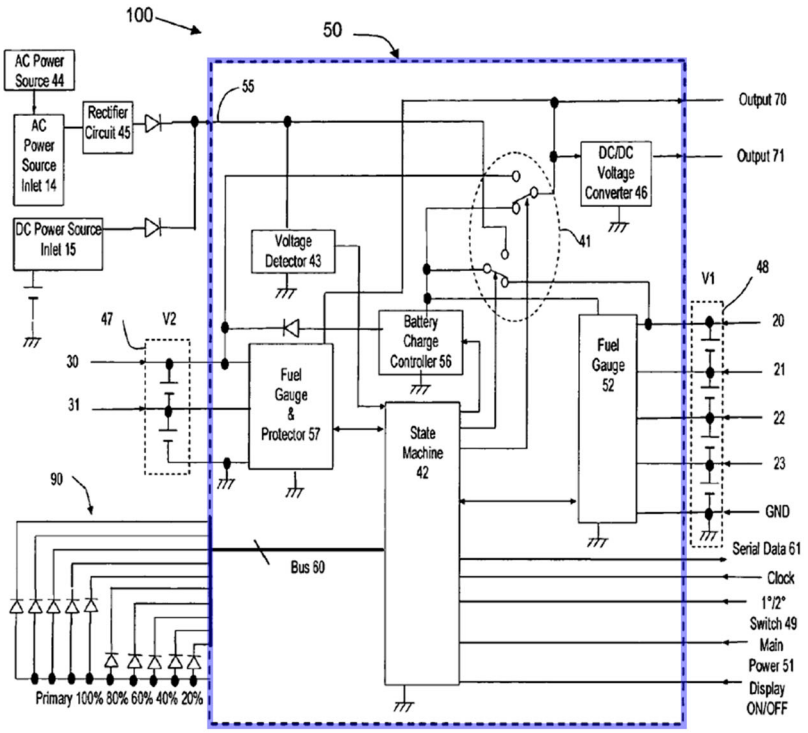


FIG. 4

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

H. *Chen* (Ex. 1035)

108. I understand that *Chen* is a published United States patent application. (Ex. 1035, Cover.) My understanding is that *Chen* was filed October 12, 2004 and published December 8, 2005. (*Id.*) I rely on the disclosures and analysis thereof of *Chen* discussed in this section VIII for my opinions regarding *Chen*'s teachings and suggestions as applied to the challenged claims of the '371 patent below in Section IX.

109. *Chen* discloses powering/charging system features/configurations that utilize inductive windings/coils. (*See, e.g.*, Ex. 1035, Title ("Integration of Planar Transformer and/or Planar Inductor with Power Switches in Power Converter"), Abstract, FIG. 1, ¶¶0002, 0035, 0042 ("The first transformer T1 comprises a first side T1a and a second side T1b. Where power is transferred from the power source VI to the load(s) R1, R2, the first side T1a is typically referred to as the primary winding and the second side T1b as the secondary winding. . . .").) *Chen* discloses designs/layers/materials associated with a multi-layer inductor substrate associated with a planar transformer arrangement in an inductive power transfer system. (Ex. 1035, Abstract.) For example, *Chen* explains:

> A power converter integrates at least one planar transformer comprising a multi-layer transformer substrate and/or at least one planar inductor comprising a multi-layer inductor substrate with a number of power semiconductor switches physically and thermally coupled to a heat sink via one or more multi-layer switch substrates.

(Ex. 1035, Abstract.)

110. *Chen* explains that such configurations include use of thermally conductive materials to dissipate heat according to known heat sink configurations in circuit design. (Ex. 1035, FIG. 4, ¶¶0057-0060, 0063, 0085.)

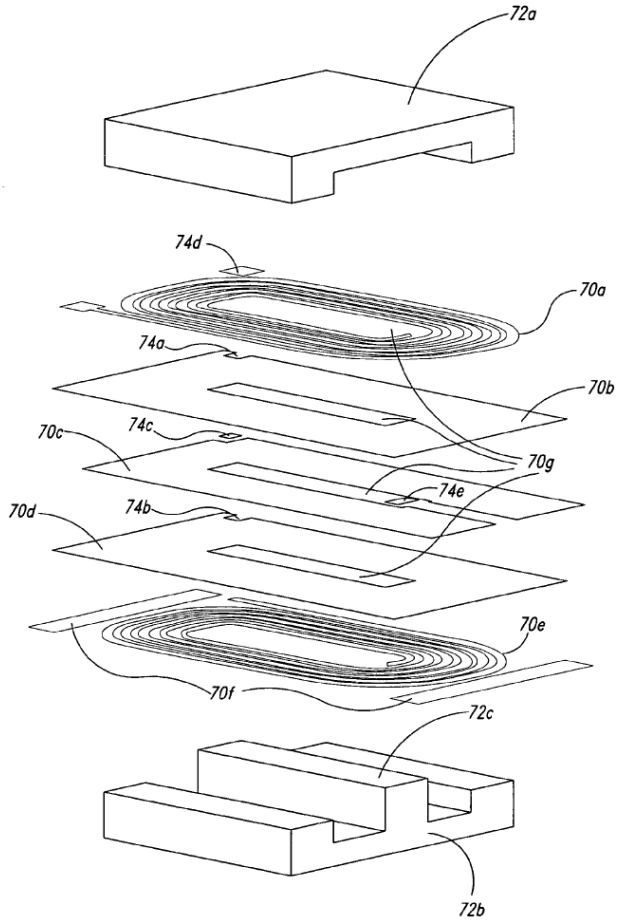


FIG. 4

(Ex. 1035, FIG. 4.) For example, *Chen* explains that transformer T1 may be configured with multiple layers electrically interconnected through vias forming first and second windings. (Ex. 1035, FIG. 4, ¶¶0057-0059.) The first and second windings are "electrically and thermally conductive." (*Id.*, ¶0058.) *Chen* also explains that "mounting areas 70f for attaching [Transformer T1] to the heat sink 56" (*id.*, ¶0060) is "electrically and thermally conductive" (*id.*, ¶¶0058, 0060), and

may take a "variety of forms such as copper, aluminum and/or other . . . conductors" (*id.*, ¶0063). For example, *Chen* explains:

> The electrically and thermally conductive layers may take a variety of forms such as copper, aluminum and/or other good electrical and thermal conductors. While typically provided in the form of a film, the electrically and thermally conductive layers may take other forms, for example, stamped sheet metal.

(Ex. 1035, ¶0063.) *Chen* further explains that heat sink 56 may also include "thermal radiating structures such as fins or pins . . . for transferring heat" away from the heat sink. (*Id.*, ¶0085.)

111. *Chen* also explains that "power semiconductor devices dissipate large amounts of heat during high power operation, creating thermal management problems which may limit the operating range, increase cost, increase size and/or weight, adversely effect [sic] efficiency, and/or reduce reliability of the power converter." (*Id.*, ¶0006.)

I. *Takagi* (Ex. 1033)

112. 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 '371 patent below in Section IX.

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

114. *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.)

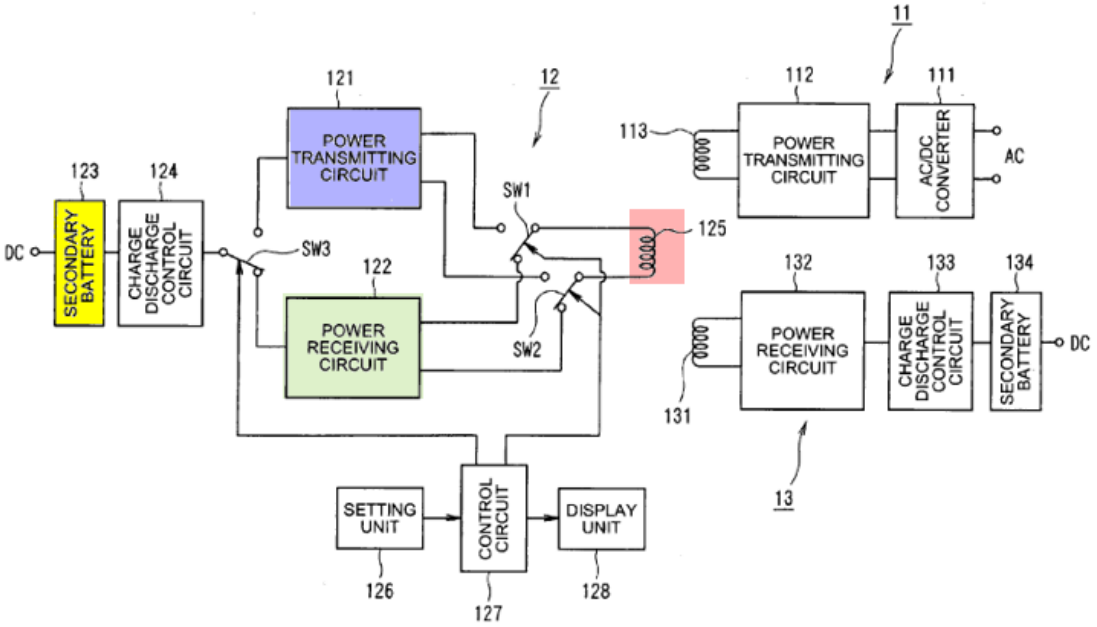


FIG. 2

(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.)

J. *Labrou* (Ex. 1062)

115. 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 '371 patent below in Section IX.

116. *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 "authenticat[ing] and approv[ing] the transaction" via an NFC signal. (*Id.*, ¶¶0021-0026, 0185.)

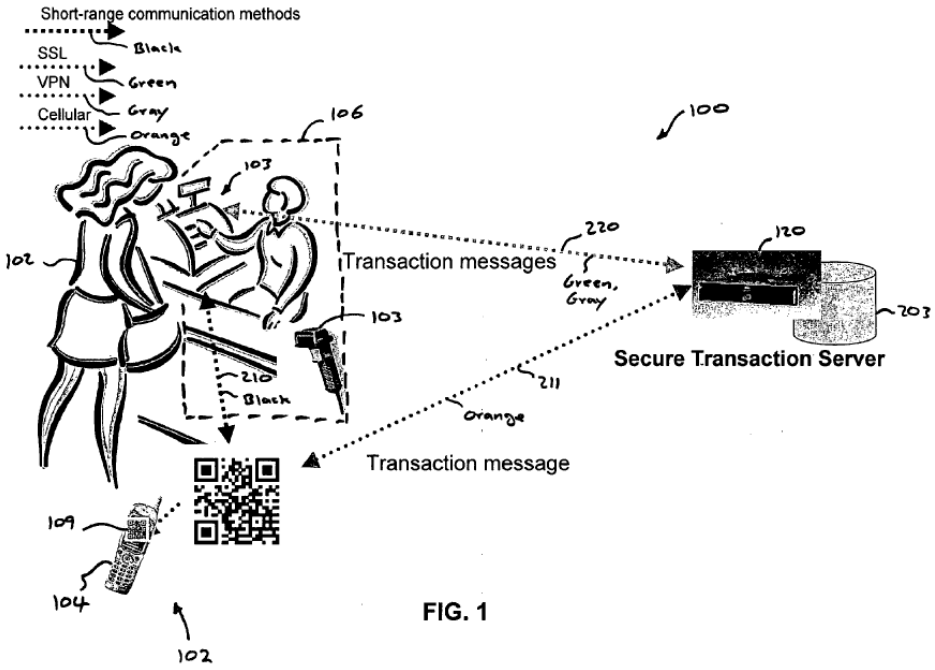


FIG. 1

(Ex. 1062, FIG. 1.)

IX. THE PRIOR ART DISCLOSES OR SUGGESTS ALL RECITED FEATURES OF CLAIMS 1-4, 8, AND 11-12 OF THE '371 PATENT[5]

A. Ground 1: *Okada* in view of *Odendaal*, *Kook*, *Calhoon*, and *Black* Discloses and/or Suggests the Features of Claims 1 and 4

117. In my opinion, *Okada* in view of *Odendaal*, *Kook*, *Calhoon*, and *Black* discloses and/or suggests all of the features of claims 1 and 4 of the '371 patent.

1. Claim 1

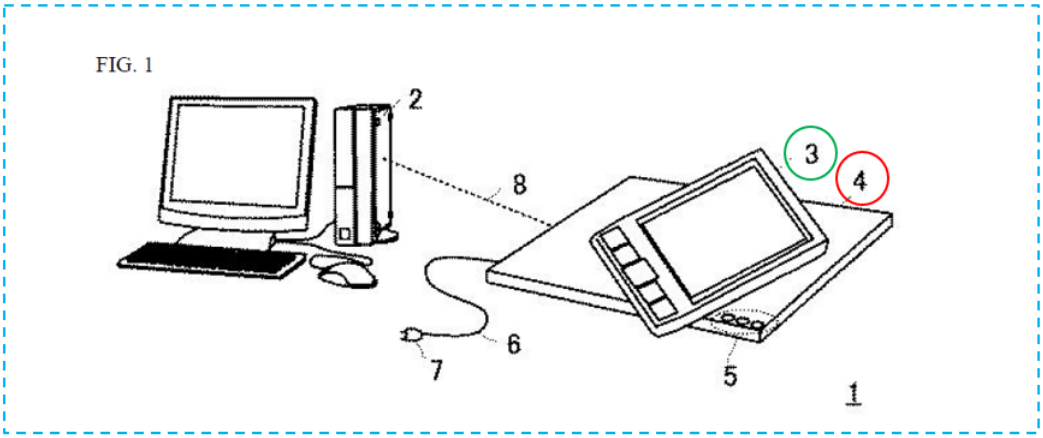
a) An apparatus comprising:

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

119. *Okada* discloses an "**apparatus**" that includes a "**system**" (*see also* my analysis and discussions in Section IX.A.1(b)) for inductive powering/charging

[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.)

portable devices such as mobile phones. (Ex. 1005, Abstract, ¶¶0001, 0047.) FIG. 1 (annotated below) shows power supply system 1 (**blue**) ("**apparatus**") including PC 2, PDA 3 (**green**) ("**portable device**"), and cradle 4 (**red**) ("**system**") (both of limitation 1(b)). (Ex. 1005, ¶¶0034-0036; *see also* my analysis and discussions in Section IX.A.1(b).)



(Ex. 1005, FIG. 1 (annotated).) *Okada* explains that "magnetic coupling" occurs between cradle coil and PDA 3 coil, which "induces voltage at both ends of the coil in the PDA" to "suppl[y] power to the PDA." (*Id.*, ¶0035; *see also* my analysis and discussions in Sections VIII.A, IX.A.1(b)-(n).) *Okada* explains:

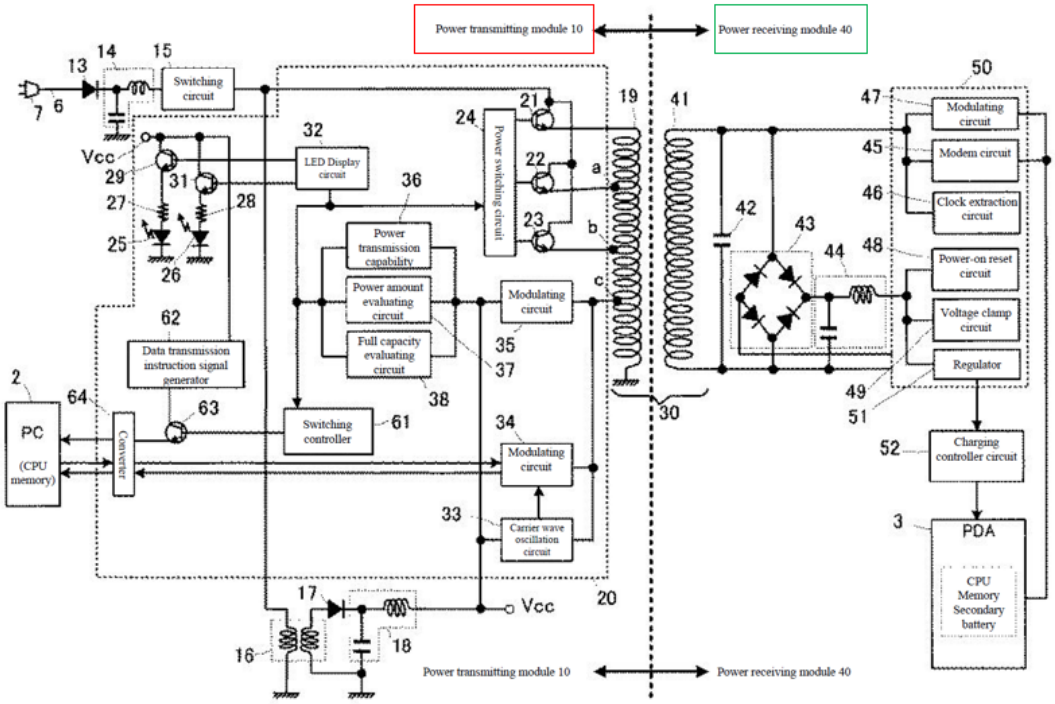
> In FIG. 1, when the AC plug 7 is inserted into an AC outlet (not shown) and the PDA 3 is placed in a prescribed position on the common cradle 4, commercial voltage is supplied to the common cradle 4 via the cord 6. In

> 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.)

120. In my opinion, a person of ordinary skill in the art would have understood that *Okada*'s FIG. 2 (annotated below) also discloses an exemplary "**apparatus**," where cradle 4 / PDA 3 each includes circuitry/components and at least one coil. (Ex. 1005, ¶¶0035, 0037, FIG. 2.) Cradle 4 includes a **power transmitting module 10** (which as I did in Section VIII.A, refer to as "PTM10"),

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



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

121. *Okada* explains that PTM10 converts received power 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 pulse signal is also supplied to primary coil 19 via switches 21/22/23. (*Id.*, ¶¶0040, 0049-0051.) Power switching circuit 24 selects a switch 21/22/23 to allow the pulse signal to traverse selected turns of coil 19, enabling the

system to select/adjust the power level transmitted to PRM40 (e.g., PDA 3). (*Id.*, ¶¶0040, 0051, 0057, 0069-0073.) *Okada* explains:

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

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

122. *Okada* further discloses that the transmitted power level may be determined based on the device's "power consumption information" provided by

PRM40 to PTM10. (*Id.*, ¶¶0057, 0063-0064, 0069-0073.) For example, *Okada* states:

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

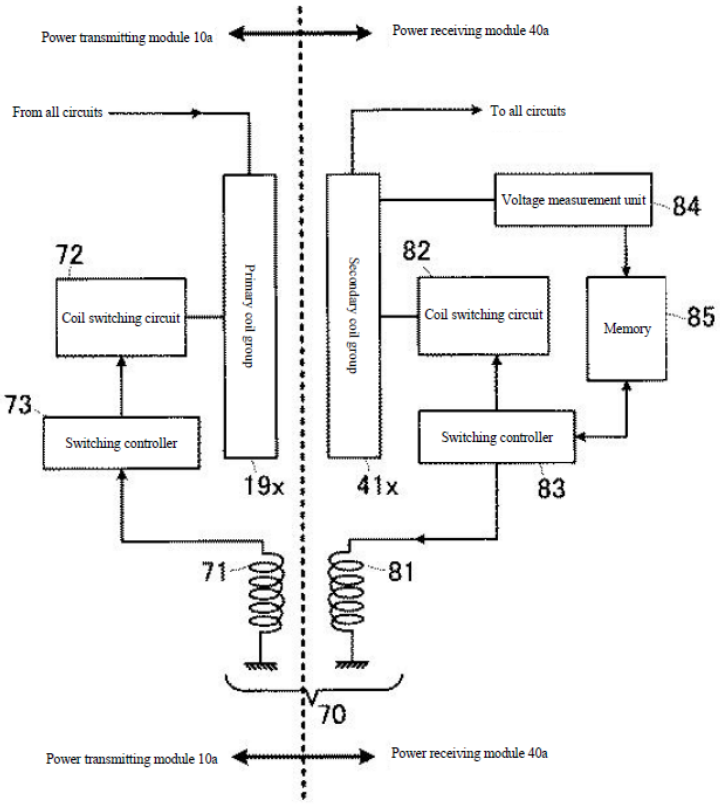
> When a device (PDA 3) is mounted on the common cradle 4, this "code indicating that a device is capable of receiving power" is used by the power transmission capability evaluating circuit 36 of the power transmitting module 10 to evaluate whether supplying power to the device via the common cradle 4 is feasible (whether the device is equipped with the power receiving module 40), as described below. Note that a device where supplying power via the common cradle 4 is feasible (common cradle 4 compatible device) is referred to as a "device capable of receiving power" hereinafter.
>
> Also, as described below, ***the "power consumption information" is used by the power amount evaluating circuit 37 of the power transmitting module 10 to determine the amount of power to supply to the device (PDA 3) placed on the common cradle 4, and for instructing providing of the signal thereof to the power switching circuit 24 to change the turn ratio of the transformer 30.*** Furthermore, the "full capacity information" is used by the full capacity evaluating circuit 38 to determine whether charging of the compatible device (PDA 3) is completed, as described below.

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

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

123. In my opinion, a person of ordinary skill in the art would have understood that *Okada* discloses various configurations of such an "**apparatus**" providing similar functionalities associated with PTM10 and PRM40, in connection with, e.g., FIGS. 2, 7-17. (Ex. 1005, ¶¶0009-0032, ¶¶0094-0096 (PTM10 and PRM40 including multiple coils), 0097-0154). In 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, 0106-0109.)

124. In my opinion, a person of ordinary skill in the art would have understood that applications of these features are described with respect to other exemplary "**apparatus(es)**." (Ex. 1005, ¶0107, FIG. 9 (below), ¶¶0116-0118, FIG. 10, ¶0119, FIGS. 11(a)-(b) (below), ¶¶0120-0122, FIGS. 12(a)-(b) (below), ¶¶0123-0126, FIGS. 13(a)-(b) (below), ¶¶0127-0132.)

FIG. 9

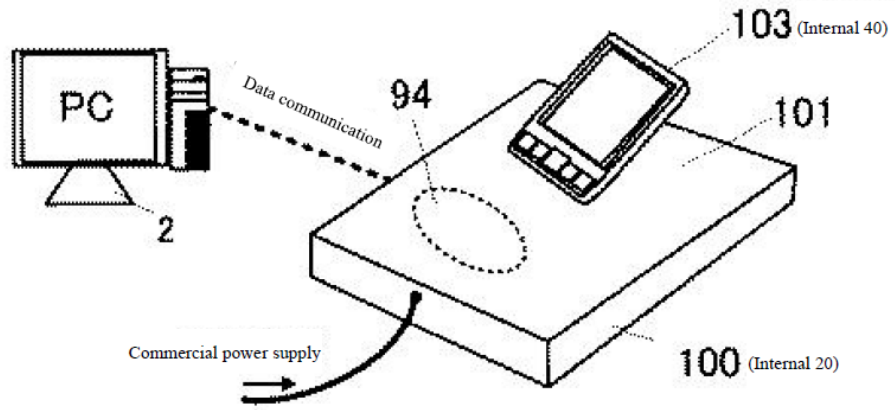


FIG. 10

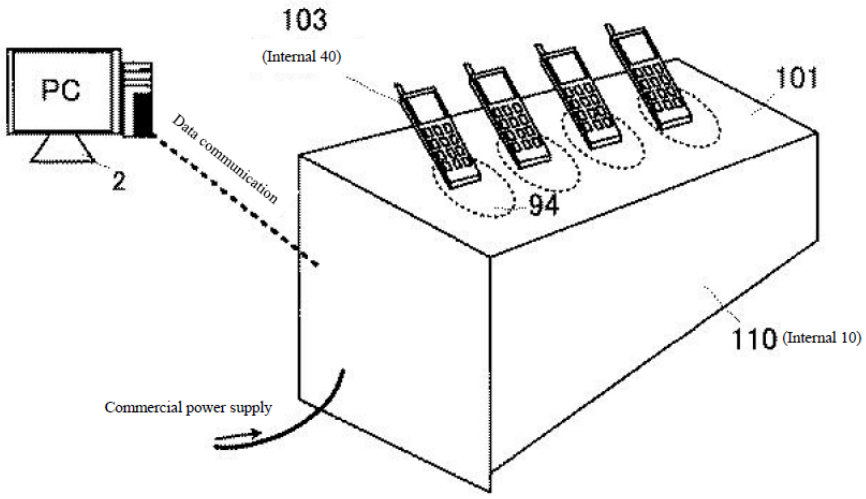


FIG. 11

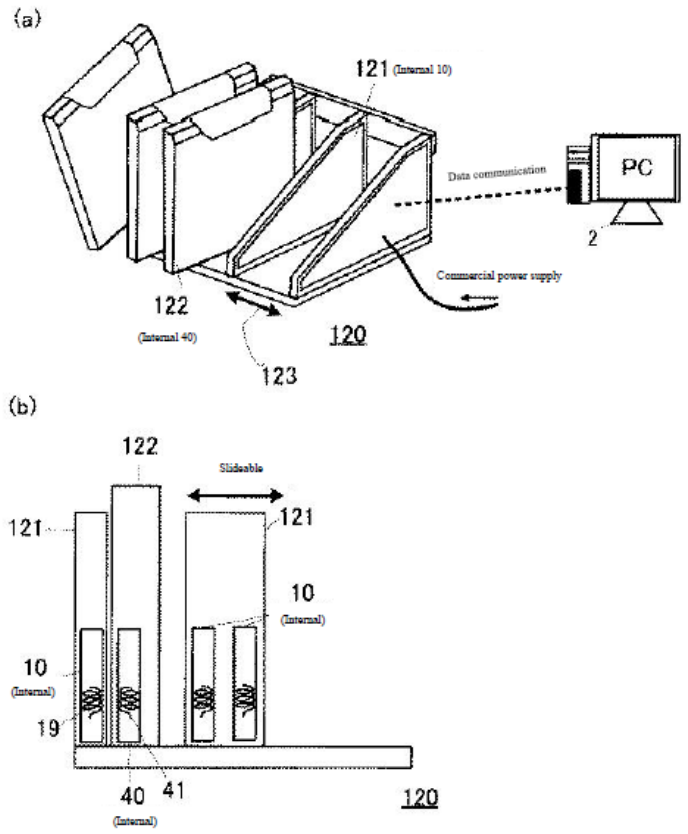
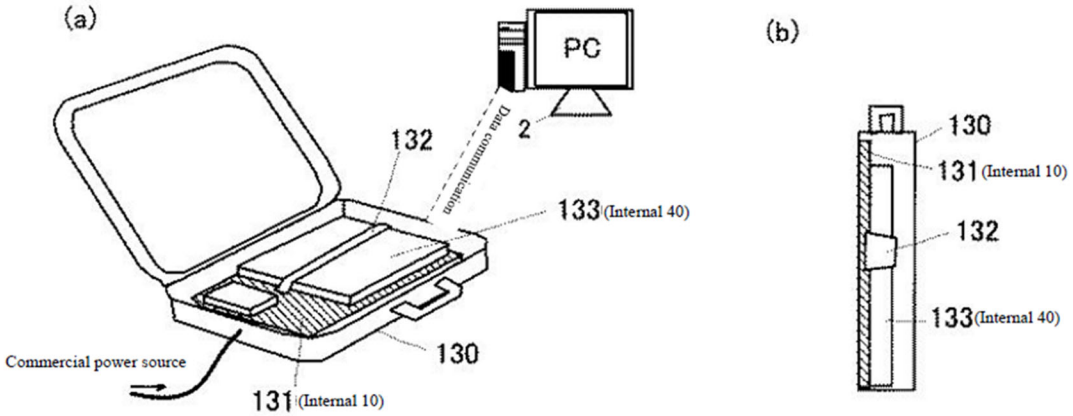
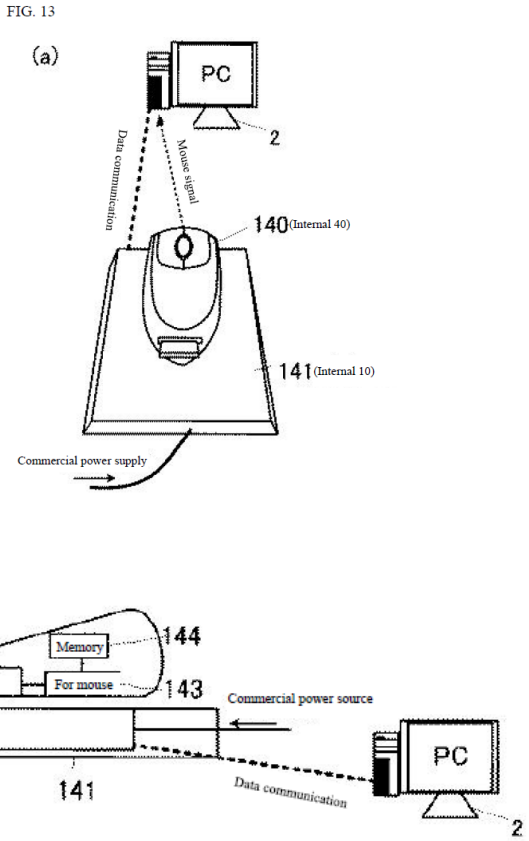

(a)
121 (Internal 10)
Data communication
PC
2
Commercial power supply
122
(Internal 40)
120
123
(b)
122
Slideable
121
121
10
(Internal)
10
(Internal)
19
40
(Internal)
41
120

FIG. 12

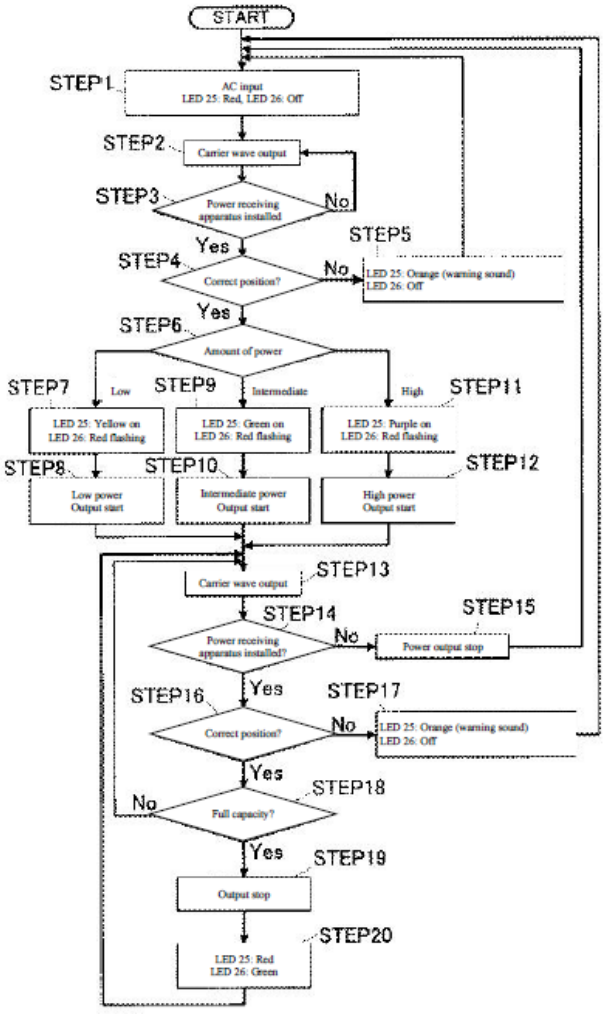

(a)
PC
Data communication
2
132
133 (Internal 40)
Commercial power source
130
131 (Internal 10)
(b)
130
131 (Internal 10)
132
133 (Internal 40)



(Ex. 1005, FIGS. 9, 10, 11(a), 11(b), 12(a), 12(b), 13(a), 13(b).)

125. In my opinion, a person of ordinary skill in the art would have understood that *Okada*'s FIG. 3 (below) shows "power supply operations carried out between [PTM10 and PRM40]," applicable to the configurations disclosed by *Okada*. (Ex. 1005, FIG. 3, ¶0059; ¶¶0060-0090; 0094-0115.) Thus, any disclosed configurations including features as recited in the limitations of claim 1 (including as modified) explained below is an "**apparatus**" (e.g., FIGS 1, 2, 7, 9-13). (Ex.

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

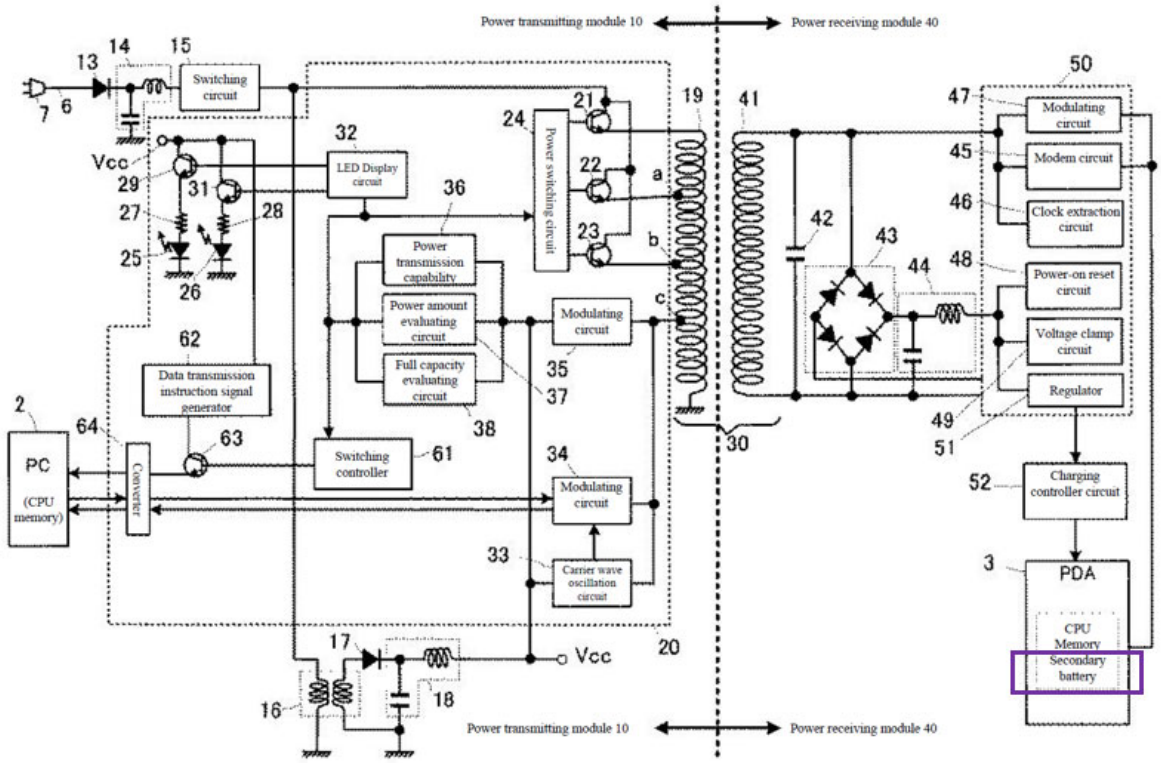


(Ex. 1005, FIG. 3.)

b) a system for providing power inductively to a portable device comprising a battery and an inductive receiver unit including a receiver coil and a receiver circuit, the system comprising:

126. In my opinion, *Okada* discloses and/or suggests this limitation. (*See* my analysis and discussions below in this section; *see also* my analysis and discussions in Sections IX.A.1(a), IX.A.1(c)-(n); *see also* my analysis and discussions in Section VIII.A.)

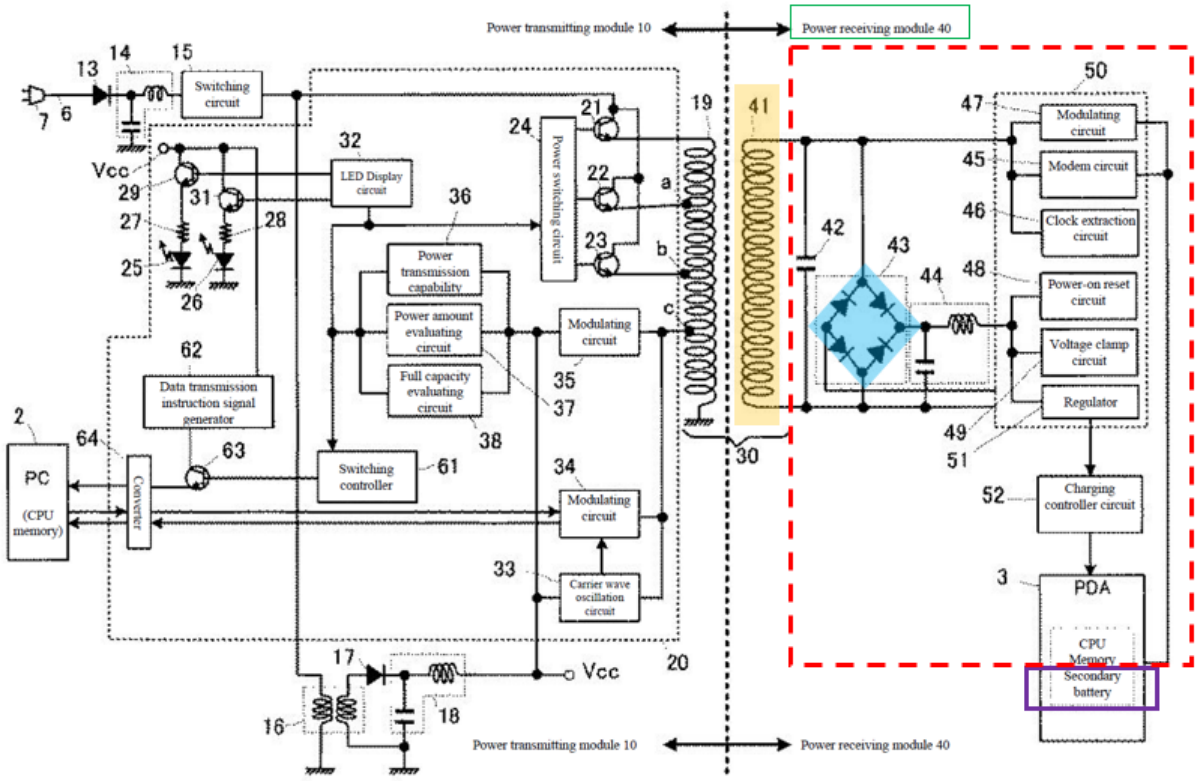
127. As I explained above, cradle 4 / PTM10 ("**system**") "**provid[es] power inductively**" to PDA 3 ("**portable device**"). (*See* my analysis and discussions in Section IX.A.1(a); Ex. 1005, Abstract, ¶¶0001, 0034-0036, 0047.) In my opinion, a person of ordinary skill in the art would have understood, based on *Okada*'s disclosures, that the disclosed "**portable device**" includes "**a battery and an inductive receiver unit**." For example, an exemplary PDA 3 includes a "secondary battery" and PRM40. (Ex. 1005, ¶¶0012, 0015, 0037, FIG. 14, ¶¶0134-0136, FIG. 15, ¶¶0138-0140, FIG. 16, ¶¶0142-0144, claim 4, FIG. 2 (**purple** below); *see also* my analysis and discussions in Sections VIII.A, IX.A.1(a).)



(Ex. 1005, FIG. 2 (annotated).) In my opinion, a person of ordinary skill in the art would have understood that PRM40 in the portable device exemplifies an "**inductive receiver unit**" including "**a receiver coil and a receiver circuit**." For example, FIG. 2 (annotated below) exemplifies a PRM40 ("**inductive receiver unit**") including coil 41 (**orange**) ("**receiver coil**") (Ex. 1005, ¶0040), and a "**receiver circuit**" (e.g., **red** below), which includes at least rectifier 43 (**blue**), clock and modulating circuits 46-47, and may further include one or more other PRM40 components (other than the **battery**) (e.g., circuits 42, 44-45, 48-49, 51, and/or 52).

(Ex. 1005, ¶0047; *see also* my analysis and discussions in Sections VIII.A, IX.A.1(a), (c)-(n).)[6]

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

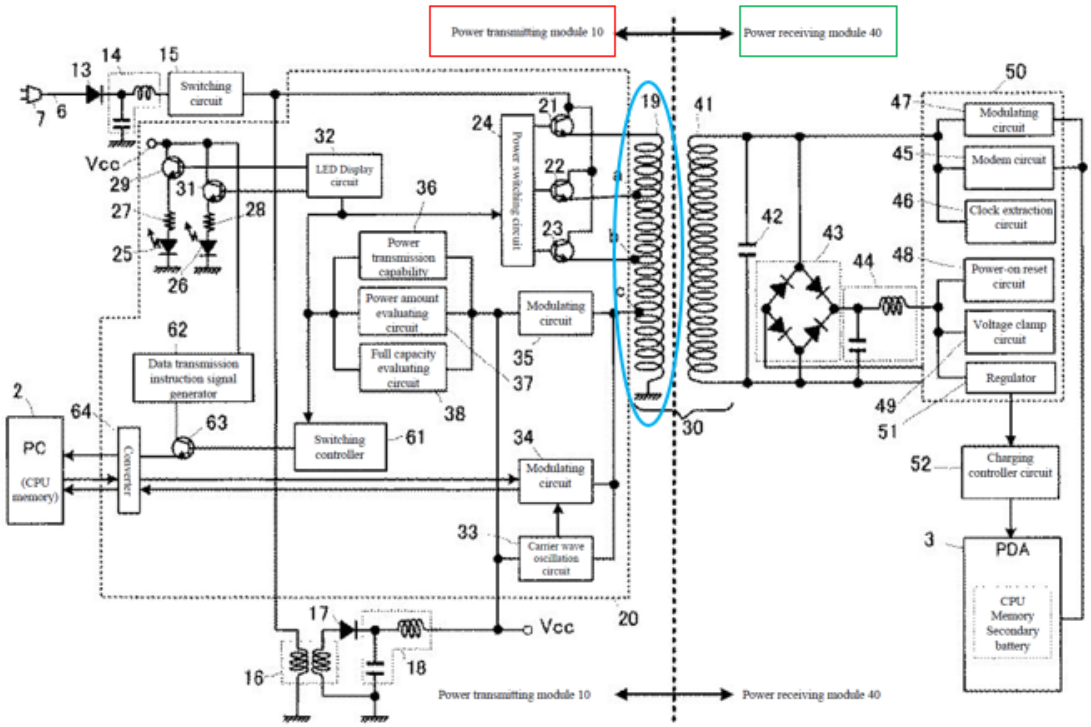


(Ex. 1005, FIG. 2 (annotated).)

c) a first primary coil that is substantially planar and substantially parallel to a surface of the system for providing power inductively to the portable device;

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

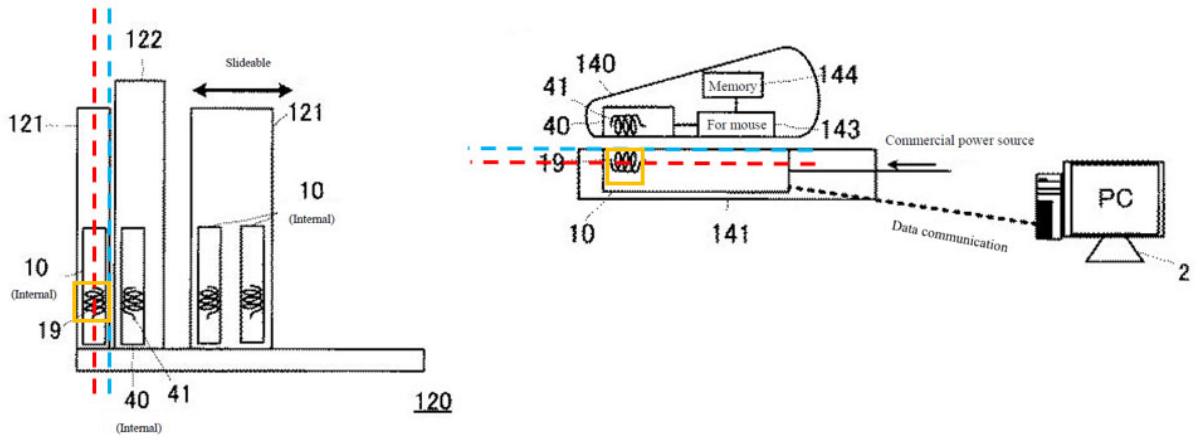
129. In my opinion, a person of ordinary skill in the art would have understood that *Okada*'s "**system**" includes "**a first primary coil**." (*See also* my analysis and discussions in Sections IX.A.1(a)-(b); *see also e.g.*, Ex. 1005, FIG. 2 (**blue** below), ¶¶0040, 0050, FIG. 7, ¶¶0095-0107, FIGS. 9-10, ¶¶0116-119, FIGS. 11(a)-(b), ¶0121, FIGS. 12(a)-(b), ¶¶0123-0125, FIG. 13, ¶0132.)



130. In my opinion, a person of ordinary skill in the art would have understood that the "**first primary coil**" is used for "**providing power inductively to the portable device**." (*See* my analysis and discussions below in this section; *see also* my analysis and discussions in Sections VIII.A, IX.A.1(a).) As I explained

above, *Okada* discloses that switches 21/22/23 are selected to provide selected power level(s) transmitted to PRM40 of "**portable device**" via primary coil(s) 19 and secondary/receiver coil 41 through induction. (*See* my analysis and discussions in Section IX.A.1(a); Ex. 1005, FIG. 3, ¶¶0035, 0040, 0051, 0057, 0069-0073; *see also* my analysis and discussions in Section VIII.A.)

131. In my opinion, a person of ordinary skill in the art would have understood that FIGS. 11(b) and 13(b) show examples of "**first primary coil**" 19 positioned "**substantially parallel to a surface of the system**" (**blue** parallel (**red**) to primary coil 19 (**orange**) below). (Ex. 1005, FIGS. 11(b) (below left), 13(b) (right); *see also* my analysis and discussions in Sections IX.A.1(a)-(b).) In my opinion, a person of ordinary skill in the art would have understood that a similar arrangement exists with the other exemplary system/apparatus configurations discussed above. (*Id.*; *see also* my analysis and discussions in Sections IX.A.1(a).)



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

132. In my opinion, while *Okada* does not expressly state that the "**first primary coil . . . is *substantially planar* and substantially parallel to a surface of the system**," a person of ordinary skill in the art would have been motivated to configure the *Okada* system to implement/use a planar primary coil (and secondary coil) in light of *Odendaal*. (*See* my analysis and discussions in this section and in Sections IX.A.1(a)-(b), (d)-(n); *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)[7] 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

[7] 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 also* 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.)

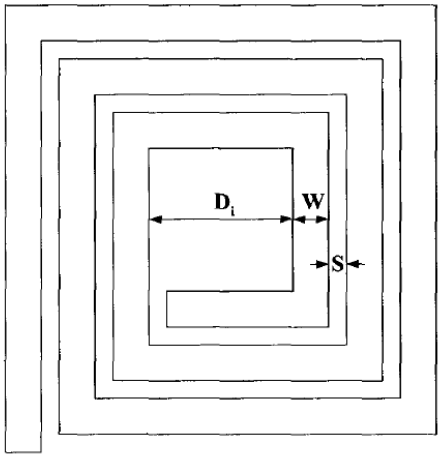


Fig. 1. A planar square spiral inductor structure.

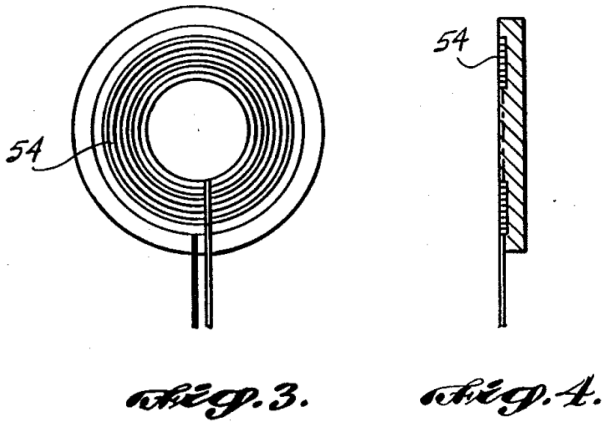
(*Id.*, FIG. 1 (showing a "**planar square spiral inductor** structure").)

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.)

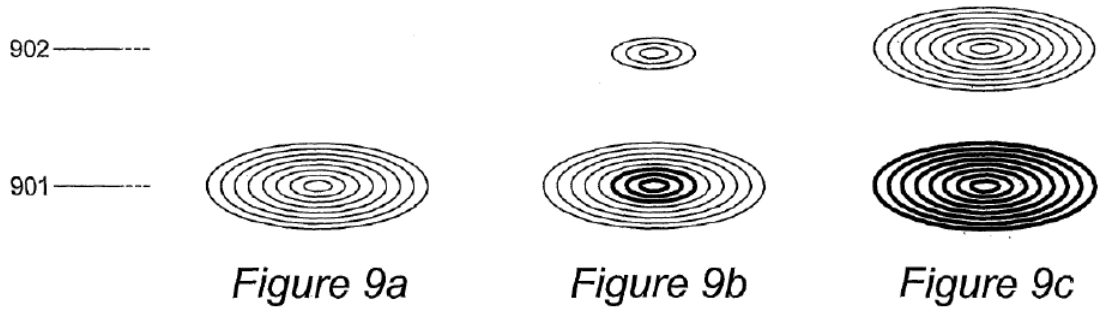


Figure 9a *Figure 9b* *Figure 9c*

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

137. There are other state of art references that demonstrate and exemplify the above-discussed knowledge of a person of ordinary skill in the art. (*See, e.g.*,

Ex. 1027, 1-3; 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 (reasons to consider thin coil designs), 2:14-3:2, 4:19-32, 7:25-9:28, 12:27-32, 14:4-17; Ex. 1026, FIGS. 1-2, 5, 9A-9C, Abstract, 1:3-4:4, 4:6-9:4, 11:4-15; Ex. 1009, Abstract, FIGS. 1-3, 1:4-51, 1:54-2:26, 2:47-3:8, 3:9-39, 4:18-60; Ex. 1024, FIGS. 3, 8-9, 1:12-15, 1:39-2:29, 9:41-53, 10:45-57, 11:60-13:4; Ex. 1028, Abstract, FIGS. 2-7, ¶¶0001, 0004-0007, 0025-0032, 0041; Ex. 1029, 1-4, 9-19; Ex. 1030, FIGS. 3-7B, 1:5-9, 1:59-61, 3:19-56, 4:62-567, 5:25-44; Ex. 1036, Abstract, 2:22-3:6 ("primary winding…***substantially parallel*** to [] planar charging surface" and formed on planar PCB), 5:22, 11:18, 23:20-24:8 ("Each secondary charging module 200 is provided with a housing 203," where "[t]he housing 203 should have at least one preferably flat surface" and "[t]his flat surface is preferably parallel to the plane of the secondary winding within the housing such that when the secondary module is placed in a slot of the primary extension system the secondary winding is substantially parallel to the primary winding beneath the surface of the slot."), 24:19-22 ("The secondary coil or PCB winding should be placed close to the (preferably flat) 20 surface of the housing of the secondary charging module so as to pick up

maximum changing AC magnetic flux from the primary inductive charging extension system or platform."); *see also* my discussions above in Section V.)

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 Sections IX.A.1(a)-(b); *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)-(n).) 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 '371 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, 1:54-5:17; *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 '371 patent discusses. (*See, e.g.*, Ex. 1001, 1:60-5:17, 28:11-20; Ex. 1008, Abstract, 1:5-3:57,

4:50-5:8, 5:24-28, 6:59-64; Ex. 1005, FIGS. 1, 2, 7, 9-12, ¶¶0037-0048, 0049-0058, 0094-0109, 0116-0126; *see also* my analysis and discussions in Sections VIII.A-B, IX.A.1(a)-(b).) As I discussed above and below, *Odendaal* also discloses techniques and technologies for addressing the need to power mobile devices using contactless inductive coupling. Therefore, in my opinion, a person of ordinary skill in the art contemplating designing and configuring a system/device/apparatus 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/device/apparatus to include planar primary coils that are parallel to a surface of the system to provide features like those discussed herein and claimed (and complemented such a design with corresponding planar secondary/receiver coil(s) in an inductive power receiver / portable device). (*Id.*)

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

> ***The spiral-shaped conductor may comprise pcb spiral-wound conductors.*** In addition, a battery charging circuit can be coupled to one of the first and second spiral-shaped

> conductors, and a load can be coupled to the other of the first and second ***spiral-shaped conductors***. The coupling between battery charging circuit and the battery may comprise capacitive coupling and/or ***magnetic coupling, and wherein power is transferred by the coupling of an electric field and/or magnetic flux across the IOET*** [interface-of-energy-transfer].
>
> According to an aspect of the present invention, a signal applied to the first spiral-shaped conductor can be transferred to the second spiral-shaped conductor by coupling of magnetic flux of the first and second spiral-shaped conductors across the IOET.
>
> ***The first and second spiral-shaped conductors*** and the IOET are preferably integrated into ***a planar (flat/thin) structure***.

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

> According to another aspect of the invention, an isolating coupling interface and a resonant tank are functionally integrated into a planar configuration for transferring power with isolation properties. ***The device may comprise two separable structures on either side of the IOET, such as, for example, a cellphone and its charger***. . . .

> An advantage of the present invention is that it facilitates the use of ***wearable electronics***. For example, ***flex circuits may be used so as to cause the surface of the coils to be flexible.*** In addition to the flexibility, the coils may be formed in any arbitrary shape to facilitate woven wire arranged in ***a fabric, or pads with embedded conductors that can be attached to clothes***. In this way, for example, ***one could charge a radio, cellphone, and/or computer (just to name a few of the many wearable items) by bringing the device in close proximity to the fabric.*** Thus, implementation of the invention with wearable electronics could provide an ***interface between the wearable device(s) and external power sources.*** Digital or analog signals may also be transmitted across such interfaces to, for instance, up- or download digital information.

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

142. *Odendaal* describes using a planar resonator for power transfer with characteristics of an integrated inductor-capacitor transformer. (*Id.*, 1:53-57.) The planar resonator includes spirals on opposite sides used for energy transfer "so that a battery of a cellphone could be charged without physical wires." (*Id.*, 1:60-67.) 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, 7-10 ("can permit transformer action . . . **without** capacitive energy transfer"), 2:65-3:5, 4:44-5:8, 6:1-18.) "The spiral-shaped conductor may comprise **pcb** spiral-wound conductors" and "a battery charging circuit can be coupled to one of the . . . spiral shaped conductors, and **load** . . . **coupled to the other** . . ." where "coupling between" the battery and charger "may comprise . . . **magnetic coupling,** wherein power is transferred by the **coupling of** . . . **and/or magnetic flux** across the IOET." (*Id*., 2:55-64.) In my opinion, *Odendaal*'s teachings of "**planar**" coils (*id.*, 1:60-67) is consistent with that known in the art. (Ex. 1008, 1:60-67, 2:19-21, 2:29-44, 3:65-67; *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.)

143. Additionally, 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 the spiral coils "are preferably integrated into a **planar (flat/thin) structure**" (Ex. 1008, 3:3-5) and may conform to the housing surface to facilitate charging a device "in close proximity" (*id.*, 2:29-44). A person of ordinary skill in the art would have understood that such

arrangements disclose coils that are parallel to a system's surface. (*Id.*; *see also* my analysis and discussions above in this section; *see also* my analysis and discussions in Sections VIII.A-B, IX.A.1(a)-(b).)

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

145. Further, as I explained above (*see* Section V.B.3), a person of ordinary skill in the art would have understood complementing a primary/secondary-side planar coil with a secondary/primary-side planar coil would provide for efficient transmission of energy between the two planar coils in an inductive charging/power systems, especially where the coils were aligned to face each other to allow the perpendicular magnetic field generated from the transmitting planar coil to be received by the receiving planar coil. (*See* my discussions above in Section V.B.1.) Thus, in my opinion, where design applications in an inductive power transfer system called for planar transmitting or receiving coil designs (e.g., to provide for thin, compact, versatile devices), such a skilled person would have had reasons to

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

146. In my opinion, a person of ordinary skill in the art would have had the skills and rationale in light of the teachings/suggestions of *Okada*, *Odendaal*, and a person of ordinary skill in the art's state of art knowledge, to implement the above-modification while considering design tradeoffs and techniques/technologies with a reasonable expectation of success, especially given such modification would have involved known technologies/techniques (e.g., planar coils to facilitate wireless power transfer) foreseeably resulting in providing an inductive powering/charging system with thinner charger units and portable devices, like that contemplated by *Okada* and *Odendaal*. (*Id.*; *see also* my analysis and discussions above in this

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

d) Limitation 1(d)

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

(1) 1(d)(1): a first drive circuit, including a FET driver, a capacitor, and a FET switch, coupled to a DC voltage input and coupled to the first primary coil,

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

> The ***power transmitting module 10 has the switching pulse voltage output from the switching circuit 15*** input thereto and also includes a primary-side coil 19 that together with the secondary-side coil 41 equipped in the power receiving module 40, described below, constitutes a transformer. ***The primary-side coil 19 is configured to have the switching pulse voltage supplied via one of switching element 21, switching element 22, or switching***

> ***element 23.*** Therefore, the transformation ratio of the transformer 30 constituting the selected switching element and the secondary-side coil 41 changes. In addition, ***the power transmitting module 10 is provided with a power switching circuit 24 that controls ON/OFF switching of the switching element 21, switching element 22, and switching element 23 based on a control signal from the power switching circuit 24.*** Note that the number of switching elements that determine the transformation ratio of the transformer 30 constituted by the primary-side coil 19 and the secondary-side coil 41 is configured by three elements, switching element 21, switching element 22, and switching element 23 in FIG. 2 but this number is not limited to three.

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

149. The switching pulse signal is also converted (via circuits 16-18) to V_{CC} for powering PTM10 components. (*See* my analysis and discussions in Section IX.A.1(a); Ex. 1005, ¶¶0038-0040, 0046, 0049-0051, FIG. 2.) In my opinion, a person of ordinary skill in the art would have understood that such PTM10 components are (directly/indirectly) coupled/configured to drive/power primary coil

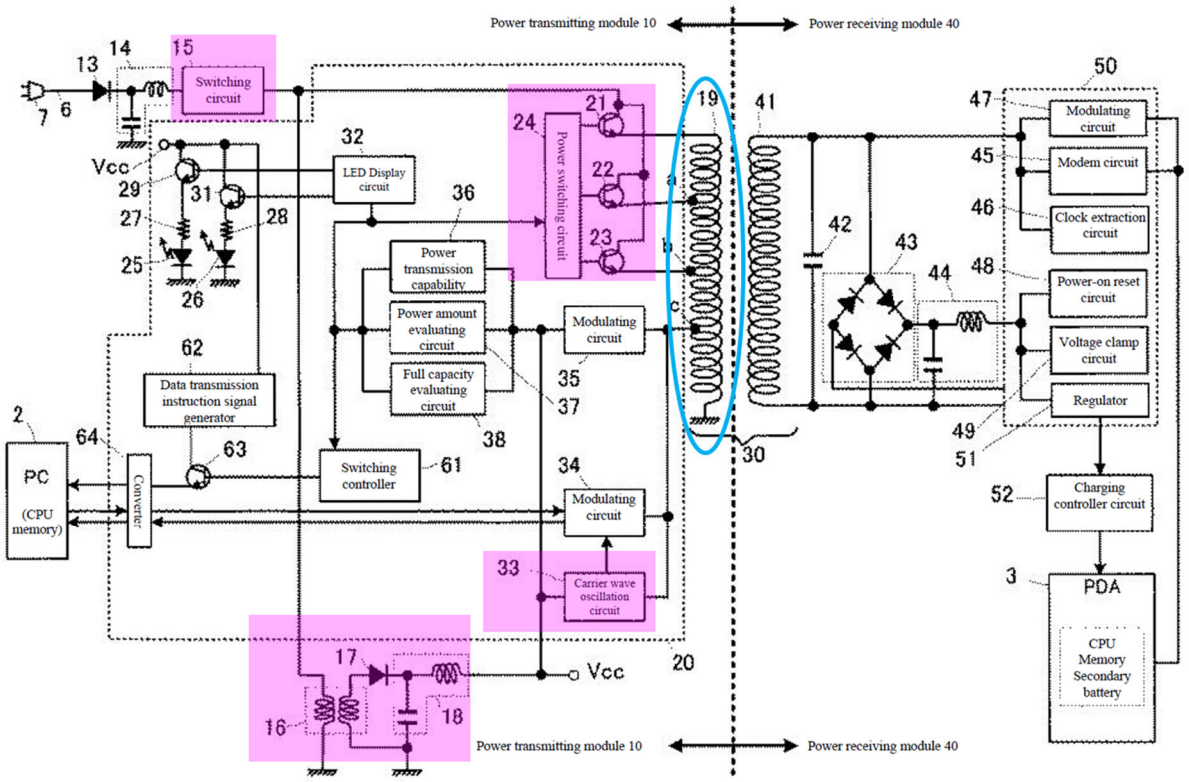
19. (*Id.*) For example, circuits 16-18 provide power to other components, e.g., circuit 33, which outputs signals driving coil 19 to send a carrier wave signal to PRM40. (Ex. 1005, ¶¶0062-0063, ¶¶0010-0014, 0042-0046, 0055-0058, Claims 2-3, 6; *see also* my analysis and discussions in Sections IX.A.1(d)(3), IX.A.1(f)-(g).) As I explained above, switching circuit 15 also provides the switching pulsed signal to (FET) switch 21/22/23, and together with circuit 24, provides signals that drive coil 19 to transfer power. (*Id.*; Ex. 1005, ¶¶0040, 0049-0051, 0070-0073.)

150. Accordingly, in my opinion, a person of ordinary skill in the art would have understood that *Okada*'s examples of a "**first drive circuit**" include:

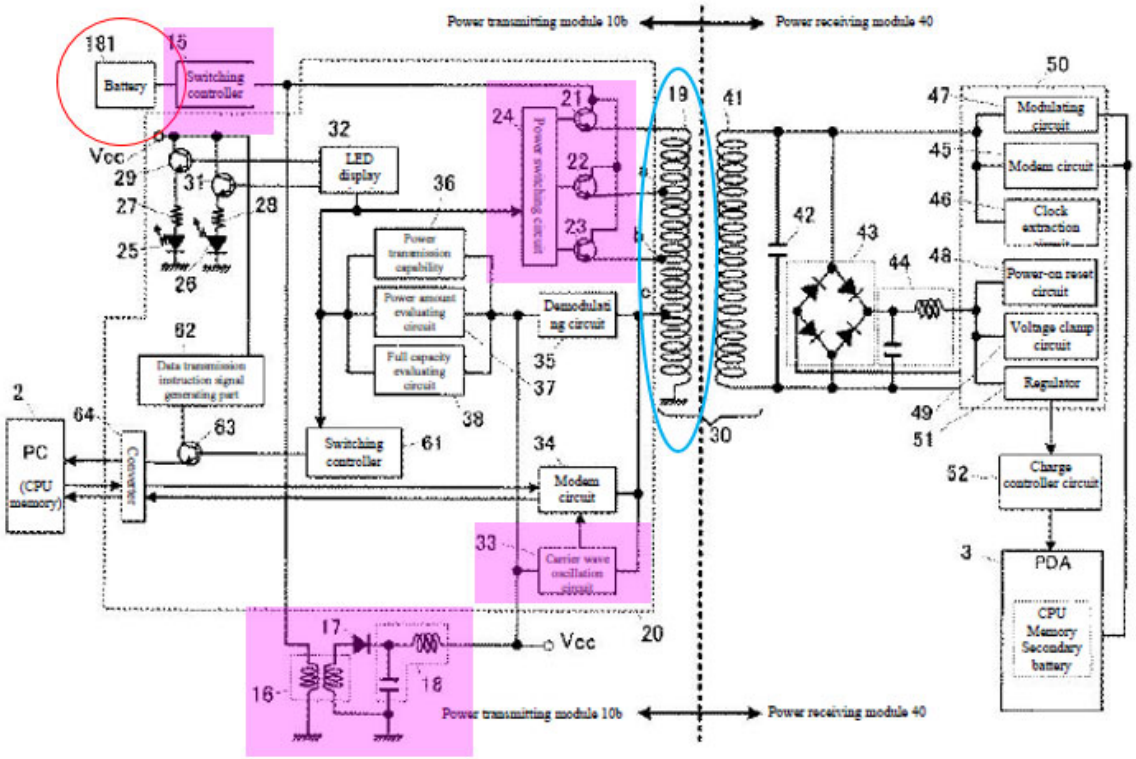
> **(1)** switching circuit 15 (including as modified below) and circuits 21-24;
>
> **(2)** same with circuits 16-18 (providing Vcc for IC 20, including circuit 24 (controlling (FET) switches 21/22/23));
>
> **(3)** same with circuit 33 (driving coil 19 to send carrier wave to PRM40); or
>
> **(4)** a combination of such components (with/without other circuitry in IC 20).

(*Id.*, FIG. 2 (annotated below (**pink**)); *see also* my analysis, citations, and discussions above and below.) In my opinion, such a skilled person would have understood that the "**first drive circuit**" includes an "**FET driver**" (e.g., switch 15, circuit 24, and/or one or more of circuits 16-18, or a combination of such components) and "**a FET switch**" (e.g., switch 21/22/23). (*See* my analysis, citations, and discussions above and below in this section.)[8] In my opinion, a person of ordinary skill in the art would have understood that these components forming the "**first drive circuit**" are (directly/indirectly) coupled to rectifier/smoothing circuits 13/14 (providing a "DC voltage") (Ex. 1005, FIG. 2, ¶0038, FIG. 17, ¶¶0148-0149 (battery 181 input)) thus having a "**DC voltage input**" and also (directly/indirectly) coupled to primary coil 19 ("**first primary coil**") (Ex. 1005, FIG. 2, ¶¶0039-0049; *see also* my analysis, citations, and discussions above and below in this section).

[8] In my opinion, a person of ordinary skill in the art would have understood that *Okada*'s circuitry that provides a switching signal to power primary coil 19 is similar to drive circuitry discussed in the '371 patent. (*See* my analysis and discussions in Section IX.A.1(a); Ex. 1001, 22:45-49, 24:3-4, 41:38-47, 44:5-6.)



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

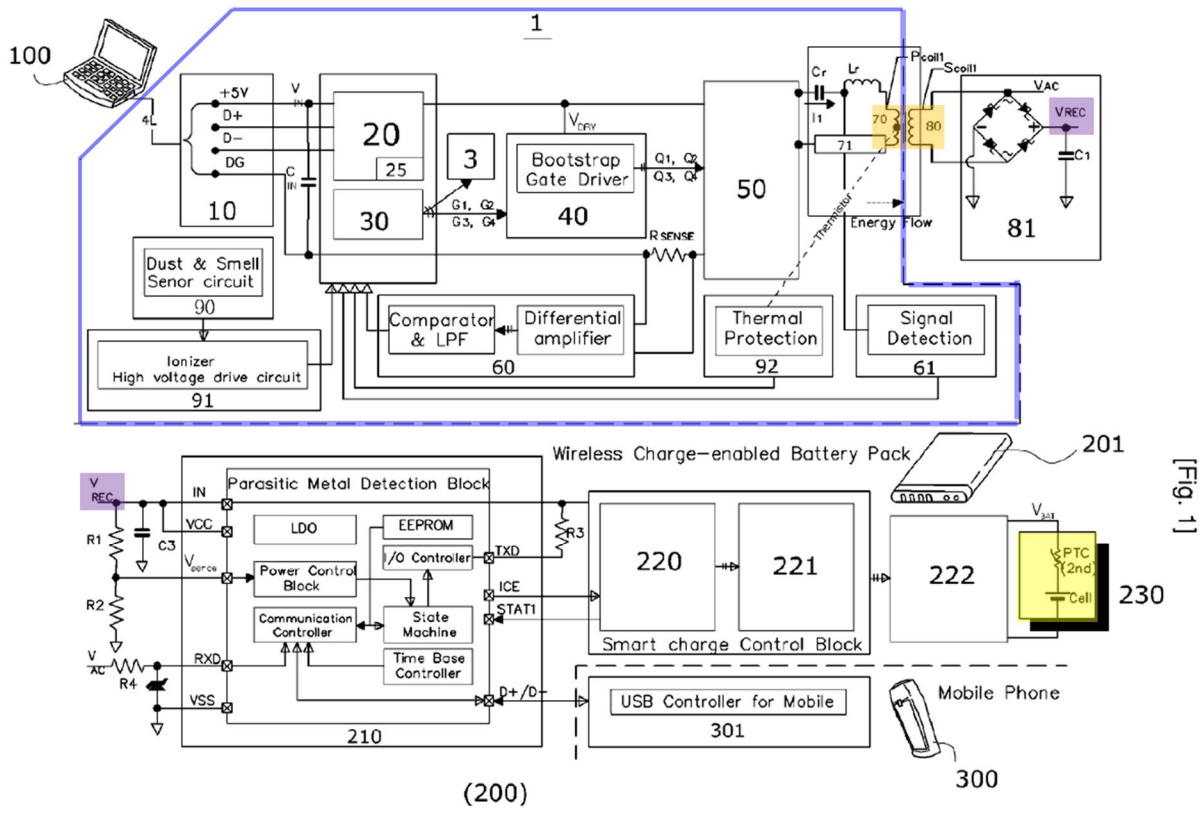


(Ex. 1005, FIG. 17 (annotated).)

151. *Okada* does not expressly disclose the drive circuit(s) having a "**capacitor.**" However, in my opinion, a person of ordinary skill in the art would have been motivated to modify the *Okada-Odendaal* system to include such features in light of *Kook*. (*See* my analysis and discussions below in this section.) In my opinion, a person of ordinary skill in the art would have understood that *Kook* is in the same technical field as the '371 patent and *Okada* and discloses features reasonably pertinent to particular problem(s) the '371 patent discusses and a person

of ordinary skill in the art was trying to solve. (Ex. 1001, Abstract, 1:54-5:16; *see also* my analysis and discussions in Sections VIII.A-C, IX.A.1(a)-(c); Ex. 1059, Abstract, ¶¶0009, 0035, 0041, 0049.) Therefore, in my opinion, a person of ordinary skill in the art would have consulted *Kook* in context of *Okada-Odendaal*. (*Id.*)

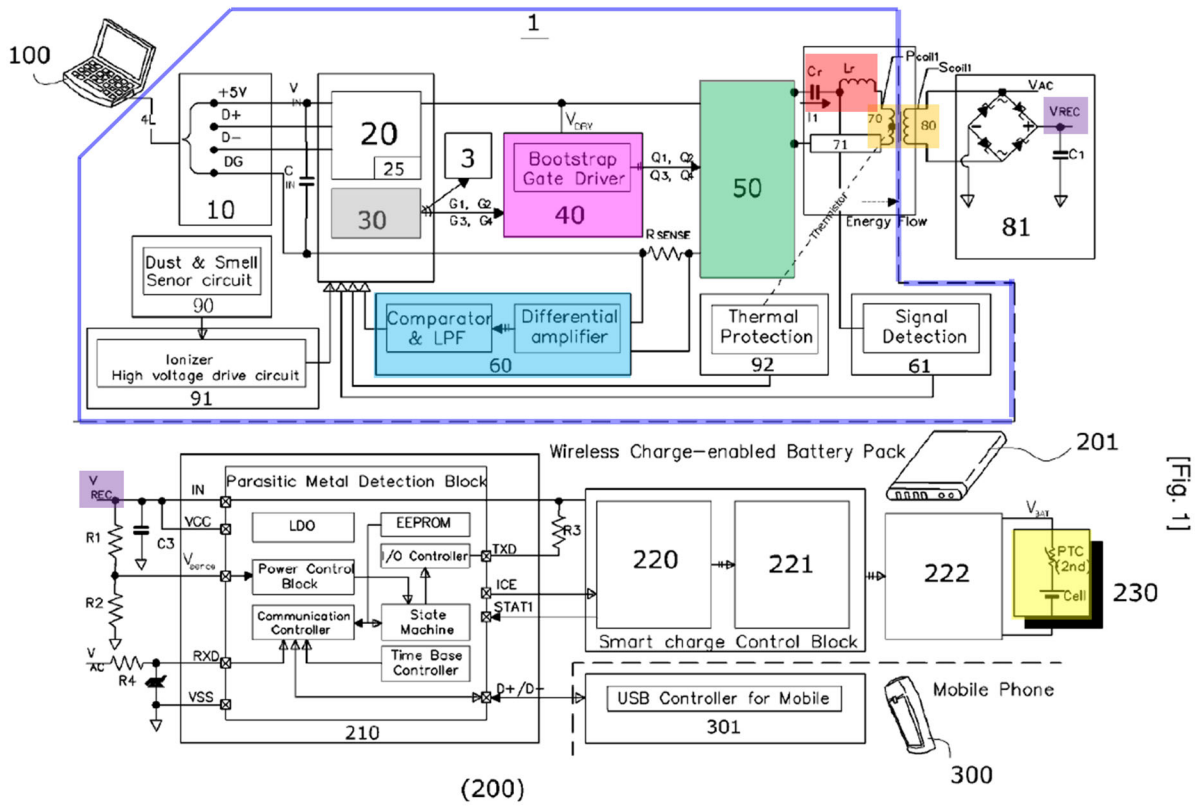
152. For example, *Kook* discloses "a non-contact charger capable of wireless data communication and . . . charging battery-pack of a mobile device." (Ex. 1059, Abstract, ¶¶0001, 0006, 0037-0042.) Charger 1 (**blue** below) receives power from computer 100 to power/charge mobile device 300 having a battery pack 200 (containing battery 230 (**yellow**)), via primary coil 70 and secondary coil 80 (both **orange**). (Ex. 1059, ¶¶0015 (mobile device has battery-pack 200), 0032, 0036-0037, FIG. 1 (below (rectification block 81 of battery pack 200 providing VREC (**purple**) to charger controller 210 of the same)).)



[Fig. 1]

(Ex. 1059, FIG. 1 (annotated).)

153. A person of ordinary skill in the art would have understood that charger 1 includes an MPU 30 "for controlling internal elements" of charger 1. (Ex. 1059, ¶0041.) Charger 1 also includes gate drive block 40 (magenta below) and serial resonator converter 50 (e.g., a LLC full/half wave type serial resonator converter, **green**), a "**C-L resonator**" (**red** (**Cr**/Lr)), coupled to primary coil 70, and current sensing block 60 (**blue**). (*Id.*, ¶¶0032-0035, 0041.)



(Ex. 1059, FIG. 1 (annotated).)

154. In my opinion, a person of ordinary skill in the art would have understood that the "C-L resonator" coupled to primary coil 70, including capacitor Cr, discloses a "**capacitor**." (Ex. 1059, FIG. 1, ¶0041.) In my opinion, a person of ordinary skill in the art would have understood that by using a "resonator converter to induce LC resonance," it "make[s] an electric current into a sine wave and transmit[s] an electric power to the secondary side by means of the inductive coupling." (*Id.*, ¶0049.) In my opinion, consistent with that known in the art and

Kook, a person of ordinary skill in the art would have understood such a capacitor-based circuit would have allowed the coil to transmit less-distorted and efficient signals (e.g., sine wave) with reduced harmonics. (*Id.*; *see also* my analysis and discussions below in this section and in Section V.) In my opinion, a person of ordinary skill in the art was aware that capacitor-based circuits (similar to that taught by *Kook*) improved signal transmissions in inductive-based systems, like *Okada* and *Kook* (e.g., minimizing/reducing unwanted radiations and heat issues caused by harmonics, etc.). (Ex. 1016, 631 ("Resonant circuits . . . useful for constructing filters"), 641, 798, ("**blocks out all higher harmonics**")[9]; Ex. 1013, (capacitor/switches reducing harmonics from primary coil), FIGS. 3 (annotated below), 6, 3:29-4:5, 4:19-5:7, 7:24-8:14, 8:17-23, 24-31, 9:26-12:27; Ex. 1008, 2:16-

[9] As I indicated above, I cite Exs. 1016 and 1013 (and other non-asserted prior art references for given grounds) to support my opinions as to the state of the art knowledge of a person of ordinary skill in the art at the time of the alleged invention, which is consistent with how such a person would have understood *Okada*, *Odendaal*, and *Kook*'s teachings.

19 (resonant tank); Ex. 1001, 22:13-30 (acknowledging harmonics are "undesirable").)

155. For example, *Alexander* (Ex. 1016) explains that "[r]esonance is a condition in an RLC circuit in which the capacitive and inductive reactances are equal in magnitude, thereby resulting in a purely resistive impedance. Resonant circuits (series or parallel) are useful for constructing filters." (Ex. 1016, 631.) *Alexander* also explains that "[a] bandpass filter is designed to pass all frequencies within a band of frequencies, w1 < w < w2. . . . the bandpass filter in Fig. 14.35 is a series resonant circuit." (*Id.*, 641.) *Alexander* also explains regarding "a bandpass filter . . . [i]f the filter is made highly selective . . ., the filter passes only the fundamental component (n=1) of the input and **blocks out all higher harmonics**." (*Id.*, 798.)

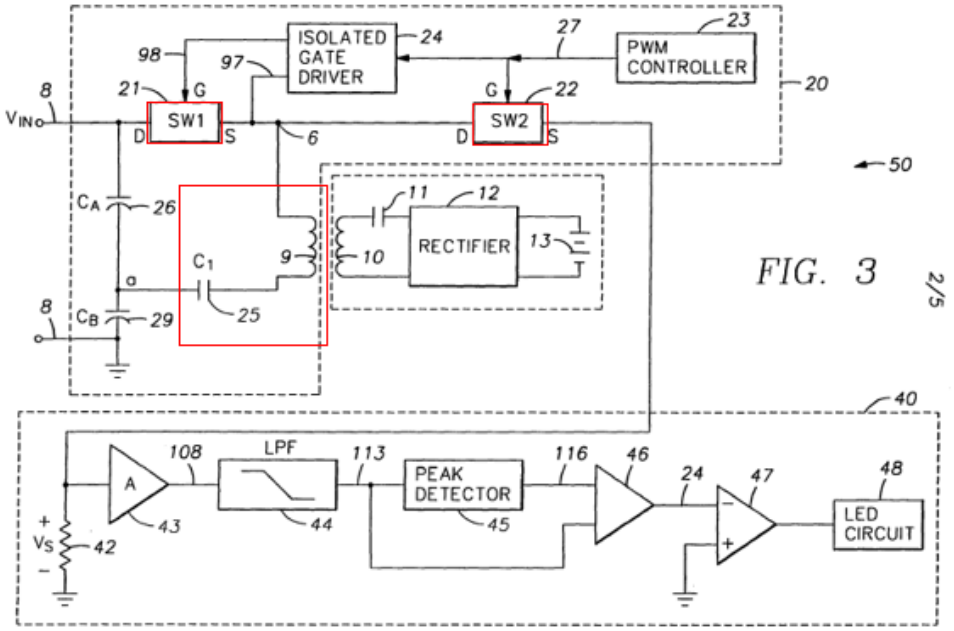
156. Similarly, references such as *WangII* (Ex. 1013) disclose the known use of switch(es) loaded by a capacitor coupled to a primary coil providing wireless power to secondary coil that reduces harmonics in signals generated by a primary coil, consistent with a person of ordinary skill in the art's knowledge at the time. (Ex. 1013, FIGS. 3 (*see* annotated figure below), 6, Abstract, 3:29-4:5 (discussing prior art where primary/secondary coils arrangement using a switching DC voltage

across a tuning capacitor where "high frequency harmonic components are present in the waveform," which "induce eddy currents" that increase temperature that is detrimental to operation of the device), 4:19-28 (battery charging device to efficiently charge a battery in device without excessive heat), 4:29-5:7 (use of capacitor-based resonant circuit with switches that provides full sinusoidal wave that "**reduce harmonics and eddy current**" to minimize heat and "without causing excessive energy loss"), 7:24-8:14, 8:17-23 (tuning capacitor 25 designed so that a sinusoidal waveform "flows through the primary coil 9 with **little high order frequency content**"), 8:24-31, 9:26-12:27).) For example, *WangII* explains:

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

> **which current is induced in a secondary coil attached to an implanted medical device. The medical device receives the induced current for charging rechargeable batteries.**
>
> The present invention can be implemented in a circuit in which a 5 KHz gate signal turns a first MOSFET switch on and off. The gate signal also turns on and off a second MOSFET switch at opposite times than the first MOSFET switch. **In addition to minimizing harmonics, the use of the optimum switching frequency reduces the eddy current in the housing (or can) of the implanted device, without causing excessive energy loss.**

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



(Ex. 1013, FIG. 3 (annotated).) (*See also* other state of art disclosures supporting my opinions as to the knowledge of a person of ordinary skill in the art at the relevant timeframe, such as Ex. 1012, FIGS. 2, 5 (C1 25, inductor 9), 8, 3:30-62, 8:47-9:51; Ex. 1014, 67-68 ("filter . . . 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, 5:45-6:4; Ex. 1020, Abstract, (harmonic reducing tuning capacitor); Ex. 1021, ¶¶00164-0165; Ex. 1029, 22-25; *see also* my analysis and discussions in Section V.)

157. In my opinion, in light of *Kook* in context of a person of ordinary skill in the art's knowledge, a person of ordinary skill in the art would have been motivated to consider and implement a capacitor with the above-discussed "**first**

drive circuit" and primary coil arrangement in PTM10 of the modified *Okada-Odendaal* system to improve power transmission and reduce harmonics, consistent with that known in the art. (*Id.*; *see also* my analysis and discussions regarding *Okada*, *Kook*, and state of art disclosures above in this section; *see also* my analysis and discussions above and below in this section; *see also* my analysis and discussions in Section V.) In my opinion, a person of ordinary skill in the art would have had the skill and rationale in implementing, and reasonable expectation of success in achieving, the above-modification, especially given the known benefits of capacitor-based filter circuits and use of capacitor(s) to enhance the transmission efficiency in inductive power transfer systems, and that the modification would have involved implementation of known technologies/techniques (capacitor-based filter design). (*Id.*) For example, in my opinion, a person of ordinary skill in the art would have known, and been motivated to consider and implement an appropriately designed capacitor-based circuit/filter positioned between switches 21/22/23 and primary coil 19, or between switching circuit 15 and the switches, (each as part of the "**first drive circuit**" I explained above), which would have achieved the above-discussed filtering benefits (e.g., reduced harmonics). (*Id.*; *see also* my analysis and discussions regarding *Okada*, *Kook*, and state of art disclosures above in this section;

see also my analysis and discussions above and below in this section; *see also* my analysis and discussions in Section V.)

158. In my opinion, beyond the capacitor-based disclosures I discussed above, a person of ordinary skill in the art would have also recognized other advantages/benefits from *Kook*'s teachings in context of *Okada* (which are relevant to features recited in other limitations (e.g., limitations 1(d)(3), 1(l), I discussed below (*see* my analysis and discussions in Sections IX.A.1(d)(3), IX.A.1(l))). For example, while capable of adjusting power levels based on device power requirements and selective switching at the **onset** of a charging process, *Okada* does not expressly indicate controlling power levels **during** the charging process. (Ex. 1005, ¶¶0069-0076, FIG. 3.) However, in my opinion, in light of *Kook*'s other teachings, a person of ordinary skill in the art would have been motivated to modify the *Okada*-*Odendaal* system to include such features. (*Id.*; *see also* my analysis and discussions regarding *Okada* and *Kook* above in this section; *see also* my analysis and discussions above and below in this section.)

159. For example, in addition to that I explained above, *Kook* describes feedback controlled type functionalities that allow the charger to adjust the operating frequency of the charger circuit, to control charging power/voltage to the portable

device **during** charge/power transfer operations. (*See* my analysis and discussions regarding *Kook* above and below in this section.) For example, a person of ordinary skill in the art would have understood that, in connection with FIG. 1 (annotated above), *Kook* explains that current sensing block 60 "stably control[s] an electric power through a current **feedback** using an automatic variation algorithm of **primary** frequency so as . . . to control a voltage of a **secondary** rectification terminal in the charging battery-pack 200." (Ex. 1059, ¶0041, FIG. 1.) In my opinion, a person of ordinary skill in the art would have also understood that current sensing block 60 analyzes "a signal of the secondary coil 80 to recognize the mobile device 300, monitor the primary coil 70 and the secondary coil 80 to control a charge voltage to a stable voltage." (*Id*., ¶0033; *see also id.*, ¶0047 ("voltage of the secondary rectification terminal . . . is controlled to a constant voltage" via coils 70/80, which "may control the secondary charging power . . . using an automatic variation algorithm of primary frequency of the non-contact charger 1"), ¶0083 ("adjusting a voltage of the secondary side to the stable voltage . . . using a parameter (frequency).").)

160. In my opinion, a person of ordinary skill in the art would have understood that resonator converter 50 includes switching FETs and a capacitor.

(*See* my analysis and discussions regarding *Kook* above and below in this section.) For example, *Kook* describes bootstrap ***gate*** drive block 40 providing four signals Q1-Q4 to serial resonator converter 50. (Ex. 1059, FIG. 1, ¶¶0009, 0032-0035, 0041.) In my opinion, a person of ordinary skill in the art would have understood such signals necessarily control corresponding "gates" of associated **FET** switches in converter 50 since it was understood that only FET switches have "gate(s)" (unlike a BJT), and *Kook* discusses "switching" in relation to serial resonator converter 50. (Ex. 1059, ¶¶0049, 0075.) As I explained above, *Kook* describes serial resonator converter 50 as including an "LLC" serial resonator converter (Ex. 1059, ¶¶0009, 0041, 0033, 0064), which a person of ordinary skill in the art would have understood to reflect a **capacitor** ("C") with inductors ("LL"). (*Id.*; *see also* my analysis and discussions regarding *Kook* above in this section.)

161. In my opinion, in view of such teachings/suggestions of *Kook*, a person of ordinary skill in the art would have been further motivated to configure the above modified *Okada* system such that the switching circuit 15 and/or other relevant components (part of the "**first drive circuit**," as modified above to implement an **"FET driver**," "**FET switch**," and a "**capacitor**" coupled to the primary coil, similar to the features described/suggested by *Kook*, of the "**system**") implement the

above-discussed features (e.g., in view of *Kook*'s disclosures) to improve/enhance power transmission control during charging operations, by adjusting the switching/operating frequency of the primary circuitry in response to current feedback information, while providing a more efficient power transfer via capacitive filtering as discussed above. (*Id.*; *see also* my analysis and discussions regarding *Okada* and *Kook* above in this section; *see also* my analysis and discussions in Sections VIII.A, C, IX.A.1(a)-(c).) In my opinion, a person of ordinary skill in the art would have appreciated the guidance of *Kook*, which describes a closed-loop feedback arrangement, where powering/charging is controlled through a current feedback by varying the primary-side circuit operating frequency using FET driver/switch/capacitor-based circuitry.[10] (*Id.*; Ex. 1059, ¶¶0033, 0041, 0047, 0083.)

[10] In my opinion, a person of ordinary skill in the art would have appreciated configuring the "drive circuit" in the modified *Okada* system to use "FET switches/FET driver"-circuitry with the modified switching circuit 15 to accommodate the frequency adjustment features discussed above. (*See* my analysis and discussions above in this section; *see also* my analysis and discussions in Sections VIII.A, C, IX.A.1(a)-(c).)

162. In my opinion, a person of ordinary skill in the art would have understood that such a configuration would have improved/complemented the *Okada-Odendaal* system, which also uses device information to control/adjust power delivery in a closed-loop feedback fashion, but does so at the onset of charging, not during charging. (Ex. 1005, ¶¶0069-0076, FIG. 3; *see also* my analysis and discussions in Sections VIII.A, IX.A.1(a)-(c).) In my opinion, a person of ordinary skill in the art would have understood that implementing features similar to those I explained above would have improved the power transmission control in the modified *Okada* apparatus/system, providing a stabilized voltage for the battery of the mobile device, for efficient power transfer/consumption during charging operations. (*Id.*; *see also* my analysis and discussions above in this section.)

163. In my opinion, consistent with that explained above, a person of ordinary skill in the art would have had the skill and rationale in implementing, and reasonable expectation of success in achieving, the above-modifications, especially because the use of capacitor(s) and closed-loop feedback control technologies/techniques for adjusting power delivery was known (e.g., *Okada* and *Kook*). (*See* my analysis and discussions above in this section; *see also* my analysis and discussions in Sections V, VIII.A, C, IX.A.1(a)-(c).) In my opinion, such a

modification would have involved applying known technologies/techniques (e.g., FET-based drive circuitry in closed-loop feedback power transfer system with capacitive filtering to adjust power delivery (*Okada* and *Kook*, state-of-art knowledge)) to foreseeably result in an inductive power/charging system that ensures sufficient power is available to portable device during power delivery that achieves energy-efficient continuous power transfer with reduced heat waste and signal distortion. (*See* my analysis and discussions above in this section; *see also* my analysis and discussions in Sections VIII.A, C, IX.A.1(a)-(c); *see also* my analysis and discussions in Section V.)

164. In my opinion, there were various ways for a person of ordinary skill in the art to implement such modifications. (*Id.*) For example, in addition to implementing an appropriately designed/positioned capacitor-based circuit/filter (*see* my analysis and discussions above in this section), a person of ordinary skill in the art would have been motivated to configure/leverage features/components in *Okada*'s system that are used to receive/pass/process device information for power transfer control (e.g., demodulator 35, circuits 36-38 (Ex. 1005, ¶0064; *see also* my analysis and discussions in Sections IX.A.1(e)-(m))) to achieve the noted foreseeable and beneficial power delivery features during charging/powering operations. (*Id.*;

see also my analysis and discussions above in this section.) For example, a person of ordinary skill in the art would have recognized and appreciate the benefits of configuring the system to receive current feedback information/signals (e.g., via demodulator 35, processed by one/more circuits (e.g., 36-38), provided to the modified switching circuit 15) to vary the operating frequency of the primary side "drive circuit" to control a voltage of output by the rectifier circuitry 43 used to charge/power the battery in the portable device. (*Id.*; *see also* my analysis and discussions above in this section; *see also* my analysis and discussions in Sections IX.A.1(e)-(m); *see also* my analysis and discussions in Sections V, VIII.A, C, IX.A.1(a)-(c), (n).)[11]

[11] In my opinion, such exemplary configurations do not limit the possible modifications/implementations of the modified system. In my opinion, other successful designs/configurations within the capabilities/knowledge of a person of ordinary skill in the art would have been contemplated to achieve the same functionalities. (*See* my analysis and discussions above in this section; *see also* my analysis and discussions in Sections V, VIII.A, C, IX.A.1(a)-(c), (e)-(n).)

(2) 1(d)(2): wherein during operation the first drive circuit is configured to apply an alternating electrical current to the first primary coil at an operating frequency and duty cycle to generate an alternating magnetic field in a direction substantially perpendicular to the plane of the first primary coil and the surface of the system to provide power inductively to the portable device,

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

166. As I explained above, the *Okada-Odendaal-Kook* system would have been configured to include a first drive circuit (with FET driver, FET switch, capacitor) having current-based closed-loop feedback control to adjust the power/voltage used to charge the battery of the portable device by adjusting the operating frequency on the primary side. (*See* my analysis and discussions in Section IX.A.1(d)(1).) In my opinion, in light of *Kook* and *Okada*, a person of ordinary skill in the art would have understood that the configured drive circuit in the *Okada-Odendaal-Kook* system, during operation, would have provided an alternating electrical current to the primary coil 19 at an "**operating frequency and**

duty cycle," consistent with the features taught/suggested by *Kook*. (Ex. 1059, ¶¶0041 ("stably controlling an electric power through a current feedback using an automatic variation algorithm of primary frequency"), 0047, 0083 ("receives AC current from the secondary coil 80"); *see also* my analysis and discussions in Section IX.A.1(d)(1); Ex. 1005, ¶¶0110-0111.)

167. In my opinion, consistent with such teachings, a person of ordinary skill in the art would have also understood that the ac signal applied to the primary coils in the modified *Okada* system (employing planar coil(s)) would have generated "**an alternating magnetic field in a direction substantially perpendicular to the plane of the first primary coil and the surface of the system**" as claimed, given such a field would have been the natural result of activating the planar primary coil to inductively transfer power to the portable device as described by *Okada*, *Odendaal*, and *Kook*. (Ex. 1005, ¶¶0035 ("magnetic coupling occurs between the [coils]"), 0051, 0056 ("magnetic coupling occurs between" coils), 0063, 0066, 0121, ¶¶0127-0132, FIGS. 11(b) and 13(b) (showing parallel coils that would generate a magnetic field perpendicular to the plane of coil 19 and system) (*see* annotated FIGS. 11(b) and 13(b) and my analysis in Section IX.A.1(b)); Ex. 1059, ¶¶0032, 0037-0042; *see also* my analysis and discussions in Section IX.A.1(c); Ex. 1008, 1:17-20,

2:1-29; *see also* my analysis and discussions in Sections V, IX.A.1(a)-(b).) For example, *Koreis* (Ex. 1009) and other references I reference below[12] demonstrate such knowledge of a person of ordinary skill in the art. *Koreis* explains:

> 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

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

> also be used to charge batteries (not shown) of the computing device 18 in addition to supplying power. . . .
>
> **More specifically, the contactless power supply 10 comprises *a two-part transformer, wherein the transformer has a flat configuration so as to fit within, for example, a seatback tray or a desktop. The first part of the transformer is located within the seatback tray* and is coupled to a source of AC power.** The second part of the transformer, hereinafter referred to as receiving coil and core, is located within the computing device 18 and is coupled to a rectifier that converts AC power to DC power. ***When magnetic field lines are approximately 90 degrees to the first part of the transformer*** when the receiving coil and core are placed within the field, ***current is induced into the computing device 18.***

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

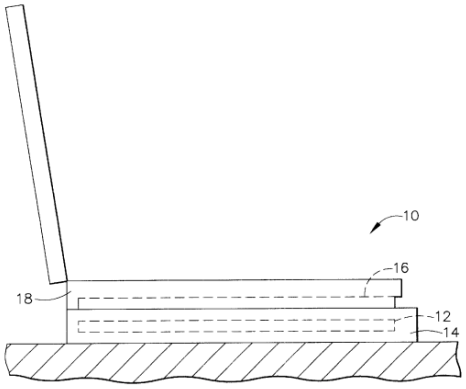
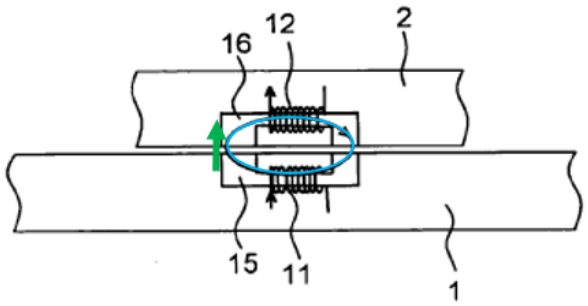


FIG. 1

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

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

FIG. 2B



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

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

> . . . Here, the power transmission capability evaluating circuit 36 determines whether a power receiving apparatus is mounted onto a power transmitting device 1 based on the "code indicating that a device is capable of receiving power" (STEP 3). If a prescribed "code indicating that a device is capable of receiving power" is received (STEP

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

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

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

As illustrated in FIG. 4(a), **the greater the amount of offset of the positions of the common cradle 4 and the PDA 3, the worse the power transmission efficiency**

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

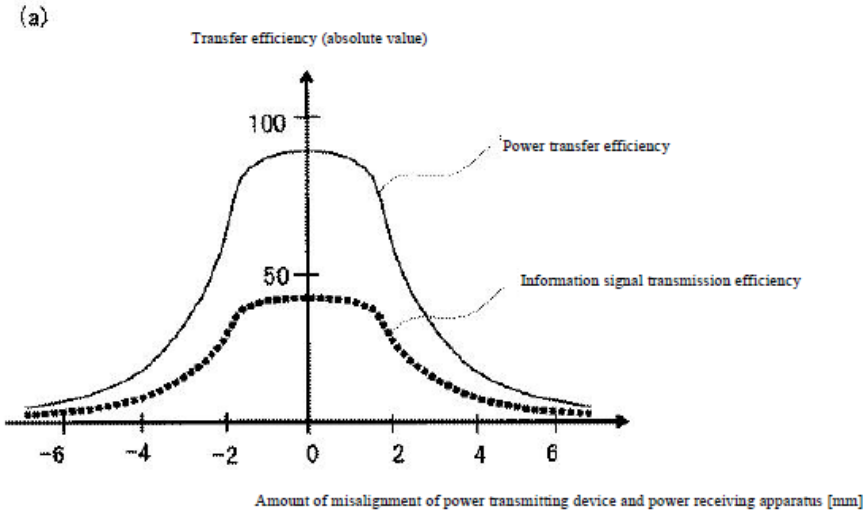
The greater the amount of positional offset of the common cradle 4 and the PDA 3, the worse the power transmission efficiency, so when power transmission efficiency is significantly low, the PDA 3 cannot receive power even if power is transmitted from the common cradle 4, which defeats the purpose of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

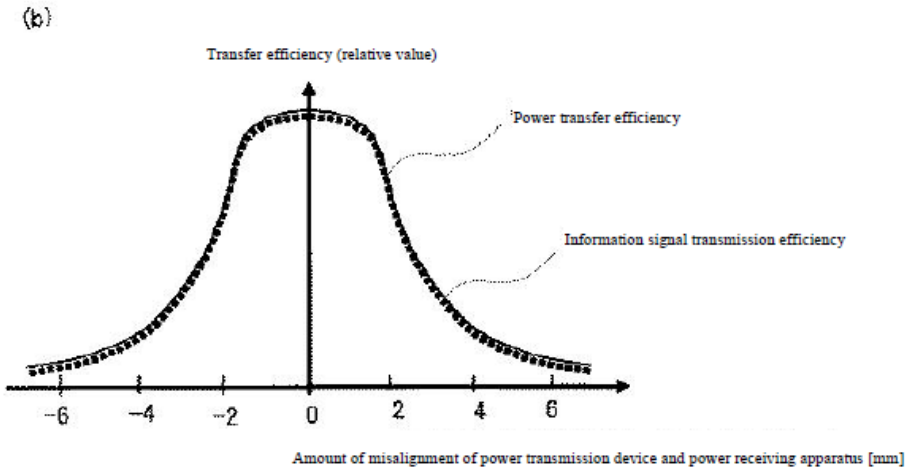
Meanwhile, **when the amount of positional offset of the common cradle 4 and the PDA 3 does not exceed the prescribed amount of offset (STEP 4: Yes), processing**

proceeds to evaluating an amount of power to transmit (STEP 6). . . .

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

FIG. 4





(Ex. 1005, FIGS. 4(a) and (b) ("Amount of ***misalignment*** of power transmission device and power receiving apparatus [mm]").) Thus, based on such disclosures of *Okada* that the system provides power inductively when primary coil 19 is present and properly aligned with a portable device such as PDA 3 (and its secondary/receiver coil 41) where appropriate magnetic coupling for high power transmission efficiency exists between the primary and secondary coils (Ex. 1005, ¶¶0064-0069, 0074-0076, FIGS. 3, 4(a)-(b)), in view of *Okada*'s configurations (discussed above (e.g., parallel primary and secondary coils, etc.)) and a person of ordinary skill in the art's state of art knowledge (also discussed above), such a skilled person would have understood that the ac signal applied to the primary coils in the modified *Okada* system would have generated "**an alternating magnetic field in a direction substantially perpendicular to the plane of the first primary coil and the surface of the system**" as claimed. (*Id.*; *see also* my analysis and discussions above in this section; *see also* my analysis and discussions in Sections V, VIII.A, IX.A.1(a)-(d)1.)

169. Also, in my opinion, a person of ordinary skill in the art would have understood the planar primary coils in the *Okada-Odendaal-Kook* system, when providing power inductively to the coil(s) of the portable device (which also may be

planar in the modified system), would have likewise generated a magnetic field that was substantially perpendicular to the plane of coils 19 and system surface, as known in the art. (*Id.*; *see* my analysis, discussions, and citations above in this section and in Section IX.A.1(b).) For example, consistent with known planar coil designs and how magnetic coupling occurs in such configurations (*see* my discussions above in Section V.B and those above and below in this section where I reference state of art references supporting such understanding), and also consistent with *Okada*'s teachings that look to detect and confirm coil/device position/alignment where appropriate magnetic coupling for high power transmission efficiency exists based on positional offset (*see* Ex. 1005, ¶¶0064-0069, 0074-0076, FIGS. 3, 4(a)-(b)), a person of ordinary skill in the art would have understood (and been motivated to design/implement a system where) when the primary planar coil(s) is/are aligned with the (planar) secondary coil in the modified *Okada* system/device/apparatus to maximize/increase magnetic coupling (energy transfer efficiency), that a ***substantially perpendicular*** magnetic field (relative to the plane of the primary coil(s) and surface of the system) would be generated by the planar primary coil(s) and received by the planar secondary coil. (*Id.*; *see also* my analysis and discussions in this section (including analysis and discussions regarding a person of ordinary

skill in the art's state of art knowledge); *see also* my analysis and discussions in Sections V.B, IX.A.1(b)-(c); *see also* Ex. 1048, Abstract, FIGS. 1-6, 1:28-2:4 ("spiral coil" with a "high magnetic field strength at the center of the coil"), 2:27-3:14, 4:11-24, 5:23-6:15, claims 1-88; Ex. 1049, Abstract, FIGS. 1, 5-6, 9, 11-12, 24-26, ¶¶0008-0010, 0044-0050, 0051 (peak intensity of magnetic field at center of the inductor), 0065-0066; Ex. 1050, Abstract, FIGS. 1-5, 9A-9C, 5:22-6:45, 11:22-33, 12:28-38, 16:25-17:23, 17:61-18:3 ("**substantially perpendicular**" magnetic field from planar coils).)

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

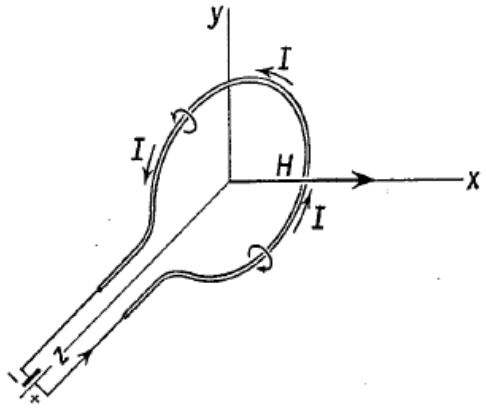


Fig. 30-4 Magnetic field produced by a current in a circular loop of wire. The magnetic field at the center is at right angles to the plane of the loop.

(Ex. 1011, 559, FIG. 30-4, 562.) A person of ordinary skill in the art knew of, and how to determine, the magnetic field intensity "at the center of a singular circular loop of wire carrying a current, and likewise, that the magnetic field at center of such a single conductor loop coil in the positive z direction as shown in the figure below (perpendicular to center of loop). (*Id.*, 562.)

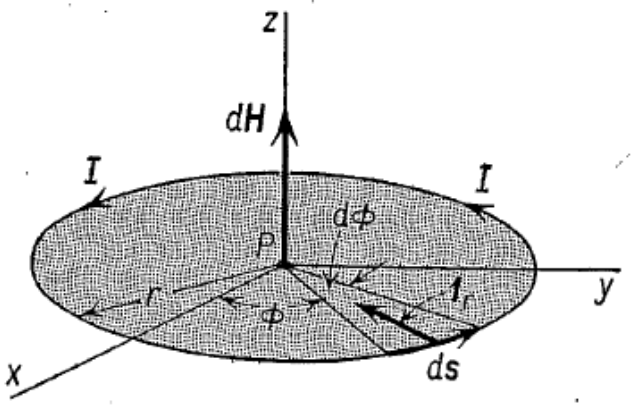


Fig. 30-8

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

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

(*Id.*, 564; *see also id.*, 592 (magnetic flux ϕ being total number of lines pass perpendicularly through an element of area).)

> **(3) 1(d)(3): wherein the operating frequency is within a range of frequencies (i) that are near a resonance frequency of a circuit comprising the first primary coil and the capacitor, (ii) such that increasing values of the operating frequency within the range of frequencies would correspond to a lower voltage or current induced in an output of the receiver circuit and (iii) that allow activation and powering of the receiver unit and charging the battery of the portable device;**

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

172. In my opinion, consistent with that discussed above for the *Okada-Odendaal-Kook* system (*see* my analysis and discussions in Sections IX.A.1(d)(1)-(2)), a person of ordinary skill in the art would have been motivated to configure the system's first drive circuit to provide a sine wave-type signal to primary coil 19 coupled to a resonating circuit (e.g., C-L circuit), based on circuitry/techniques consistent with those taught by *Kook*, such as a serial resonator converter type circuitry that "induce[s] **LC resonance**" to provide "a sine wave" to a primary coil coupled to a "**C-L resonator**." (*See* my analysis and discussions in Section

IX.A.1(d)(1); Ex. 1059, ¶¶0032-0035, 0047, 0055, 0081.) For example, *Kook* describes that the **switching frequency** [may be] set to a higher level than the **resonant frequency**" (Ex. 1059, ¶0049) and that "resonator converter 50…may operate at a lower **switching frequency** than a **resonance frequency**" to reduce "switching loss of the [secondary rectifier] diodes." (*Id.*, ¶0075.) In my opinion, a person of ordinary skill in the art would have understood that *Kook*'s resonant frequency is that of a circuit including at least the primary coil and associated capacitor, e.g., Cr of the C-L resonator and/or the capacitor of the [LLC full-bridge] serial resonator converter 50 ("**a resonance frequency of a circuit comprising the first primary coil and the capacitor**") as *Kook* discloses transmitting power from the primary coil by using the resonance converter to "induce **LC resonance**." (Ex. 1059, ¶0049; *see also* my analysis and discussions regarding *Kook* in this section and in Sections IX.A.1(d)(1)-(2).) In my opinion, the above modified *Okada* system (implementing a resonant circuit (C-L) and frequency-based switching operations (*see* Sections IX.A.1(d)(1)-(2)) would have been configured to provide similar features for similar reasons I explained in context of *Kook*'s teachings. (*See* my analysis and discussions regarding *Kook* in this section; *see also* my analysis and discussions in Sections IX.A.1(d)(1)-(2).)

173. In my opinion, likewise, similar to and consistent with *Kook*'s teachings, a person of ordinary skill in the art would have been motivated to configure the "drive circuit" in the above *Okada-Odendaal-Kook* system to apply current to the primary coil 19 at an operating frequency that is "**within a range of frequencies**" that are "**near**" the "**resonance frequency**" set by the capacitor-based resonance circuit (L-C circuit) in the modified system as I explained above and in Sections IX.A.1(d)(1)-(2), to effectively filter the unwanted harmonics for reasons I explained. (*See* my analysis and discussions above in this section and in Sections IX.A.1(d)(1)-(2).)

174. Furthermore, in my opinion, consistent with *Kook*'s teachings and a person of ordinary skill in the art's state of art knowledge, a person of ordinary skill in the art would have designed/configured the LC circuit in the modified *Okada* system to filter signals having frequencies higher than the resonance frequency (as it was known such signals are unwanted harmonics). (*See* my analysis and discussions in Section IX.A.1(d)(1); *see also* my analysis and discussions above in this section and in Section V.C.) In my opinion, a person of ordinary skill in the art would have thus understood as a natural result of the operating frequency provided by the modified "driver circuit" being increased (including when operating in

accordance with the frequency adjustment features I discussed above (*see* Sections IX.A.1(d)(1)-(2)) and within the range of frequencies that would produce a sine wave signal or "near" the resonance frequency of the circuit as noted above), at least some of the fundamental sine wave signal (non-harmonics signal) would be filtered by the LC circuit, resulting in a signal having reduced strength (in terms of its voltage/current, due to increased impedance) being transmitted to the portable device's receiver circuit (*see* Section IX.A.1(b)). (*See* my analysis and discussions above in this section; *see also* my analysis and discussions in Sections IX.A.1(b), IX.A.1(d)(1)-(2); Ex. 1008, 5:33-55 (FIG. 8B showing that "there is minimal impedance at…the resonant frequency").) In my opinion, a person of ordinary skill in the art would have understood that consequently, the output signal induced at the output of "receiver circuit" (provided to the battery of the portable device) in the modified *Okada* system would have a corresponding lower voltage/current, consistent with that recited in part "**(ii)**" of limitation 1(d)(3) (". . . **(ii) such that increasing values of the operating frequency within the range of frequencies would correspond to a lower voltage or current induced in an output of the receiver circuit** . . ."). (*Id.*; *see also* my analysis and discussions above in this section; *see also* my analysis and discussions in Sections IX.A.1(b), IX.A.1(d)(1)-

(2).) Accordingly, for reasons I explained, a person of ordinary skill in the art would have been motivated to configured the *Okada-Odendaal-Kook* system to implement closed-loop feedback controlled frequency switching power delivery (consistent with that discussed above and recited in limitation 1(d)) based on device information to provide appropriate power to accommodate changes in PDA 3's load during power/charging operations. (*See* my analysis and discussions in Sections IX.A.1(a)-IX.A.1(d)(2); *see also* my analysis and discussions above in this section.)

175. In my opinion, for similar reasons, the modified *Okada-Odendaal-Kook* system (and its "drive circuit") likewise would have been configured (and thus discloses/suggests) operating within the above-described range of frequencies that result in wireless powering/charging of the battery in the portable device. (*Id.*) In my opinion, as I explained, the *Okada-Odendaal-Kook* system would have been configured to improve control of the power transmission by adjusting the switching/operating frequency of the primary-side circuitry, e.g., including the "first drive circuit" with modified switching circuit 15, while providing a more efficient power transfer via capacitive filtering during powering/charging of the portable device's battery. (*Id.*; *see also* my analysis and discussions in Sections IX.A.1(d)(1)-(2), IX.A.1(a)-(c).)

176. Additionally, in my opinion, a person of ordinary skill in the art would have appreciated that *Okada* discloses that circuit 15's switching signal is converted to a V_{CC} to power components in PTM10, including circuit 33, which generates "a prescribed carrier wave at a certain interval" that is sent to PRM40. (Ex. 1005, ¶¶0039, 0056-0057; *see also* my analysis and discussions in Section IX.A.1(d)(1).) *Okada* discloses that a DC signal "generated by a carrier wave provided by the carrier wave oscillating circuit 33 can be **used as a driving power source for the clock extracting circuit 46 and the modulating circuit 47**" in the "**receiver circuit**" of PRM40. (Ex. 1005, ¶0058; *see also* my analysis and discussions in Section IX.A.1(b).) *Okada* also discloses that even during power transmission, the carrier wave is periodically transmitted to PRM40, and, based on the received device information, PTM10 determines whether PDA 3 remains and/or is properly positioned. (Ex. 1005, FIG. 3, ¶¶0074-0075; *see also* my analysis and discussions in Section VIII.A.) Only when properly positioned does PDA 3 receive power until fully charged, which is determined using the "periodically transmitted" carrier wave. (Ex. 1005, FIG. 3, ¶0074, 0076; *see also* my analysis and discussions in Section VIII.A.) Thus, in my opinion, a person of ordinary skill in the art would have been motivated by such teachings to configure the above-discussed modified *Okada*-

Odendaal-Kook system to include similar features to "**allow activation and powering of the receiver unit and charging the battery of the portable device**" as claimed. (*Id.*; *see also* my analysis and discussions above in this section; *see also* my analysis and discussions in Sections VIII.A-C, IX.A.1(a)-(d)(2), (e)-(n).)

e) a first sense circuit to monitor current flow through the first primary coil during operation of the first drive circuit, wherein the first sense circuit includes a low pass filter and an amplifier to assist in detecting and amplifying a signal corresponding to a current modulation in the first primary coil induced by modulation of current in the receiver coil; and

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

178. Limitation 1(e) recites "first sense circuit . . . **detecting** . . . signal corresponding to a current **modulation** in the first primary coil." (*See also* my analysis and discussions for Section IX.A.1(g) / limitation 1(g) (reciting "detect, through the first **sense circuit**, a received communication of information in the **current modulation** in the first primary coil").) In my opinion, a person of ordinary skill in the art would have understood that in *Okada*, PTM10 transmits a carrier wave

signal to PRM40, resulting in PDA 3 to generate/send a modulated signal including device information back to PTM10 via coils 41 and 19. Circuit 35 "**demodulates modulated** signals included with the voltage from" primary coil 19 (Ex. 1005, ¶0042), and the information is evaluated by circuits 36-38 as part of power transfer operations. (Ex. 1005, FIG. 3, ¶¶0060-0077; *see also* my analysis and discussions in Section VIII.A.) For example, *Okada* explains:

> A carrier wave output from the carrier wave oscillating circuit 33 is applied to the tap c of the primary-side coil 19, which, when the PDA 3 is mounted on the common cradle 4, is transmitted to the magnetically coupled secondary-side coil 41. This carrier wave transmitted to the secondary-side coil 41 is rectified, smoothed, and converted to a DC voltage via the smoothing capacitor 42, the rectifying circuit 43, and the smoothing circuit 44 as described above. Furthermore, the power-on reset circuit 48 detects the DC voltage converted from this carrier wave and recognizes that the carrier wave has been transmitted. Furthermore, the clock extracting circuit 46 connected to the secondary-side coil 41 extracts a clock signal necessary for ***modulation from the carrier wave***, and a ***modulating circuit 47 applies to the secondary-side coil 41 a modulated wave in which the carrier wave is***

> ***modulated based on information on the PDA 3: such as "the code indicating that a device is capable of receiving power," "power consumption information," and "full capacity information."*** . . .
>
> ***The modulated wave provided to the secondary-side coil 41 from the modulating circuit 47 is transmitted to the magnetically coupled primary-side coil 19.***
>
> Furthermore***, a demodulating circuit 35 connected to the tap c of the primary-side coil 19 receives and demodulates the transmitted modulated wave, and provides the "code indicating that a device is capable of receiving power," "power consumption information," and "full capacity information" included in the demodulated information signal*** to the power transmission capability evaluating circuit 36, the power amount evaluating circuit 37, and full capacity evaluating circuit 38. . . .

(Ex. 1005, ¶¶0063-0064.) Therefore, a person of ordinary skill in the art would have understood that demodulating circuit 35 is an example of "**a first sense circuit**" given it senses/receives/demodulates a modulated response signal from PRM40 via

coil 19. (Ex. 1005, FIG. 2, ¶¶0050, 0064, 0069, 0076; *see also* my analysis and discussions in Sections VIII.A, IX.A.1(a)-(d).)

179. *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 *Okada-Odendaal-Kook* does not expressly disclose "a first sense circuit to **monitor current flow** through the first primary coil during operation of the first drive circuit, wherein the first sense circuit…[detects] a signal corresponding to **a current modulation in the first primary coil induced by modulation of current in the receiver coil**," it is my opinion that a person of ordinary skill in the art would have been motivated to implement such features as I explain below. (*See* my analysis and discussions below in this section.)

180. In my opinion, a person of ordinary skill in the art would have understood that modulating/demodulating a waveform (as discussed in *Okada*) and sensing communications based on monitoring an inherent property of the waveform (e.g., current) in order to detect/sense/process information contained therein during charging operations (operation of the drive circuit) was a known and foreseeable technique, approach, and/or solution for including/encoding/decoding information

from the portable device in the modified system, such as information used to confirm power reception equipment, full charge, and/or power level used to verify presence/alignment of coils, consistent with that disclosed by *Okada*. (Ex. 1005, ¶¶0056-0057, 0062-0064; *see also* my analysis and discussions in this section and in Sections VIII.A, IX.A.1(a)-(d).) Therefore, 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 (including current sense circuit(s) that monitor current flow in the primary coil 19) to facilitate the communication of information from the secondary side coil, consistent with that known in the art. (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; *see also* my analysis and discussions in Section IX.A.1(g).) (*See also* Ex. 1001, 24:32-45 (discussing "current modulation" in context of conventional technologies, which supports that such features were known); Ex. 1063.) For example, state-of-the art references such as *Delatorre* (Ex. 1056), *Cunningham* (Ex. 1057), and *Due-Hansen* (Ex. 1058) describe use of current modulation/demodulation at receiver and primary side devices/circuits for communicating data in inductively coupled systems, and sensing

such communications.[13] (*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 is halted or quenched (1303) in a relatively complete

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

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.)

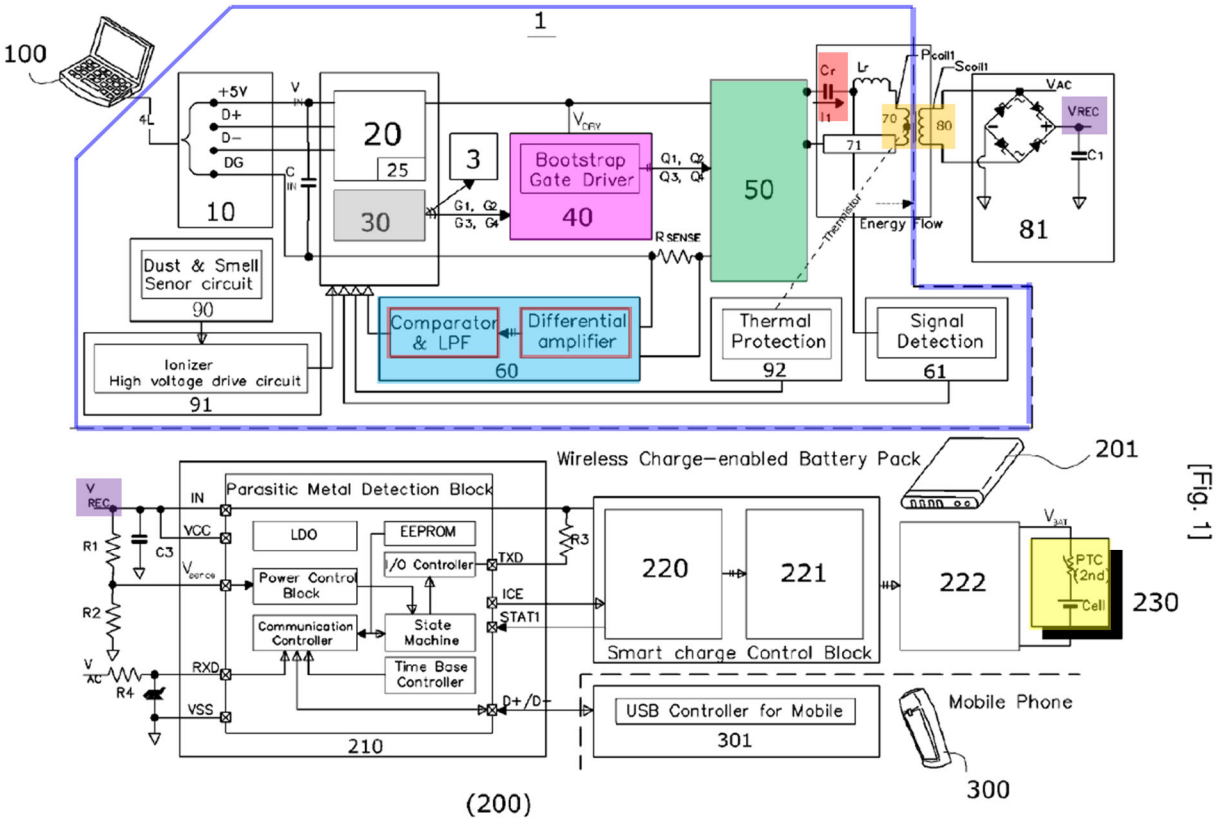
181. For example, *Okada* describes verifying PDA 3's presence by measuring intensity of the signal(s) communicated via primary coil(s) 19 and secondary coil 12. (Ex. 1005, FIGS. 4(a)-4(b), ¶¶0066-0068, 0074-0076, FIG. 8 (current sensor 91), ¶0110 ("**current measuring sensor**" measuring current "through the primary-side coil 19" when PDA 3 "is in proximity" of cradle 4), ¶0111.) Therefore, in my opinion, a person of ordinary skill in the art would have been motivated to configure and implement such current sensing / detecting / modulation / demodulation features in the *Okada-Odendaal-Kook* system for detecting communications of the modulated information signal (e.g., device capability code) when received via coil 19 (detected as current corresponding to current modulation in coil 19 induced from the current modulation via coil 41) so

that it is timely/properly detected, demodulated, and used to verify that PDA 3 is "placed in a correct position" and "capable of data transmission and reception." (*Id.*, ¶0080, FIGS. 3, 8, 4(a)-4(b), ¶¶0081-0082.) In my opinion, a person of ordinary skill in the art would have been motivated to implement such a modification in light of *Okada*'s teachings, e.g., using signal intensity and sensed current in coil 19 for determining/verifying PDA 3 presence, and state of art knowledge (as exemplified 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)-(d).) In my opinion, a person of ordinary skill in the art would have considered various ways of configuring the modification, such as configuring the "sense circuit(s)" associated with current sensors 91, demodulation circuit 35, and/or other components to allow PTM10 to monitor the current flow through coil(s) 19 to sense/detect communications from PRM40 via coil 41, consistent with known current modulation/demodulation techniques as I explained. (*Id.*)

182. In my opinion, a person of ordinary skill in the art would have had the requisite skills and rationale to design/implement such "**sense circuit…**" and related current modulation/demodulation-type features in the *Okada-Odendaal-Kook* system, and done so with a reasonable expectation of success given the teachings of

Okada and the knowledge of such a person of ordinary skill in the art at the time, especially since such a skilled person would have appreciated and understood that such modification would have involved applying known technologies/techniques (as I explained above) to foreseeably result in an inductive power transfer system that senses/detects communications received by coil 19 via known current modulation/demodulation techniques in the *Okada-Odendaal-Kook* system. (*Id.*; *see also* my analysis, discussions, and citations above in this section; *see also* my analysis and discussions in Sections VIII.A-C, IX.A.1(a)-(d), IX.A.1(f)-(n).)

183. While *Okada* does not expressly disclose "the first sense circuit includes **a low pass filter and an amplifier to *assist* in detecting and amplifying a signal**…," in my opinion, a person of ordinary skill in the art would have been motivated to implement such features in view of *Kook*. (*See* my analysis and discussions below in this section.) For example, *Kook* discloses that charger 1 includes **current sensing block 60** (**blue** in FIG. 1 below) that **monitors primary coil 70** to receive signals and associated information. (Ex. 1059, ¶¶0008, 0010, 0032-0033, 0041 ("a current sensing block 60 for stably controlling an electric power through a current feedback"), 0045 ("current sensing block 60 receives a signal").)



(Ex. 1059, FIG. 1 (annotated).) In my opinion, a person of ordinary skill in the art would have understood that current sensing block 60 includes a differential "**amplifier**" and a "LPF" ("**Low Pass Filter**" (**red** above)). A person of ordinary skill in the art would have understood that that the "LPF" and "amplifier" would "**assist in detecting and amplifying a signal**" from a primary coil (similar to that described by *Okada-Odendaal-Kook*) because it was known that an amplifier increases signal strength and a LPF reduces impacts of unwanted noise/distortion for optimizing signal detection/sensing. (*Id.*; *see also* my analysis, discussions, and

citations regarding *Kook* in this section; *see also* my analysis and discussions in Sections VIII.C, IX.A.1(d).)

184. In my opinion, in light of such teachings/knowledge, a person of ordinary skill in the art would have been motivated to configure the "sense circuit" in the modified *Okada* system (e.g., demodulating circuit 35) to include amplifier/LPF circuitry to provide similar features like that suggested by *Kook*'s current sensing block 60 (e.g., to amplify and filter the signal received by circuit 35 to ensure proper/efficient demodulation of the current modulated information signal(s) sent by coil 41 in the receiver circuit. (*Id.*; *see also* my analysis, discussions, and citations above in this section.)

185. In my opinion, a person of ordinary skill in the art would have had the requisite skills and rationale to design/implement such features in the above modified *Okada-Odendaal-Kook* system, and done so with a reasonable expectation of success given the teachings of *Okada* and *Kook* in context of a person of ordinary skill in the art's state of art knowledge at the time, especially since such a skilled person would have appreciated and understood that such modification would have involved applying known technologies/techniques (e.g., known signal enhancement/processing and filter technologies/techniques) to foreseeably result in

an inductive power transfer system having an optimized/improved sense circuit (through the use of known LPF and amplifier components/techniques (*Kook*)) for monitoring current flow through the primary coil in accordance with the above-modified *Okada-Odendaal-Kook* system. (*See* my analysis and discussions above in this section and in Section IX.A.1(d); *see also* my analysis and discussions in Sections VIII.A-C, IX.A.1(a)-(c), (f)-(n).)

f) a communication and control circuit, including a microcontroller coupled to the first drive circuit and the first sense circuit, configured to:

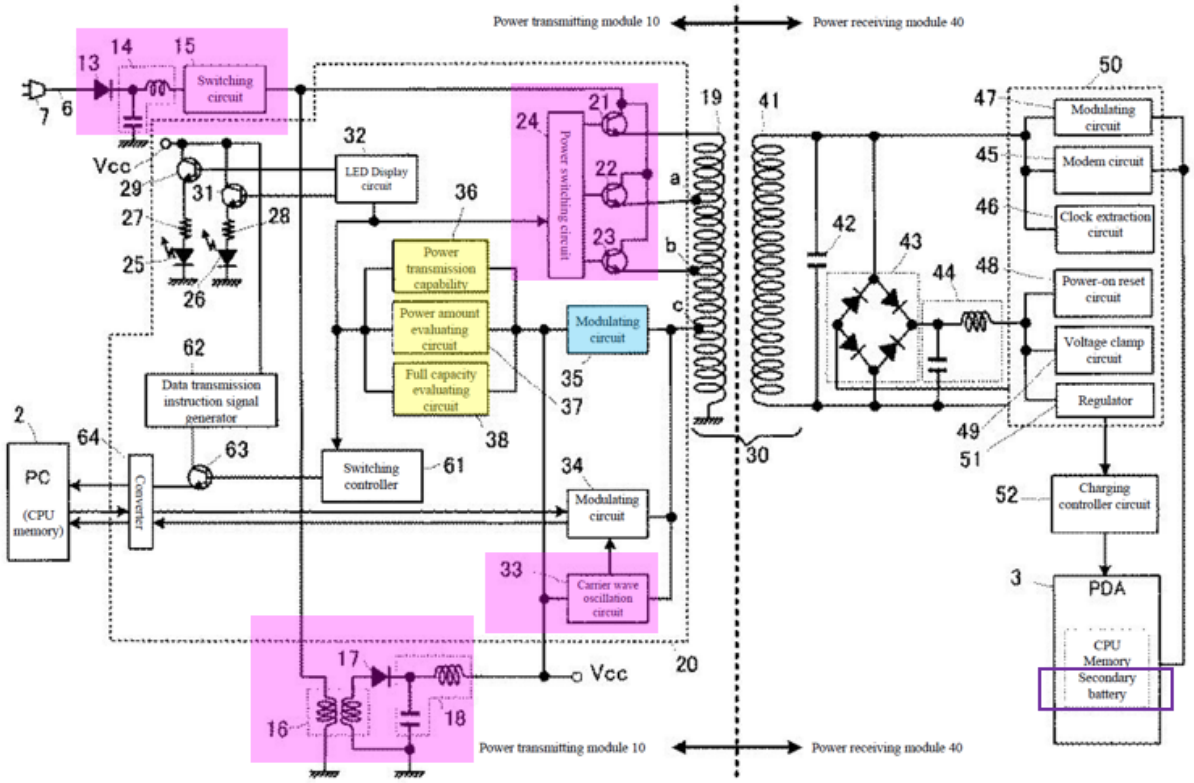
186. In my opinion, *Okada* in view of *Odendaal* and *Kook* discloses and/or suggests this limitation. (*See* my analysis and discussions below in this section; *see also* my analysis and discussions in Sections IX.A.1(a)-(e), (g)-(n); *see also* my analysis and discussions in Sections VIII.A-C.)

187. For example, as I explained above, circuit 33 provides a carrier wave to PRM40 that causes responsive device information from circuit 47 of PRM40 via coils 41-19 to be received/processed by demodulator 35. (*See* my analysis and discussions in Sections VIII.A, IX.A.1(b), 1(d)(3); Ex. 1005, ¶¶0056-0057, 0062-0064.) PTM10's evaluation circuits 36-38 "perform various decision-making processes based on information included in the signal demodulated by the

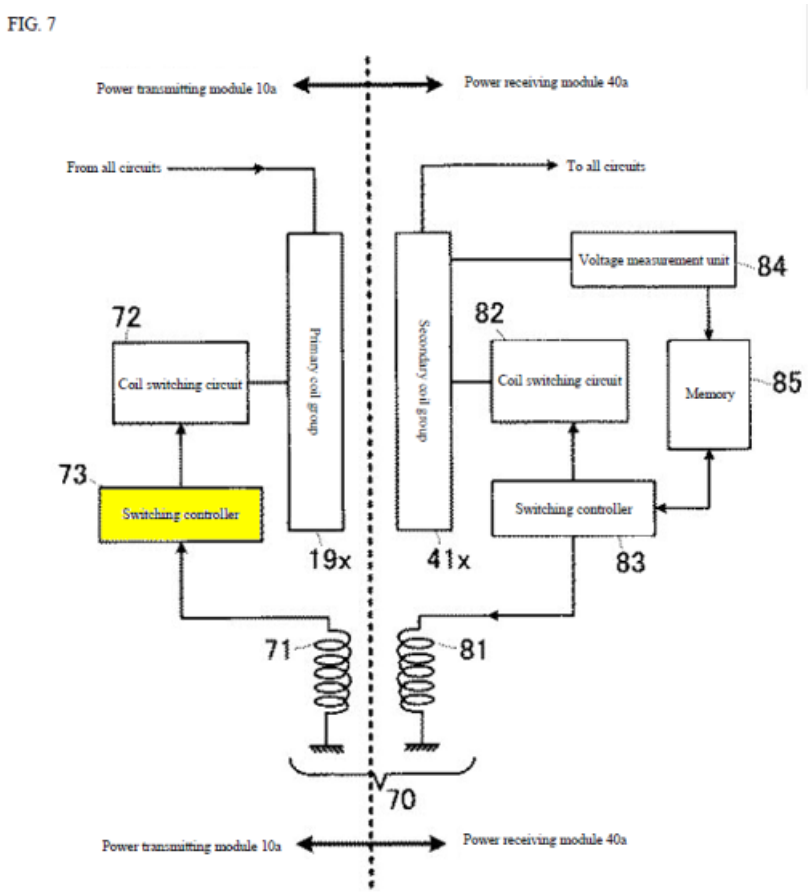
demodulating circuit 35." (Ex. 1005, FIG. 2, ¶0042, FIG. 3, ¶¶0060-0077.) *Okada* explains that those circuits control power transmission processes (FIG. 3) by providing signals to circuit 24 that controls/selects switches 21/22/23 (part of "**first drive circuit**"). (Ex. 1005, FIG. 3, ¶¶0057-0076; *see also* my analysis and discussions in Sections IX.A.1(a), (d)(1).) Circuits 36-38 provide a signal to switching control 61 (Ex. 1005, ¶0045) that determines whether "data can be **transmitted and received**" (*id.*, ¶0081, ¶¶0082-0085) and whether PDA 3's charge capacity exceeds a "minimum capacity" for it to transmit/receive data (*id.*, ¶¶0082-0089, FIG. 6). Circuits 36-38 additionally control LEDs 25-26 that communicate charging status to a user. (*Id.*, ¶¶0041, 0053-0055, 0061, 0069-0072, 0077, FIG. 5.)

188. Thus, in my opinion, a person of ordinary skill in the art would have understood that one or more circuits 36/37/38 disclose one example of "**a communication and control circuit** [FIG. 2, **yellow** below]…**coupled to the first drive circuit** [*see, e.g.*, Section IX.A.1(d)(1) **pink**] **and the first sense circuit** [*see, e.g.*, Section IX.A.1(e), modulating circuit 35 **blue**]" as claimed. (*See* my analysis and discussions above and below in this section; Ex. 1005, FIG. 2; *see also* my analysis and discussions in Sections IX.A.1(g)-(n).) In my opinion, a person of ordinary skill in the art would have understood that other components may also be

included in such claimed "**communication and control circuit**," e.g., switching controller 61, signal generator 62, controller 64, and/or "switching controller 73" in the multi-coil arrangement of FIG. 7 "system" (Ex. 1005, FIG. 7 (**yellow** below), ¶¶0094-0115).



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



(Ex. 1005, FIG. 7 (annotated).)

189. In my opinion, a person of ordinary skill in the art would have understood that such inter-relationships would have enabled the "**communication and control circuit**" implemented in the modified *Okada-Odendaal-Kook* system to perform various processes/functions discussed in limitations (g)-(n) that I address below. (*See* my analysis and discussions in Sections IX.A.1(g)-(n).) A person of ordinary skill in the art would have been motivated to configure the above-identified

"**communication and control circuit**" in the *Okada-Odendaal-Kook* system to, e.g., process the current feedback information received from demodulator 35 (including as modified in view of *Kook*) for controlling the operating frequency of the modified "**first drive circuit**" to control the voltage output of secondary rectification terminal during charging/powering operations, as I explained. (*See* my analysis and discussions above and below in this section; *see also* my analysis and discussions in Section IX.A.1(d)(1).)

190. In my opinion, a person of ordinary skill in the art would have understood, based on *Okada*'s disclosures, that circuits 33, 36-38 may be "configured on the same **IC chip**," e.g., "power transmission control **IC** 20," which includes other components like "controller" 61, 73. (Ex. 1005, ¶¶0046, 0081-0084, FIGS. 2, 7.) In my opinion, a person of ordinary skill in the art would have understood such circuitry would have been understood as compact integrated circuitry designed to perform certain operations in PTM10, which is consistent with a "**microcontroller**" as understood by a person of ordinary skill in the art in context of the '371 patent. (Ex. 1001, 24:32-45, 39:33-38 (exemplifying an "IC" or "chip" as a "microcontroller").) The same is true where "switching controller 73" is part of

such "**communication and control circuit**" since it sends "instructions" to control the switching to select specific primary coils. (Ex. 1005, ¶¶0095, 0101.)

191. I have been asked to consider the scenario where the claimed "microcontroller" requires a processor or the like, and *Okada* does not expressly disclose such features. Under that scenario, it is my opinion that a person of ordinary skill in the art would have been motivated to configure PTM10 in *Okada-Odendaal-Kook* to include such features because it would have been a foreseeable and straightforward application of known technologies/techniques to use in PTM10, which uses integrated circuit(s) to perform "control[ler]"-type operations. (*See* my analysis and discussions above in this section; Ex. 1006, 5:65-6:59, FIGS. 4-5 (controller 40); Ex. 1024, 6:60-7:14 (inductive power source including "microprocessor controller 308" for controlling modes of power supply operation), FIG. 3.)[14] In my opinion, a person of ordinary skill in the art would have appreciated implementing well-known processor-based microcontroller technology with PTM10

[14] I cite Exs. 1006 and 1024 to reflect the state of the art known to a person of ordinary skill in the art at the time of the alleged invention, which is consistent with how such a person would have understood *Okada*, *Odendaal*, and *Kook*'s teachings.

would have been a foreseeable variation to how the module can perform similar functionalities, while providing known programmable functionalities. (*Id.*) For example, *Kook* discloses "MPU block 30 for controlling internal elements" of charger 1 (*see* my analysis and discussions in Section IX.A.1(d)(1); Ex. 1059, ¶0041), and a person of ordinary skill in the art would have been motivated to configure the *Okada-Odendaal-Kook* to include a "**microcontroller**" similar to MPU block 30 for controlling PTM10 components. (*Id.*; *see also* my analysis and discussions above in this section.) In my opinion, 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. (*Id.*; *see* my analysis and discussions above in this section; *see also* my analysis and discussions in Sections VIII.A-C, IX.A.1(a)-(e), (g)-(n).)

g) detect, through the first sense circuit, a received communication of information in the current modulation in the first primary coil;

192. In my opinion, *Okada* in view of *Odendaal* and *Kook* discloses and/or suggests this limitation. (*See* my analysis and discussions below in this section; *see*

also my analysis and discussions in Sections IX.A.1(a)-(f), (h)-(n); *see also* my analysis and discussions in Sections VIII.A-C.)

193. For reasons I explained for limitations 1(e)-1(f), one or more circuits 36/37/38 (part of the "**communication and control circuit**" in the modified *Okada* system) (*see* my analysis and discussions in Section IX.A.1(f)) detects, through demodulator 35 ("**first sense circuit**") sensing, a current-modulated response signal from PRM40 (including information corresponding to PDA 3 (e.g., device compatibility/capability, power level, and charge status information)) via primary coil 19 ("**a received communication of information in the current modulation in the first primary coil**") used to facilitate power/charge operations, like that described by *Okada*. (*See* my analysis and discussions in Sections IX.A.1(e)-IX.A.1(f); *see also* my analysis and discussions in Sections VIII.A-C, IX.A.1(a)-IX.A.1(d), (h)-(n); Ex. 1005, FIG. 3, ¶¶0056-0057, 0059-0077.)

h) operate the first drive circuit to inductively transfer power from the first primary coil to the receiver coil to activate and power the receiver unit to enable the receiver circuit to communicate the information detected in the current modulation in the first primary coil, wherein the communication of information includes information to enable the communication and control circuit to configure the inductive transfer of power to the portable device,

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

195. For example, as I explained above, a person of ordinary skill in the art would have been motivated to configure the *Okada-Odendaal-Kook* system to implement closed-loop feedback controlled frequency switching power delivery based on device information to provide appropriate power to PDA 3's battery during power/charging operations. (*See* my analysis and discussions in Section IX.A.1(d).) For example, as I explained (for limitations 1(c)-1(g)), the communication/control circuit (e.g., circuit(s) 36/37/38) in the *Okada-Odendaal-Kook* system would have operated the "**first drive circuit**" (*see* my analysis and discussions in Sections IX.A.1(d)-IX.A.1(g), e.g., with modified switching circuit 15 and e.g., circuits 16-

18, 21-24, 33) by e.g., providing control signal(s) to circuit 24 for selecting a switch 21/22/23 at the **onset** of a charging process, and/or by controlling power transmission based on received/demodulated current feedback information to control the operation frequency of the "**first drive circuit**" (discussed above) **during** the charging process in the modified system to inductively transfer power from coil 19 to coil 41 (the "communication and control circuit…configured to" "**operate the first drive circuit to inductively transfer power from the first primary coil to the receiver coil**"), consistent with that disclosed/suggested by *Okada-Odendaal-Kook*. (*See* my analysis and discussions in Sections IX.A.1(c)-1(g); Ex. 1005, ¶¶0040, 0047, 0051, 0057, 0069-0073.)

196. Additionally, as I explained above, a person of ordinary skill in the art would have understood that operating the "first drive circuit" (including circuit 33) in the modified *Okada* system within a range of frequencies near a resonance frequency would allow "activation and powering of the receiver unit…" (*see* my analysis and discussions in Section IX.A.1(d)(3)) causing the "receiver circuit" (e.g., modulator 47) to provide responsive device information that is received/processed by demodulator 35 (*see* my analysis and discussions in Section IX.A.1(f)) based on current modulation in primary coil 19 (*see* my analysis and discussions in Section

IX.A.1(e)) ("operate the first drive circuit…**to activate and power the receiver unit to enable the receiver circuit to communicate the information detected in the current modulation in the first primary coil**"). (*See* my analysis and discussions in Sections VIII.A, IX.A.1(d)-(f).) Consistent with *Okada*, in the above-discussed modified *Okada* system (*see, e.g.*, my analysis and discussions in Sections IX.A.1(c)-(IX.A.1(d)), circuits 36/37/38 (part of "**communication and control circuit**") controls the operating frequency of the modified switching circuit 15, which provides power to drive oscillating circuit 33 via circuits 16-18 (all part of part of "**drive circuit**" (*see* Section IX.A.1(d)); Ex. 1005, ¶0060-0064). Thus, after power/charge operations have begun, circuit 33 (part of "**drive circuit**") in the modified system would generate/transmit, via coil 19, the carrier wave that is used to "**activate and power**" components in PRM40 ("**receiver unit**") to enable its "**receiver circuit**" (*see* Section IX.A.1(b)) to generate/communicate the responsive device information that is transmitted back to PTM10 via coils 41 and 19 based on current modulation techniques/technologies as explained (*see* my analysis and discussions in Sections IX.A.1(e)). (Ex. 1005, FIG. 3, ¶¶0062-0064, 0074-0090; *see also* my analysis and discussions in Sections IX.A.1(a)-(g).) For example, *Okada* explains:

A carrier wave output from the carrier wave oscillating circuit 33 is applied to the tap c of the primary-side coil 19, which, when the PDA 3 is mounted on the common cradle 4, **is transmitted to the magnetically coupled secondary-side coil 41**. This carrier wave transmitted to the secondary-side coil 41 is rectified, smoothed, and converted to a DC voltage via the smoothing capacitor 42, the rectifying circuit 43, and the smoothing circuit 44 as described above. Furthermore, the power-on reset circuit 48 detects the DC voltage converted from this carrier wave and recognizes that the carrier wave has been transmitted. Furthermore, the clock extracting circuit 46 connected to the secondary-side coil 41 extracts a clock signal necessary for **modulation from the carrier wave**, and a **modulating circuit 47 applies to the secondary-side coil 41 a modulated wave in which the carrier wave is modulated based on information on the PDA 3: such as "the code indicating that a device is capable of receiving power," "power consumption information," and "full capacity information."** . . .

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

(Ex. 1005, ¶¶0063-0064.)

197. Additionally, a person of ordinary skill in the art would have understood that, consistent with *Okada*'s teachings, the "**communication and control circuit**" in the modified system (e.g., circuits 36/37/38) "perform various decision-making processes based on information included in the signal demodulated by the demodulating circuit 35" (via current modulation/demodulation (*see* my analysis and discussions in Section IX.A.1(e)). (Ex. 1005, ¶¶0040, 0042, 0049-0051, 0057-0077, FIGS. 2-3.) For example, *Okada* explains:

> 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, ¶0064.)

198. In my opinion, a person of ordinary skill in the art would have understood that such processes include controlling/configuring inductive powering/charging of the portable device ("**wherein the communication of information includes information to enable the communication and control circuit to configure the inductive transfer of power to the portable device**"), as I explained above. (*Id.*; *see* my analysis and discussions in Sections IX.A.1(a)-(f); *see also* my analysis and discussions in Sections VIII.A-C, IX.A.1(g), (i)-(n).)

i) wherein the received communication of information includes: information corresponding to a voltage or current induced by the first primary coil at the output of the receiver circuit; a unique identification code; a manufacturer code; a charge algorithm profile; and a power requirement; and

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

200. For example, as I explained above, consistent with *Okada*, in the above-discussed *Okada-Odendaal-Kook* system/apparatus, PTM10 receives the device information from the "receiver circuit" in PRM40, which is provided to circuits 36/37/38 (part of "**communication and control circuit**") to determine PDA 3's

power requirement ("**a power requirement**"). (*See* my analysis and discussions in Sections VIII.A, IX.A.1(a)-(h); Ex. 1005, ¶¶0057, 0063-0064, 0069, FIG. 3.)

201. In my opinion, a person of ordinary skill in the art would have understood that, like *Okada*, *Kook* describes communicating mobile device related information to the charger. (*See* my analysis and discussions in Section IX.A.1(d)(1).) For example, a person of ordinary skill in the art would have understood that current sensing block 60 "stably control[s] an electric power through ***a current feedback*** **using an automatic variation algorithm of primary frequency . . .** ***to control a voltage of a secondary rectification terminal*** in the charging battery-pack 200," which describes information **corresponding to voltage/current induced by a primary coil at the output of the device's receiver circuitry**. (Ex. 1059, ¶¶0041; *see also id.*, ¶¶0047, 0054, 0071, 0083; *see also* my analysis and discussions in Section IX.A.1(d)(1).) *Kook* also discloses that "a unique ID" ("**a unique identification code**") is "generated in the [battery or mobile device] in response to the pulse signal of the non-contact charger 1" and is "transmitted to the non-contact charger 1," which, based on the unique ID, supplies power to the battery/mobile device. (Ex. 1059, ¶¶0012, 0046.)

202. In my opinion, in light of such teachings, in addition to other teachings/suggestions in *Kook* and *Okada* and reasons I discussed above (*see* my analysis and discussions in Sections IX.A.1(d)(1), IX.A.1(a)-(h)), a person of ordinary skill in the art would have been motivated to configure the *Okada-Odendaal-Kook* system such that the information communicated (*see, e.g.*, Section IX.A.1(h)) includes, information corresponding to PDA 3 (e.g., *Okada*'s device capability/compatibility, charge status), information corresponding to a voltage/current induced by primary coil 19 at the output of the receiver circuit in PDA 3 (*see, e.g.*, Section IX.A.1(b)), e.g., output of rectifying circuit 43 (which provides DC signal to charge/power PDA 3's battery), and a unique ID (similar to that disclosed/suggested by *Kook*) to facilitate the power transmission/adjustment features/operations in the modified *Okada* system as discussed above. (*See* my analysis and discussions in Sections IX.A.1(d)-(h); *see also* my analysis and discussions in Sections VIII.A, C, IX.A.1(a)-(c).) In my opinion, a person of ordinary skill in the art would have had similar rationale, skills, and expectation of success as that I discussed above for the modifications involving *Kook*'s teachings. (*Id*.) In my opinion, a person of ordinary skill in the art would have appreciated the benefit of obtaining additional information with the device

capability/compatibility/charge information (Ex. 1005, FIG. 3, ¶¶0060-0090), such as a unique PDA 3 ID that is used to recognize/confirm/verify the mobile device to receive power from the charger system (Ex. 1059, ¶¶0046-0047). Such modification(s) would have been within a person of ordinary skill in the art's skill and expectation of success, given it would have involved known technologies/techniques (e.g., leveraging *Okada-Kook*'s modified feedback mechanisms/operation for receiving information, including an identifier, for verifying the mobile device and controlling rectifier voltage output for battery charging, like that taught/suggested by *Okada-Odendaal-Kook*. (*Id.*; *see also* my analysis and discussions above in this section; *see also* my analysis and discussions in Sections VIII.A, C, IX.A.1(a)-(h).)

203. In my opinion, a person of ordinary skill in the art would have also been motivated to consider and implement use of other information to further enhance such power transfer control operations, especially in light of *Calhoon*. (*See* my analysis and discussions below in this section.) *Calhoon* is in the same technical field as *Okada-Odendaal-Kook* and the '371 patent, and discloses features reasonably pertinent to particular problem(s) the '371 patent discusses and a person of ordinary skill in the art was trying to solve. (*See* my analysis and 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, 1:60-2:17; *see* my analysis and discussions below in this section; *see also* my analysis and discussions in Sections VIII.A-D, IX.A.1(a)-(h).) Thus, *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 the *Okada* (as modified above). (*Id.*)

204. For example, *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.)

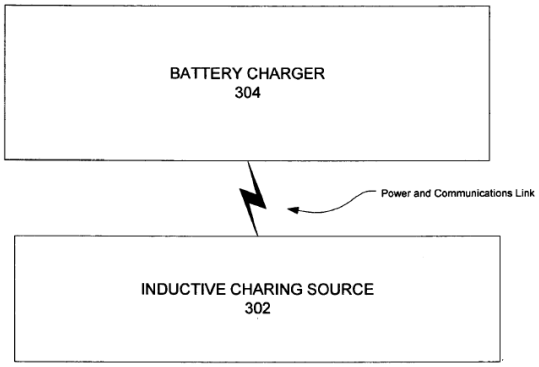


FIGURE 2

(Ex. 1041, FIG. 2.)

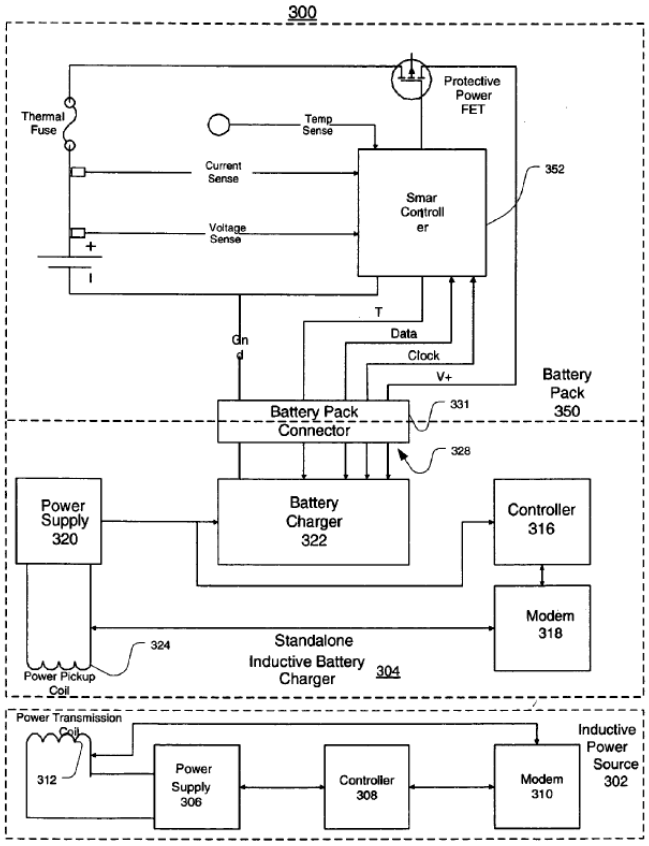


FIGURE 3

(Ex. 1041, FIG. 3.) *Calhoon* describes 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). (*Id.*, Abstract, ¶¶0022, 0034, 0046-0048, 0050-0052, 0056, FIGS. 3, 5A, 6.) Additionally, *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; *id.*, FIGS. 5A-6, ¶¶0034, 0042-0044, 0045-0048, 0049, 0050-0052, 0056.) *Calhoon* explains:

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

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

205. Thus, *Calhoon* discloses that 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.) "***This information can be used for security, data integrity, or other purposes***." (*Id.*) Thus, a person of ordinary skill in the art would have understood that *Calhoon* discloses providing power receiver information including a "**manufacturer code**" (e.g., battery charger ID/serial number/manufacturer's name). (Ex. 1041, ¶0047; *id.*, FIGS. 3-5A, ¶¶0036-0037, 0040-0043.)

206. In my opinion, in light of such teachings/suggestions, a person of ordinary skill in the art would have been motivated to modify the *Okada*-based

system to include in the information communicated (*see, e.g.*, Section IX.A.1(h)) device serial/ID number and/or manufacturer's name information ("**manufacturer code**"). (*See* my analysis and discussions above in this section.) Such a modification would have enhanced the verification features I discussed above (*id.*) by allowing the modified system/cradle 4 to verify and/or authenticate each mobile device based on multiple types of information (e.g., device/battery manufacturer's name (*Calhoon*) and/or with unique ID (*Kook/Calhoon*)). (*Id.*; *see* my analysis and discussions above in this section; *see also* my analysis and discussions in Sections VIII.A, C-D, IX.A.1(a)-(h).) Thus, for similar reasons (including similar rationale/expectation of success, etc.) I discussed above (regarding use of unique ID information), a person of ordinary skill in the art would have been further motivated in light of *Calhoon*, to configure the modified *Okada* system to maintain, transmit, and use device information like that taught by *Okada*, and by *Kook/Calhoon*, to ensure properly verified and positions/aligned mobile device receives appropriate power in accordance with the charging/power operations I discussed above. (*Id.*; *see* my analysis and discussions in Sections IX.A.1(a)-IX.A.1(h).)

207. Furthermore, while *Okada-Odendaal-Kook-Calhoon* do not expressly disclose communicating "**a charge algorithm profile**," in my opinion, a person of

ordinary skill in the art would been motivated, in view of *Black*, to configure the modified apparatus to communicate charging/powering algorithm profile information with the above-discussed device information in order to enhance/complement how cradle 4 ("system") determines and inductively provides power to PDA 3 for changing its battery. (*See* my analysis and discussions below in this section.)

208. As I explained, *Okada* discloses using received device information to determine a power level (low/intermediate/high) based on power requirements of the portable device. (Ex. 1005, FIGS. 3, 5, ¶¶0069, 0073-0076, 0090; *see also* my analysis and discussions in Sections VIII.A, IX.A.1(a)-(h).) Also, in my opinion, a person of ordinary skill in the art would have been aware of charging algorithm profile(s) to control mobile device battery charging (e.g., to avoid overcharging). (*See* my analysis and discussions below in this section; Ex. 1001, 38:13-16 ('371 patent acknowledging "[m]ost mobile devices today already include a Charge Management IC . . . to control charging of their internal battery").) In my opinion, a person of ordinary skill in the art would have understood that, consistent with such knowledge, *Black* discloses communicating charging profile information for controlling charging operations in an inductive power transfer system having similar

features like those of *Okada-Odendaal-Kook-Calhoon*. (*See* my analysis and discussions below in this section; *see also* my analysis and discussions in Sections VIII.A-E, IX.A.1(a)-(h).)

209. For example, *Black* discloses inductively charging a portable device battery, which includes a transceiver for communications with a charger. (Ex. 1007, Abstract, FIGS. 1-2 (below), ¶¶0002, 0013-0017.) As *Black*'s FIGS. 1-2 (below) show, a battery 100/200 includes a charging coupler 108/208 coupled to cell 104/204 through charging circuit 110/210, and communications coupler 112/212. (*Id.*, ¶¶0015, 0017, 0018.)

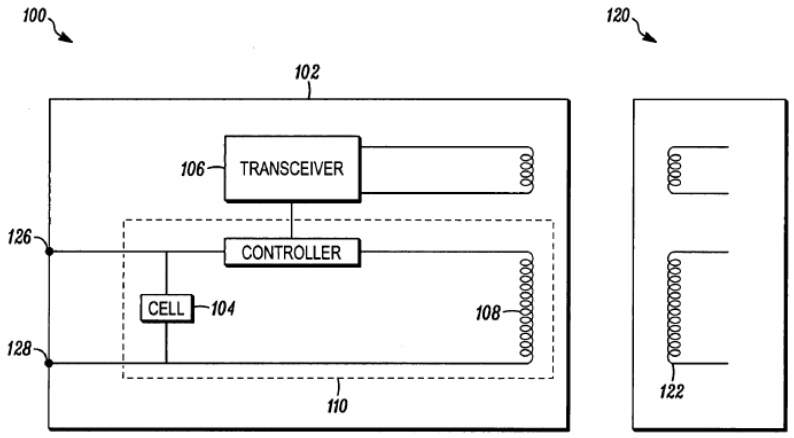


FIG. 1

(Ex. 1007, FIG. 1.)

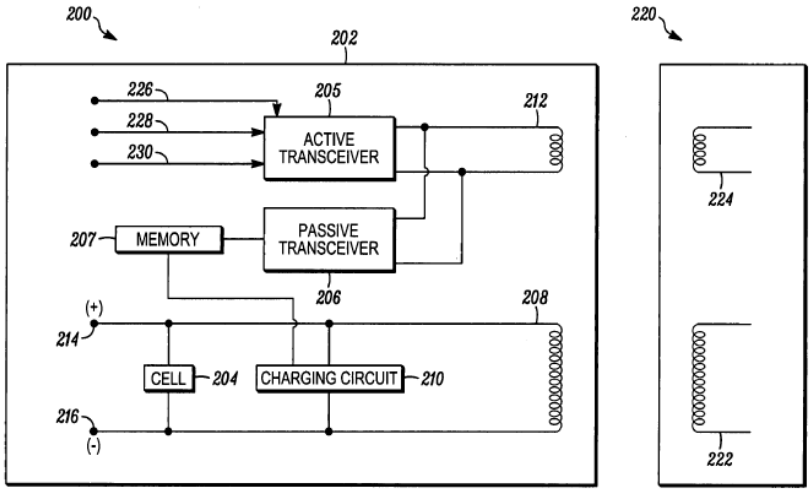


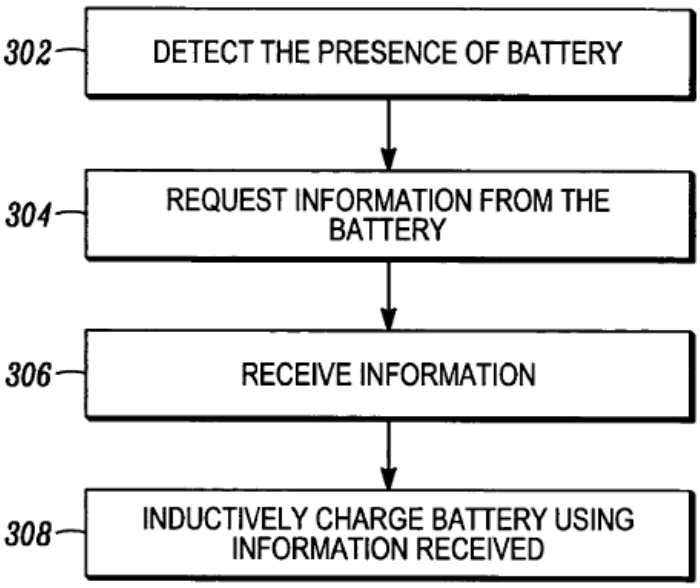
FIG. 2

(Ex. 1007, FIG. 2.) Black explains that "[t]he first coil 212 may be a portion of the second coil 208." (*Id.*, FIG. 2, ¶0018.) Black discloses that when the battery is in range of the charger, communications between them "may take place and inductive charging can occur." (*Id.*, ¶0019.)

210. Therefore, in my opinion, a person of ordinary skill in the art would have understood that *Black* is in the same technical field as *Okada-Odendaal-Kook-Calhoon*, and the '371 patent, and discloses features that were reasonably pertinent to one or more particular problems the '371 patent discusses and a person of ordinary skill in the art was trying to solve. (*See* my analysis and discussions above in this section; *see also* my analysis and discussions in Sections VIII.A-E, IX.A.1(a)-(b), IX.A.1(d); Ex. 1007, Abstract, FIGS. 1-4, ¶¶0002, 0005, 0012-0028 (and my

analysis and discussions below); Ex. 1001, 11:31-39.) Therefore, a person of ordinary skill in the art would have considered the teachings of *Black* when looking to design/implement the above *Okada-Odendaal-Kook-Calhoon* system. (*Id.*)

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



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

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

device 100. The battery may respond with information, the device ID for example.

If the battery has the capacity to provide power, more information may be transmitted to the charger 120, such as the type of device the battery 100 is coupled to, encryption information, battery characteristics or charging profile or the like. The information may come from the battery memory 207 or memory in the device. The battery may also only send a Device ID, charging profile or the like, particularly when only the passive transceiver can operate because, for example the battery has been depleted and no other power source is available.

The charger receives, in step 306 the information and based thereon, inductively charges, in step 308, the battery 100. To determine how to inductively charge the battery 100, the charger 120, in one exemplary embodiment, may use a lookup table or database to compare the information sent by the battery to that in the charger 120, such as device ID to indicate a valid battery, to determine the charger profile or settings for that particular battery 100. If more information is sent by the battery 100, the charger 120 may use that information to set the charging parameters.

(Ex. 1007, ¶¶0020-0022.) Thus, *Black* discloses that the information may include, e.g., device ID and additional information, "such as the type of device the battery 100 is coupled to, encryption information, **battery characteristics** or **charging profile** or the like." (*Id.*, ¶0021.) Charger 120 inductively charges the battery based on the received information. (*Id.*, ¶0022 ("[t]o determine how to inductively charge the battery 100, . . . determine the charger profile or settings for that particular battery 100" and "more information" to "set the charging parameters.").)

212. In my opinion, in view of *Black*, a person of ordinary skill in the art would have been motivated to modify the *Okada-Odendaal-Kook-Calhoon* system to include a charging algorithm profile associated with PDA 3 and/or its battery ("**a charge algorithm profile**") with the above-discussed device information communicated by PRM40's "**receiver circuit**" (*see, e.g.*, Sections IX.A.1(c), IX.A.1(h)) to enable circuits 36/37/38 (part of "**communication and control circuit**") to determine/configure the inductive transfer of power to PDA 3 in accordance with the closed loop feedback features implemented by the modified *Okada-Odendaal-Kook-Calhoon* system (*see* my analysis and discussions in Sections IX.A.1(d)-IX.A.1(h)). In my opinion, a person of ordinary skill in the art would have appreciated receiving charging algorithm profile information would

have allowed the modified charger "system" to accurately/properly adjust the power suitable for each specific battery/device determined to be capable of, and properly positioned/aligned, to receive such power, as I explained. (*Id.*; *see also* my analysis and discussions in Sections IX.A.1(c)-(h); *see also* my analysis and discussions in Sections VIII.A-E, IX.A.1(a)-(b); *see also* my analysis and discussions above in this section.)

213. In my opinion, a person of ordinary skill in the art would have had reasons to consider and implement such features given it was known that different types of batteries/portable devices have different power/charge characteristics/algorithm-profiles. (Ex. 1007, ¶0003; Ex. 1037, 1:56-2:6, 2:18-19, 6:51-7:2, 7:36-53 ("utilize a particular battery charging algorithm which is optimized for the particular electrochemical cell technology"), FIGS. 4A-4C; Ex. 1039, Abstract, 3:23-35, FIG. 1, 5:20-34.)[15] Therefore, in my opinion, a person of

[15] I cite Ex. 1037 and Ex. 1039 to support my opinions as to the state of the art knowledge of a person of ordinary skill in the art at the time of the alleged invention, which is consistent with how such a person would have understood *Okada*, *Odendaal*, *Kook*, *Calhoon*, and *Black*'s teachings.

ordinary skill in the art would have had the requisite motivation, skills, and knowledge to implement, and reasonable expectation of success in achieving, the above-discussed modification, especially since such a skilled person would have appreciated and understood that it would have involved applying known technologies/techniques (e.g., charging algorithms profiles to control charging) to foreseeably result in providing an inductive power/charging system that uses specific device information to control power transfer, consistent with the features disclosed by *Okada-Odendaal-Kook-Calhoon-Black*. (*Id.*; *see also* my analysis and discussions above in this section; *see also* my analysis and discussions in Sections VIII.A-E, IX.A.1(a)-(h), (j)-(n).)

j) operate the first drive circuit according to the power requirement and charge algorithm profile to provide the power from the first primary coil to the receiver coil to power the receiver unit and charge the battery of the portable device,

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

215. For reasons I explained for limitation 1(i) and other limitations, a person of ordinary skill in the art would have been motivated to modify the *Okada-Odendaal-Kook-Calhoon-Black* combination to "**operate**" the modified charger "system" (including the "**first drive circuit**" (*see* my analysis and discussions in Section IX.A.1(d)) according to the received "**power requirement and charge algorithm profile**" to inductively power/charge, via coils 19 and 41, PRM40 ("**receiver unit**") and PDA 3's battery ("**battery of the portable device**"). (*See* my analysis and discussions in Section IX.A.1(i); *see also* my analysis and discussions in Sections VIII.A-E, IX.A.1(a)-(h), (k)-(n).)

> **k) wherein to charge the battery of the portable device the communication and control circuit is further configured to: receive additional information in the current modulation in the first primary coil from the modulation of the current in the receiver coil corresponding to the voltage or current at the output of the receiver circuit while charging the battery of the portable device;**

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

217. As I explained above, a person of ordinary skill in the art would have modified the *Okada-Odendaal-Kook-Calhoon-Black* system/apparatus such that the communicated information includes information **corresponding to a voltage/current** induced by the first primary coil **at the output of the receiver circuit** (*see* my analysis and discussions in Section IX.A.1(i)), where such information would have been detected in the **current modulation** in primary coil 19 from the **current modulated** in **receiver coil** 41. (*Id.*; *see also* my analysis and discussions in Sections VIII.A, IX.A.1(e), IX.A.1(h).)

218. As I also explained, *Okada* discloses continuously providing device information after the onset of power transfer operations (receiving additional information "**while charging the battery of the portable device**"). (Ex. 1005, ¶¶0074-0090, FIG. 3; *see also* my analysis and discussions in Sections VIII.A, IX.A.1(g)-1(j), (m).)

219. Additionally, as I explained above, *Kook* describes feedback controlled type functionalities that allow the charger to adjust the operating frequency of the charger circuit, to control charging power/voltage to the portable device during charge/power transfer operations. (*See* my analysis and discussions in Section IX.A.1(d)(1).) *Kook* explains that upon recognizing the "unique ID" of the

battery/device, "a voltage of the secondary rectification terminal in [the battery/device] is controlled to a **constant voltage**" via coils 70/80 by "using an automatic variation algorithm of primary frequency of the non-contact charger 1." (Ex. 1059, ¶0047.) *Kook* also discloses:

> a current sensing block 60 for **stably controlling** an electric power **through a current feedback using an automatic variation algorithm of primary frequency** so as to recognize ID of the charging battery-pack 200 in the MPU block 30 of the charging module in the primary coil 70 through the load regulation in the mobile device having a wireless charging module installed inside of it, the wireless charging module being coupled to the secondary coil 80 and arranged in the charging battery-pack 200, and to **control a voltage of a secondary rectification terminal in the charging battery-pack 200** . . .

(Ex. 1059, ¶0041; *see also id.*, FIG. 1.)

220. Thus, consistent with the above-discussed modified *Okada* system in light of, for example *Kook* (*see* my analysis and discussions in Section IX.A.1(d)), and for similar reasons I explained above, a person of ordinary skill in the art would have been motivated to configure the "**communication/control circuit**" (*see, e.g.*,

Section IX.A.1(f)) in the *Okada-Odendaal-Kook-Calhoon-Black* system (*see* my analysis and discussions in Sections IX.A.1(d)-IX.A.1(j)) to continuously "**receive additional information**" (e.g., information corresponding to a voltage/current induced by coil 19 at the output of the "receiver circuit") "**while charging the battery of the portable device**" in order to "stably control[]" an output voltage to "a constant voltage," thus allowing the charger system to adjust its operation, and thus the transmitted power (similar to that taught/suggested by *Kook* and *Okada* and explained above (*see* my analysis and discussions in Section IX.A.1(d)). (*See* my analysis and discussions above in this section; Ex. 1059, ¶¶0041, 0047, FIG. 1; *see also* my analysis and discussions in Sections VIII.A, C, IX.A.1(d)-(j); *see also* my analysis and discussions in Sections IX.A.1(a)-(c).) In my opinion, a person of ordinary skill in the art would have understood that given the above modified system would have been configured to communicate such information using current modulation/demodulation techniques/components for reasons I explained (*see* my analysis and discussions in Sections IX.A.1(e)-(j)), such "additional information" would have been received "**in the current modulation in the first primary coil** [19] **from the modulation of the current in the receiver coil** [41]" like that

claimed. (*Id.*; *see also* my analysis and discussions in Sections VIII.A-E, IX.A.1(a)-(j), (l)-(n).)

> **l) regulate in a closed loop feedback manner the voltage or current at the output of the receiver circuit in accordance with the received additional information corresponding to the voltage or current at the output of the receiver circuit by adjusting at least one of the operating frequency and the duty cycle of the first drive circuit while charging the battery of the portable device;**

221. In my opinion, *Okada* in view of *Odendaal*, *Kook*, *Calhoon*, and *Black* discloses and/or suggests this limitation. (*See* my analysis and discussions below in this section; *see also* my analysis and discussions in Sections IX.A.1(a)-(k), (m)-(n); *see also* my analysis and discussions in Sections VIII.A-E.)

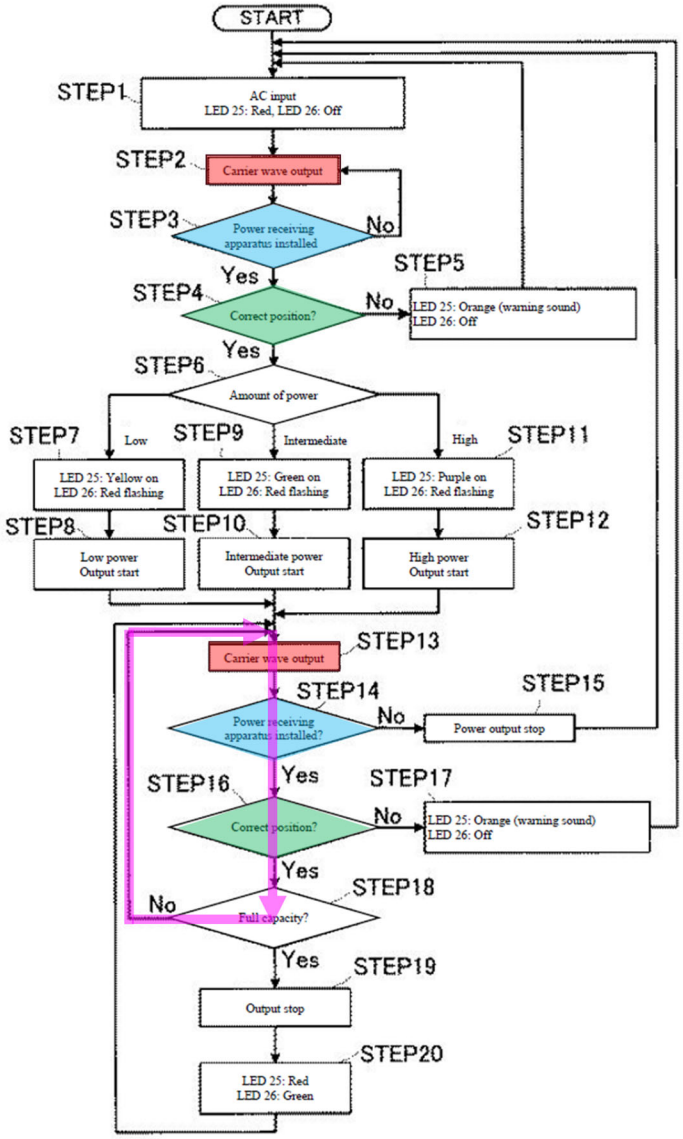
222. As I explained above for limitations 1(d)-(k), the *Okada-Odendaal-Kook-Calhoon-Black* system/apparatus would have been configured to perform a closed loop feedback process (*see* my analysis and discussions in Section IX.A.1(d)) to stably control, using current feedback, the portable device's rectification terminal voltage (provided as output of receiver circuit (*see* my analysis and discussions in Section IX.A.1(b)) used to charge PDA 3's battery) ("**regulate in a closed loop feedback manner the voltage or current at the output of the receiver circuit**"). (*See* my analysis and discussions in Sections IX.A.1(d)-IX.A.1(k).) In my opinion,

for similar reasons I explained above, such features would have been provided in accordance with the current feedback information continuously received during operation ("**the received additional information corresponding to the voltage or current at the output of the receiver circuit**") (*see* my analysis and discussions in Section IX.A.1(k)) by varying the operating frequency of the primary-side circuit (via, for example, modified switching circuit 15 (part of "**first drive circuit**")) (*see* my analysis and discussions in Section IX.A.1(d)) while transferring power to charge PDA 3's battery (*see* my analysis and discussions in Sections IX.A.1(e)-IX.A.1(l)) ("**while charging the battery of the portable device**"). (*See also* my analysis and discussions in Sections IX.A.1(a)-(c); *see also* my analysis and discussions in Sections VIII.A-E, IX.A.1(d)-(k), (m)-(n).)

> **m) monitor for continued presence of the portable device and completion of the charging of the battery of the portable device based on the communication from the receiver circuit and detected by the communication and control circuit through the first sense circuit; and**

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

224. As I explained above, *Okada* discloses "[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. (*See* my analysis and discussions in Sections VIII.A, IX.A.1(f)-(l); Ex. 1005, ¶¶0074-0077, FIG. 3 (below).)



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

225. *Okada* discloses that based on the information received/detected through demodulator 35 ("**the first sense circuit**") and provided from PRM40's circuit 47 (part of "**receiver circuit**"), circuit 36 determines whether PDA 3 is

properly positioned on cradle 4 (Ex. 1005, ¶¶0074-0075) and circuit 38 determines whether PDA 3 is fully charged (*id.*, ¶0076), where circuits 36/38 are part of the "**communication and control circuit**" (*see* my analysis and discussions in Section IX.A.1(f)). (Ex. 1005, ¶¶0074-0090.) For reasons I explained, the *Okada-Odendaal-Kook-Calhoon-Black* system/apparatus would have been configured to perform similar features in similar fashion, like that recited in limitation 1(m). (*See* my analysis and discussions in Sections IX.A.1(a)-IX.A.1(l); *see also* my analysis and discussions in Sections VIII.A, IX.A.1(n).)

> **n) if the portable device is no longer present or charging is complete, stop operation of the first drive circuit for the provision of power inductively to the portable device.**

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

227. *Okada* discloses that if circuit 36 determines whether a "capable" device "has been removed" from cradle 4 and/or not properly positioned, then "the power switching circuit 24 controls all of the transistors [21/22/23]…into an OFF state and stops power transmission." (Ex. 1005, ¶¶0074-0075, FIG. 3; *see also* my

analysis and discussions in Sections VIII.A.) A person of ordinary skill in the art would have also recognized that circuit 38 determines whether "a charged state of the PDA 3 is at full capacity," and if so, "the power switching circuit 24 controls all of the transistors [21-23] into an OFF state, ends power output." (Ex. 1005, ¶0076, FIG. 3.) Therefore, consistent with that disclosed in *Okada* and for reasons I explained, the "**communication and control circuit**" (*see* my analysis and discussions in Sections IX.A.1(f) (circuits 36, 38), IX.A.1(k)) in the *Okada-Odendaal-Kook-Calhoon-Black* system would have likewise been configured to "**stop operation of the first drive circuit**" (*see* my analysis and discussions in Section IX.A.1(d), e.g., regarding **inductive power transfer to PDA 3**, upon determination that PDA 3 was removed or its battery is fully charged ("**device is no longer present or charging is complete**"). (*See also* my analysis and discussions in Sections VIII.A, IX.A.1(d)-(m).)

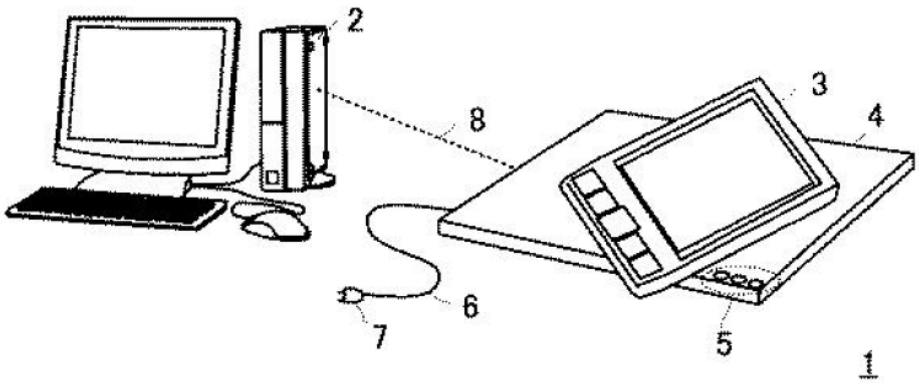
2. Claim 4

a) The apparatus of claim 1 wherein: the DC voltage input is configured to connect to and receive a DC voltage from a DC power supply via a universal serial bus (USB); and the communication and control circuit is further configured to communicate with the DC power supply via the USB.

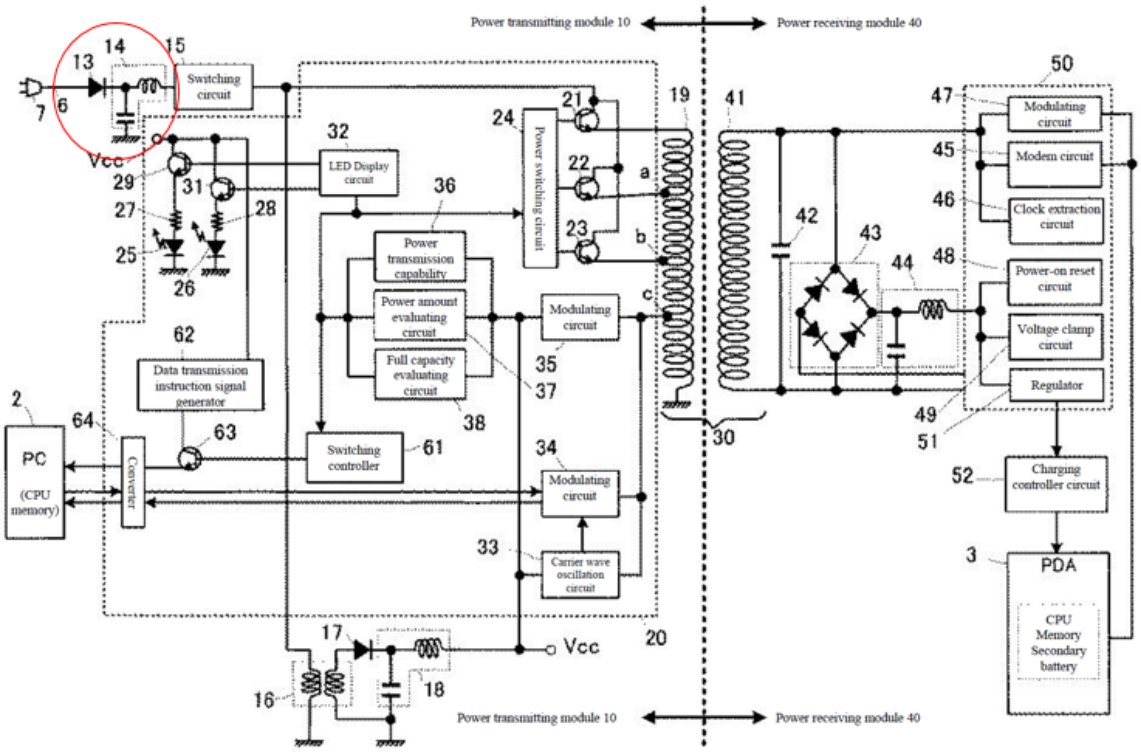
228. In my opinion, *Okada* in view of *Odendaal*, *Kook*, *Calhoon*, and *Black* discloses and/or suggests this limitation. (*See* my analysis and discussions below in this section; *see also* my analysis and discussions in Section IX.A.1; *see also* my analysis and discussions in Sections VIII.A-E.)

229. As I explained, *Okada* discloses cradle 4 has an "DC voltage input" (*see* my analysis and discussions in Section IX.A.1(d)(1)) (associated with circuits 13/14) connecting cradle 4 to a PC 2 via "wire (line 8)." (Ex. 1005, FIG. 1 (below), ¶¶0034, 0036.)

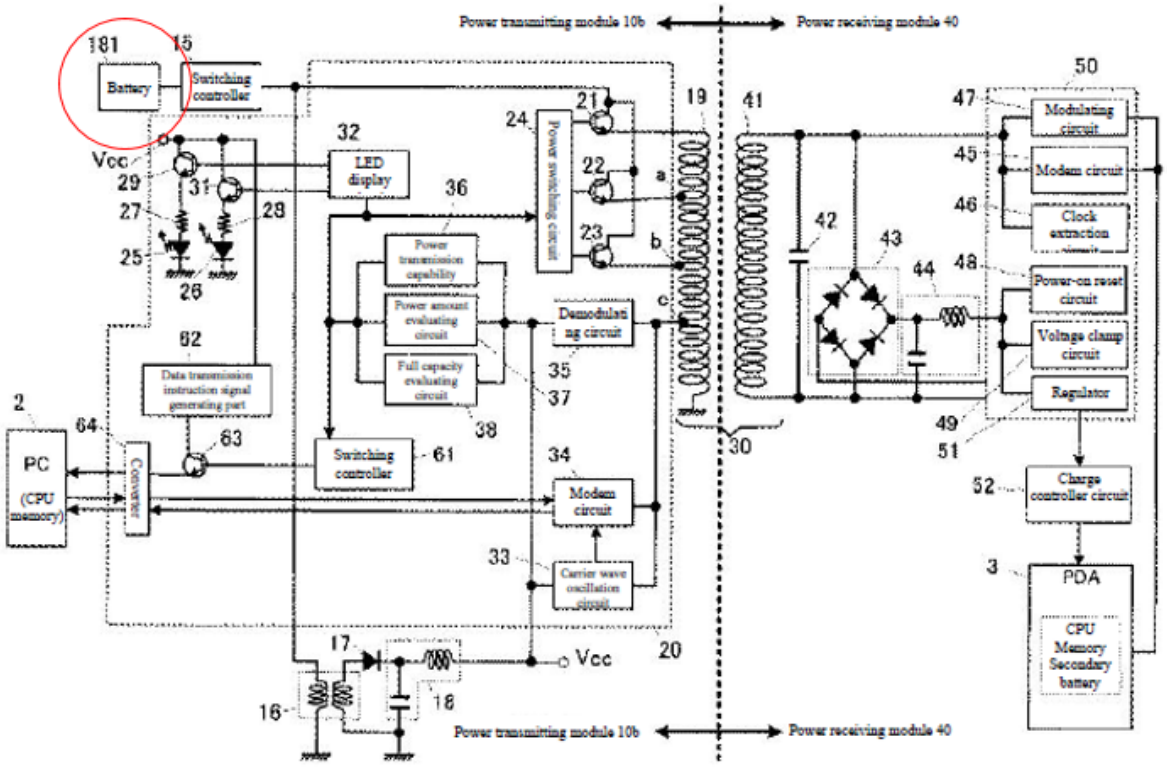
FIG. 1



(Ex. 1005, FIG. 1.)



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

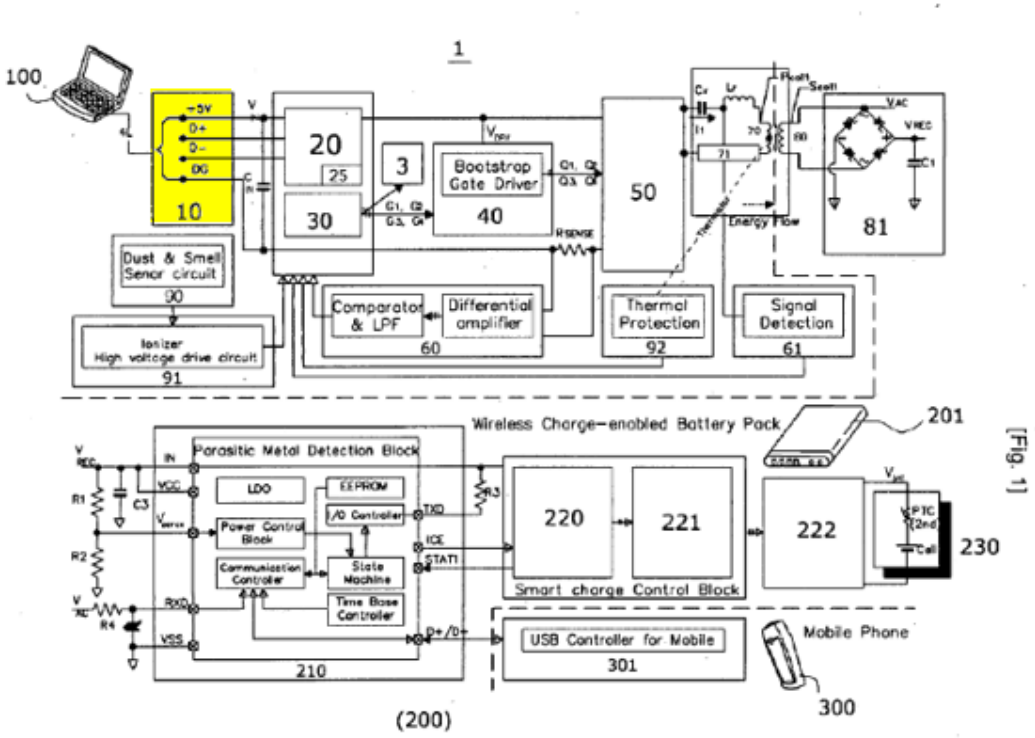


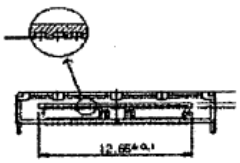
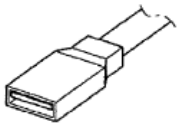
(Ex. 1005, FIG. 17 (annotated).)

230. *Okada* discloses that cradle 4 (and PTM10) communicates with PC 2. (*Id.*, ¶¶0042-0044, 0078-0079, 0088-0089, FIGS. 14(a)-(b), ¶¶0136-0137.) *Okada* also discloses that cradle 4 and PC 2 may each include a "connection interface" where connection/communication occurs through "the same cable." (*Id.*, ¶0079.) *Okada* does not expressly state the use of known USB power/data communications. However, in my opinion, in view of *Kook* (in context of a skilled person's state-of-art knowledge), a person of ordinary skill in the art would have been motivated to

implement such features in the *Okada-Odendaal-Kook-Calhoon-Black* charger system so that cradle 4 is able to receive power and communicate data over a common interface/bus that was known to provide such dual functionalities (e.g., USB).

231. In my opinion, a person of ordinary skill in the art would have understood that *Kook* discloses that charger 1 has a USB connector 10 (**yellow** below) connected to a USB port/bus of computer 100 (a DC power supply) to receive a DC voltage, e.g., 5V (e.g., receives a DC voltage via a USB), which is used to power/charge device 300/battery 200. (Ex. 1059, FIGS. 1, 4 (below), ¶¶0008, 0017, 0023, 0033, 0042, 0044, 0055 ("charger 1…may be charged with an electric power from the computer or notebook computer 100 using a USB port"), 0061.)



Standard 24PIN Socket	USB Connector	Cigar Socket
		

232. In my opinion, a person of ordinary skill in the art would have understood that charger 1 communicates via the USB port/bus with computer 100, e.g., to receive music/data and provide it to the mobile device. For example, *Kook* explains:

> the mobile device 300 may use the above-mentioned non-contact charger 1 as a hub of the USB communication to receive music, moving pictures, data, etc. from the computer (PC) or notebook computer 100, and further control the mobile device 300 in the computer or notebook computer 100.

(Ex. 1059, ¶0042; *see also id.*, ¶¶0008, 0032 (MPU30 coupled to USB 10), 0038 ("USB communication makes it possible" for both "data communication" and "charging power" between computer 100 and charger 1), 0039, 0041.)

233. In my opinion, in view of such teachings/suggestions, a person of ordinary skill in the art would have been motivated to configure "system" to employ known USB technologies/techniques to transfer power to the "**DC voltage input**" of the "**first drive circuit**" (*see* Section IX.A.1(d)) and communicate data to the "**communications and control circuit**" (e.g., circuits 36/37/38, with e.g., one or more of circuits 61-64, *see* Section IX.A.1(f)) because it would have enhanced the charger's versatility by using a single interface/port/cable to receive both DC power and data communications with PC 2 ("**DC power supply**"), consistent with the teachings of *Kook* and *Okada*. (*See* my analysis and discussions above in this section; *see* my analysis and discussions in Sections IX.A.1(d), (f).)

234. In my opinion, a person of ordinary skill in the art would have been motivated to design and implement such a modification since it would have enabled cradle 4 to receive DC power (DC voltage input) from alternative sources, e.g., a computer's USB port (PC 2 ("**DC power supply**")), allowing additional flexibility and conveniences when using cradle 4 to power/charge a mobile device, consistent with *Okada*'s teachings that contemplate alternative power sources to drive cradle 4. (Ex. 1005, ¶¶0148-0149.) Additionally, a person of ordinary skill in the art would have understood that it would have also allowed cradle 4 (including circuits 36/37/38) to perform data communications with PC 2 (e.g., to facilitate communications between PDA 3 and PC 2 via cradle 4 (Ex. 1005, ¶¶0034-0036, 0078-0079, FIG. 6)) also **through the same USB connection/port**, enhancing versatility in the various applications of PTM10 and providing alternative power/data input connections/wires (e.g., reduce cables for communicating data and receiving power via USB connection), consistent with the teachings of *Okada* and *Kook*. (*See* my analysis and discussions above in this section; *see* my analysis and discussions in Sections VIII.A, D, IX.A.1.)

235. In my opinion, a person of ordinary skill in the art would have been motivated to connect cradle 4 (PTM10) to PC 2 ("**DC power supply**") via the USB

connection such that the "**communication and control circuit**" (*see* my analysis and discussions in Section IX.A.1(f)) can communicate with PC 2 ("**DC power supply**") via the USB connection for similar reasons. As I explained, the **communications/control circuit** in *Okada* (including as modified) can include circuits 36-38 and circuit(s) 61/62/63/64, which receives signal(s) from PC 2 and transmits an instruction signal in a "format that the PC 2 can read" to enable PC 2 to "recognize[] that a device capable of transmitting and receiving data is mounted" on cradle 4 and "that data transmission and reception preparation is completed" and "data to be transmitted" to PDA 3 is "transmitted to converter 64." (Ex. 1005, ¶¶0083-0085; *see also id.*, ¶¶0078-0090.) In my opinion, a person of ordinary skill in the art would have understood that configuring the modified *Okada* system (*see* Section IX.A.1) to leverage the same USB connection to communicate data and receive DC power would have been a well-known implementation of conventional technologies (*Kook*) with known and foreseeable benefits (e.g., reduced cables, compatibility enhancements, etc.)

236. In my opinion, 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 in view of the teachings of *Okada/Kook* and

such a skilled person's state of art knowledge of conventional USB communications that would have been employed to foreseeably result in an inductive power/charging system that receives/communicates DC power/data from/with PC 2 in the modified *Okada-Odendaal-Kook-Calhoon-Black* system. (*Id.*; *see also* my analysis and discussions above in this section; *see also* my analysis and discussions in Section IX.A.1.)

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

237. In my opinion, *Okada* in view of *Odendaal*, *Kook*, *Calhoon*, *Black*, and *Kazutoshi* discloses and/or suggests all of the features of claim 2 of the '371 patent.

1. Claim 2

a) The apparatus of claim 1, wherein the closed loop feedback manner comprises a Proportional-Integral-Derivative (PID) control technique for regulating the voltage or current at the output of the receiver circuit.

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

239. As I discussed above for limitation 1(l), the **communication/control circuit** in the modified *Okada* system (*see* Section IX.A.1(f)) would have been configured to regulate in a "**closed loop feedback manner**" the voltage/current at the receiver circuit output (*see* Section IX.A.1(l)). While the *Okada-Odendaal-Kook-Calhoon-Black* combination does not expressly state that such a closed loop feedback process/technique comprises "**a…(PID) control technique**," it is my

opinion that a person of ordinary skill in the art would have been motivated to implement such features in view of *Kazutoshi*.

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

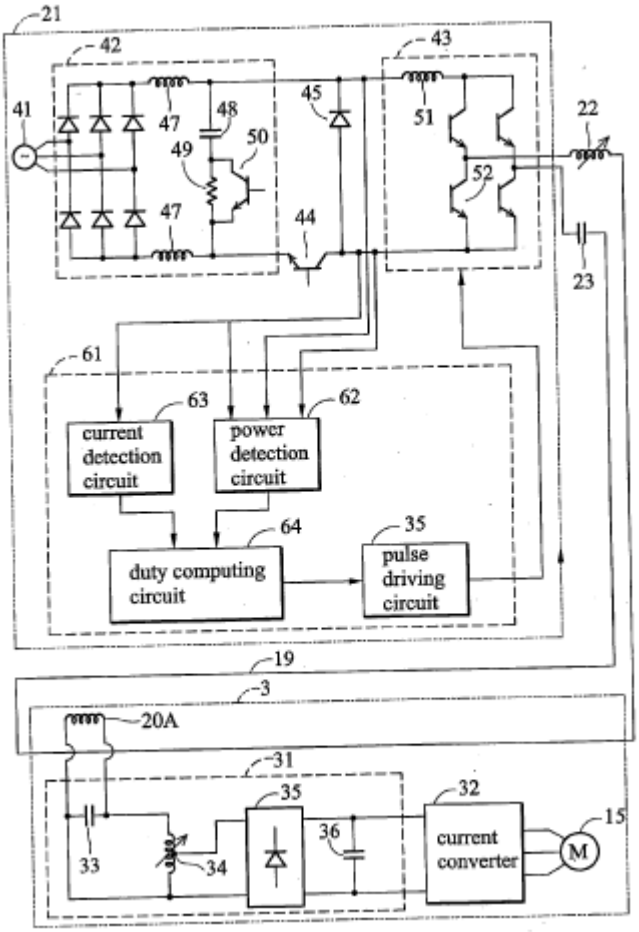


FIG. 3

(Ex. 1034, FIG. 3.)

241. *Kazutoshi* discloses that power supply device 21 includes controller 61 having power detection circuit 62, current detection circuit 63, duty computing circuit 64, and pulse driving circuit 65. (*Id.*, ¶0038.) Duty computing circuit 64 receives signals (associated with the output of current converter 42 and current alternator 43, and output power of inductive wires 19) from power detection circuit

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

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

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

242. Thus, in my opinion, a person of ordinary skill in the art would have understood that *Kazutoshi* is in the same technical field as *Okada* (including as modified) and the '371 patent, and also discloses features that were reasonably pertinent to one or more particular problems the '371 patent discusses and a person of ordinary skill in the art was trying to solve. (*See* my analysis and discussions in Sections IX.A.1(a)-IX.A.1(c); Ex. 1001, Abstract, 3:55-5:17, 33:39-35:3; Ex. 1034, Abstract, ¶¶0029, 0036-0039.) Thus, in my opinion, a person of ordinary skill in the art would have considered *Kazutoshi* in context of modified *Okada* apparatus, looking to design/implement an inductive charging system like that described by the modified *Okada* apparatus. (*See* my analysis and discussions in Section IX.A.1.)

243. In my opinion, a person of ordinary skill in the art would have understood that *Kazutoshi* also discloses that duty computing circuit 64 comprises other components (e.g., 71-76), where "[t]he multiplier 72, the integrator 73, and the differentiator 74 make up a ***proportional integral derivative (PID)*** controller." (Ex. 1034, ¶0039.) In my opinion, a person of ordinary skill in the art would have understood that, in operation, the controller uses the difference between the output current (current detection circuit 63) and a reference value to determine an output

signal to pulse generating circuit 65 for driving transistor 52 and inductive wires 19 to inductively power cart 3. (*Id.*; *id.*, ¶¶0040-0043.) In my opinion, such a skilled person would have understood that the PID controller provides "an output voltage for load resistance R and an output current within the range of the reference current." (*Id.*, ¶0043; *id.*, ¶0044.)

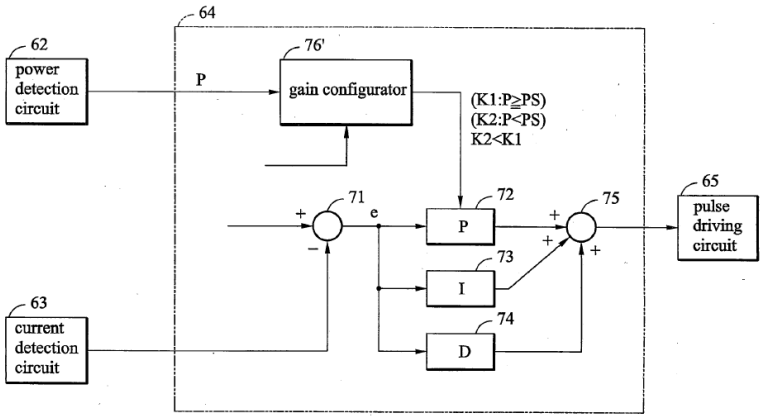


FIG. 5

(Ex. 1034, FIG. 5.)

244. In my opinion, based on such teachings and suggestions, a person of ordinary skill in the art would have been motivated to configure the **communication/control circuit** in the modified *Okada* apparatus/system that I discussed above (*see* my analysis and discussions in Sections IX.A.1(d), IX.A.1(l)) to use a PID control technique to regulate one or more outputs of the one or more receiver rectifier circuits in the apparatus (similar to features described by

Kazutoshi) for regulating the receiver circuit output. (*See* my analysis and discussions above in this section; *see also* my analysis and discussions in Section IX.A.1(l).) In my opinion, a person of ordinary skill in the art would have recognized/appreciated the known use of PID control techniques/technologies in a controller of a powering/charging system and to regulate a rectified/output DC voltage, as demonstrated by *Kazutoshi* and known in the art. (Ex. 1044, ¶¶0031, 0078; Ex. 1046, ¶0073 ("Persons of ordinary skill in the art will be aware that many different algorithms may be employed to enable the aforementioned tuning of the device. For example…the algorithm may implement PID (proportional, integral, differential) processing").)[16]

245. In my opinion, 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 such a skilled person would have

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

understood that it would have involved applying known technologies (PID control technologies) (*Kazutoshi* and state of art knowledge) with wireless power transfer/charging systems (*Okada-Odendaal-Kook-Calhoon-Black*) according to known techniques (e.g., regulating an output signal of a powering/charging system) to foreseeably result in providing an inductive power/charging system with a regulated current/voltage output signal at the receiver circuit, consistent with the features of the modified *Okada* apparatus I explained above. (*See* my analysis and discussions in Section IX.A.1; *see also* my analysis and discussions above in this section.)

C. Ground 3: *Okada* in view of *Odendaal*, *Kook*, *Calhoon*, *Black*, and *Masias* Discloses and/or Suggests the Features of Claim 3

246. In my opinion, *Okada* in view of *Odendaal*, *Kook*, *Calhoon*, *Black*, and *Masias* discloses and/or suggests all of the features of claim 3 of the '371 patent.

1. Claim 3

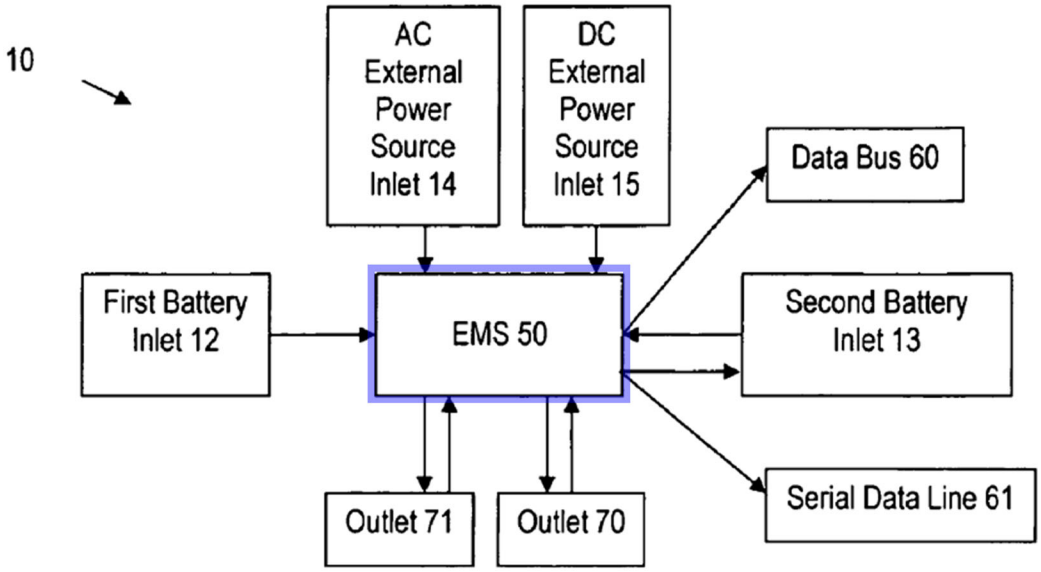
a) The apparatus of claim 1, wherein the DC voltage input is configured to receive a DC voltage and the system further comprises: a voltage regulator circuit coupled to the DC voltage input and to the microcontroller, wherein the microcontroller is configured to control the voltage regulator circuit to switch a level of the DC voltage between multiple discrete values based on the received communication of information and the additional information received by the communication and control circuit from the portable device.

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

248. As I explained above, the "**DC voltage input**" of the modified *Okada* system/apparatus (*see* Section IX.A.1(d)(1)) receives a "**DC voltage**" from circuits 13/14. (*See* my analysis and discussions in Section IX.A.1(d)(1); Ex. 1005, ¶0038 ("DC voltage").) As I explained above, *Okada* discloses adjusting the level of power

transmission based on the mobile device's "power consumption information." (*See* my analysis and discussions in Section IX.A.1; Ex. 1005, ¶¶0057, 0063-0064, 0069-0073.) However, to the extent the modified *Okada* combination does not expressly disclose the features recited in claim 3, it is in my opinion that a person of ordinary skill in the art would have been motivated to configure the modified *Okada* apparatus (*see* Section IX.A.1) in view of *Masias* to implement such features. (*See* my analysis and discussions below in this section; *see also* my analysis and discussions in Section IX.A.1.)

249. *Masias* discloses "[a] power source system including a power distribution apparatus." (Ex. 1031, Abstract.) *Masias* discloses that, e.g., regarding Figure 1, a power distribution apparatus 10 is described including an energy management system (EMS) 50 having first/second battery inlets (12/13), AC and DC external power source inlets (14/15), outlets 70/71, among other things. (*Id.*, 4:5-9.) EMS 50 manages "allocation of power from one or more power sources connected at the inlets," and also manages "the supply of power to a plurality of outlets at multiple and customizable voltage levels." (*Id.*, 4:9-13.) *Masias* explains that the inlet and outlet couplings can involve "inductive" connections. (*Id.*, 2:8-12, 3:26-29, 4:9-24, 7:9-41 (recharging done "inductively").)



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

> The inlets may connect the various power sources to the EMS 50 by continuous conductive paths, or by conductive paths that include **inductive** sections, or both. Similarly, the outlets may connect the various devices to the EMS 50 by continuous conductive paths, or by conductive paths that include **inductive** sections, or both. Inductive power source coupling is taught, for example, in . . . .

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

250. Therefore, in my opinion, a person of ordinary skill in the art would have understood that *Masias* is similar to (and in same technical field as) *Okada-Kook* and the '371 patent, as it discloses a power transfer system (with indicative

couplings) that provides power to a device based on its level of power consumption. (*See* my analysis and discussions in Sections IX.A.1(a)-(d); Ex. 1005, ¶¶0057, 0034-0038, ¶¶0148-0151.) Thus, in my opinion, a person of ordinary skill in the art would have understood that *Masias* discloses features reasonably pertinent to particular problem(s) the '371 patent discusses and a person of ordinary skill in the art was trying to solve. (Ex. 1001, Abstract, 1:60-5:17; Ex. 1031, 6:5-37; *see also* my analysis and discussions in Sections IX.A.1(a)-(d); Ex. 1005, ¶¶0037-0058, 0094-0109, 0116-0126.) Thus, in my opinion, a person of ordinary skill in the art would have considered *Masias* when looking to design/implement an inductive charging/powering system like that described by *Okada* (as modified above in Section IX.A.1).

251. *Masias* discloses that EMS 50 is coupled to an AC source rectified using rectifier circuit 45 and a DC power source via inlet 15 and may "include ***a voltage regulator device*** or process to ***provide multiple, constant, preprogrammed output voltages in any range…dependent on power needs of various equipment***." (Ex. 1031, FIG. 4 (below), 6:3-13; *id.*, 6:14-8:14 (system 100 uses various power sources based on power criteria (e.g., "output power requirements,"

monitors/displays charge state, capacity, voltage, current, recharging status, etc.), 9:7-62, 10:56-12:65.)

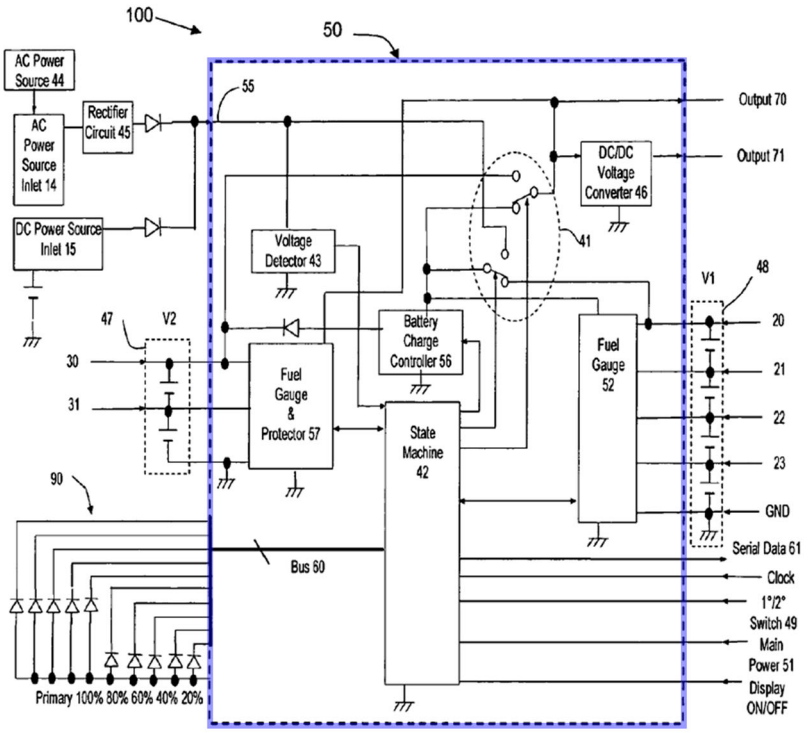


FIG. 4

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

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

> **equipment.** Additionally or alternatively, a high voltage may be provided by the EMS 50 internally switching its circuitry to put a greater number of its available energy storage devices in series. A high current may be supplied by the EMS placing a greater number of energy storage devices in parallel.

(Ex. 1031, 6:3-13.) *Masias* also explains that the operations and functions of EMS 50 components are "controlled by a…programmable state machine 42" in response to information/data received from various component(s)/detector(s)/gauge(s). (*Id.*, 5:41-6:2.) Therefore, a person of ordinary skill in the art would have understood that programmable state machine 42 likewise controls the voltage regulator's output level "depending on power needs of various equipment." (*Id.*, 6:3-8.)

252. In my opinion, in view of the teachings of *Masias*, a person of ordinary skill in the art would have been motivated to modify the *Okada-Odendaal-Kook-Calhoon-Black* apparatus/system to include power management features via a voltage regulator circuit coupled to the "DC voltage input" (*see* Section IX.A.1(b)) and provide different DC voltages between multiple discrete values to "first drive circuit" (*see* Section IX.A.1(d)), where the voltage regulator circuit is coupled to and controlled by the "**communication and control circuit**"/"**microcontroller**" (*see*

Section IX.A.1(f)) depending on various device information, e.g., "**received communication of information**" (*see* Section IX.A.1(g)) and the "**additional information**" received by the **communication and control circuit** (and its "**microcontroller**") from PDA 3 (*see* Section IX.A.1(k)), similar to the features/techniques provided by EMS 50 in *Masias*, to enhance/complement the modified *Okada* system's ability to accommodate, e.g., different voltage levels supplied to different mobile devices with respective power requirements. (*See* my analysis and discussions above in this section; *see also* my analysis and discussions in Sections IX.A.1(i)-(l).)

253. As I explained, the modified *Okada* system (via, for example, *Kook*) would have been configured consistent with features taught by *Okada* (including as modified) to account for mobile devices having different power requirements and regulation/control of the output voltage at the receive circuitry during charging operations. (*See* my analysis and discussions in Section IX.A.1; Ex. 1005, ¶¶0057, 0063-0064, 0069-0073; Ex. 1059, ¶0041.) Therefore, in my opinion, a person of ordinary skill in the art would have been motivated to implement such regulator circuitry capable of providing different levels of constant voltages to the "**drive**

circuit" based on received/determined power requirement/demand of a detected/aligned mobile device. (Ex. 1031, 6:5-13.)

254. In my opinion, while the *Okada-Odendaal-Kook-Calhoon-Black* system would have included ways to adjust power delivery to PDA 3 via selection of the transformation ratio using switching elements 21/22/23 and/or adjusting the operating frequency of the drive circuit (*see* Section IX.A.1(d)), a person of ordinary skill in the art would have understood that implementing the above modification based on *Masias*' teachings would have enhanced/complemented the *Okada-Odendaal-Kook-Calhoon-Black* system. (*See* my analysis and discussions above in this section; *see also* my analysis and discussions in Section IX.A.1.)

255. In my opinion, a person of ordinary skill in the art would have appreciated that implementing power management circuitry (e.g., including regulator circuit(s)) that receives the "DC voltage input (*see* Section IX.A.1(b)) and provides different DC voltages between multiple discrete values to the "**first drive circuit**" (*see* Section IX.A.1(d)) would have improved the flexibility of the modified *Okada* system in terms of, for example, the types of external power source(s) that the system may use at the charger. (*Id.*; *see also* my analysis and discussions above in this section; *see also* my analysis and discussions in Section IX.A.1.) In my

opinion, a person of ordinary skill in the art would have recognized how *Masias*' EMS 50 is capable of receiving different types of power sources (e.g., AC, DC (e.g., similar to those provided by circuits 13/14 of *Okada*), and multiple battery sources) and ways to provide a "constant" output voltage at different levels based on such source(s), consistent with known voltage regulation technologies/techniques. (*Id.*; Ex. 1031, 5:37-13, 8:15-22.) Further, a person of ordinary skill in the art would have understood that such a modification would have provided redundancy to ensure "uninterrupted power" is provided to the charger of the modified *Okada* system for facilitating the inductive power transfer features discussed above for claim 1. (*See* my analysis and discussions in Section IX.A.1; Ex. 1031, 6:48-52 ("[r]edundancy is provided…resulting in uninterrupted power even when changing batteries").)

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

provided to such drive circuit to not only drive the primary coil but also covert it into an the internal power source V_{cc} to power circuitry on the primary side. (*See* my analysis and discussions in Section IX.A.1.) Thus, by providing a regulated, constant, and uninterrupted power at one of the multiple voltage levels based on device information, e.g., the power demand of the mobile device in the modified *Okada* "system" would have enhanced overall stability of system operations while providing flexibility for power/charging mobile devices of different power requirements/demands. (*See* my analysis, discussions, and citations above in this section; *see also* my analysis and discussions in Sections VIII.A-E, G, IX.A.1.)

257. In my opinion, a person of ordinary skill in the art would have had the skill, rationale in implementing, and a reasonable expectation of success in achieving, the above-discussed modification, especially because such a skilled person would have understood that the modification would have involved applying known technologies/techniques as noted above, to foreseeably result in a charging system providing uninterrupted/stable/regulated voltage levels depending on various power demand/requirement of detected mobile device. (*Id.*)

D. Ground 4: *Okada* in view of *Odendaal*, *Kook*, *Calhoon*, *Black*, and *Chen* Discloses and/or Suggests the Features of Claim 8

258. In my opinion, *Okada* in view of *Odendaal*, *Kook*, *Calhoon*, *Black*, and *Chen* discloses and/or suggests all of the features of claim 8 of the '371 patent.

1. Claim 8

a) The apparatus of claim 1, wherein the system further comprises a high heat conductivity layer positioned proximate to the first primary coil and at least covering an area surrounding the first primary coil to disperse any heat generated during provision of power inductively.

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

260. In my opinion, while *Okada* (as modified) does not expressly disclose the high heat conductivity layer features as claimed, a person of ordinary skill in the art would have been motivated to implement such features in view of *Chen*. (*See* my analysis and discussions below in this section.)

261. In my opinion, a person of ordinary skill in the art would have understood that *Chen*, like *Okada-Odendaal-Kook-Calhoon-Black* discloses

powering/charging system features/configurations that utilize inductive windings/coils (Ex. 1035, FIG. 1, ¶¶0002, 0035, 0042) and thus is similarly in the same technical field as the '371 patent. (*See* my analysis and discussions in Section IX.A.1; Ex. 1001, Abstract.) In my opinion, a person of ordinary skill in the art would have also understood that *Chen* discloses features reasonably pertinent to particular problem(s) the '371 patent discusses and a person of ordinary skill in the art was trying to solve. (*Id.*; Ex. 1035, Abstract, ¶¶0057-058; Ex. 1001, 65:39-41; *see also* my analysis and discussions in Sections VIII.A-E, H, IX.A.1.) Thus, in my opinion, a person of ordinary skill in the art would have had reasons to consider/consult *Chen* when looking to design/implement the above-discussed *Okada-Odendaal-Kook-Calhoon-Black* system. (*Id.*; *see also* my analysis and discussions in Section IX.A.1.)

262. *Chen* discloses designs/layers/materials associated with a multi-layer inductor substrate associated with a planar transformer arrangement in an inductive power transfer system. (Ex. 1035, Abstract.) For example, *Chen* explains:

> A power converter integrates at least one planar transformer comprising a multi-layer transformer substrate and/or at least one planar inductor comprising a multi-layer inductor substrate with a number of power

> semiconductor switches physically and thermally coupled to a heat sink via one or more multi-layer switch substrates.

(Ex. 1035, Abstract.) *Chen* explains that such configurations include use of thermally conductive materials to dissipate heat according to known heat sink configurations. (Ex. 1035, FIG. 4 (below), ¶¶0057-0060, 0063, 0085.)

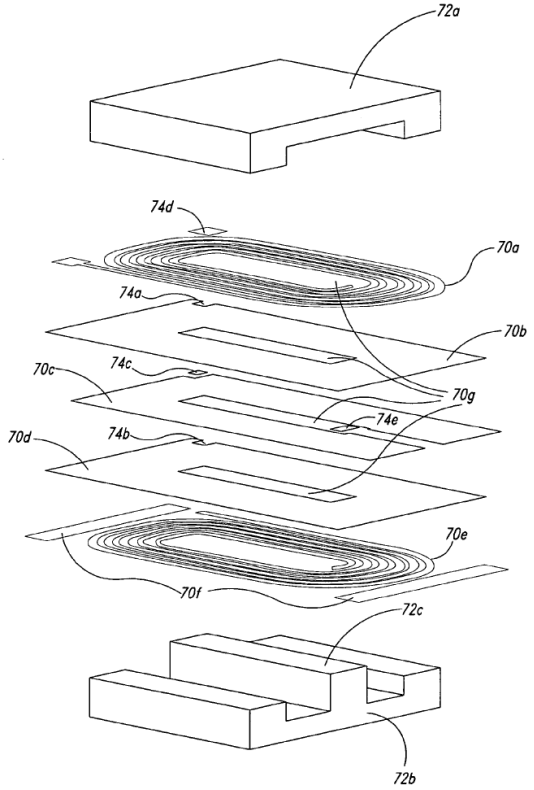


FIG. 4

(Ex. 1035, FIG. 4.) For example, *Chen* explains that transformer T1 may be configured with multiple layers electrically interconnected through vias forming

first/second windings. (Ex. 1035, FIG. 4, ¶¶0057-0059.) The first/second windings are "electrically and thermally conductive." (*Id.*, ¶0058.) *Chen* also explains that "mounting areas 70f for attaching [Transformer T1] to the heat sink 56" (*id.*, ¶0060) is "electrically and thermally conductive" (*id.*, ¶¶0058, 0060), and may take a "variety of forms such as copper, aluminum and/or other…conductors" (*id.*, ¶0063; ¶0085 (heat transferring fins/pins).) Thus, in my opinion, a person of ordinary skill in the art would have understood that mounting areas 70f is an example of "**a high heat conductivity layer**" that is **"positioned proximate to**" a coil/winding "**and at least covering an area surrounding the** [the coil/winding] **to disperse any heat generated during provision of power inductively**." (*Id.*; *see also* my analysis, discussions, and citations regarding *Chen* in this section.)

263. In my opinion, a person of ordinary skill in the art would have been motivated to configure the modified *Okada* apparatus (*see* Section IX.A.1) to implement known heat sink designs/technologies (e.g., a metallic and thermally conductive layer), as taught by *Chen*, to remove heat from primary coil 19 during power transfer. (*See* my analysis and discussions regarding *Chen* above in this section; *see also* my analysis and discussions in Section IX.A.1.) In my opinion, a person of ordinary skill in the art would have understood that heat dissipation was a

common design consideration in electronic circuits, especially in view of the accepted understanding/knowledge that circuits typically generate excessive heat and inductive coupling has a tendency to heat surrounding components (Ex. 1042, 5:4:7; Ex. 1059, ¶0041), reducing electronic component reliability (Ex. 1035, ¶0006). (Ex. 1054, ¶¶0021-0022 (aluminum/copper heat sink to promote thermal convection in LED circuit system); Ex. 1055, ¶0035 (benefits of adding heat sink materials).)[17] Therefore, in my opinion, in view of *Chen*, a person of ordinary skill in the art would have found it beneficial to implement such a heat conductivity layer to direct heat away from coil 19 and other components/circuits in the *Okada-Odendaal-Kook-Calhoon-Black* system. (*Id.*; *see also* my analysis and discussions regarding *Chen* and a person of ordinary skill in the art's state of art knowledge in this section; *see also* my analysis and discussions in Section IX.A.1.)

[17] I cite references such as Exhibits 1042, 1054, and 1055 to reflect the state of the art known to a person of ordinary skill in the art at the time of the alleged invention, which is consistent with how such a person would have understood *Okada*, *Odendaal*, *Kook*, *Calhoon*, *Black*, and *Chen*'s teachings.

264. In my opinion, 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. (*Id.*) In my opinion, a person of ordinary skill in the art would have understood that such modification would have involved applying known technologies/techniques (e.g., known use of metallic layer-based heat sink material to dissipate heat) foreseeably resulting in providing an inductive charging system that would maintain operations with reduced heat damage, consistent with that discussed above by *Chen* and known in the art. (*Id.*; *see also* my analysis and discussions regarding *Chen* and a person of ordinary skill in the art's state of art knowledge in this section; *see also* my analysis and discussions in Sections VIII.A-E, H, IX.A.1.)

E. Ground 5: *Okada* in view of *Odendaal*, *Kook*, *Calhoon*, *Black*, *Kazutoshi*, *Takagi,* and *Masias* Discloses and/or Suggests the Features of Claim 11

265. In my opinion, *Okada* in view of *Odendaal*, *Kook*, *Calhoon*, *Black*, *Kazutoshi*, *Takagi,* and *Masias* discloses and/or suggests all of the features of claim 11 of the '371 patent.

1. Claim 11

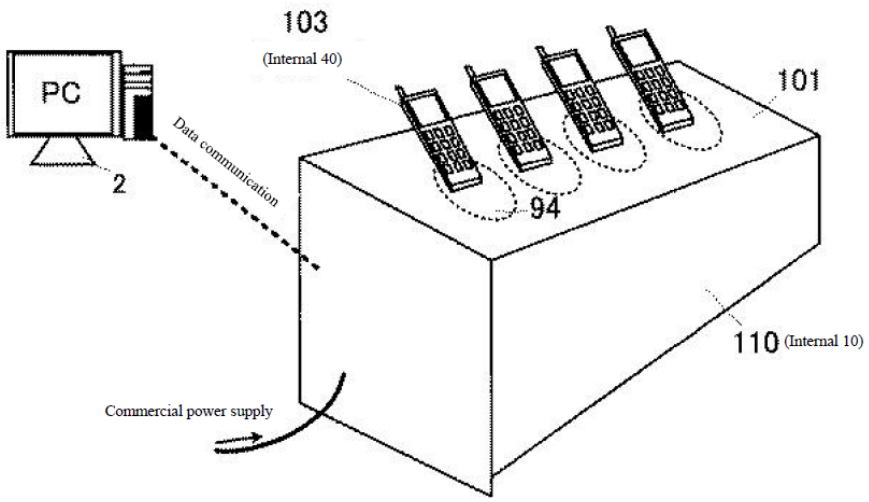
a) The apparatus of claim 1, wherein the closed loop feedback manner comprises a Proportional-Integral-Derivative (PID) control technique for regulating the voltage or current at the output of the receiver circuit, the portable device is a first portable device, and the receiver unit of the first portable device is a first receiver unit, the apparatus further comprises:

266. In my opinion, *Okada* in view of *Odendaal*, *Kook*, *Calhoon*, *Black*, and *Kazutoshi* discloses and/or suggests this limitation. (*See* my analysis and discussions below in this section; *see also* my analysis and discussions in Sections IX.A.1, IX.E.1(b)-(d); *see also* my analysis and discussions in Sections VIII.A-F.)

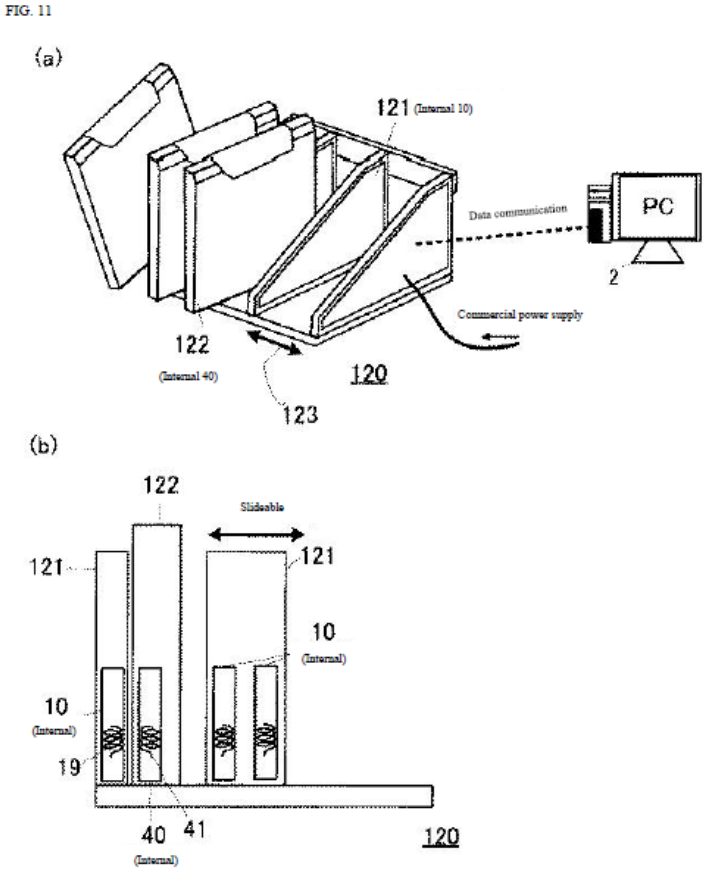
267. As I explained above, a person of ordinary skill in the art would have been motivated to configure the closed loop feedback process implemented in the *Okada-Odendaal-Kook-Calhoon-Black-Kazutoshi* system to comprise a (PID) control technique for regulating the voltage or current at the output of the receiver

circuit. (*See* my analysis and discussions in Sections IX.A.1; IX.B.) Additionally, *Okada* (including as modified) discloses the "apparatus" can include/operate with multiple mobile devices 104 (including "**a first portable device**"), each of which includes PRM40 ("**a first receiver unit**"). (Ex. 1005, ¶0119, FIG. 10; *id.*, ¶¶0116 ("power receiving module 40 provided to the electronic device 103"), 0121-0122 ("power receiving module 40 inside the mobile device 122"; "plurality of the mobile devices 122"), FIGS. 11(a)-(b); *see also* my analysis and discussions in Section IX.A.1(a).)

FIG. 10



(Ex. 1005, FIG. 10.)



(Ex. 1005, FIGS. 11(a)-(b).)

b) a second portable device;

268. For reasons I explained above, and consistent with *Okada*'s teachings, the modified *Okada* apparatus (*see* Section IX.A.1) would have been configured to operate with multiple portable devices, including "**a second portable device**." (*See* my analysis and discussions in Sections IX.B.1(a), IX.E.1(a).) Additionally, as I explained below, a person of ordinary skill in the art would have been motivated to

implement the charger system as a portable device (e.g., "**second portable device**"). (*See* my analysis and discussions in Sections IX.E.1(b)-(d).)

c) the system is incorporated into the second portable device; and

269. In my opinion, *Okada* in view of *Odendaal*, *Kook*, *Calhoon*, *Black*, *Kazutoshi*, and *Takagi* discloses and/or suggests this limitation. (*See* my analysis and discussions below in this section; *see also* my analysis and discussions in Sections IX.A.1, IX.E.1(a)-(b), (d); *see also* my analysis and discussions in Sections VIII.A-F, I.)

270. In my opinion, while *Okada-Odendaal-Kook-Calhoon-Black-Kazutoshi* does not expressly disclose that the charging "**system**" is incorporated into a "**second portable device**," a person of ordinary skill in the art would have been motivated to implement such features in view of *Takagi*.

271. In my opinion, a person of ordinary skill in the art would have understood that *Takagi*, like *Okada-Odendaal-Kook-Calhoon-Black-Kazutoshi*, 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 '371 patent. (*Id.*; *see* my analysis and discussions in Section IX.A.1; Ex. 1001, Abstract.) In my opinion, a person of ordinary skill in the art

would have understood that *Takagi* discloses features reasonably pertinent to particular problem(s) the '371 patent discusses and a person of ordinary skill in the art was trying to solve. (*Id.*; Ex. 1033, ¶¶0005-0015; Ex. 1001, Abstract, 1:60-3:51.) Thus, in my opinion, a person of ordinary skill in the art had reasons to consider/consult *Takagi* when looking to design/implement *Okada-Odendaal-Kook-Calhoon-Black-Kazutoshi*. (*Id.*)

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

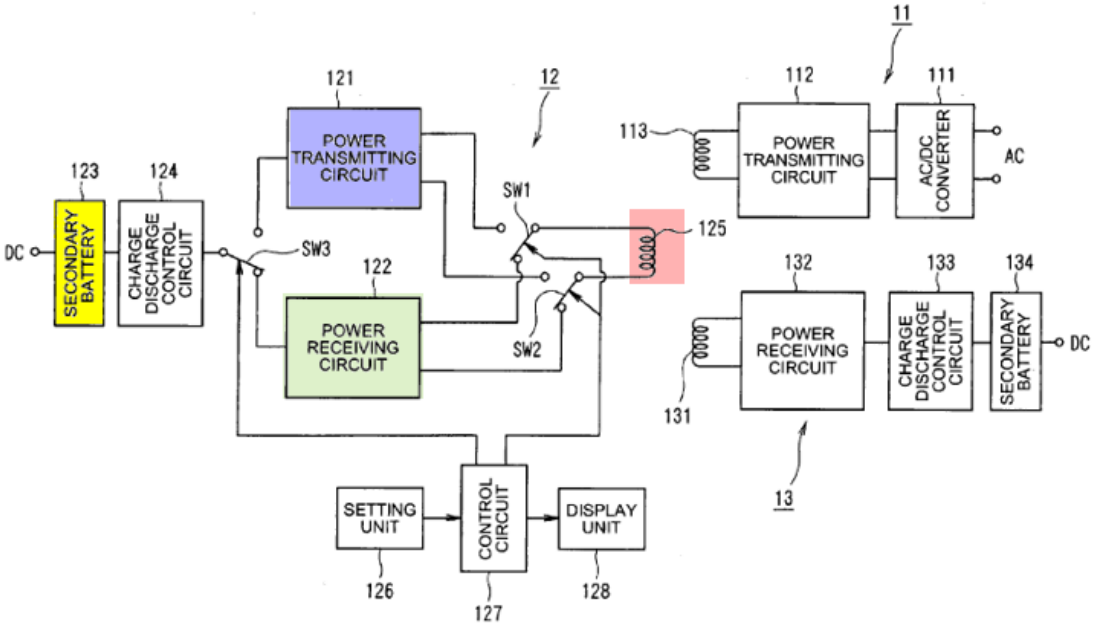


FIG. 2

(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 **charging device 13** via coil 131. (*Id.*, ¶¶0048, 0054-0056.) Alternatively, based on switch SW1/SW2 settings, power receiving circuity 122 in device 12 may also **receive power from device 11** via coils 125 and 113 for recharging battery 123. (*Id.*, ¶¶0048-0053, 0057-0072.) Therefore, 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.)

273. In my opinion, in view of *Takagi*'s teachings, a person of ordinary skill in the art would have been motivated to configure the charger system in the modified *Okada* apparatus to be a portable device (e.g., "**second portable device**") to enhance the versatility of applications of *Okada*'s power/charging apparatus, including providing mobility that complemented the mobile nature of the portable device(s) (e.g., PDA 3) the charger system is designed to power/charge. (*See* my analysis and discussions in Sections IX.E.1(a)-(b); *see also* my analysis and discussions regarding *Takagi* in this section; *see also* my analysis and discussions in Section IX.A.1.) As I also explained below (*see* Section IX.E.1(d)), implementing a rechargeable battery with such a mobile charger system (similar to that suggested by *Takagi*) would have facilitated such mobile charging features. (*See* my analysis and discussions in Section IX.E.1(d).) In my opinion, 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 being recharged itself), thus

expanding the device's functionalities, as taught/suggested by *Takagi*. (*Id.*; *see also* my analysis and discussions regarding *Takagi* in this section.)

274. In my opinion, 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 because it was known to provide devices that can both power other devices and receive power for charging an internal battery. (*See* my analysis, discussions, and citations regarding *Takagi* above in this section; Ex. 1043, 4:34-55, FIG. 3, 5:23-25.) Therefore, in my opinion, such modification would have involved applying known technologies/techniques (multi-function portable power transfer device using known inductive power components (*Okada*, *Takagi*) foreseeably resulting in providing a versatile and portable device that would inductively charge/power another portable device having a battery, consistent with that discussed above by *Takagi* and *Okada-Odendaal-Kook-Calhoon-Black-Kazutoshi*. (*See* my analysis and discussions above in this section and in Sections IX.A.1, IX.E.1(a)-(b), (d).)

d) the second portable device further comprises:

(1) an internal, rechargeable battery and a DC-to-DC voltage converter to provide power to the system to inductively power the first receiver unit of the first portable device and charge the battery of the first portable device;

275. In my opinion, *Okada* in view of *Odendaal*, *Kook*, *Calhoon*, *Black*, *Kazutoshi*, *Takagi*, and *Masias* discloses and/or suggests this limitation. (*See* my analysis and discussions below in this section; *see also* my analysis and discussions in Sections IX.A.1, IX.E.1(a)-(c), (d)(2)-(3); *see also* my analysis and discussions in Sections VIII.A-G, I.)

276. As I explained above, a person of ordinary skill in the art would have been motivated to configure the charger system in the modified *Okada* apparatus as a "**second portable device**." (*See* my analysis and discussions in Sections IX.E.1(a)-(c).) In my opinion, consistent with that I explained above (*see* Section IX.E.1(c)), a person of ordinary skill in the art would have been motivated to implement such features by configuring such a system with a rechargeable battery that provides a source of DC power that PTM10 (as modified) can use to facilitate the power/charge operations consistent with that discussed above for claim 1, while

also being capable of being recharged itself. (*See* my analysis and discussions in Sections IX.A.1, IX.E.1(a)-(c).)

277. In my opinion, while *Okada* (as modified) does not expressly disclose use of a "**DC-to-DC voltage converter to provide power to the system**" to "**inductively power the first receiver unit of the first portable device and charge the battery of the first portable device**," a person of ordinary skill in the art would have found been motivated to implement such features in view of *Masias*. (*Id.*; *see also* my analysis and discussions above and below in this section.)

278. For reasons similar to that I explained above in Ground 3 (*see* Section IX.C), a person of ordinary skill in the art would have been motivated to consider the teachings of *Masias* and modify *Okada*'s "**system**" in view of *Masias* to include power management features via a voltage regulator circuit that is coupled to a **DC voltage *input*** (e.g., circuits 13-14 of PTM10) and provides **different DC *output*** voltages between multiple discrete values to power the drive circuit for inductive powering/charging purposes. (Ex. 1031, 6:3-13; *see* my analysis and discussions in Section IX.C.1.) In my opinion, a person of ordinary skill in the art would have been motivated and understood that such a modification would have thus foreseeably resulted in the modified *Okada* "**system**" to include a "**DC-to-DC voltage**

converter to provide power to the system to inductively power" other devices/batteries. (*Id.*) In my opinion, a person of ordinary skill in the art would have been motivated to include a DC to DC voltage converter in the "**system**" incorporated in the "**second portable device**" as it would have provided various benefits, for example, allowing the portable device to enhance/complement the system/device's ability to accommodate different levels of voltages supplied to different mobile devices based on respective power requirements. (*See* my analysis and discussions in Section IX.C.1.)

279. Additionally, for reasons I explained above and those I explained for limitation 11(c) and claim 1, a person of ordinary skill in the art would have been motivated to configure the portable charger system (in view of *Takagi* and *Masias*) to use the internal battery power and DC/DC converter features above to power the "first receiver unit" of PDA 3 (*see* Section IX.A.1(b)) and charge its battery, consistent with the teachings of *Okada* as modified in view of *Odendaal-Kook-Calhoon-Black-Kazutoshi-Takagi-Masias*. (*See* my analysis and discussions in Sections IX.A.1, IX.E.1(a)-(c).) In my opinion, a person of ordinary skill in the art would have had similar skill, rationale, and expectation of success to implement such

a modification in the portable charger system as that I explained above for those combination(s). (*Id.*)

(2) a second receiver unit coupled to the first primary coil to enable the internal, rechargeable battery to be recharged inductively through the first primary coil; and

280. In my opinion, *Okada* in view of *Odendaal*, *Kook*, *Calhoon*, *Black*, *Kazutoshi*, *Takagi*, and *Masias* discloses and/or suggests this limitation. (*See* my analysis and discussions below in this section; *see also* my analysis and discussions in Sections IX.A.1, IX.E.1(a)-(d)(1), (d)(3); *see also* my analysis and discussions in Sections VIII.A-G, I.)

281. As I explained, a person of ordinary skill in the art would have been motivated to configure the charger system in the modified *Okada* apparatus to be portable ("**second portable device**") and have a rechargeable battery ("**internal rechargeable battery**"). (*See* my analysis and discussions in Sections IX.E.1(b)-(d)(1).) In my opinion, for similar reasons, motivations, and teachings/suggestions from *Takagi* in context of *Okada*, a person of ordinary skill in the art would have been motivated to configure the modified portable charger system to include receiver circuitry ("**second receiver unit**") that receives power inductively via coil 19 (*see* Section IX.A.1(c) ("**first primary coil**") to facilitate wireless recharging of the

portable charger system's battery. In my opinion, a person of ordinary skill in the art would have appreciated the benefits of inductive recharging of a portable charging system's battery based on the guidance in *Takagi*, which discloses a "power receiving circuit" in a dual-function portable charger (that can both inductively receive and transmit power) for charging an battery 123 and the battery of another portable device 134. (Ex. 1033, FIG. 2 (below), ¶¶0026, 0043, 0047-0072; *see also* my analysis and discussions in Sections IX.E.1(c)-(d)(1).)

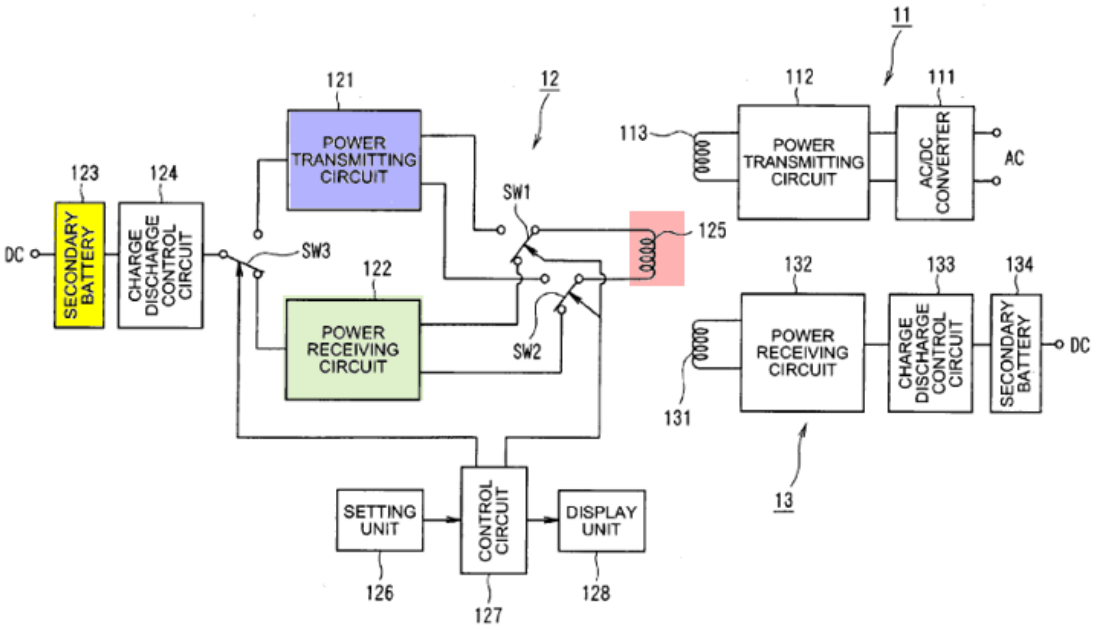


FIG. 2

(Ex. 1033, FIG. 2 (annotated).)

282. In my opinion, a person of ordinary skill in the art would have appreciated such wireless recharging features would have expanded the applications of *Okada*'s charging system applications (as implemented in the above-modified apparatus (*see* my analysis and discussions in Sections IX.A.1; IX.E.1(a)-(d)(1)), thus foreseeably providing a mobile charger system that was capable of maintaining charging operations (for other device) while likewise advantageously being capable of having its internal DC power source (battery) inductively recharged without wires. (Ex.1005, ¶¶0001-0008; Ex. 1033, ¶¶0003-0030; *see also* my analysis and discussions above in this section.) In my opinion, a person of ordinary skill in the art would have had similar skill, rationale, and expectation of success to implement such a modification in the portable charger system as that I explained above for those combination(s). (*Id*; *see also* my analysis and discussions above in this section; *see also* my analysis and discussions in Sections IX.A.1, IX.E.1(a)-(d)(1), (d)(3); *see also* my analysis and discussions in Sections VIII.A-G, I.)

(3) the communication and control circuit is further configured to control whether the second portable device is receiving power inductively or charging the first portable device inductively.

283. In my opinion, *Okada* in view of *Odendaal*, *Kook*, *Calhoon*, *Black*, *Kazutoshi*, *Takagi*, and *Masias* discloses and/or suggests this limitation. (*See* my

analysis and discussions below in this section; *see also* my analysis and discussions in Sections IX.A.1, IX.E.1(a)-(d)(2); *see also* my analysis and discussions in Sections VIII.A-G, I.)

284. In my opinion, for similar reasons as that I explained above (*see* my analysis and discussions in Sections IX.E.1(c)-(d)(2)), in view of *Takagi*, a person of ordinary skill in the art would have been motivated to modify the portable charger system ("second portable device") to be configured to both inductively charge other device(s) (e.g., PDA 3 ("first portable device")) and inductively charge its internal battery via coil 19 and "[second] receiver circuitry" implemented in the portable charger system. (*See* my analysis and discussions in Sections IX.E.1(d)(1)-(2).)

285. In my opinion, consistent with the teachings of *Takagi*, a person of ordinary skill in the art would have likewise been motivated to implement such features by configuring the "**communication and control circuit**" (*see* Section IX.A.1(f)) to include features/circuitry that controls when/how the portable charger operates as a charger for another device, or a recipient of inductive power for recharging its internal battery. In my opinion, a person of ordinary skill in the art would have understood that charge/discharge control circuit 124 monitors the remaining charge of battery 123. (Ex. 1033, FIG. 2 (below), ¶¶0076-0077 (use of

charge/discharge control circuit 124, transmitting/receiving circuits 121-122, and switches SW1-SW3 (among other things) to control whether device 12 inductively receives or transmits power).)

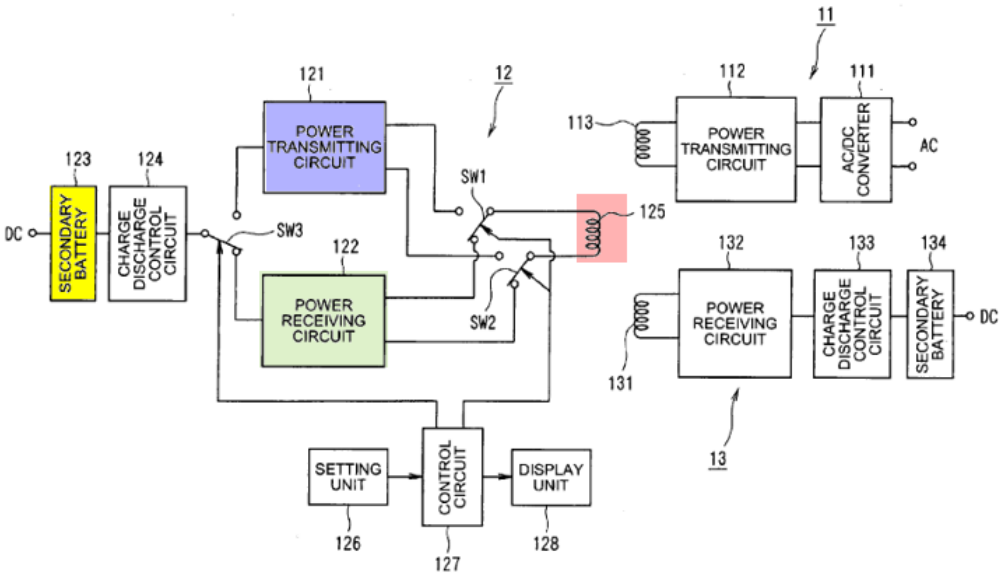


FIG. 2

(Ex. 1033, FIG. 2 (annotated).)

286. Therefore, in my opinion, for similar reasons as that I explained, a person of ordinary skill in the art would have had similar reasons to consider such teachings, and had similar skills and expectation of success in implementing similar features (as I explained above) in the portable charger system. (*See* my analysis and discussions in Sections IX.E.1(c)-(d)(2).) For example, a person of ordinary skill in the art would have been motivated to configure the portable charger system's

communication/control circuitry to include features/circuitry to monitor its internal battery status to determine whether to inductively receive power (to recharge the battery) or whether sufficient power remains to allow the portable charger to inductively charge another device. (*Id.*; *see also* my analysis and discussions above in this section; *see also* my analysis and discussions in Sections IX.A.1, IX.E.1(a)-(d)(2); *see also* my analysis and discussions in Sections VIII.A-G, I.)

F. Ground 6: *Okada* in view of *Odendaal*, *Kook*, *Calhoon*, *Black*, and *Labrou* Discloses and/or Suggests the Features of Claim 12

287. In my opinion, *Okada* in view of *Odendaal*, *Kook*, *Calhoon*, *Black*, and *Labrou* discloses and/or suggests all of the features of claim 12 of the '371 patent.

1. Claim 12

a) The apparatus of claim 1 wherein the first primary coil includes a magnetic core of ferromagnetic material within a central area of the first primary coil and the apparatus further comprises a Near Field Communication (NFC) antenna and circuitry for communication of data.

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

289. In my opinion, a person of ordinary skill in the art would have understood that, consistent with the combined teachings based on *Odendaal* and the state of art (*see* Section IX.A.1(c)), *Kook* describes use of a primary coil 70 that can be "composed of any one of FPCB, PCB, coil and ferrite core…and formed in a flat or cylindrical shape of a circle, tetragon, or polygon to facilitate the signal transmission." (Ex. 1059, ¶0076, *id.* ¶¶0009, 0012, 0033, 0041-42.) In my opinion,

in light of such teachings/suggestions (*Odendaal-Kook* in context of a person of ordinary skill in the art's state of art knowledge (*see* Section IX.A.1(c)), a person of ordinary skill in the art would have been motivated to configure the modified planar primary coil 19 in the modified *Okada* system to have a central ferrite core/area ("**a magnetic core of ferromagnetic material within a central area of the first primary coil**") in order to improve the charging efficiency, as was known in the art. (*See, e.g.*, 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.").)[18]

290. In my opinion, a person of ordinary skill in the art would have had the skill, knowledge, and rationale in implementing, and expectation of success in achieving, the above-modification, especially given the use/benefits of a ferrite core/material in planar coils was known. (Ex. 1059, ¶0009; Ex. 1061, 17:10-23:13 (ferrite material/core for inductive coils), FIG. 11 (planar primary coil 52-3 surrounding a ferrite sheet 60-3).) Thus, in my opinion, a person of ordinary skill in

[18] I cite Ex. 1061 to support my opinions as to the state of the art knowledge of a person of ordinary skill in the art at the time of the alleged invention.

the art would have had the motivation and skills in configuring, and an reasonable expectation of success in achieving, the above-modification, especially in view of the teachings from *Kook*, *Odendaal*, in context of a person of ordinary skill in the art's state art knowledge concerning the use of ferrite material to enhance inductive energy transfer efficiency. (*Id.*; *see also* my analysis and discussions above in this section.)

291. In my opinion, while the *Okada-Odendaal-Kook-Calhoon-Black* combination does not disclose the "apparatus" using NFC technologies/techniques to communicate data as claimed,[19] a person of ordinary skill in the art would been motivated to implement such features in view of *Labrou*.

292. In my opinion, a person of ordinary skill in the art would have understood that *Labrou*, like *Okada-Odendaal-Kook-Calhoon-Black*, discloses mobile devices having wireless communication capability (Ex. 1062, ¶0009) and thus is similarly in the same technical field as the '371 patent. (*See* my analysis and discussions in Section IX.A.1; Ex. 1001, Abstract.) In my opinion, a person of

[19] Claim 12 thus encompasses such NFC features in the portable device, charger system (both part of the "apparatus").

ordinary skill in the art would have also understood that *Labrou* also discloses features reasonably pertinent to particular problem(s) the '371 patent discusses and a person of ordinary skill in the art was trying to solve. (*Id.*; Ex. 1062, ¶0185; Ex. 1001, 11:64-12:4, 39:52-62.) Thus, in my opinion, a person of ordinary skill in the art would have had reasons to consider/consult *Labrou* when looking to design/implement the *Okada-Odendaal-Kook-Calhoon-Black* combination I discussed above. (*Id.*)

293. *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.) *Labrou* also explains that if the NFC chip is "integrated with the circuitry of [the mobile device]," the mobile device may send a confirmation message to the POS upon the consumer entering a PIN on the mobile device. (*Id.*, ¶0185.) In my opinion, a person of ordinary skill in the art would have understood that the disclosed NFC chip necessarily includes "**antenna and circuitry for communication of data**" given it communicates with an RFID reader at the

POS. (*Id.*, ¶0185.) In my opinion, a person of ordinary skill in the art would have understood that without such an antenna, such wireless (radio frequency) communications would not occur as disclosed. (*Id.*)

294. In my opinion, 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., PDA 3 ("portable device"—part of the claimed "**apparatus**" and modified *Okada* "apparatus") to provide additional functionalities/techniques for PDA 3 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). (*Id.*; *see also* my analysis and discussions above in this section.) In my opinion, a person of ordinary skill in the art would have understood that such an implementation/modification would have allowed the portable device in the modified "apparatus" to perform/provide common communication techniques/technologies (known to be used with mobile devices at the time, as demonstrated by *Labrou*). (*Id.*)

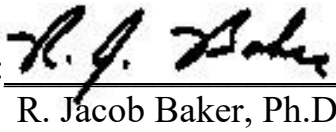
295. In my opinion, a person of ordinary skill in the art would have had the skill and rationale in implementing, and reasonable expectation of success in

achieving, such modification, especially because it was known 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.) (*Id.*; *see also* my analysis and discussions above in this section.) Therefore, in my opinion, a person of ordinary skill in the art would have understood that such modification would have involved applying known technologies/techniques (e.g., known use of NFC antenna/circuitry) foreseeably resulting 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. (*Id.*; *see also* my analysis and discussions above in this section; *see also* my analysis and discussions in Sections VIII.A-E, J, IX.A.1.)

X. CONCLUSION

296. In summary, it is my opinion that all of the features recited in claims 1-4, 8, and 11-12 of the '371 patent are disclosed and/or suggested by the prior art.

297. 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.