

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. 11,292,349

**DECLARATION OF R. JACOB BAKER, PH.D., P.E.
IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 11,292,349**

TABLE OF CONTENTS

I.	INTRODUCTION	1
II.	BACKGROUND AND QUALIFICATIONS	1
III.	MATERIALS REVIEWED	6
IV.	PERSON OF ORDINARY SKILL IN THE ART AND THE TIME OF THE ALLEGED INVENTION	10
V.	TECHNICAL BACKGROUND	12
A.	Electronic Circuits and Components	13
B.	Contactless Power/Data Transfer	19
1.	Inductance and Inductive Coupling	20
2.	Applications of Contactless Power/Data Transfer	24
3.	Use of Planar Coils	31
4.	Controlling and Regulating Contactless Power/Data Transfer	36
VI.	OVERVIEW OF THE '349 PATENT	40
VII.	CLAIM CONSTRUCTION	41
VIII.	OVERVIEW OF THE PRIOR ART	44
A.	<i>Fells</i> (Ex.1005)	44
B.	<i>Jung</i> (Ex.1016)	54
C.	<i>Stoner</i> (Ex.1011)	61
D.	<i>Nakamura</i> (Ex.1010)	63
E.	<i>Silva</i> (Ex.1019)	67
F.	<i>Sagoo</i> (Ex.1048)	70
G.	<i>Walley</i> (Ex.1049)	74
H.	<i>Ben-Shalom</i> (Ex.1050)	76
IX.	THE PRIOR ART DISCLOSES OR SUGGESTS ALL RECITED FEATURES OF CLAIMS 8, 13, and 15-18 OF THE '349 PATENT	82

A.	Ground 1: <i>Fells</i> Discloses and/or Suggests the Features of Claim 17	82
1.	Claim 1	82
a)	Limitation 1(a): A system for inductive power transfer comprising:	82
b)	Limitation 1(b): a charger, wherein the charger is an inductive charger, and the charger includes:	90
c)	Limitation 1(c): a printed circuit board having a charger coil, wherein the charger coil has a substantially planar charger surface;	96
d)	Limitation 1(d): a substantially planar magnetic layer under the charger coil opposite the charger surface; and, ...	97
e)	Limitation 1(e): a charger drive circuit, wherein the charger drive circuit includes a resonant capacitor and a FET switch to apply an alternating voltage to the charger coil; and	100
f)	Limitation 1(f): a first mobile device that includes a receiver to inductively receive power for the first mobile device, wherein the receiver includes:	117
g)	Limitation 1(g): a solenoid, wherein the solenoid includes:	122
h)	Limitation 1(h): a magnetic core having a relative magnetic permeability exceeding 1 and having first and second ends; and	128
i)	Limitation 1(i): Litz wire wrapped around a section of the magnetic core forming a wire wound section around the magnetic core, with the magnetic core extending beyond the wire wound section; and	132
j)	Limitation 1(j): a receiver electronic circuit, wherein the receiver electronic circuit includes a resonant capacitor and a rectifier; and	137

- k) Limitation 1(k): the charger further includes a means for positioning the receiver in a power transfer position, proximate to the charger surface, to inductively transfer power to the receiver of the first mobile device; 139
- l) Limitation 1(l): the charger drive circuit is configured to drive the charger coil at one or more operating frequencies to inductively transfer power from the charger to the receiver when the receiver is positioned in the power transfer position, wherein when the receiver is positioned in the power transfer position, a tuned circuit, including the charger coil and the resonant capacitor of the charger drive circuit and the solenoid and the resonant capacitor of the receiver electronic circuit, has a resonant frequency that allows the charger to transfer the power to the receiver at the one or more operating frequencies;.....147
- m) Limitation 1(m): the charger coil includes a conductor patterned to include multiple, substantially concentric turns for generating a magnetic flux through a first end of the solenoid when the receiver is placed in the power transfer position, wherein an outermost of the concentric turns defines a perimeter of a charger coil area; 153
- n) Limitations 1(n): the multiple concentric turns, when driven by the charger drive circuit, generate a magnetic field that is substantially perpendicular to the charger surface at a geometric center of the charger coil area,.....159
- o) Limitation 1(o): the charger coil area is larger than an area of the first end and larger than an area of the second end of the magnetic core of the solenoid; 164
- p) Limitation 1(p): the magnetic layer of the charger extends beyond the charger coil area; and;.....175

q)	Limitation 1(q): when the receiver is in the power transfer position, the first end of the magnetic core is located proximate to the charger coil area above the charger surface to receive magnetic flux from the charger coil area and guide the magnetic flux in a closed magnetic loop from the charger coil area through the solenoid and return through the charger magnetic layer to the charger coil area to form the closed magnetic loop.	179
2.	Claim 17	184
a)	The system of claim 1, wherein: the receiver and the charger include communication and control electronics circuits to communicate, between the receiver and the charger, information associated with the transfer of power to the first mobile device; and.....	184
b)	the communication is through a charger antenna that includes the charger coil and a receiver antenna that includes the solenoid.	184
B.	Ground 2: <i>Fells, Silva, and Jung</i> Disclose and/or Suggest the Features of Claim 8	189
1.	Claim 8	189
a)	The system of claim 1, wherein the Litz wire is selected for operation at a frequency of greater than 205 kHz.....	189
C.	Ground 3: <i>Fells</i> in Combination with <i>Sagoo</i> Discloses and/or Suggests the Features of Claims 13, 15 and 16.....	200
1.	Claim 13	200
a)	The system of claim 1, wherein, the charger is incorporated into a second mobile device;	200
b)	the second mobile device includes an internal, rechargeable battery;.....	208

c)	the second mobile device uses the internal battery to transfer power to and operate the charger for a period of time; and;.....	212
d)	the first and second mobile devices comprise Bluetooth communication systems to communicate with each other during non-power transfer operations.....	213
2.	Claim 15	216
a)	The system of claim 13, wherein the second mobile device further includes: an additional inductive charger, wherein the additional inductive charger includes an additional charger coil to transfer power to additional mobile devices.....	216
3.	Claim 16	222
a)	The system of claim 13, wherein the receiver of the first mobile device is a first receiver, and the second mobile device includes a second receiver to inductively receive power to charge the internal, rechargeable battery of the second mobile device.....	222
D.	Ground 4: <i>Fells</i> in Combination with <i>Walley</i> Discloses and/or Suggests the Features of Claim 17	226
1.	Claim 17	226
a)	The system of claim 1, wherein: the receiver and the charger include communication and control electronics circuits to communicate, between the receiver and the charger, information associated with the transfer of power to the first mobile device; and.....	226
b)	the communication is through a charger antenna that includes the charger coil and a receiver antenna that includes the solenoid.	226
E.	Ground 5: <i>Fells</i> in View of <i>Ben-Shalom</i> Discloses and/or Suggests the Features of Claim 18	234

Declaration of R. Jacob Baker, Ph.D., P.E.
U.S. Patent No. 11,292,349

1.	Claim 18.....	234
a)	The system of claim 1, wherein the charger is incorporated into an enclosed volume for placement of the receiver in the power transfer position to receive inductive power.....	234
F.	Ground 6: <i>Fells</i> in Combination with <i>Stoner</i> and <i>Nakamura</i> Discloses and/or Suggests the Features of Claim 17	242
G.	Ground 7: <i>Fells</i> in View of <i>Stoner</i> , <i>Nakamura</i> , <i>Silva</i> and <i>Jung</i> Discloses and/or Suggests the Features of Claim 8	246
H.	Ground 8: <i>Fells</i> in View of <i>Stoner</i> , <i>Nakamura</i> , and <i>Sagoo</i> Discloses and/or Suggests the Features of Claims 13, 15, and 16...	247
I.	Ground 9: <i>Fells</i> in View of <i>Stoner</i> , <i>Nakamura</i> , and <i>Walley</i> Discloses and/or Suggests the Features of Claim 17	249
J.	Ground 10: <i>Fells</i> in View of <i>Stoner</i> , <i>Nakamura</i> , and <i>Ben-Shalom</i> Discloses and/or Suggests the Features of Claim 18	251
X.	CONCLUSION.....	253

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. 11,292,349 (“the ’349 patent”) (Ex.1001).¹ I have been asked to consider whether the prior art discloses or suggest the features recited in claims 8, 13, and 15-18 (“the challenged claims”) of the ’349 patent.² 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.

II. BACKGROUND AND QUALIFICATIONS

¹ Where appropriate, I refer to exhibits that I understand are to be attached to the petition for *Inter Partes* Review of the ’349 patent.

² I have also been asked to consider whether the prior art discloses or suggest the features recited in claims 1, 4-5, 7, 10-12, and 26 of the ’349 patent, where my opinions regarding those claims are included in a separate declaration.

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

Declaration of R. Jacob Baker, Ph.D., P.E.
U.S. Patent No. 11,292,349

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. 11,292,349
Ex.1004	Prosecution History of U.S. Patent No. 11,292,349
Ex.1005	U.S. Patent No. 8,587,154 (“ <i>Fells</i> ”)
Ex.1006	U.S. Patent No. 8,829,732 (“ <i>Tengner</i> ”)
Ex.1007	U.S. Patent No. 7,782,169 (“ <i>Guenther</i> ”)
Ex.1008	U.S. Patent Application Publication No. 2009/0267721 (“ <i>Okada</i> ”)
Ex.1009	DOE Fundamentals Handbook Electrical Science, FSC-6910, Vol. 1, DOE-HDBK-1011/1-92, U.S. Department of Energy, June 1992
Ex.1010	U.S. Patent Application Publication No. 2005/0068019 (“ <i>Nakamura</i> ”)
Ex.1011	U.S. Patent No. 8,912,686 (“ <i>Stoner</i> ”)
Ex.1012	Physics, Henry Semat et al., Rinehart & Co., Inc., 1958, Chapters 29-32 (“ <i>Semat</i> ”)
Ex.1013	International Patent Application Publication No. WO2009155000A2 (“ <i>Lin</i> ”)

Ex.1014	U.S. Patent Application Publication No. 2008/0067874 (“ <i>Tseng</i> ”)
Ex.1015	U.S. Patent No. 9,356,473 (“ <i>Ghovanloo</i> ”)
Ex.1016	U.S. Patent No. 9,178,376 (“ <i>Jung</i> ”)
Ex.1017	U.S. Patent No. 8,830,036 (“ <i>Park</i> ”)
Ex.1018	TeckChuan Beh et al., Wireless Power Transfer System via Magnetic Resonant Coupling at Fixed Resonance Frequency—Power Transfer System Based on Impedance Matching—, 25 th World Battery, Hybrid and Fuel Cell Electric Vehicle Symposium & Exhibition, Nov. 5-9, 2010 (“ <i>Beh</i> ”)
Ex.1019	U.S. Patent No. 8,975,523 (“ <i>Silva</i> ”)
Ex.1026	Watson, J., <u>Mastering Electronics</u> , Third Ed., McGraw-Hill, Inc. (1990)
Ex.1027	Sedra <i>et al</i> , <u>Microelectronic Circuits</u> , Fourth Ed., Oxford University Press (1998)
Ex.1028	GB Patent Application Publication No. 2202414 (“ <i>Logan</i> ”)
Ex.1029	U.S. Patent No. 7,226,442 (“ <i>Sheppard</i> ”)
Ex.1030	International Patent Application Publication No. WO1996040367 (“ <i>WangIP</i> ”)
Ex.1031	U.S. Patent No. 6,960,968 (“ <i>Odendaal</i> ”)
Ex.1032	U.S. Patent No. 6,489,745 (“ <i>Koreis</i> ”)
Ex.1033	U.S. Patent Application Publication No. 2004/0201988 (“ <i>Allen</i> ”)
Ex.1034	International Patent Application Publication No. WO2003/096361 (“ <i>Cheng</i> ”)
Ex.1035	U.S. Patent No. 6,366,817 (“ <i>Kung</i> ”)
Ex.1036	AN710 Antenna Circuit Design for RFID Applications
Ex.1037	Spiral Inductor Design for Quality Factor, Sang-Gug Lee et al., Journal of Semiconductor Technology and Science, Vol. 2. No. 1, March 2002 (“ <i>Lee</i> ”)
Ex.1038	U.S. Patent No. 4,942,352 (“ <i>Sano</i> ”)
Ex.1039	U.S. Patent Application Publication No. 2006/0202665 (“ <i>Hsu</i> ”)

Ex.1040	International Patent Application Publication No. WO2004/038888 (“ <i>ChengII</i> ”)
Ex.1041	U.S. Patent Application Publication No. 2005/0127868 (“ <i>Calhoon</i> ”)
Ex.1042	U.S. Patent Application Publication No. 2006/0145660A1 (“ <i>Black</i> ”)
Ex.1043	U.S. Patent No. 5,780,992 (“ <i>Beard-I</i> ”)
Ex.1044	U.S. Patent No. 6,912,137 (“ <i>Berghegger</i> ”)
Ex.1045	U.S. Patent No. 7,378,817 (“ <i>CalhoonII</i> ”)
Ex.1046	U.S. Patent No. 6,606,247 (“ <i>Credelle</i> ”)
Ex.1047	U.S. Patent Application Publication No. 2001/0055207 (“ <i>Barbeau</i> ”)
Ex.1048	U.S. Patent No. 7,791,311 (“ <i>Sagoo</i> ”)
Ex.1049	U.S. Patent No. 8,390,249 (“ <i>Walley</i> ”)
Ex.1050	International Patent Application Publication No. WO2012095850A1 (“ <i>Ben-Shalom</i> ”)

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

17. My opinions contained in this declaration are based on the documents I reviewed and my knowledge and professional judgment. My opinions have also been guided by my appreciation of how a person of ordinary skill in the art would have understood the state of the art, the prior art, and the claims and the specification of the '349 patent at the time of the alleged invention.

18. I understand that the '349 patent issued from Application No. 17/467,032, (now U.S. Patent No. 11,114,886), which is a continuation of Application No. 15,830,411 (now U.S. Patent No. 10,594,155), which is a continuation of Application No. 14/252,627 (now U.S. Patent No. 9,837,846), and

claims priority to U.S. Provisional Application No. 61/811,638 (filed April 12, 2013). (Ex.1001, Cover.) For purposes of rendering my opinions, I have been asked to initially consider that the time of the alleged invention of the '349 patent is around January 13, 2013 to April 13, 2013. My opinions reflect how one of ordinary skill in the art (which I described below) would have understood the '349 patent, the prior art to the patent, and the state of the art at the time of the alleged invention as I was asked to consider noted above.

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 8, 13, and 15-18 of the '349 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, which I discussed above as being around January 13, 2013 to April 13, 2013. 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 '349 patent, a person of ordinary skill in the art as of the claimed priority date of the '349 patent would have had at least a bachelor'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 being around January 13, 2013 to April 13, 2013. My opinions in this declaration are also applicable from the perspective of such a skilled person at other related timeframes (e.g., 2012 to late 2013 timeframes),

Declaration of R. Jacob Baker, Ph.D., P.E.
U.S. Patent No. 11,292,349

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 '349 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 '349 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 '349 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 '349 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 '349 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.1026, 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.) It was known that “[a]lternating current is used for all mains power supplies because a.c. [i.e., alternating current] permits the use 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.*) 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.*)

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.) The potential difference is also called voltage and is expressed in units of volts. (*Id.*, 10.)

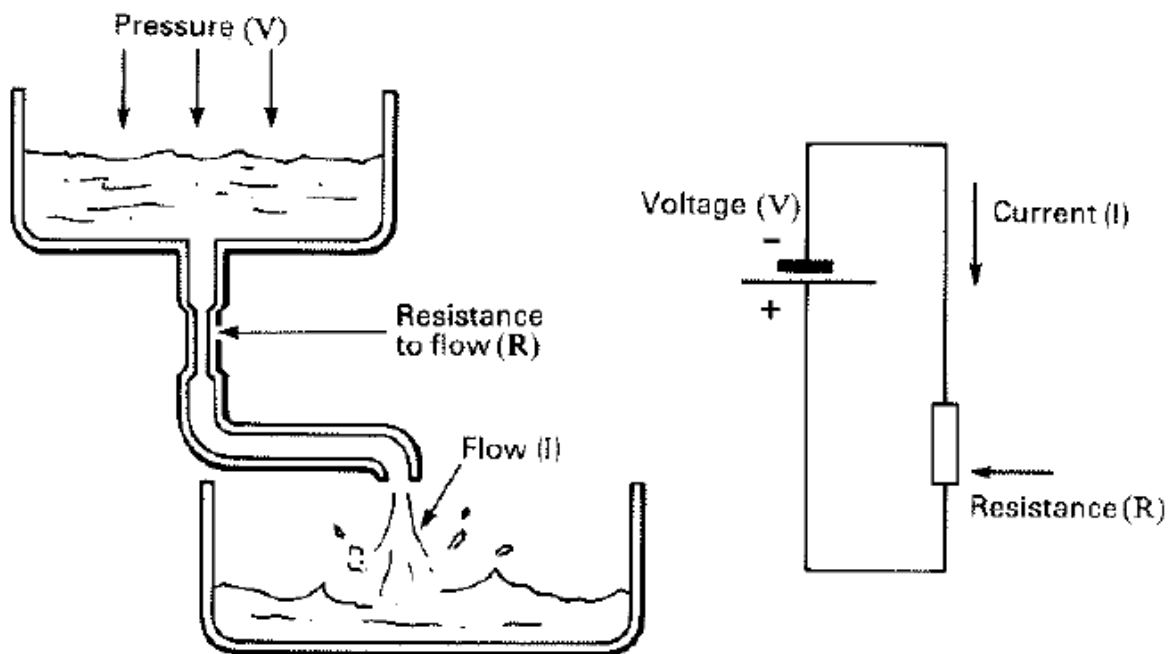
27. Additionally, a person of ordinary skill would have known that resistance is another fundamental concept involved in the flow of electrons. “Resistance is a property of all materials that reduces the flow of electricity through them,” so that “[t]he higher the resistance, the more difficult it is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

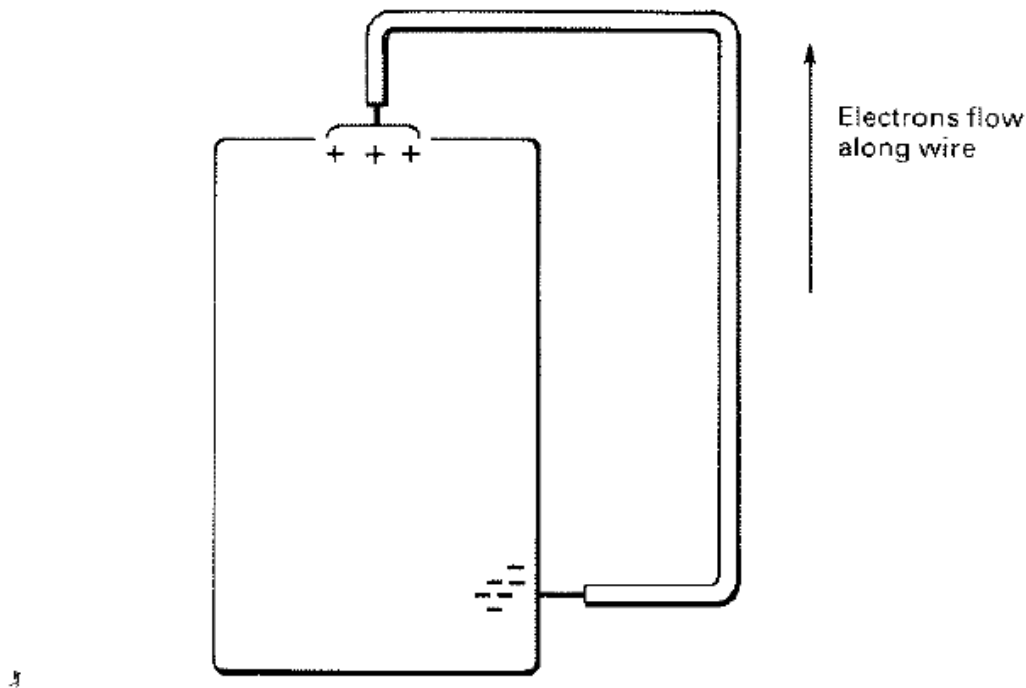
fig 2.5 a plumbing analogy: voltage, current and resistance all have their equivalents in the water system



(*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*



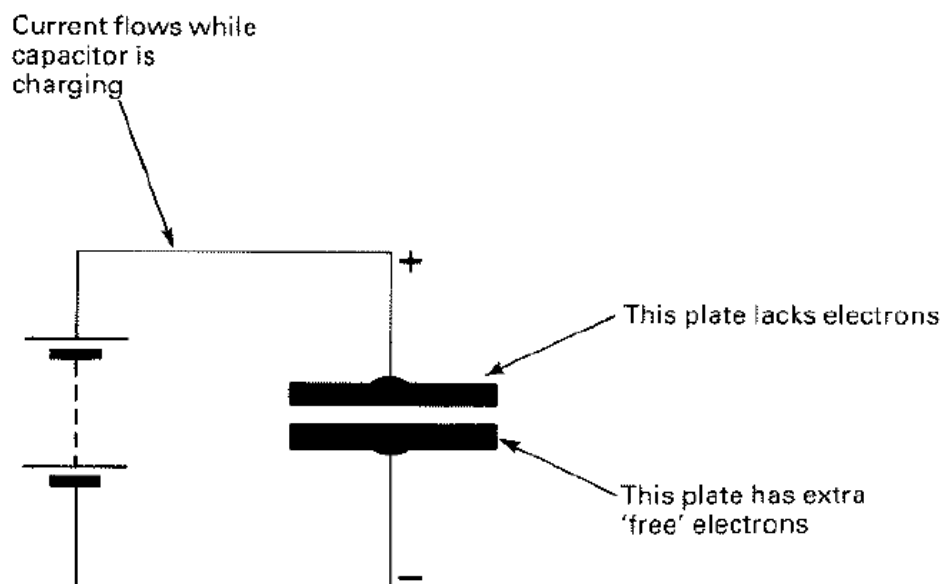
(*Id.*, FIG. 2.3.) A person of ordinary skill would have known that without such a closed path (e.g., as shown above in Figure 2.3), current cannot flow. (*Id.*, 8-11, FIGS. 2.3-2.5.)

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.) “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.)

34. A person of ordinary skill in the art would have known that in circuits, “L” signifies inductance and “C” signifies capacitance. (Ex.1027, 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).) Moreover, it was also known to use a combination of capacitor(s) and inductor(s) to construct filters to filter electrical signals, which I will discuss further below. (*Id.*, 884.)

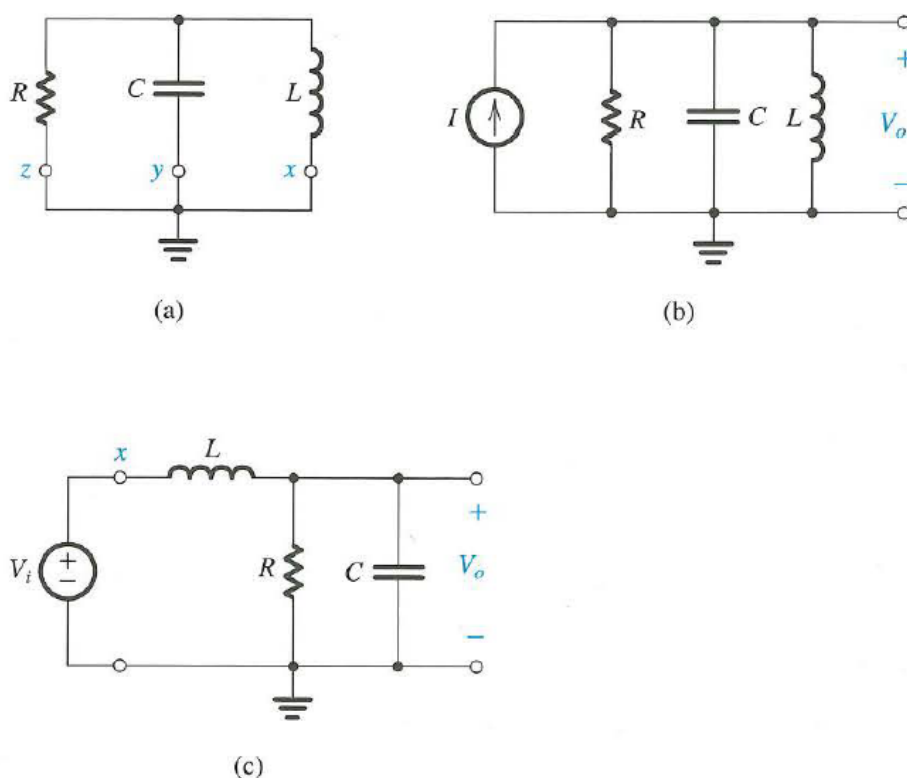


Fig. 11.17 (a) The second-order parallel LCR resonator. (b) and (c) Two ways for exciting the resonator of (a) without changing its *natural structure*. The resonator poles are the poles of V_o/I and V_o/V_i .

(*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.1012, 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.)

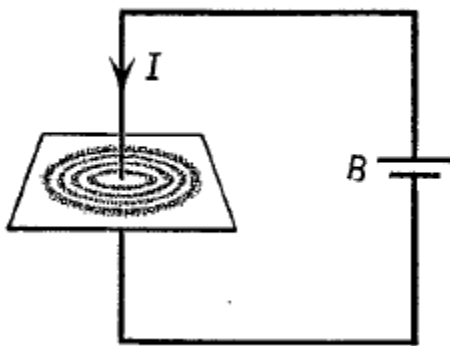
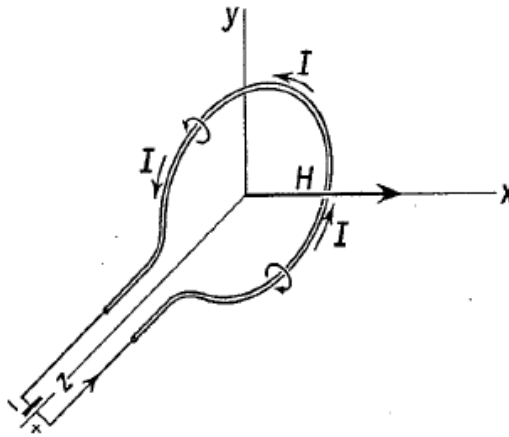


Fig. 30-2 Pattern formed by iron filings showing the circular magnetic field around a wire carrying current.

(*Id.* at 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 show 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.)

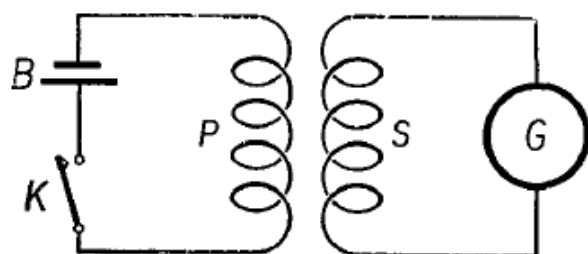


Fig. 32-3 Faraday's experiment on electromagnetic induction.

(*Id.* at 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.* at 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.*)

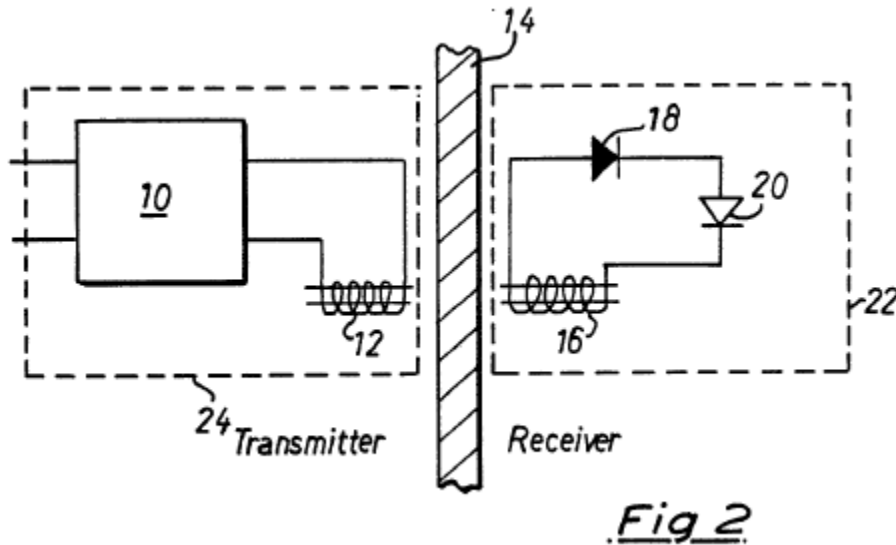
43. Therefore, in order to maintain current in the secondary circuit, the current in the first circuit can be continuously varied. By varying the current in the first circuit, the magnetic field (and therefore, magnetic flux) generated by the primary coil P is continuously varied, thereby inducing a 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.1028, 1:10-12.) It was well known to use inductor coils to facilitate wireless signal transmission. (Ex.1029, 5:39-66 (describing “receiv[ing] power from an electromagnetic (EM) energy source” and “a coil for the receipt of electromagnetic energy”); Ex.1028, 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. (*Id.*, Title, Abstract, FIG. 2 (reproduced below).) *Logan* demonstrates it was known to use an “electromagnetic signal ... of sinusoidal form” to convey power between a transmitter 24 and a receiver 22. (*Id.*, 6:12-14, FIG. 2.) Likewise, *Logan* provides guidance about “energising a transmitter coil 12 to create an alternating

electromagnetic flux,” which “induces an E.M.F. in a receiver coil 16” (*id.*, 3:19-23)
“to [wirelessly] convey information to a demodulator in the receiver” (*id.*, 3:24-25).



(*Id.*, FIG. 2.)

46. Thus, the use of inductor coils to facilitate the wireless transmission of power 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 transfer. (Ex.1029, 5:39-66 (describing “receiv[ing] power from an electromagnetic (EM) energy source” and “a coil for the receipt of electromagnetic energy”); Ex.1028, Abstract, FIGS. 1-2, 3:19-23, 4:12-14, 6:3-5.) Moreover, *Koreis* discloses using a contactless power supply to charge a battery:

Referring to the drawings, a **contactless power supply** according to the present invention is illustrated and

generally indicated by reference numeral 10 in FIG. 1. The **contactless power supply comprises an inductive coil 12 disposed within a charging unit 14**, along with a receptor 16 disposed within or on a computing device 18, wherein the computing device 18 is positioned proximate the charging unit 14 as shown. **When energized, the inductive coil 12 generates magnetic fields to provide electrical current to the receptor 16**, which powers the computing device 18. Further, the electrical current may also be used to charge batteries (not shown) of the computing device 18 in addition to supplying power. . . . **More specifically, the contactless power supply 10 comprises a two-part transformer**, wherein the transformer has a flat configuration so as to fit within, for example, a seatback tray or a desktop. **The first part of the transformer is located within the seatback tray** and is coupled to a source of AC power. **The second part of the transformer, hereinafter referred to as receiving coil and core, is located within the computing device 18** and is coupled to a rectifier that converts AC power to DC power. **When magnetic field lines are approximately 90 degrees to the first part of the transformer when the receiving coil and core are placed within the field, current is induced into the computing device 18.**

(Ex.1032, 2:46-3:8; *see also id.*, FIG. 1.)

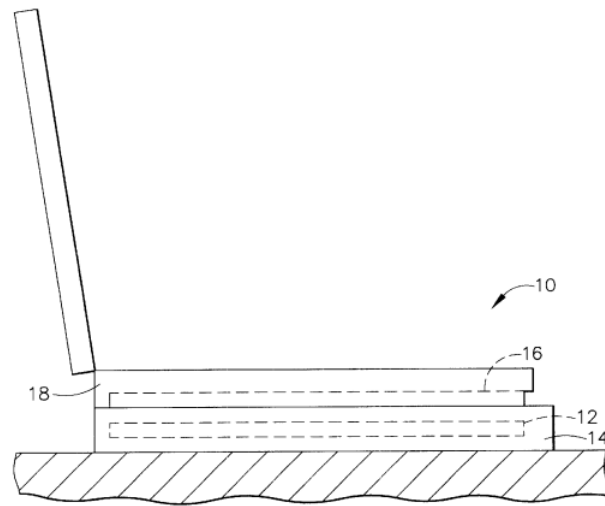


FIG. 1

(*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.1031, 1:13-27; *see also* Ex.1030, Abstract (“current induced in a secondary coil”), 4:29-5:2; Ex.1033, Abstract, ¶¶0039 (electromagnetic field induces a current), 0088; Ex.1034, 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.

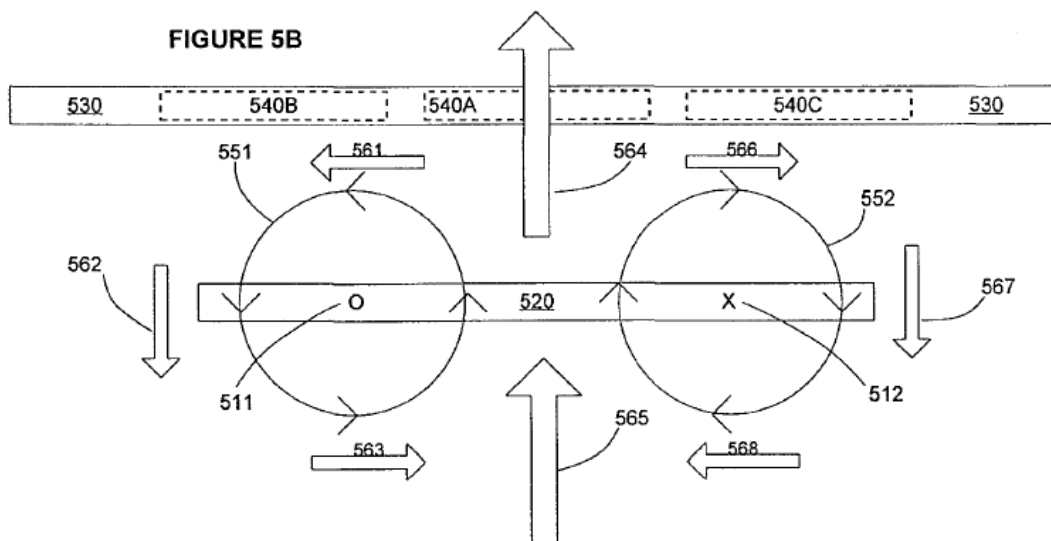
(Ex.1035, Abstract.)

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 secondary coil 510.

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.1035, FIG. 5B; *see also id.*, FIGS. 1-5A, FIGS. 6A-10, 7:21-8:54, 9:53-10:22, 11:27-14:67; Ex.1012, 557-562, 593-594, 601; Ex.1036, 3-4, 27-50; Ex.1009, 51.)

50. A person of ordinary skill in the art would have considered power efficiencies and other factors when implementing inductive transfer systems. (Ex.1017, 1:15-4:16, 5:1-8 (“the method using electromagnetic induction may have a power utilization efficiency of approximately 60-98%”), 5:18-42 (“use of the method using magnetic resonance enables power transmission efficiency may increase by approximately 50-60%”), 14:37-50 (“[w]hen a power transmission uses a resonance, transmission efficiency is improved,” which “may be about 90%” when the distance between source and receiver is 1 m); Ex.1018, Abstract, 1-6, (discussing importance of impedance matching to the resonant frequency in inductive power transfer system to improve the efficiency of the system); Ex.1041, ¶¶0044-0045 (polling operations to charge multiple device battery pack assemblies).)

3. Use of Planar Coils

51. Because the inductive coils, such as those mentioned above, are often integrated into a portable device into 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. A planar coil, given its relatively flat and thin structure, are known to be suitable for use in portable devices. 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 to be “**integrated into a planar (flat/thin) structure.**” (Ex.1031, 2:44-64, 3:3-5.)

52. *Lee*, for example, also discusses uses of a planar spiral coil inductor:

Since the arrival of the silicon-based RF IC era, much effort has been put into the **spiral inductor designs**. The main focus of the endeavor was to improve the quality factor. The major concern for the silicon-based spiral inductors has been the resistivities of the metal and the silicon substrate. **Numerous techniques have been proposed** to reduce the resistivities of the interconnect lines and the silicon substrates [1,2]. Yet, **many planar spiral inductor structures have been designed and evaluated** without a clear understanding for the layout dependences of the quality factor. Simple and clear guidelines of inductor layout rules for optimum quality factor are presented for the required inductance and process information. . . . **Figure 1 shows the top view of 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.1037, 1; *see also id.*, 1-3.)

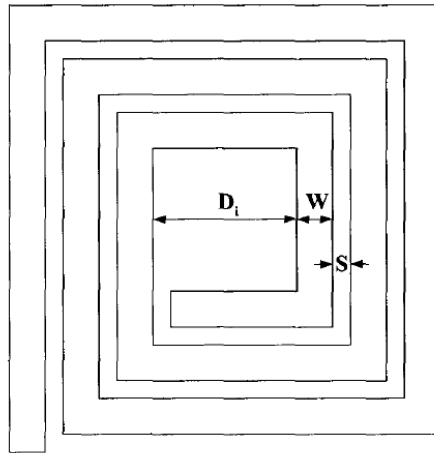


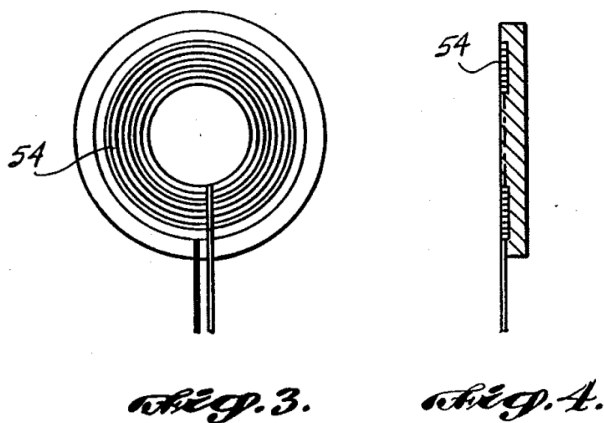
Fig. 1. A planar square spiral inductor structure.

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

53. Additionally, *Sano* (Ex.1038) discusses 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.1038, 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.)



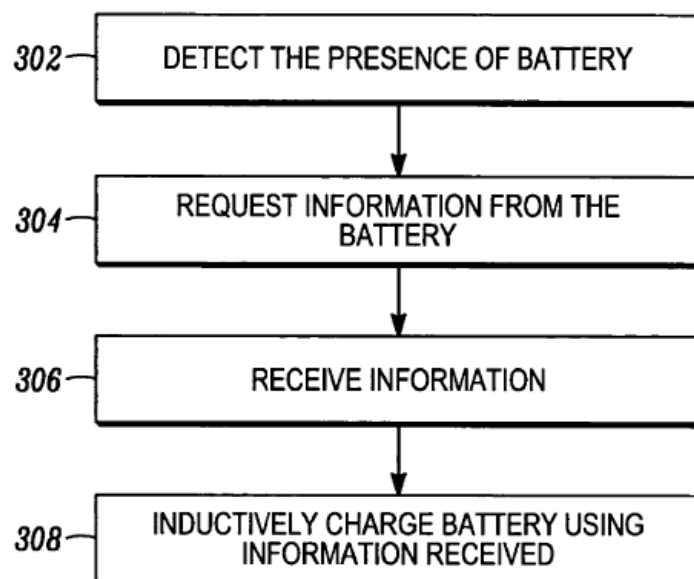
(*Id.*, FIGS. 3-4.)

54. 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.1039, FIGS. 1-3, 6, 8A-9, ¶¶0002, 0006-0007, 0018-0025-0034; Ex.1034, 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.1040, 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.1032, 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.1045, FIGS. 3, 8-9, 1:12-15, 1:39-2:29, 9:41-53, 10:45-57, 11:60-13:4; Ex.1047, Abstract, FIGS. 2-7, ¶¶0001, 0004-0007, 0025-0032, 0041; Ex.1036, 1-4, 9-19 (planar, spiral coils); Ex.1046, FIGS. 3-7B, 1:5-9, 1:59-61, 3:19-56, 4:62-567, 5:25-44); Ex.1013, 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 (“region of interest can cover a portion of, or all of the area of the coil” including “the area enclosed by the outermost turn of the coil”), 5:23-6:15, claims 1-88; Ex.1014, Abstract, FIGS. 1, 5-6, 9, 11-12, 24-26, ¶¶0008-0010, 0044-0050, 0051 (peak intensity of magnetic field at the center of the inductor), 0065-0066, 0070, 0073 (tuning for resonant frequency matching between primary and second sides), 0078 (resonant frequency is controllable depending on coil design and secondary side capacitance); Ex.1015, 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).)

4. Controlling and Regulating Contactless Power/Data Transfer

55. 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 at least in the 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.1042, ¶0020.)



(*Id.*, FIG. 3.) The procedure involves the charger first detecting the **presence** of a battery placed the charger, then requesting **information from the battery**, such as it's the ID of the battery/device. (Ex.10XXBlack, ¶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.1043, 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.

(*Id.*, 1:56-2:6.)

56. Additionally, mechanisms for identifying whether a device subject to charging is **present** and **properly placed** on the charger 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 on the charger. (Ex.1010, ¶¶0080-0083, FIGS. 11A-11B.) 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* discloses:

[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.1010, ¶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.

(Ex.1010, ¶0079.)

57. Moreover, once the power transmission process has started, mechanisms were known to adjust the power output to the device subject to charging based on the device's power demand. This is to accommodate the fact that the power demand may be variable in time. (Ex.1044, 6:12-15.) For example, *Berghegger* 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. (*Id.*, 5:65-6:37.)

VI. OVERVIEW OF THE '349 PATENT

58. The '349 patent relates to systems and method for enabling transfer of power, from a wireless charger or power supply, to one or more receivers placed on or near the wireless charger or power supply. (Ex.1001, 1:53-56.) For example, the patent describes a system for inductive power transfer that includes a charger and a mobile device that includes a receiver to inductively receive power. (*Id.*, 2:8-12; 2:13-33, Abstract.) The Summary section of the '349 patent states that in an embodiment, "a charger for inductive charging includes a printed circuit board having a charger coil, a substantially planar magnetic layer, a charger drive circuit, and a means for positioning a receiver in a power transfer position." (*Id.*, 2:12-16.) The Summary further states that in an embodiment, "a mobile device that receives power inductively includes a receiver to inductively receive power for the mobile

device.” (*Id.*, 2:16-18.) “In accordance with an embodiment, a receiver coil can be generally shaped as a blade or thin solenoid, which receives power inductively, which is then used to power or charge one or more electronic devices.” (*Id.*, 2:30-33.) These features, in my opinion, were conventional at the time. Likewise, these and other features recited in claims 1, 4-5, 7, 10-12, and 26, were known and consistent with contactless power 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

59. 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, 4-5, 7, 10-12, and 26, I have been asked to apply the plain and ordinary meaning of the terms in those claims, where applicable (although I may address other interpretations that I have been asked to consider below in my analysis of those claims in Section IX). For example, I have been asked to consider interpretations for the terms “means for positioning the receiver in a power transfer position, proximate to the charger surface, to inductively transfer power to the receiver of the first mobile device” and “means for positioning a receiver in a power transfer position, which is proximate to the charger surface, to inductively transfer

power to the receiver” that are recited in claim limitation 1(k) and 26(e), respectively. I discuss those below and also in Section IX.1(k). My opinions concerning the interpretation of the claims terms is based on the time of the alleged invention I have been asked to consider as I noted above (e.g., January 13, 2013 to April 13, 2013). 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 petition where appropriate.

60. As I noted above, limitation 1(k) in claim 1 recites a “means for positioning the receiver in a power transfer position, proximate to the charger surface, to inductively transfer power to the receiver of the first mobile device,” and limitation 26(e) in claim 26 recites a “means for positioning a receiver in a power transfer position, which is proximate to the charger surface, to inductively transfer power to the receiver.” (Ex.1001, 23:49-52, 26:6-8.) I have been asked to consider those terms as a means-plus-function terms. I understand that where a claim term is a means-plus-function term (such as in here), the specification must clearly link or associate structure to the identified function for the claim term. I have been asked to provide my opinions under the following construction for the above “means for positioning...” terms:

- a. The identified function is: **positioning [the/a] receiver in a power transfer position, [which is] proximate to the charger surface, to inductively transfer power to the receiver [of the first mobile device]** as recited in the claim terms.
- b. The corresponding structure is: the structure identified in the '349 patent's specification and dependent claims 24-25 and/or equivalents thereof. (*See* Ex.1001, 14:35-38 (“[T]he charger and or receiver can include means to provide more precise alignment between the charger and receiver coils or antennas. These can include **visual, physical, or magnetic means to assist the user in alignment of parts.**”), 25:56-57-63 (claim 24: “the means for position includes **one or more magnets** to position the receiver in the power transfer position”, claim 25: “means for positioning includes one or more members of a group consistent of **visual, physical, or magnetic means** to assist in the positioning the receiver in the power transfer position.”).)

In my opinions below for limitations 1(k) and 26(e) in Section IX.A.1(k), I applied both the plain meaning and the above-discussed means-plus-function construction for the “means for positioning...” terms. As explained, in either case, it is my

opinion that the prior art discloses and/or suggest the features recited in limitations 1(k) and 26(e). (*See my analysis and discussions below in Section IX.A.1(k).*)

VIII. OVERVIEW OF THE PRIOR ART

61. 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 '349 patent below in Section IX. Accordingly, the following discussions are incorporated into my analysis below in Section IX.

A. *Fells* (Ex.1005)

62. I understand that *Fells* is an issued United States patent. (Ex.1005, Cover.) My understanding is that *Fells* was filed February 9, 2010 and issued November 19, 2013. (*Id.*) I rely on the disclosures and analysis thereof of *Fells* discussed in this section VIII for my opinions regarding *Fells*' teachings and suggestions as applied to the challenged claims of the '349 patent below in Section IX.

63. *Fells* discloses “an inductive power transfer system including a primary unit and a secondary device,” where the primary unit includes a “power transfer surface” and “field generators” (e.g., primary coils) and where the secondary device (which can be a mobile device) includes a “power receiver having a secondary coil.” (Ex.1005, Abstract.)

64. *Fells* describes various configurations of such a power transfer system including components that include, for example, a primary unit with a surface, primary coils (e.g., field generators, cells, coils), mobile device (e.g., a mobile phone, etc.) with a receiver that includes a secondary coil (e.g., a solenoid with magnetic core and wires), and related circuitry. (Ex.1005, Abstract, FIGS. 1-8, 16-20, 22-23, 1:3-6:3, 6:56-8:9, 10:26-11:8, 11:26-12:19.)

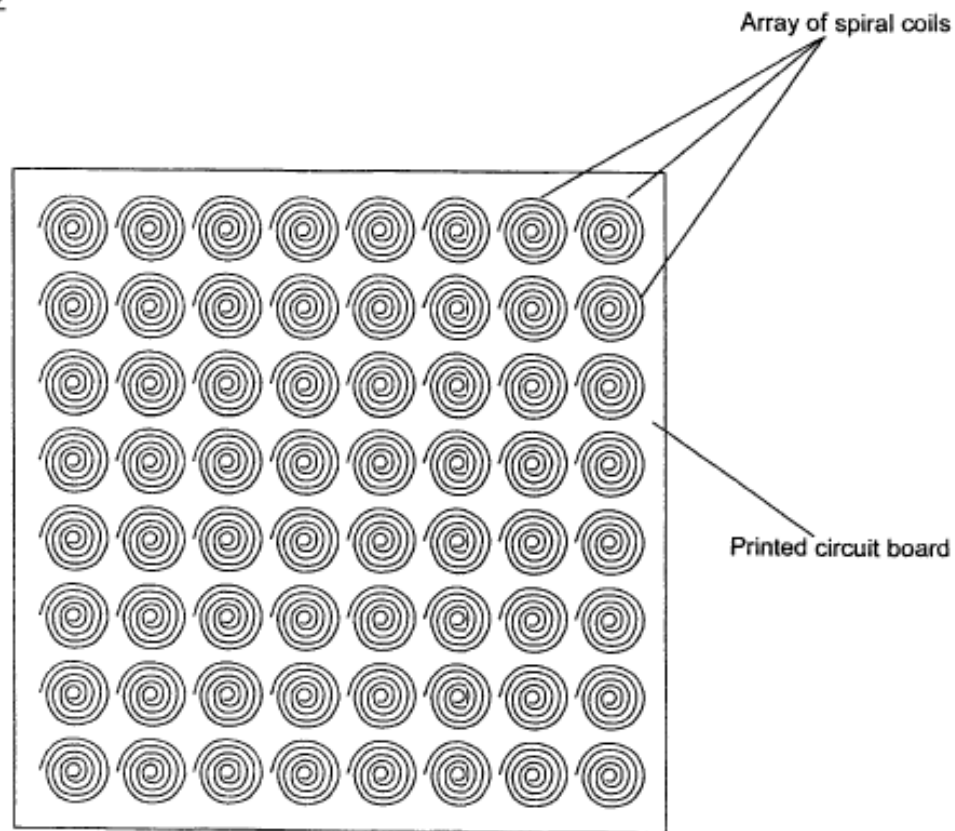
65. *Fells* discloses a number of different arrangements and configurations of such inductive power transfer systems, where different concepts and disclosures relating to the various arrangement and configurations are not limited to the specific arrangement or configuration for which those concepts and disclosures are presented. For example, the arrangement of components for one example system depicted in the figures and/or described in *Fells*' disclosure, materials used for aspects of that system, the configuration of the components of that system, etc. are related to and applicable to other inductive power transfer systems in the context of *Fell's* disclosure.

66. *Fells* discloses embodiments where the charging pad on which the charging coils are included is formed using a printed circuit board (PCB). (Ex.1005, 10:26-37; 11:45-64, claim 1, FIGs. 16-17, 23.) For example, *Fells* explains that the charger can be formed "using a **PCB** implementation":

FIG. 16 shows **a charger formed using a PCB implementation**. In this arrangement there is **an array of planar spiral coils used to generate the vertical fields**. Typically multiple PCB layers would be used, each having an array of coils. These coil arrays would be aligned with each other to enhance the magnitude to the field generated. A ferrite back plate would typically be required to complete the magnetic circuit. It may be desirable to have holes in the centre of the spiral, which could accommodate cylinders of magnetic material.

(*Id.*, 10:26-34.)

Fig. 16

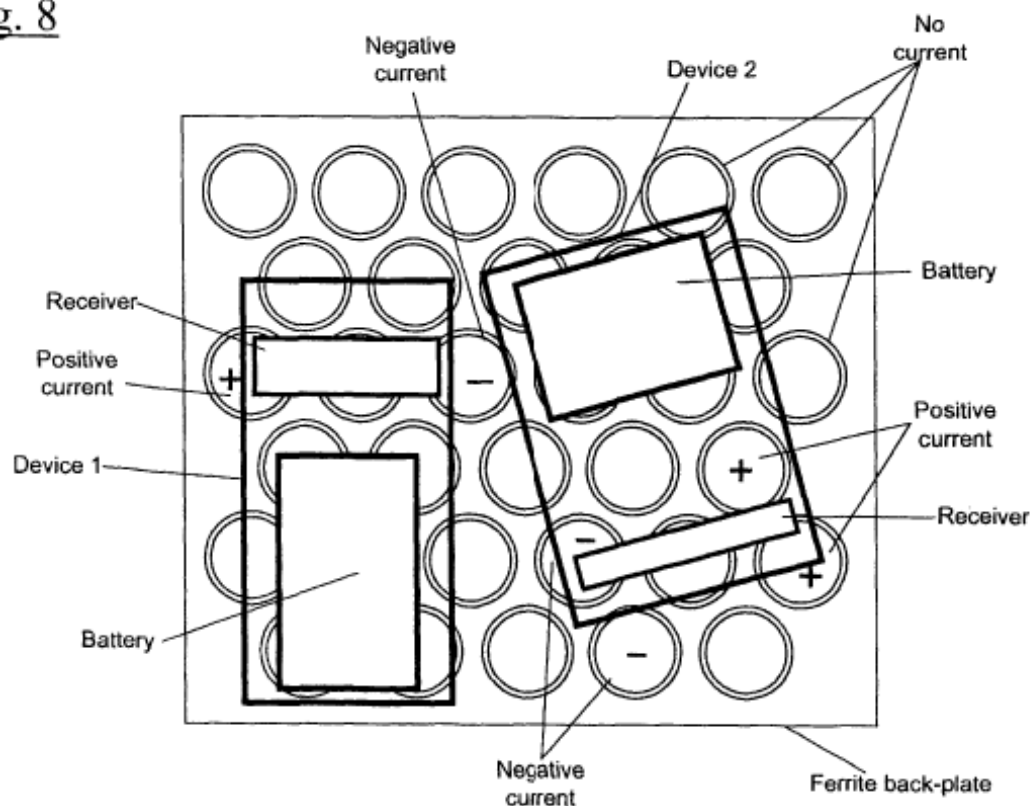


(*Id.*, FIG. 16.)

67. *Fells* explains that the charger can include a ferrite backplate positioned under the surface of the primary coil(s) that generate the magnetic field used to transfer power to the secondary coil of the mobile device(s). (Ex.1005, 10:26-34 (PCB-planar spiral coil implemented charger of FIG. 16 where “[a] *ferrite back plate* would typically be required to complete the magnetic circuit”), 11:65-12:9, 6:57-63, 7:9-21, 8:26-32, FIGs. 1(b), 2, 16, 23.)

68. *Fells* describes that the “charger” can include driver circuitry including components for sensing the position of the device coil and switching/activating appropriate primary coils on the charging pad. (*Id.*, 8:10-13 (“FIG. 9 shows an arrangement for sensing the position of the device coil and switching the appropriate coils on the charging pad. The array of coils on the charging pad are represented electrically (coil 1, coil 2, etc.).”), 6:27, 31-32.) *Fells* also discloses that multiple coils can be driven by the drive circuitry on the charger in order to provide power to multiple receiver devices simultaneously, where an example of such a configuration is shown in figure 8 below.

Fig. 8



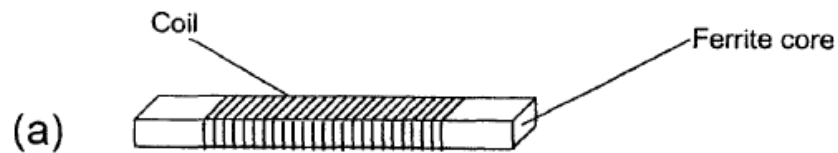
(*Id.*, FIG. 8.) As disclosed by *Fells*:

FIG. 8 shows portable devices with integrated power receivers receiving power from the charging pad. The pad is large enough for multiple devices to be charged simultaneously. In the example one device is being charged by 1 pair of coils and another device is charged by 2 pairs. The two devices also have different sized receivers and may have different power requirements. Importantly, the field is localised in the region of the active coils, such that the battery is not substantially within the magnetic field.

(*Id.*, 8:1-9.)

69. The inductive power transfer system of *Fells* is configured to inductively charge a mobile device via a power receiver in the mobile device. (*Id.*, FIGS. 1-2, 5-8, 18-23, 1:3-16, 6:57-60, 6:25-26, 7:9-21, 8:1-9, 10:38-67, 11:15-21, 11:45-55, 12:60-65.) *Fells* discloses that the power receiver in the *mobile* device can be configured in different ways, including as a solenoid like that shown in figure 1(a) below, where the solenoid has a ferrite core and coil wound around the core. (*Id.*, 6:57-7:7, 6:39, 10:60-63, 11:9-21, FIGS. 1(a), 19, 21.)

Fig. 1



(*Id.*, FIG. 1(a).)

70. *Fells* discloses that Litz wires, which include many separate strands that are insulated from each other, are preferably used for the coil wound around the ferrite core of the receiver:

FIG. 1(a) shows a **power receiver** suitable for embedding in a portable device. It **has a ferrite core and coil wound around the core. ... Preferably Litz wire is used for both the primary and secondary coils.** Litz wire has many strands of copper, each insulated from one another. This allows the copper losses to be reduced as at high frequencies the skin effect means that current is only carried in the outer skin of the conductors.

(*Id.*, 6:58-7:8.)

71. As I noted above, *Fells* discusses activating relevant charger coils based on the position of the secondary coil of the mobile device. (*Id.*, FIG. 10, 8:57-9:16; FIGS. 11-12, 9:18-45.) *Fells* includes a resonant capacitor in the circuitry driving the charger that allows the charger to provide power signals at an “oscillator

frequency” provided via the voltage source used in the charger’s “drive[r] circuit”

(Id., 9:46-67, 13:53-14:14.) As *Fells* discloses:

The arrangement of FIG. 9 requires AC voltage signals with high power and opposite polarity. FIG. 13 shows a means of generating these signals. There is a DC power source which is coupled to an inverter to generate an AC signal at a reference oscillator frequency. This is in turn coupled to an inductor and capacitor resonant at the oscillator frequency. This is in turn coupled to a transformer, via a variable capacitor. The output of the transformer has a centre-tap referenced to ground. The two ends of the transformer output provide the positive and negative polarity inputs to the circuit of FIG. 9. A variable capacitor is required because the inductance of the load on the transformer will vary as different coils are switched in and out. It may also varied with different device loads or at different device positions on the pad. The variable capacitor is therefore adjusted to ensure that the system is resonant at the oscillator frequency. In this system, the variable capacitor has been implemented using a switch network, though there are many methods of achieving this.

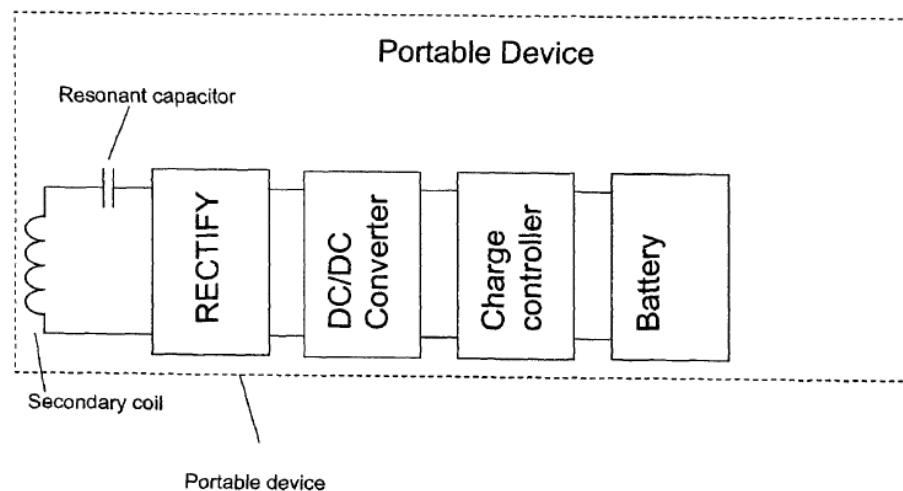
FIG. 14 shows an electrical equivalent diagram of a portable device for use with the charging pad. There is a secondary coil (represented by the inductor), a capacitor

such that the combination is resonant at the oscillator frequency.

(*Id.*, 9:46-67.)

72. *Fells* discloses that the mobile device that is being charged includes an electronic circuit that is configured to facilitate the reception of the power transferred by the charger. (*Id.*, FIG. 14, Abstract, 6:33-34 (“FIG. 14 shows a block diagram of the electronics within the portable device.”), 9:64-10:12 (“FIG. 14 shows an electrical equivalent diagram of a portable device for use with the charging pad”).)

Fig. 14



(*Id.*, FIG. 14.)

73. The circuit of the mobile device includes a rectifier (for converting the received AC signal to DC), a DC/DC converter (for converting the voltage to

“required voltage level”), and a charge controller coupled to the battery of the mobile device:

FIG. 14 shows an electrical equivalent diagram of a portable device for use with the charging pad. There is a secondary coil (represented by the inductor), a capacitor such that the combination is resonant at the oscillator frequency. This signal is converted to a DC voltage using a rectifier (which may be a bridge rectifier). The voltage is then converted to the required voltage level using a DC/DC converter. This is coupled to a charge controller, which is in turn coupled to a battery. It is sometimes possible to combine the DC/DC converter and charge-controller into a single element.

(*Id.*, 9:64-10:6.)

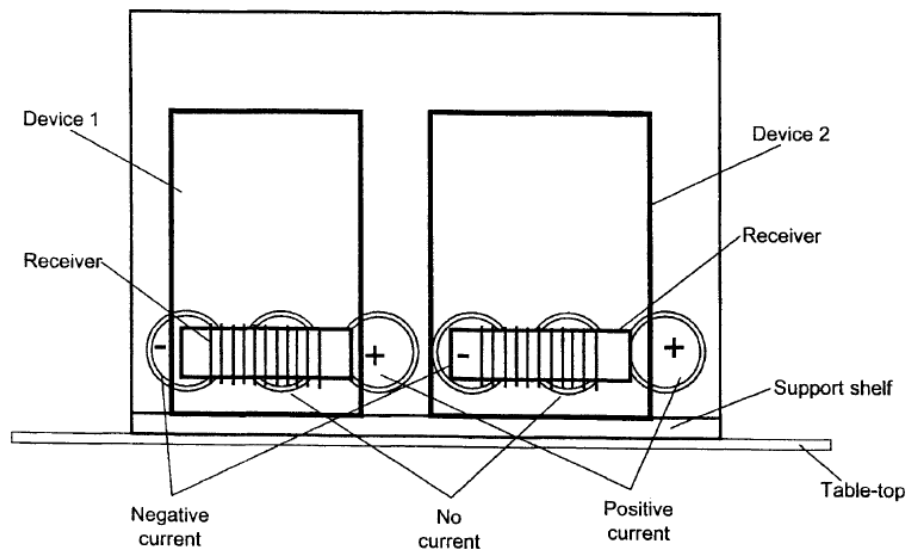
74. *Fells* discloses charger configurations that ensure the mobile device(s) placed proximate to the charger surface are aligned to facilitate the inductive transfer of power to the mobile devices. For instance, with respect to FIG. 23, *Fells* describes a charger that can be configured to sit upright (and at a slight angle) to allow mobile device(s) to be placed thereon. For example, *Fells* explains:

FIG. 23 shows a simpler and lower cost alternative to a flat pad charger. This system requires only a single line of coils. **The charger is in the form of a shelf, such that device stand upright on a ledge.** The ledge may tilt back

slightly to prevent the devices from falling off. The receiver is positioned in the portable device a set distance away from the bottom edge. **Thus there is always alignment in one dimension.** Depending on which part of the shelf the device is placed, different coils are accordingly activated. **The shelf allows devices to be placed anywhere along a line.** Further, it allows multiple devices to be charged simultaneously.

(*Id.*, 11:45-55.)

Fig. 23



(*Id.*, FIG. 23.)

B. Jung (Ex.1016)

75. I understand that *Jung* is an issued United States patent. (Ex.1016, Cover.) My understanding is that *Jung* was filed February 24, 2010 and issued

November 3, 2015. (*Id.*) I rely on the disclosures and analysis thereof of *Jung* discussed in this section VIII for my opinions regarding *Jung*'s teachings and suggestions as applied to the challenged claims of the '349 patent below in Section IX.

76. *Jung* describes an inductive power transfer system. (Ex.1016, Abstract, FIGS. 1-18, 1:9-24.) For example, *Jung* discloses:

The present invention relates to **a non-contact charging station with a planar-spiral power transmission core, a non-contact power-receiving apparatus, and a method for controlling the same**. More particularly, a primary side core of the non-contact charging station transmitting a power signal to a portable device using an induced magnetic field is configured as a power transmission Printed Circuit Board (PCB) core in which a planar-spiral core structure is formed on a core base. The power transmission PCB core has a simplified shape along with improved applicability that facilitates its mounting on a non-contact charger. In addition, the receiving core has a reduced volume to reduce the entire size of the power-receiving apparatus so that it can be easily mounted onto a portable device.

(*Id.*, 1:9-24.)

77. *Jung* discloses a contactless inductive power transfer system that uses planar spiral coils on a core base that transfers power to a portable device (e.g., mobile phone) via a magnetic field that induces a current in a secondary core 51 of the portable device (power-receiving apparatus 50), which is used to charge a battery cell. (*Id.*, FIGS. 1-4, 6, 17-18, Abstract, 3:23-5:19, 6:14-7:13, 7:38-8:67, 17:48-19:11.)

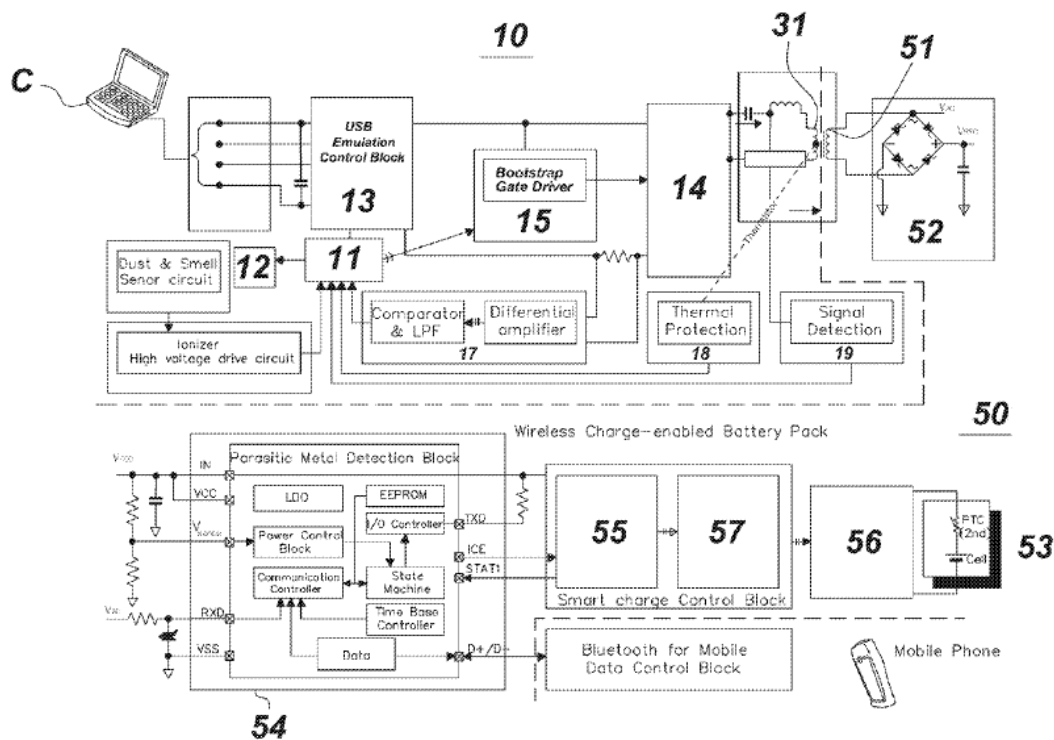


Fig. 1

(*Id.*, FIG. 1.)

Fig. 3

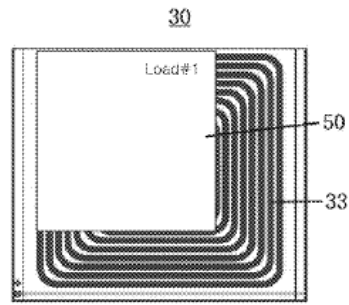
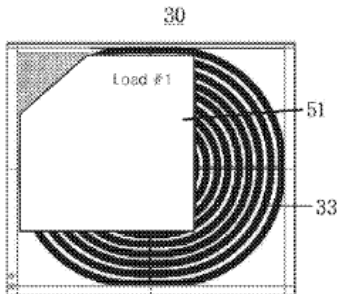


Fig. 4



(Id., FIGs. 3,4.)

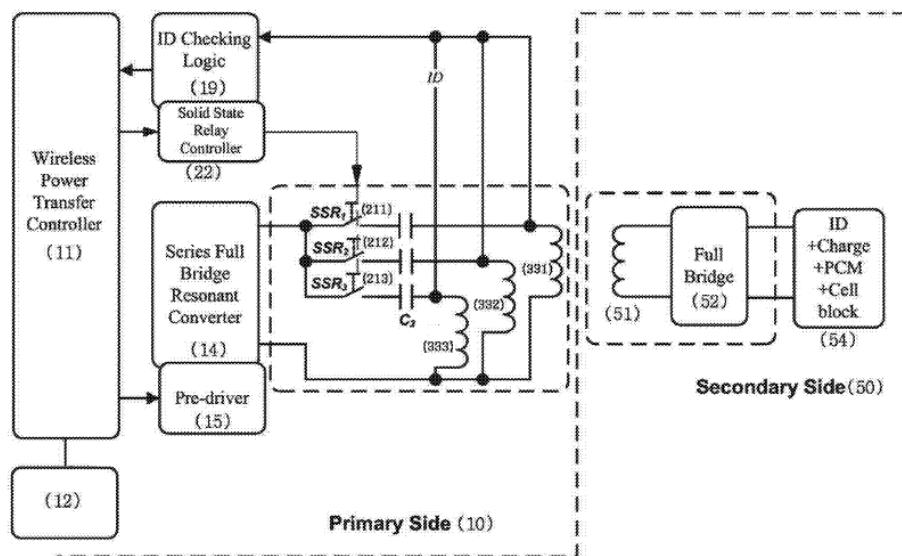


Fig. 6

(Id., FIG. 6.)

78. *Jung's* core base can include multiple planar PCB cores that can be selectively activated to perform power transfer operations. (*Id.*, FIGS. 7-9, 10:1-12:1, 12:42-13:20.) *Jung* describes various aspects of the system that can be implemented for improving power transmission efficiency, and describes power efficiencies relative to the primary and secondary side that exceed 50%. (*Id.*, 5:59-61 (“FIG. 12 is a graph illustrating amounts of induced current on the primary core and the secondary core and resultant efficiency after voltage calibration”), 9:12-30, 12:4-8 (“Especially, when only one thin film-like power transmission PCB core as described above is provided, the core can be designed with a size 45 to 55 Φ in order to prevent impurity-detecting ability and other power transmission efficiency from degrading.”), 13:21-17:47.) For example, FIG. 12 of *Jung* shows exemplary efficiencies above 50%.

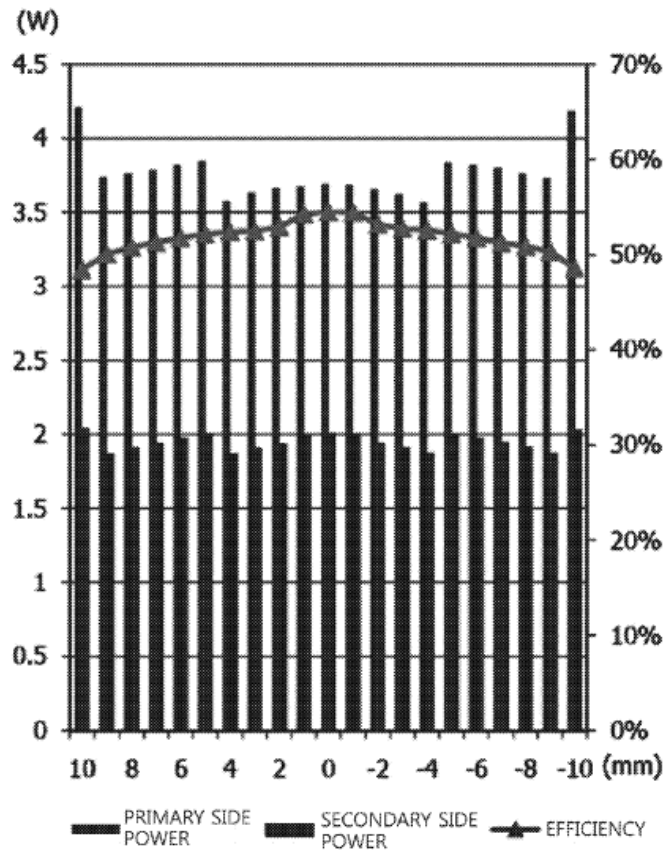


Fig.12

(*Id.*, FIG. 12; *id.*, 14:24-62, *see also id.*, 14:64-15:17 (Table 3 (“efficiency” (53%, 60%))), 15:28-40 (“the efficiency” in Table 3 “indicate an efficiency....that is *a ratio of power output from the secondary non-contact power-receiving apparatus 50 with respect to power input to the primary non-contact charging station 10* for generating an induced magnetic field when load of 2.5W is applied to the secondary side”).) *Jung* also discusses power efficiencies relative to the power measured from the mobile device’s receiver circuit’s rectifier that rectifies the signals from secondary coil 51. (*Id.*, FIG. 1 (element 52), FIG. 6 (52), 13:14-14:15 (“voltage

measured from the rectifier”, Table 1 (“DC voltage induced on secondary rectifier”), Table 2 (“energy efficiency”).)

79. As shown in Table 3 below, *Jung* also discloses using Litz wire for a wireless charging coil operating at 100-250 kHz in an inductive power transfer system.

TABLE 3			
Comparison with Convention Litz Core			
Items	Litz core	PSR PTPCB core	EGPL-PTPCB core
Material	Copper (99.99%)	Copper (70 μ m) + PSR Coating	Copper (70 μ m) + Electroless plating (0.03 μ m)
Thickness	0.35 mm	0.4 mm	0.4 mm
Size	32 $\times$ 32 mm	32 $\times$ 32 mm	32 $\times$ 32 mm
Shape	Rectangular	Planar rectangular	Planar hexagon
Number of turns	20 (Litz shape)	24/(1Layer)	24/(2Layer)
Number of threads per turn	7	1	1
Thickness of wire	0.15 Φ	1 mm/2 oz	1 mm/2 oz
Inductance	7.7 μ H	11 μ H	7.8 μ H
Q (no shield)	27	9	20
DCR (Internal resistance)	230 m Ω	850 m Ω	350 m Ω
Efficiency@2.5 W (5 V $\times$ 500 mA)	61%	53%	60%
Temp@2.5 W (5 V $\times$ 500 mA)	40	42	40
Rate of change of inductance	1.5%	0.5%	0.5%
Operation frequency	100~250 kHz	100~250 kHz	100~250 kHz
Cost	Middle (Facility investment required)	Low	Middle (Facility investment not required)
Performance	Average	Average	Good

(Ex.1016, 15:1-25, Table 3 (annotated); *id.*, 2:4-14 (known use of Litz coil for “primary and secondary cores”), 4:51-55 (“The primary core can be configured as a single-layer or multiple-layer structure since it is a thin power transmission PCB core instead of a Litz core. This as a result can ensure a portable device to be constantly and stably charged even if it is displaced to any position.”), 11:63-67 (“In

the meantime, the core of the station part 30 of the non-contact charging station 10 in accordance with the present invention is implemented with a thin film-like power transmission PCB core, instead of a Litz core, using bond wires according to the related art.”), 14:64-67, 15:28-34, 16:40-41.)

C. *Stoner* (Ex.1011)

80. I understand that *Stoner* is an issued United States patent. (Ex.1011, Cover.) My understanding is that *Stoner* was filed November 1, 2011 and issued December 16, 2014. (*Id.*) I rely on the disclosures and analysis thereof of *Stoner* discussed in this section VIII for my opinions regarding *Stoner*’s teachings and suggestions as applied to the challenged claims of the ’394 patent below in Section IX.

81. *Stoner* discloses “a self-aligning inductive wireless power system and method in which a wireless induction coil and an external DEC electromagnetic field may be used to attract the wireless induction coil toward a desired location for more efficient wireless power transfer.” (*Id.*, 2:60-64.) *Stoner* discloses alignment mechanisms to properly position devices being charged with the chargers providing power to those devices. (*Id.*, 1:6-8 (“The present invention relates to systems and methods for aligning a portable device with an inductive wireless power supply”).) *Stoner* discloses that known methods for achieving such alignment included

“geometrically matched surfaces, permanent magnets, magnetic attractors, multiple coil arrays, nested coils, and movable coils.” (*Id.*, 1:40-44.)

82. In one example embodiment shown in figure 8 below, Stoner discloses that the secondary inductor 632 of the receiver can be caused to move to a better alignment position based on, for example, generated DC magnetic fields or magnets. (*Id.*, 11:48-12:12, FIG. 8.)

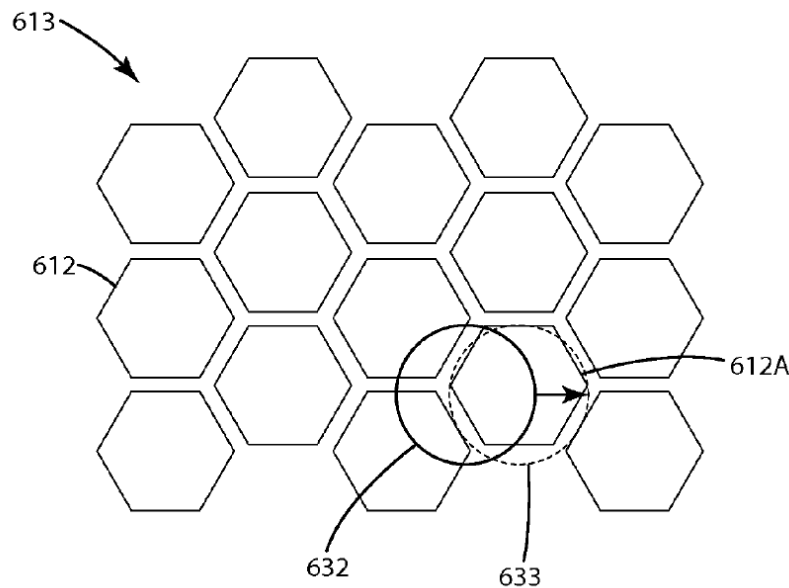


Fig. 8

(*Id.*, FIG. 8.)

83. As disclosed by Stoner:

In the fourth embodiment, the primary inductor array 613 may be setup so that at least one primary inductor 612 is in sufficiently close proximity to a secondary inductor 632 to cause an alignment operation. Secondary inductor 633

may be a representation of secondary inductor 632 after an alignment operation, which caused secondary inductor 632 to move. The alignment operation may take the form of any of the previously described embodiments. For example, at least one primary inductor 612 and secondary inductor 632 may each produce a DC magnetic field that interacts with each other, which may result in an attractive force between at least one primary inductor 612 and secondary inductor 632. Alternatively, magnetics may be used in either the inductive power supply or electronic portable device alone or in combination with DC magnetic field generated from either at least one primary inductor 612 or a secondary inductor 632.

(*Id.*, 11:64-12:12.)

D. *Nakamura* (Ex.1010)

84. I understand that *Nakamura* is a published United States patent application. (Ex.1010, Cover.) My understanding is that *Nakamura* was filed September 23, 2004 and published March 31, 2005. (*Id.*) I rely on the disclosures and analysis thereof of *Nakamura* discussed in this section VIII for my opinions regarding *Nakamura*'s teachings and suggestions as applied to the challenged claims of the '394 patent below in Section IX.

85. *Nakamura* discloses "a power supply system that supplies power to electronic equipment and, more particularly, [] a power supply system that supplies

power to mobile electronic equipment such as portable telephones, notebook personal computers, a digital cameras, and an electronic toys.” (Ex.1010, ¶0003; *see also id.*, ¶0016.) *Nakamura* discloses that such a power supply system supplies power in “a *non-contact manner*, to power reception equipment from a power transmission apparatus” that provides selective power levels “to be transmitted according to power required by the power reception equipment” (e.g., indicated by “information on consumed power”). (*Id.*, ¶0017; *see also id.*, ¶¶0062-0063, 0065, 0077-0078, 0083-0085, 0090-0091, FIGS. 3-5.)

86. *Nakamura*’s figures (e.g., FIGS. 1A, 1B, and 2A and other figures such as FIGS. 3, 5, 6, 13A-13E, 14-25, etc.) show examples of such a power supply system with a power reception equipment (e.g., mobile device 2 or 3) and a power transmission apparatus (e.g., apparatus 1). For example, *Nakamura* explains, “FIGS. 1A and 1B are views showing outer appearances of power supply systems embodying the present invention. In FIGS. 1A and 1B, a numerical symbol 1 indicates a power transmission apparatus for supplying power. FIG. 1A shows a case where power reception equipment is a portable telephone 2, and FIG. 1B shows a case where the power reception equipment is a notebook PC 3.” (Ex.1010, ¶0062.)

FIG. 1A

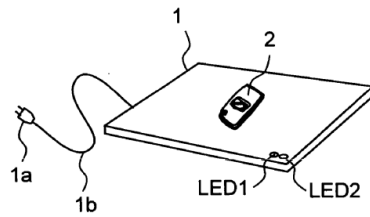
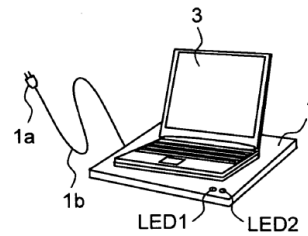


FIG. 1B



(*Id.*, FIGS. 1A-1B.) *Nakamura* also explains, “Description will be given of a principle of a non-contact transmission system with reference to FIGS. 2A and 2B. FIGS. 2A and 2B are schematic diagrams for describing schematic constructions of the interiors of the power transmission apparatus 1 and the portable telephone 2 shown in FIG. 1A.” (*Id.*, ¶0064.)

FIG. 2A

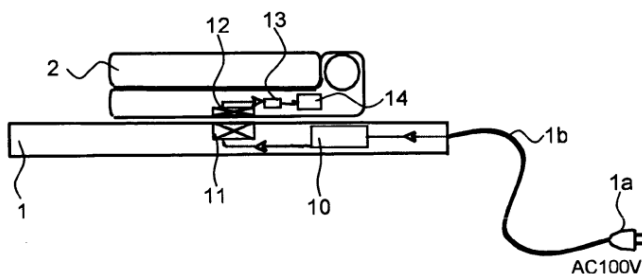
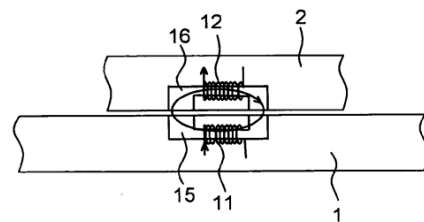


FIG. 2B

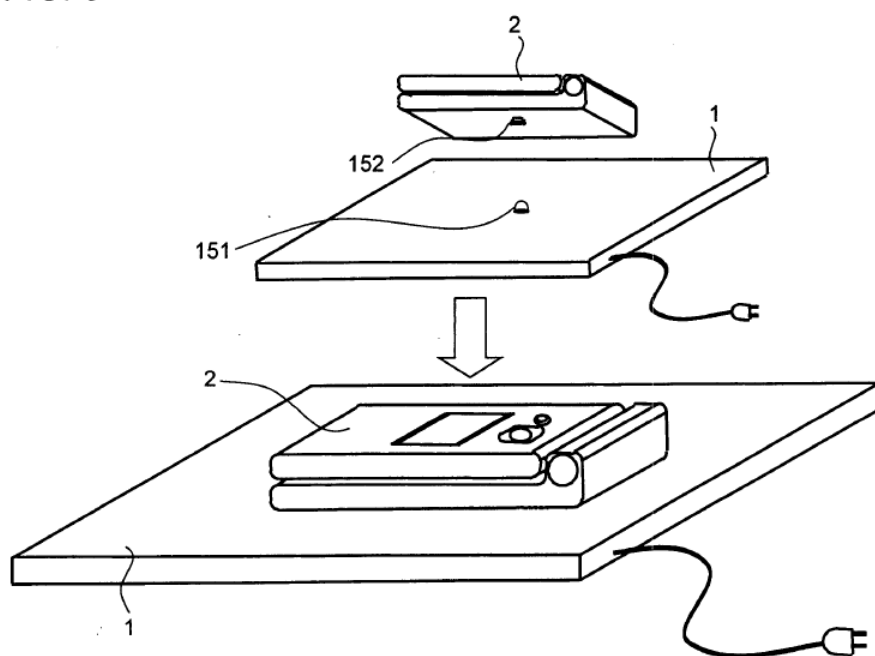


(*Id.*, FIGS. 2A-2B.)

87. *Nakamura* discloses with respect to figure 8 below that the power transmission apparatus 1 includes a protrusion 151, whereas the portable telephone 2 includes a corresponding depression 152. (Ex.1010, ¶0102.) As disclosed by *Nakamura*, “[t]he protrusion 151 and the depression 152 are engaged with each other

to thereby enable positioning of the power transmission apparatus 1 and the portable telephone 2 to be established.” (*Id.*) Nakamura further discloses that similar depressions can be formed in various types of power reception equipment, “thereby enabling positioning of each type of equipment with the power transmission apparatus 1 to be established.” (*Id.*)

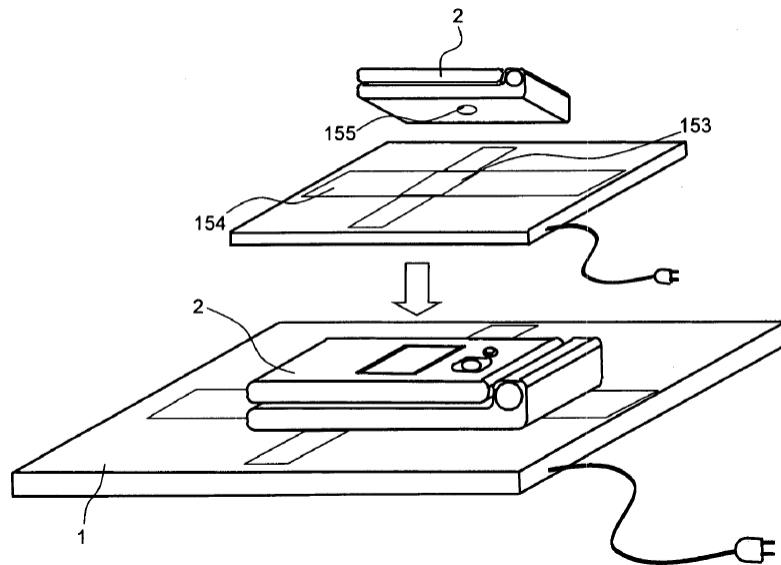
FIG. 8



(*Id.*, FIG. 8.)

88. Nakamura discloses another alignment mechanism with respect to figure 9 below, where marks are provided on the power transmission apparatus 1 and the portable telephone 2 (or other power reception equipment) in order to enable proper positioning of the power reception equipment to facilitate charging. (*Id.*, ¶0103.)

FIG. 9



(*Id.*, FIG. 9.)

E. *Silva* (Ex.1019)

89. I understand that *Silva* is an issued United States patent. (Ex.1019, Cover.) My understanding is that *Silva* was filed May 28, 2009 and issued March 10, 2015. (*Id.*) I rely on the disclosures and analysis thereof of *Stoner* discussed in this section VIII for my opinions regarding *Silva*'s teachings and suggestions as applied to the challenged claims of the '394 patent below in Section IX.

90. *Silva* demonstrates that, in the context of electrical conductors like copper wires, the "skin effect" and "skin depth" were known issues with which circuit designers were concerned:

For AC current, a phenomenon known as the "skin effect" causes that resistance to increase substantially with increasing frequency of current.

The skin effect is the tendency of an AC electric current to distribute itself within a conductor such that the current density (i.e., current per cross-sectional area) near the surface of the conductor is greater than at its core. In other words, the current tends to flow at the “skin” of the conductor. The skin effect is due to eddy currents formed by the AC current. The decline in current density verses depth from the surface is often quantified by a measure of the distance from the surface of the conductor over which the current density decays to $1/e$ (or about 37%) of its value at the surface. This measure is generally referred to as “skin depth.”

For low frequencies, the skin effect may be negligible. For AC current at frequencies high enough that the skin depth is small compared to the conductor diameter, the skin effect causes most of the conduction to happen at the conductor's surface. At high enough frequencies, the interior of a large conductor does not carry much current.

(*Id.*, 1:27-47.)

91. *Silva* further discloses that litz wires can be used to mitigate the skin effect, where an example of a litz wire is shown in figure 1 of *Silva* below. (*Id.*, 1:54-57 (“A type of cable called bunched wire or litz wire (from the German

litzendraht, braided wire) may be used to mitigate the skin effect for current with relatively high frequencies, such as a few kilohertz, a few megahertz, or more.”.)

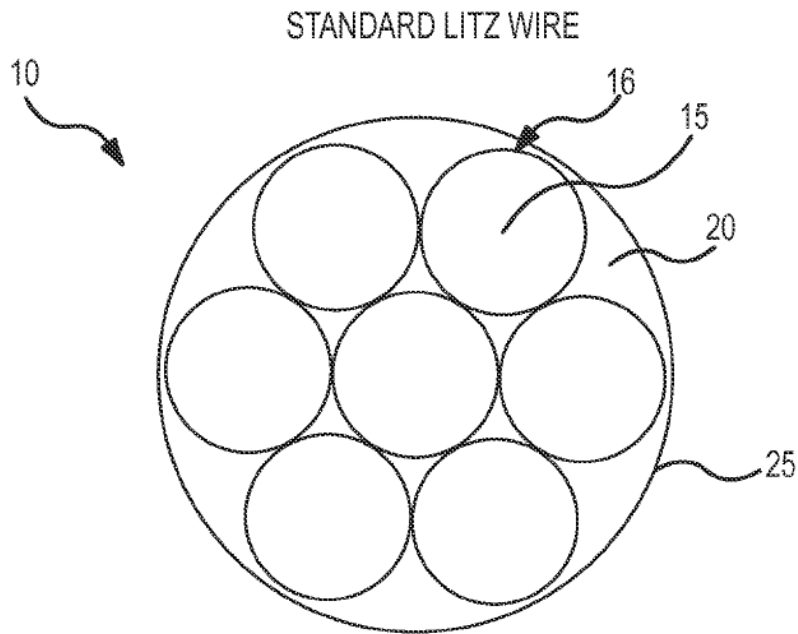


FIG.1
(PRIOR ART)

(*Id.*, FIG. 1.)

92. Silva describes figure 1 above as showing a “cross-sectional view of a litz wire 10” that “includes a number *of* insulated wire strands 15 woven together in a pattern (e.g., twisted, braided, or the like), so that the overall magnetic field acts substantially equally on all the strands and causes the total current to be distributed equally among them.” (*Id.*, 1:58-63.) Silva further discloses that “the radius of the individual strands may be chosen to be less than a skin-depth for a particular

application, so the individual strands do not suffer an appreciable skin effect loss.”
(*Id.*, 1:-63-66.)

93. *Silva* further discloses that “Litz wire may be used in the windings of high-frequency transformers, to increase their efficiency by mitigating both skin effect and...proximity effect, which is caused by an interaction of magnetic fields between multiple conductors.” (*Id.*, 2:4-8.) *Silva* further teaches that “[t]he weaving or twisting pattern of litz wire may be selected so that individual wires will reside for short intervals on the outside of [the] cable and for short intervals on the inside of the cable, which may allow the interior of the litz wire to contribute to the cable’s conductivity.” (*Id.*, 2:8-13.)

F. *Sagoo* (Ex.1048)

94. I understand that *Sagoo* is an issued United States patent. (Ex.1048, Cover.) My understanding is that *Sagoo* was filed October 24, 2006 and issued September 7, 2010. (*Id.*) I rely on the disclosures and analysis thereof of *Sagoo* discussed in this section VIII for my opinions regarding *Sagoo*’s teachings and suggestions as applied to the challenged claims of the ’394 patent below in Section IX.

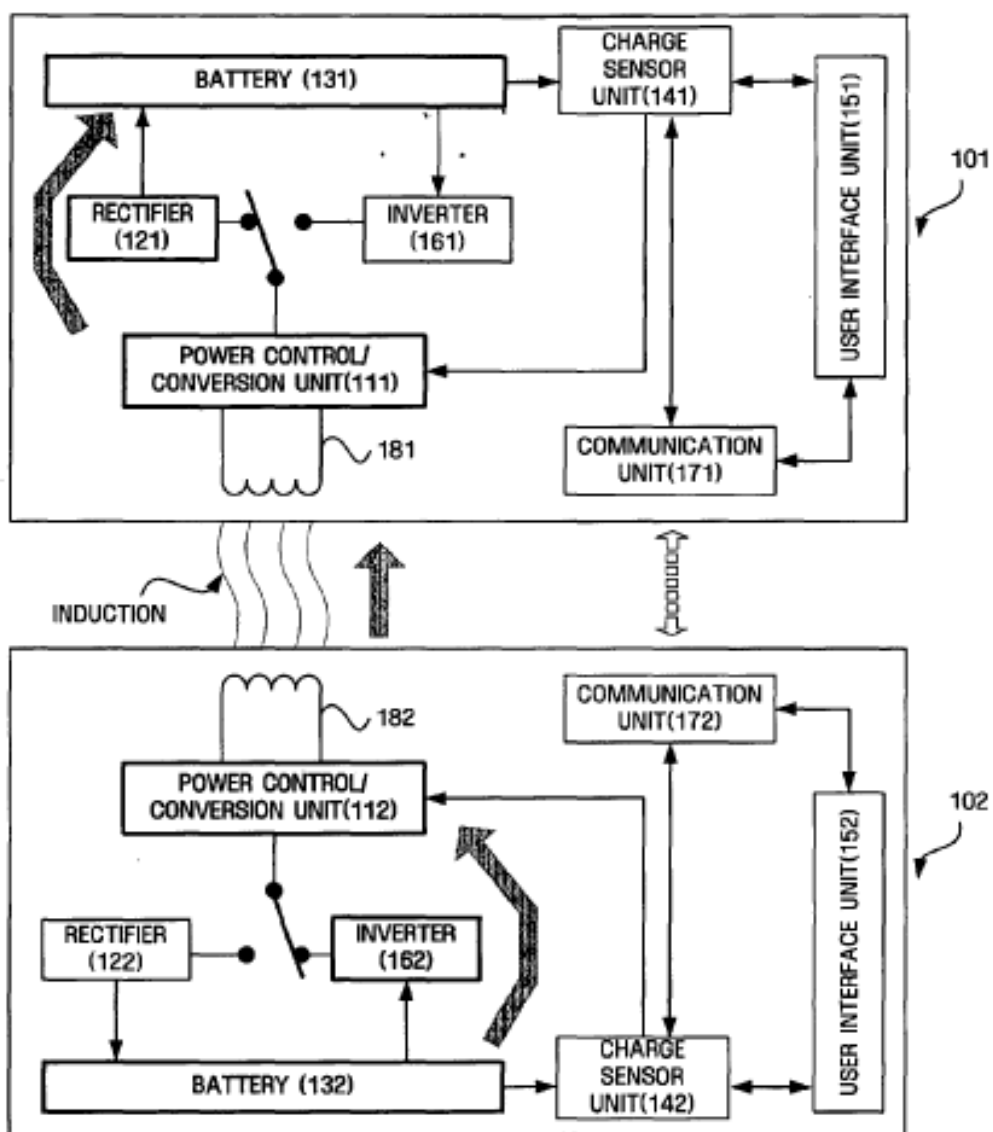
95. *Sagoo* discloses an inductive power sharing system that addresses potential limitations with chargers that are “mostly fixed or semi-fixed to power sockets,” such as a charging pad coupled to an AC power source. (Ex.1048,

Abstract, 1:15-63, FIG. 1.) Sagoo teaches configurations to “maximize the portability of a mobile device” by sharing power supplies of mobile devices. (*Id.*, 1:64-67 (“In order to maximize the portability of a mobile device, a non-contact charging method is required. Further, a charging method in which power supplies of mobile devices are shared with those of other mobile devices is required.”))

96. For example, *Sagoo* describes mobile device(s) that are configured to inductively transfer power to another mobile device using known primary/secondary coil arrangements. (*Id.*, 3:52-5:39.) *Sagoo* discloses a mobile device may operate in source mode (provides energy to another device) and a load mode (charged by energy of another device). (*Id.*, 4:30-33.) Depending on the mode in which the mobile device is operating, the inductive coil either serves as a primary coil to deliver energy or as a secondary coil to receiver energy. (*Id.*, 5:23-39.)

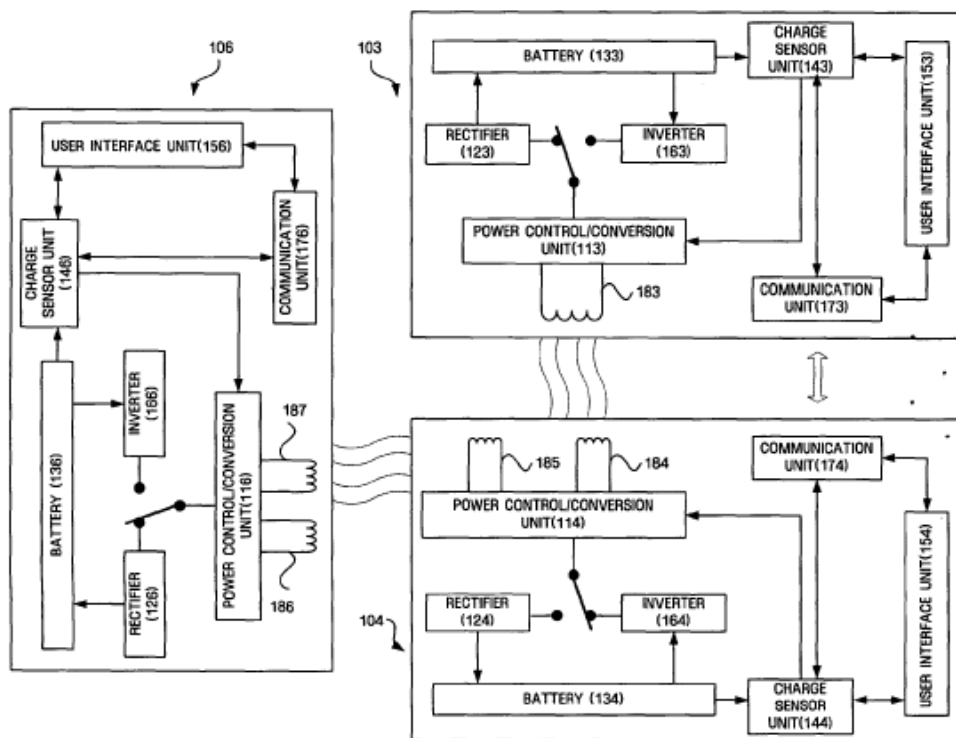
97. As shown in figures 4, 5, and 8 below, *Sagoo* provides examples of various arrangements for inductive power transfer systems.

FIG. 4



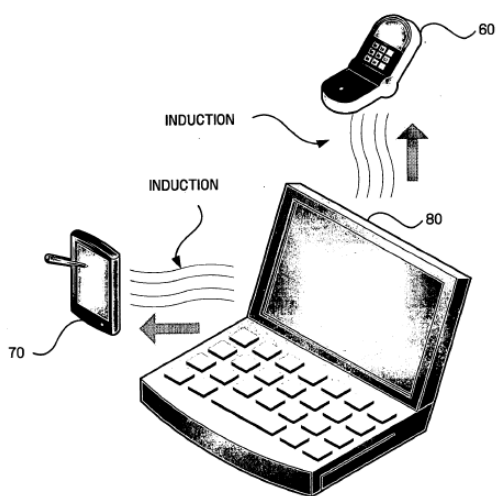
(Id., FIG. 4.)

FIG. 5



(Id., FIG. 5.)

FIG. 8



(Id., FIG. 8.)

98. *Sagoo*'s systems include rechargeable batteries within each mobile device that are used to operate that mobile device, where the batteries also act as a source of power to be inductively transferred to another mobile device (in source mode) when the mobile device is acting as a "charger." (*Id.* 4:10-11, 7:9-8:3.)

G. *Walley* (Ex.1049)

99. I understand that *Walley* is an issued United States patent. (Ex.1018, Cover.) My understanding is that *Walley* was filed June 3, 2010 and issued March 5, 2013. (*Id.*) I rely on the disclosures and analysis thereof of *Walley* discussed in this section VIII for my opinions regarding *Walley*'s teachings and suggestions as applied to the challenged claims of the '394 patent below in Section IX.

100. *Walley* describes inductive power transfer system configurations that include components and perform charging operations. (Ex.1049, Abstract, 1:23-25.) Figure 5 of *Walley* below shows such an inductive power transfer system, which includes a power transmitter circuit 84 and a power receiver circuit 86. (*Id.*, 2:30-32, 9:18-20.)

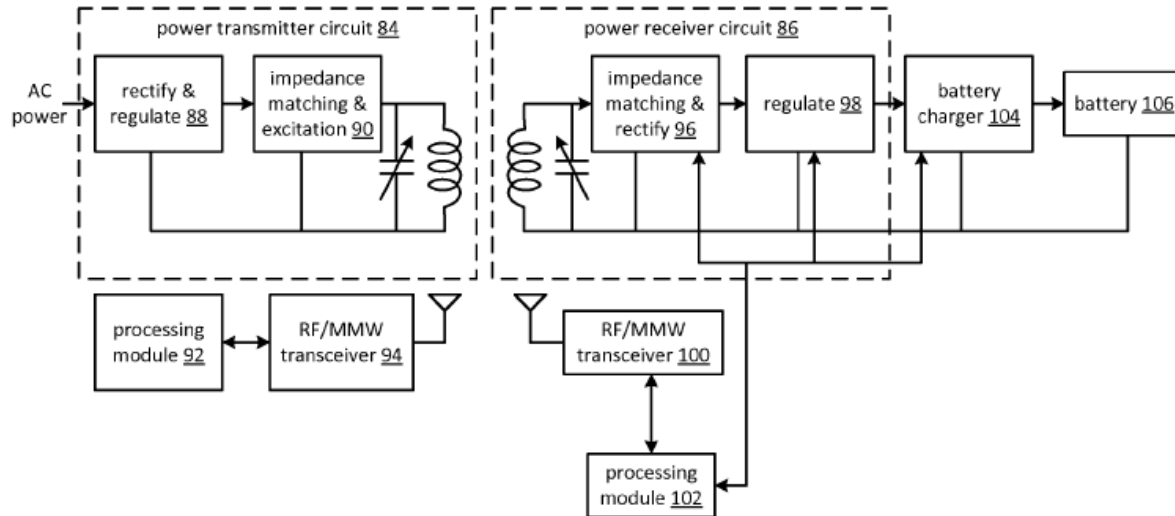


FIG. 5

(*Id.*, FIG. 5.)

101. *Walley* explains that in the wireless power transfer systems disclosed, the transmitter unit, which serves as a charger for providing power, can communicate with mobile devices via a control channel to facilitate efficient wireless power transfer. (*Id.*, 5:60-63.) Such communication allows for tuning of the components in the system to help achieve desired performance levels of energy transfer. (*Id.*, 5:63-6:6, 8:8-22, 9:18-58.)

102. *Walley* also discloses that the coils in the transmitter and receiver can be used for power transfer and communicating information (e.g., where the coil acts as an antenna). (*Id.*, 11:1-56.) An example system in which the coil serves such a dual purpose is shown in figure 8 below. (*Id.*)

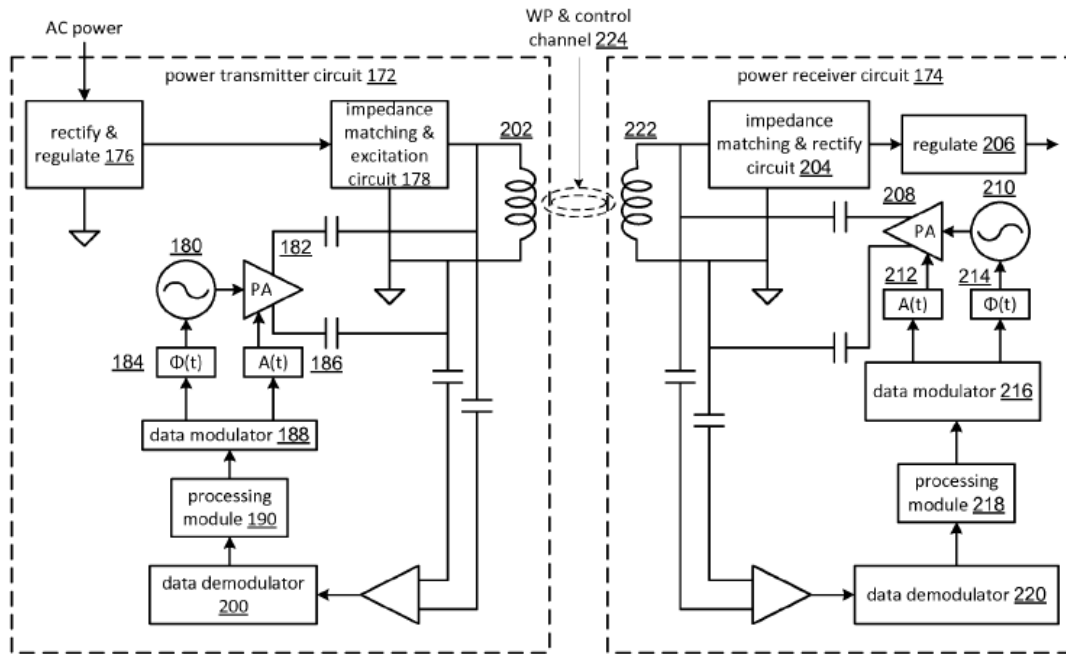


FIG. 8

(*Id.*, FIG. 8.)

H. *Ben-Shalom* (Ex.1050)

103. I understand that *Ben-Shalom* is a published international patent application. (Ex.1011, Cover.) My understanding is that *Ben-Shalom* was filed January 10, 2012 and published July 19, 2012. (*Id.*) I rely on the disclosures and analysis thereof of *Ben-Shalom* discussed in this section VIII for my opinions regarding *Ben-Shalom*'s teachings and suggestions as applied to the challenged claims of the '394 patent below in Section IX.

104. *Ben-Shalom* describes inductive power transfer system configurations that include components and perform charging operations, where *Ben-Shalom*

describes such charging operations where the receiver is inside a container that includes the charging circuitry. (Ex.1050, Abstract, 1:5-7 (“The embodiments disclosed herein relate to inductive power transfer systems. In particular the embodiments relate to inductive power transfer systems operable to transfer power to items within a container.”).) Figure 1 below shows “the main elements of an inductive power transfer system operable to provide power from an inductive power transmitter to an inductive power receiver within the interior of the inductive power transmitter.” (*Id.*, 5:17-19.)

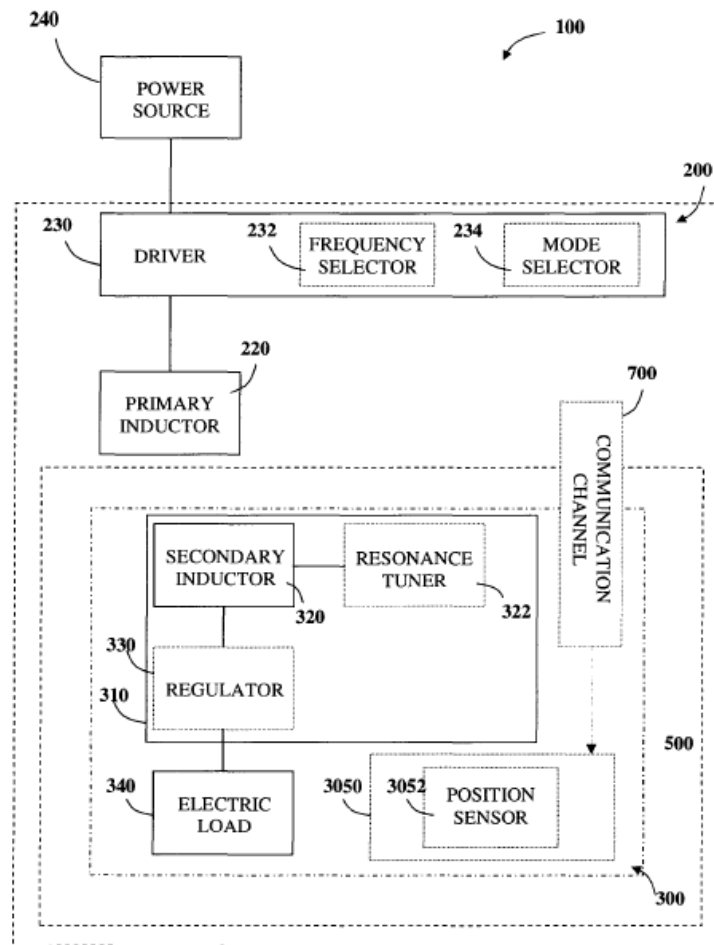
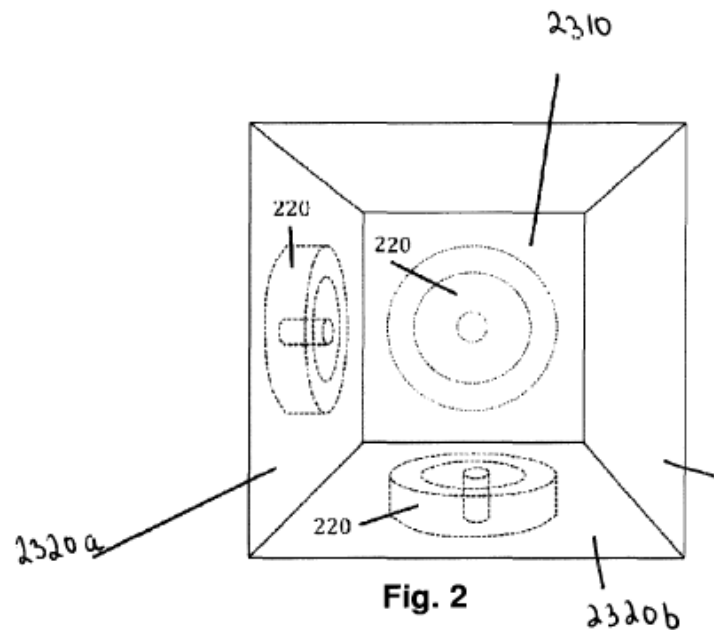


Fig. 1

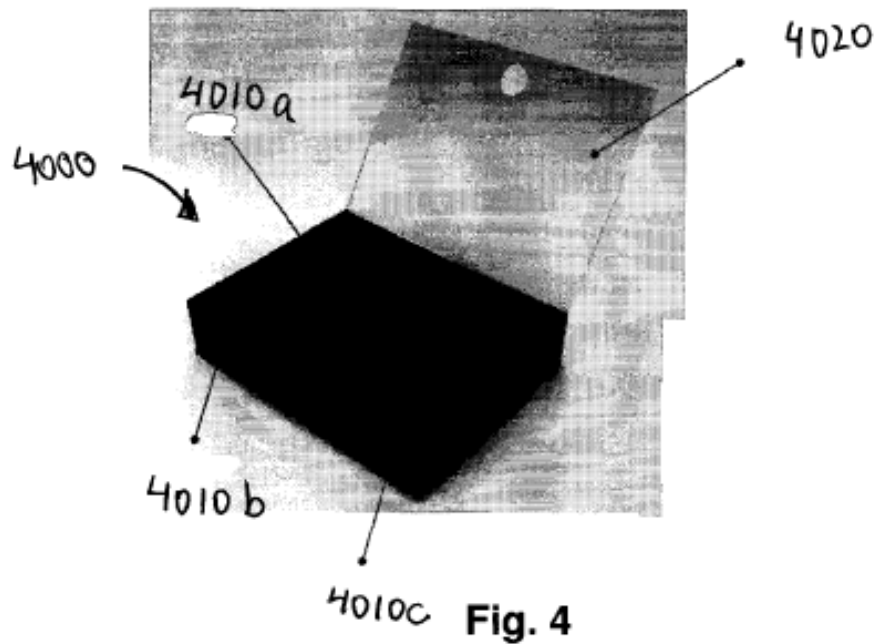
(*Id.*, FIG. 1.)

105. *Ben-Shalom* explains that the power transmitter can be in the shape of a box or container having a volume for receiving the power receiver in a position for receiving power inductively. (*Id.*, 7:17-24.) For example, figure 2 of *Ben-Shalom* shows an inductive power transmitter in a shape of a box with primary inductors in the walls of the box. (*Id.*, 8:15-19.)



(*Id.*, FIG. 2.)

106. Figure 4 of *Ben-Shalom* below shows an inductive power transmitter 4000 that has a plurality of power transmission spaces 4010A-C, where the power transmission space includes internal walls that separate the spaces. (*Id.*, 8:24-26.) The power transmitter “may be closable by a lid 4020 which may be hinged slidable or the like.” (*Id.*, 8:26-27.)



(*Id.*, FIG. 4.)

107. As shown below in figure 5 of *Ben-Shalom*, an inductive power transfer system 1700 includes multiple primary inductors 1820 arranged in an array in the wall 1810 of the container 1800. (*Id.*, 8:37-9:3.) “Inductive power receivers 1900 are provided having secondary inductors 1920 configured to receiver power inductively from the primary inductors 1820. (*Id.*, 9:3-5.)

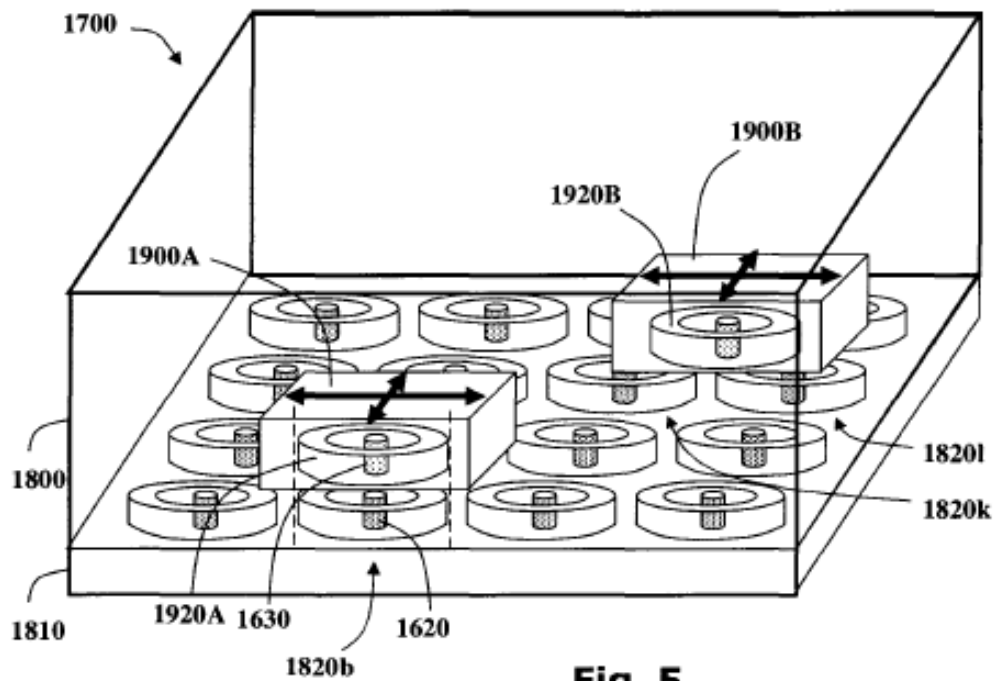


Fig. 5

(*Id.*, FIG. 5.)

IX. THE PRIOR ART DISCLOSES OR SUGGESTS ALL RECITED FEATURES OF CLAIMS 8, 13, AND 15-18 OF THE '349 PATENT³

A. Ground 1: *Fells* Discloses and/or Suggests the Features of Claim 17

108. In my opinion, *Fells* discloses and/or suggests all of the features of claims 17 of the '349 patent.

109. Because claim 17 depends from claim 1, I first address how *Fells* discloses or suggests the features of claim 1.

1. Claim 1

a) Limitation 1(a): A system for inductive power transfer comprising:

110. 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 *Fells* discloses the limitation(s) in the preamble. (*See* my analysis and

³ 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.

discussions below for this section; *see also* my analysis and discussions below for Sections IX.A.1(b)-(q)⁴.)

111. As I explain below, *Fells* discloses a “**system for inductive power transfer**” (limitation 1(a)). For example, *Fells* discloses “an ***inductive power transfer system*** including a primary unit and a secondary device,” where the primary unit includes a “power transfer surface” and “field generators” (e.g., primary coils) and where the secondary device (which can be a mobile device) includes a “power receiver having a secondary coil.” (Ex.1005, Abstract.)

112. *Fells* describes various configurations of such a power transfer system including components that include, for example, a primary unit with a surface, primary coils (e.g., field generators, cells, coils), mobile device (e.g., a mobile phone, etc.) with a receiver that includes a secondary coil (e.g., a solenoid with magnetic core and wires), and related circuitry. (*See* my analysis and discussions in Sections IX.A.1(b)-(q); Ex.1005, Abstract, FIGS. 1-8, 16-20, 22-23, 1:3-6:3, 6:56-

⁴ My analysis/discussions of *Fells* and supporting citations to *Fells* in this section are applicable to the analysis/discussions for all limitations of claims 1 and 26, and are incorporated by reference fully below in each of those sections even where not expressly cited or referenced.

8:9, 10:26-11:8, 11:26-12:19.) (*See also id.*, FIGS. 9-15, 21, 24-27, 8:10-10:25,
11:9-25, 13:26-22:35.)

Fig. 2

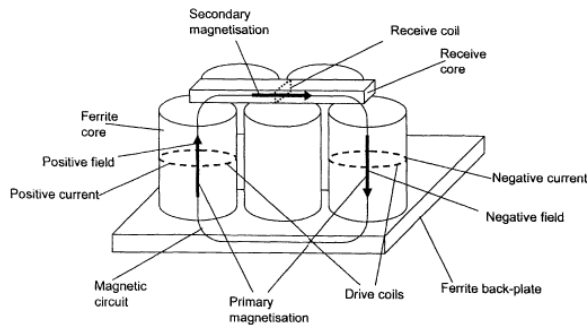
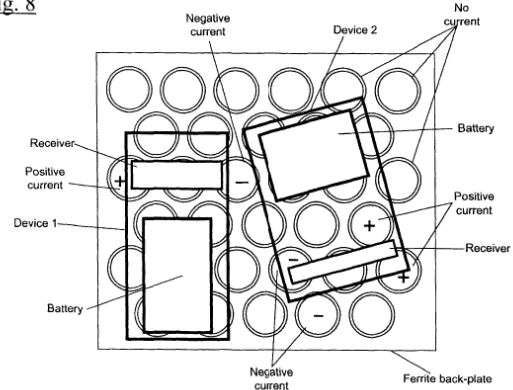


Fig. 8



(*Id.*, FIGS. 2, 8.)

Fig. 5

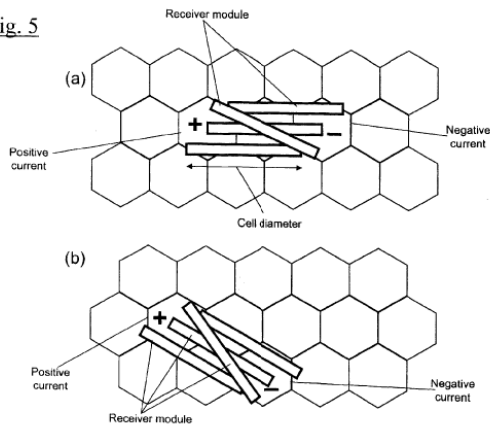
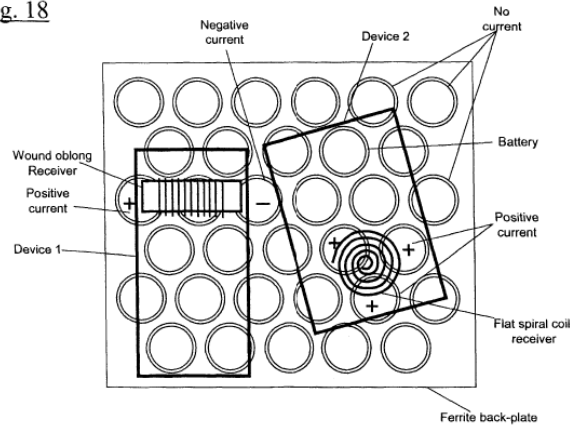


Fig. 18



(*Id.*, FIGS. 5, 18.)

Fig. 16

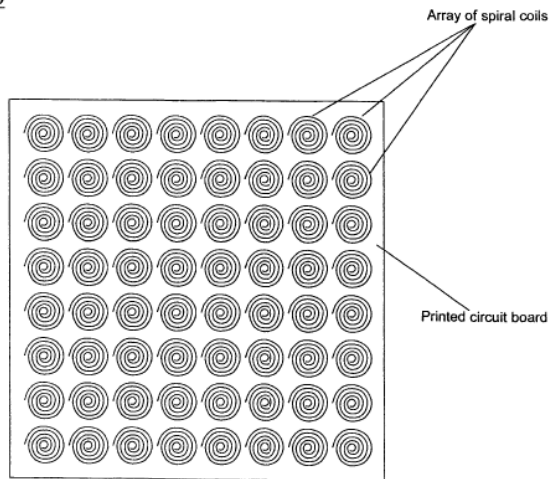
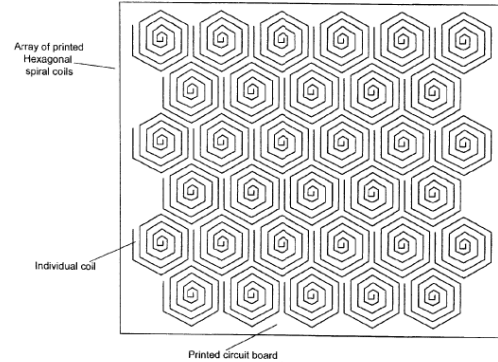
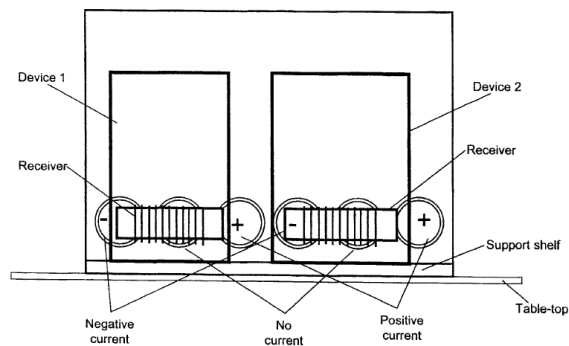


Fig. 17



(*Id.*, FIGS. 16, 17.)

Fig. 23



(*Id.*, FIG. 23.)

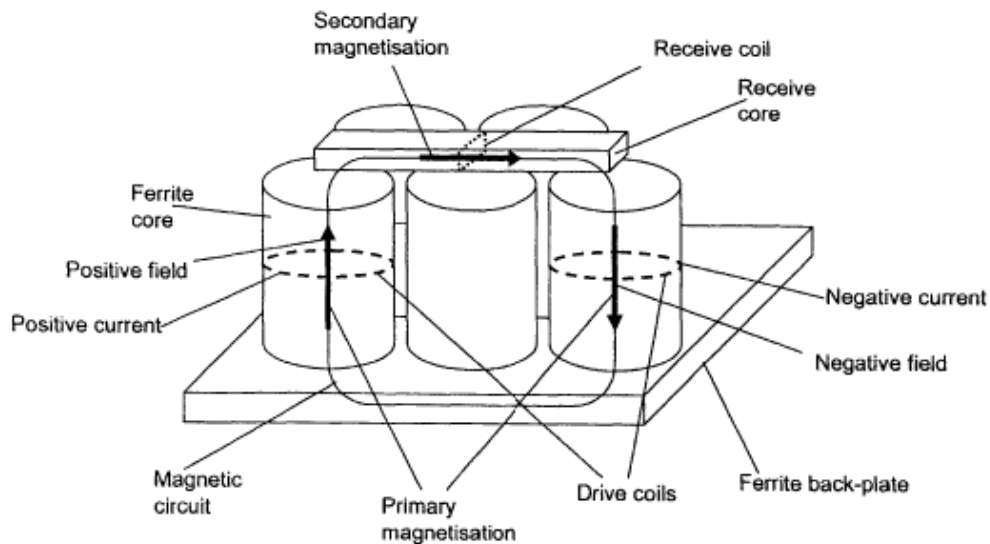
113. A person of ordinary skill in the art would have understood that *Fells* discloses a number of different arrangements and configurations of such inductive power transfer systems, where different concepts and disclosures relating to the various arrangement and configurations are not limited to the specific arrangement or configuration for which those concepts and disclosures are presented. In other

words, in my opinion, a person of ordinary skill in the art would have understood that *Fells'* discussions of similar components, features, and functionalities relating to various configurations (exemplified by the figures) are applicable to other configurations. For example, the arrangement of components for one example system depicted in the figures and/or described in *Fells'* disclosure, materials used for aspects of that system, the configuration of the components of that system, etc. are related to and applicable to other inductive power transfer systems in the context of *Fell's* disclosure. For example, some of *Fells'* embodiments include features not applied to the claim limitations herein, but the disclosures associated with those embodiments include teachings/suggestions applicable to a "system" like that claimed, especially in context of the modified *Fells* system I discuss below. (See my discussion below in Sections IX.A.1(b)-(q).)

114. For example, while FIG. 2 (below) includes non-planar charging coils and does not include a charging coil with a planar surface on a printed circuit board as recited in claim elements 1[c]/26[b], the disclosure related to how magnetic field is generated and flows in a magnetic circuit formed by activated primary coils and the mobile device's receiver (with secondary coil) that is related to figure 2 is applicable to the other configurations (e.g., a system with planar charging coils) discussed by *Fells*. (See e.g., Ex.1005, Fig. 2, 7:9-24 (discussing the "magnetic

circuit” formed), 10:26-34 (discussing the “magnetic circuit” for planar PCB coils in FIG. 16).)

Fig. 2



(*Id.*, FIG. 2.)

115. With respect to figure 2, *Fells* explains:

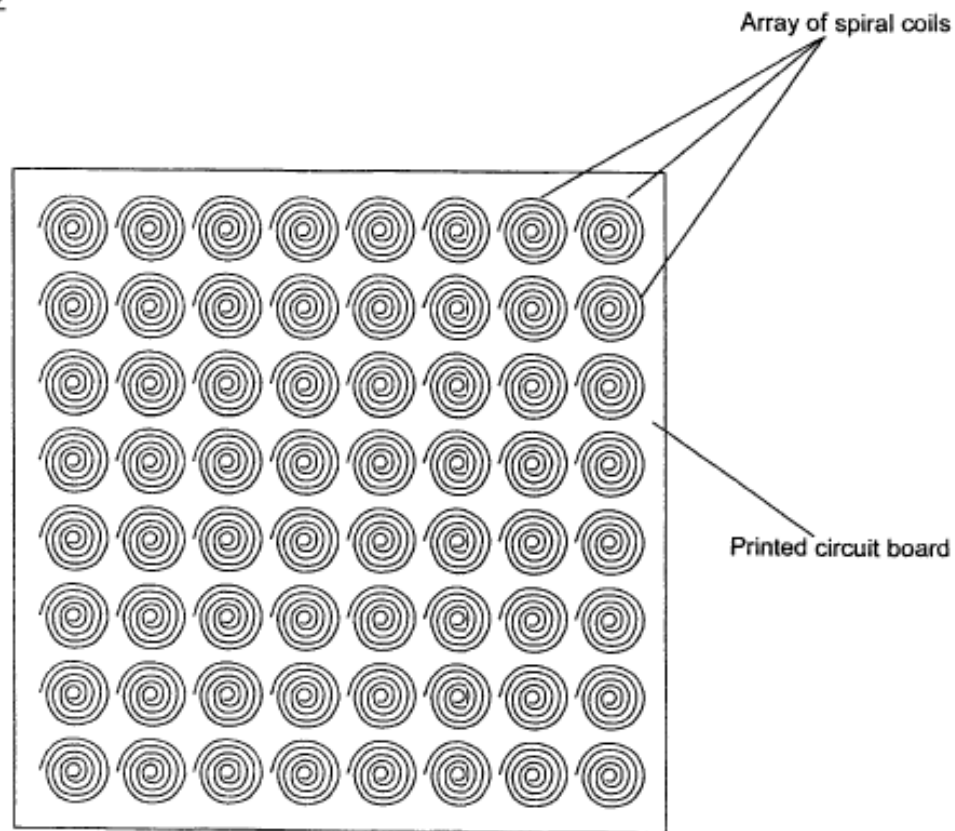
FIG. 2 illustrates the **magnetic circuit** formed when the power receiver is placed on the charging surface. A coil in proximity to one end of the receiver is driven with current in a positive sense and a coil in proximity to the other end is driven in a negative sense. The field is concentrated in the ferrite and forms a **magnetic circuit from the first coil, through the receiver core, through the second coil**

and through the ferrite backplate to complete the circuit.

(Id., 7:9-16.)

116. A person of ordinary skill in the art would have understood that Fell's teachings regarding the magnetic circuit formed in figure 2 would also be applicable to similar magnetic circuits in other inductive power transfer systems disclosed by *Fells*, including those that use a charger that has planar coils on a PCB (as depicted in figure 16 below). (*Id.*, 10:26-32 ("FIG. 16 shows a charger formed using a PCB implementation. In this arrangement there is an array of planar spiral coils used to generate the vertical fields. ... A ferrite back plate would typically be required to complete the magnetic circuit.").)

Fig. 16



(*Id.*, FIG. 16.)

117. A person of ordinary skill in the art would have understood that *Fells*' inductive power transfer system is described as versatile in configuration, where different arrangements/features are described to be related to each other (where applicable). As I discuss below, the "system for inductive power transfer" disclosed by *Fells* includes configurations that encompass components and features that track the features recited in claims 1 and 26. (Ex.1005, 1:41-6:3, 12:9-22:32; *see my* discussion below in Sections IX.A.1(b)-(q).)

b) Limitation 1(b): a charger, wherein the charger is an inductive charger, and the charger includes:

118. In my opinion, *Fells* discloses this limitation for the reasons I discussed above for limitation 1(a), for the reasons I discuss below, and my discussion of *Fells* in Section VIII.A. (See my analysis and discussions in Section IX.A.1(a); see also my analysis and discussion below in this section; see also my analysis and discussions in Section VIII.A.)

119. For example, as I discuss above for limitation 1(a), *Fells*' "**inductive power transfer**" "**system**" includes a primary unit ("**charger**") that transfers power to the secondary (mobile) device via electromagnetic induction. (See my analysis and discussions in Section IX.A.1(a).) For example, figure 9 of *Fells* depicts an electrical configuration of a charger, figure 13 depicts an electrical circuit diagram of the charger, and figure 26 shows an alternate configuration of the charger. (*Id.*, 6:27, 31-32, 50-51.)

Fig. 9

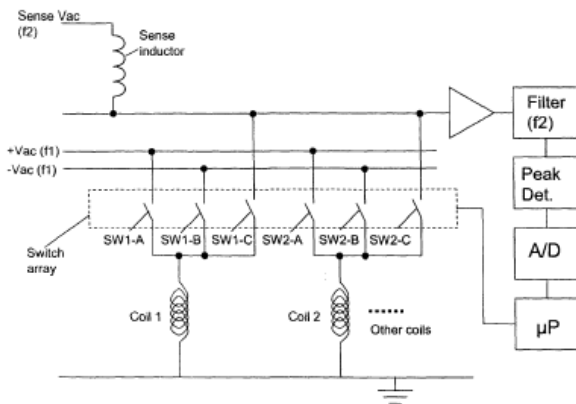
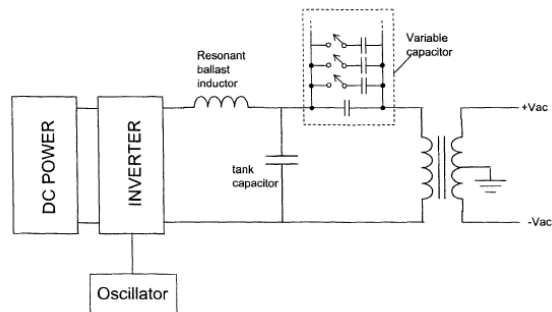
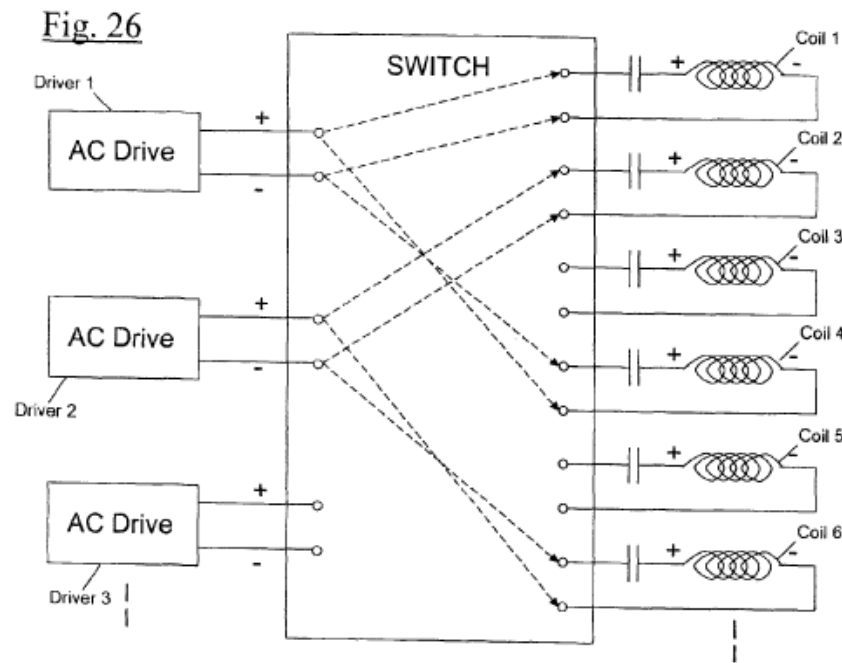


Fig. 13



(*Id.*, FIGs. 9, 13.)



(*Id.*, FIG. 26.)

120. Fells discloses an inductive charger (e.g., primary unit):

According to a third aspect of the invention there is provided a **system for transferring power from a primary unit** to a secondary device, separable from the primary unit, **by electromagnetic induction**

the primary unit comprising:

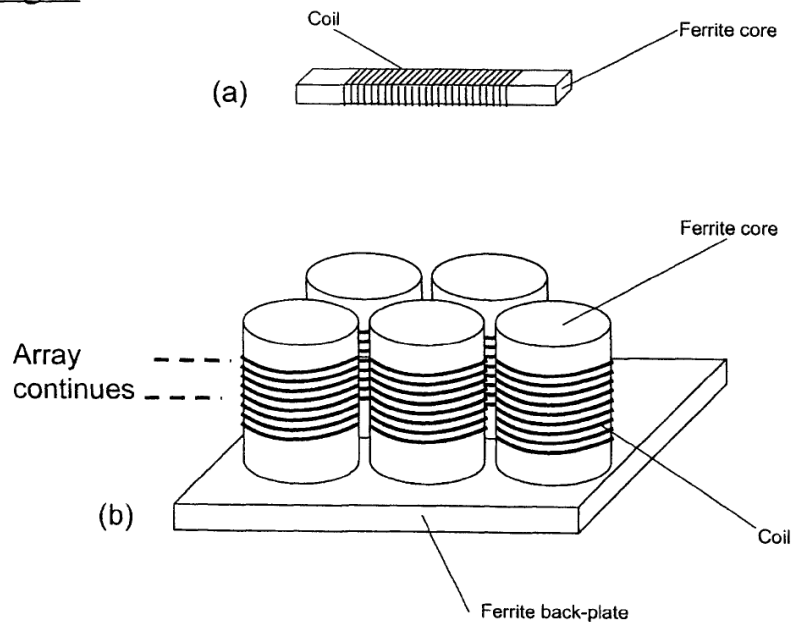
a power transfer surface;

a plurality of field generators, each able to generate a field substantially perpendicular to the power transfer surface;

(Ex.1005, 2:28-33; *see also id.*, 6:9-14 (“system for transferring power from a **charger** to a portable device”), 6:15-52 (“charger”).

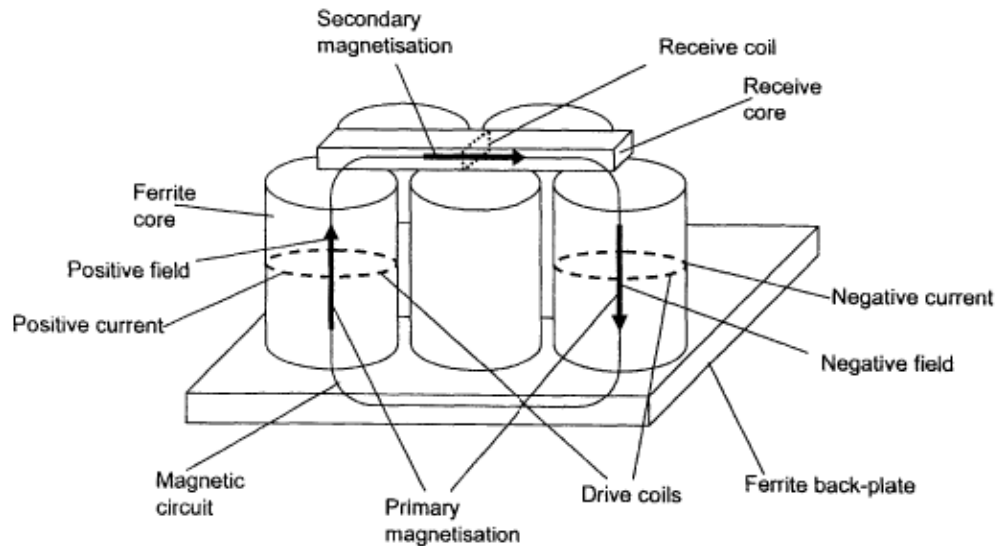
121. Figures 1 and 2 of *Fells* depict a system for inductive power transfer where figure 1(b) shows the charging pad for transmitting power to the receiver in figure 1(a), whereas figure 2 depicts the magnetic circuit formed when the power receiver is placed on the charging device. (*Id.*, FIGs. 1, 2; 6:57-7:21.)

Fig. 1



(*Id.*, FIG. 1.)

Fig. 2



(*Id.*, FIG. 2.)

122. For example, *Fells* explains:

FIG. 1 shows a system for wirelessly charging a portable device. FIG. 1(a) shows a power receiver suitable for embedding in a portable device. It has a ferrite core and coil wound around the core. **FIG. 1(b) shows part of a charging pad for transmitting power to the receiver.** The pad consists of an array of coils, each wound around a ferrite core. These cores are attached to a ferrite backplate. A charging surface is formed across the ends of the cores, such that the coil axes are perpendicular to the charging surface. This would typically be covered by a plastic housing (not shown). Current is applied to the

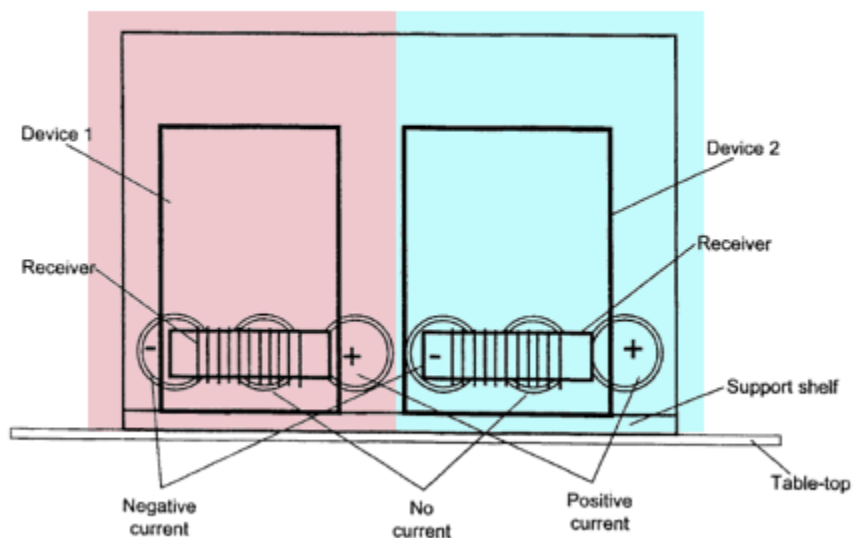
coils so as to generate a magnetic field in a direction perpendicular to the charging surface. Depending on the polarity of the current, this direction will be either out of or into the charging surface. Preferably Litz wire is used for both the primary and secondary coils. Litz wire has many strands of copper, each insulated from one another. This allows the copper losses to be reduced as at high frequencies the skin effect means that current is only carried in the outer skin of the conductors.

FIG. 2 illustrates the magnetic circuit formed when the power receiver is placed on the charging surface. A coil in proximity to one end of the receiver is driven with current in a positive sense and a coil in proximity to the other end is driven in a negative sense. The field is concentrated in the ferrite and forms a magnetic circuit from the first coil, through the receiver core, through the second coil and through the ferrite backplate to complete the circuit. There are small gaps in the circuit between the charging surface and the power receiver because of the plastic housings on both the charging pad and the portable device. The thickness of the plastic should be minimised to reduce this gap and gaps of 2 mm or less are achievable.

(Ex.1005, 6:57-7:21; *see also id.*, 7:25-42, 8:1-9 (multiple devices simultaneously charged), 8:10-9:63; 13:53-14:14.) In my opinion, the portion of the primary unit

including one or more of the charging coil(s) and associated circuitry/components discussed here and below for claim 1 is a “charger” as recited in claim 1. For example, in the configuration above for FIG. 23, a “charger” can be exemplified by the charging coils on left (red below) or right side (blue below) of the unit (and associated circuitry/components discussed above and below (*see* my analysis and discussions in Sections IX.A.1(a)-(q)). Note that highlighted portions in annotated FIG. 23 below are exemplary and not intended to be limiting in terms of precise boundaries or schematic of the “charger.”

Fig. 23



(Ex.1005, FIG. 23 (annotated).)

c) Limitation 1(c): a printed circuit board having a charger coil, wherein the charger coil has a substantially planar charger surface;

123. In my opinion, *Fells* discloses 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)-(q); *see also* my analysis and discussions in Sections VIII.A.)

124. As I discussed above, *Fells*' "charger" can be configured with one or more planar primary coils ("**charger coil [having] a substantially planar charger surface**") on a "**printed circuit board**" (PCB). (Ex.1005, 10:26-37; 11:45-64, claim 1, FIGs. 16-17, 23.) For example, *Fells* explains that the charger can be formed "using a **PCB** implementation":

FIG. 16 shows **a charger formed using a PCB implementation**. In this arrangement there is **an array of planar spiral coils used to generate the vertical fields**. Typically multiple PCB layers would be used, each having an array of coils. These coil arrays would be aligned with each other to enhance the magnitude to the field generated. A ferrite back plate would typically be required to complete the magnetic circuit. It may be desirable to have holes in the centre of the spiral, which could accommodate cylinders of magnetic material.

FIG. 17 shows another PCB implementation. However, this system uses an array of hexagonal coils which are closely packed together.

(*Id.*, 10:26-37.)

125. Indeed, Fells discloses that planar technology like PCB coils “can be used to reduce cost” of the charger. (*Id.*, 11:61-63.) Figures 16 and 17, which are annotated below, show PCB charger configurations. (*Id.*, 6:36-37, 10:26-27, 35.)

Fig. 16

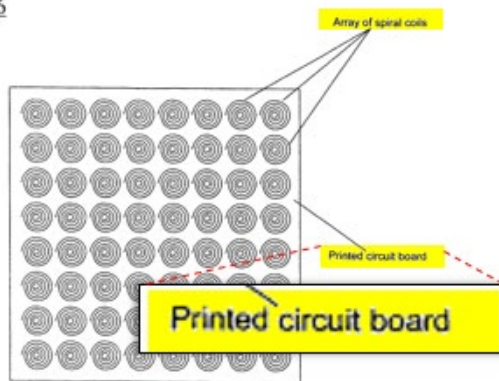
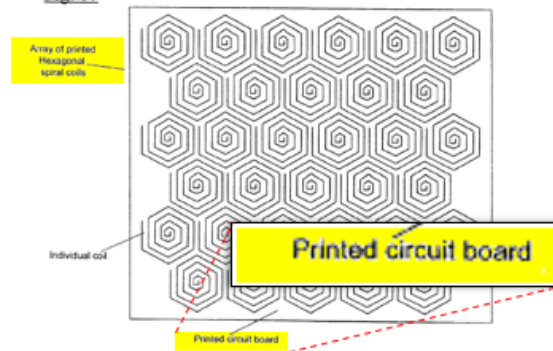


Fig. 17



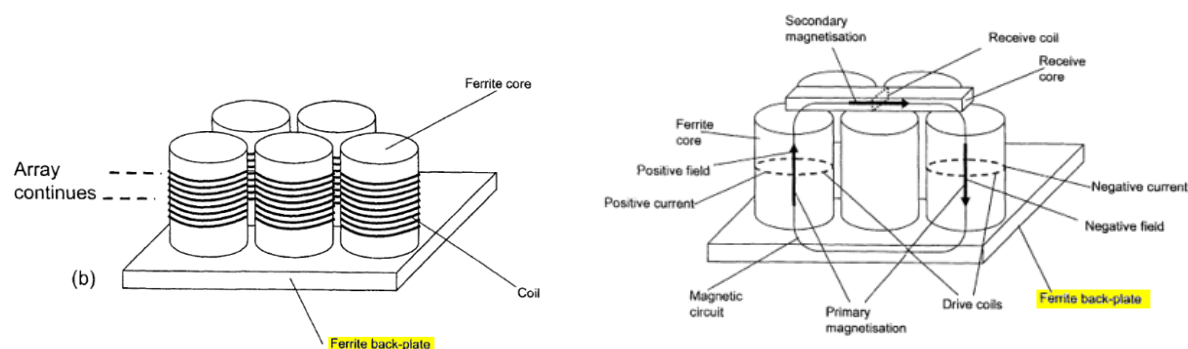
(*Id.*, FIGs. 16, 17 (annotated).)

d) Limitation 1(d): a substantially planar magnetic layer under the charger coil opposite the charger surface; and,

126. In my opinion, *Fells* discloses 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)-(q); *see also* my analysis and discussions in Sections VIII.A.)

127. For example, *Fells* explains that the charger can include a ferrite backplate (“**substantially planar magnetic layer**”) under the primary coil(s) (“**charger coil(s)**”) that is “**opposite the charger surface**” since it is positioned under the surface of the primary coil(s) that generate the magnetic field used to transfer power to the secondary coil of the mobile device(s). (Ex.1005, 10:26-34 (PCB-planar spiral coil implemented charger of FIG. 16 where “[a] *ferrite back plate* would typically be required to complete the magnetic circuit”), 11:65-12:9 (discussing FIG. 23, where “[a] ferrite back-plate may be used **behind the vertical cores to act as a flux return path**, and this improves the coupling factor” and “The permeable material from which the cores and/or back-plate are manufactured is preferably *Mn-Zn ferrite, but other magnetic materials* such as iron powder cores, carbonyl iron, amorphous metal, nanocrystalline metal or magnetic composites *could be used*”), 6:57-63 (“FIG. 1(b) shows part of a charging pad for transmitting power to the receiver. The pad consists of an array of coils, each wound around a ferrite core. These cores are attached to a *ferrite backplate*.”), 7:9-21 (discussing FIG. 2, where “[t]he field is concentrated in the ferrite and forms a magnetic circuit from the first coil, through the receiver core, through the second coil and through the *ferrite backplate* to complete the circuit”), 8:26-32, FIGs. 1(b), 2, 16, 23; *see also* FIGs. 3, 8, 17-18; *see my discussion above in IX.A.1(a).*)

Fig. 2



(Ex.1005, FIGS. 1(b), 2 (annotated).)

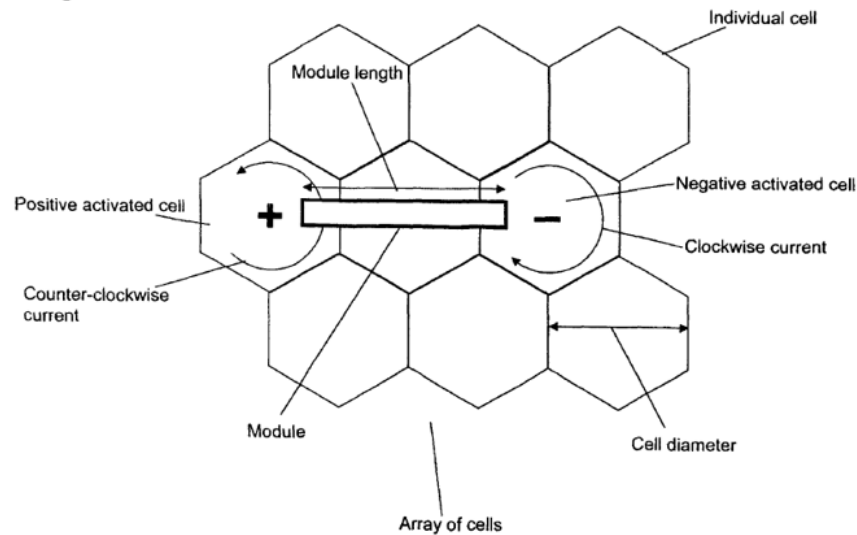
128. Based on *Fells*' disclosure regarding the positioning and purpose of the ferrite backplate, a person of ordinary skill in the art would have understood the ferrite backplate implemented in the various applications of the charger in *Fells* is a magnetic layer that is “**substantially planar**” (e.g., as depicted in, for example, figures 1(b) and 2 and as would be understood for a “plate”) and is positioned “**under the charger coil(s)**” (e.g., the primary/drive coil(s)) and “**opposite the surface of the charger**” (which in *Fells*, faces the secondary coil). Such planar form and positioning on the opposite side of the charging coils from the charging surface on which the receiver is to be positioned enables the ferrite backplate to act as a flux return path, facilitate formation of the magnetic circuit, and improve the coupling factor, as disclosed by *Fells*.

- e) **Limitation 1(e): a charger drive circuit, wherein the charger drive circuit includes a resonant capacitor and a FET switch to apply an alternating voltage to the charger coil; and**

129. In my opinion, *Fells* discloses this limitation. As I discussed above, the system described by *Fells* can be configured in different ways for various applications. (See my analysis and discussions below in this section; see also my analysis and discussions in Sections IX.A.1(a)-(d), IX.A.1(f)-(q); see also my analysis and discussions in Section VIII.A.) For example, as I discuss below, *Fells* discloses that the coil(s) in the array of coils on the charger can be selectively driven by drive circuitry (a “**charger drive circuit**”) in order to enable a receiver device to be charged when it is detected on the charging pad.

130. For example, *Fells* describes an exemplary relationship between a power receiver (“**mobile device**”), which I discuss in Section IX.A.1(f) below, and the charger coils, where such a relationship is shown, for example, in figure 4.

Fig. 4

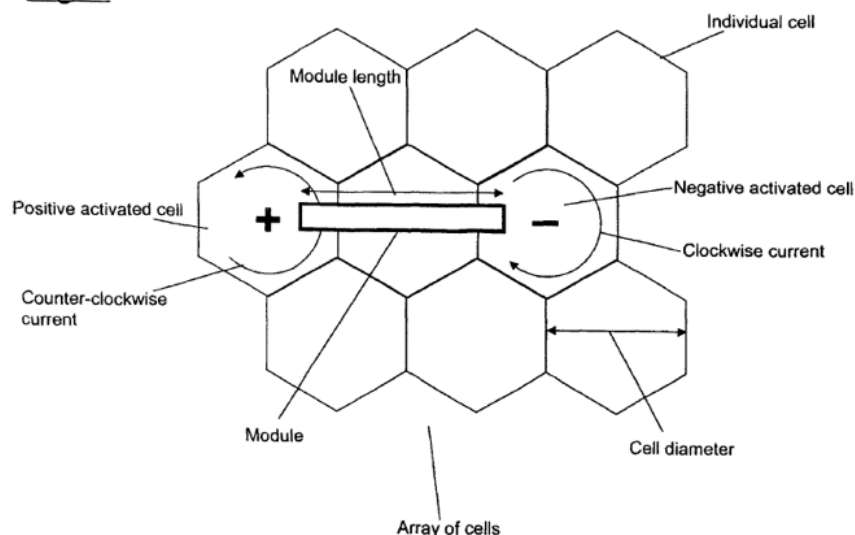


(*Id.*, FIG. 4.) As disclosed by *Fells*:

FIG. 4 illustrates the dimensional relationship between the power receiver and the charger coils. For clarity, the coil positions are represented by hexagonal cells to reflect the hexagonal symmetry of the structure. The energised coils are represented by a '+' for current flowing in a counter clockwise direction and '-' for current flowing in a clockwise direction. The coils themselves could physically be a range of different structures as will be become apparent later. Dimensions which give good performance for powers of 2-5 W are: a power receiver which is 30 mm long with a cross section of 2 mm×6 mm; and a charging surface with a cell diameter of 15 mm.

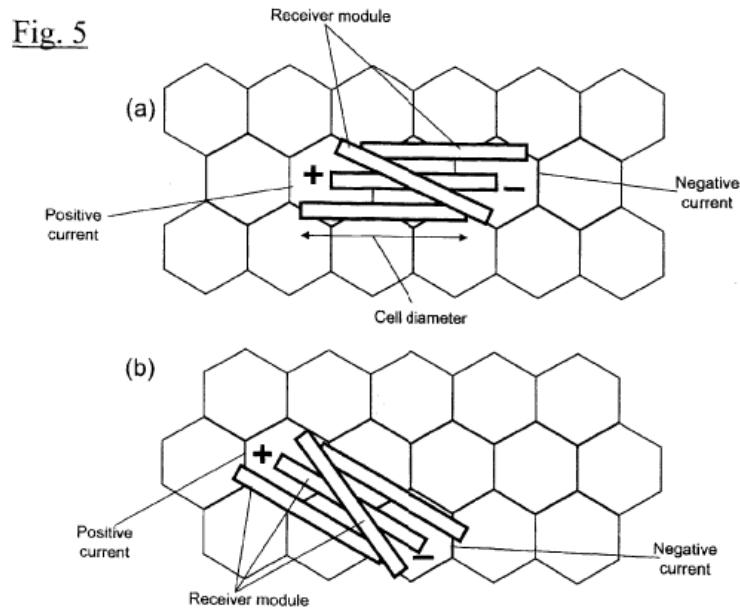
(Ex.1005, 7:31-42.)

Fig. 4



(*Id.*, FIG. 4.)

131. As shown in figure 4 above and described by *Fells*, cells corresponding to coils on the charger in *Fells* can be selectively powered based on the positioning of the receiver. (*Id.*, 7:31-42.) *Fells* further discloses that the receiver can be powered by activating multiple coils even when the receiver is placed in different positions. (*Id.*, 7: 25-67.) For example, as shown in the examples presented in figure 5 below, two charging coils on the charging pad can be driven to provide power to a receiver placed on the charging pad, where which coils are driven can be determined based on the positioning of the receiver.



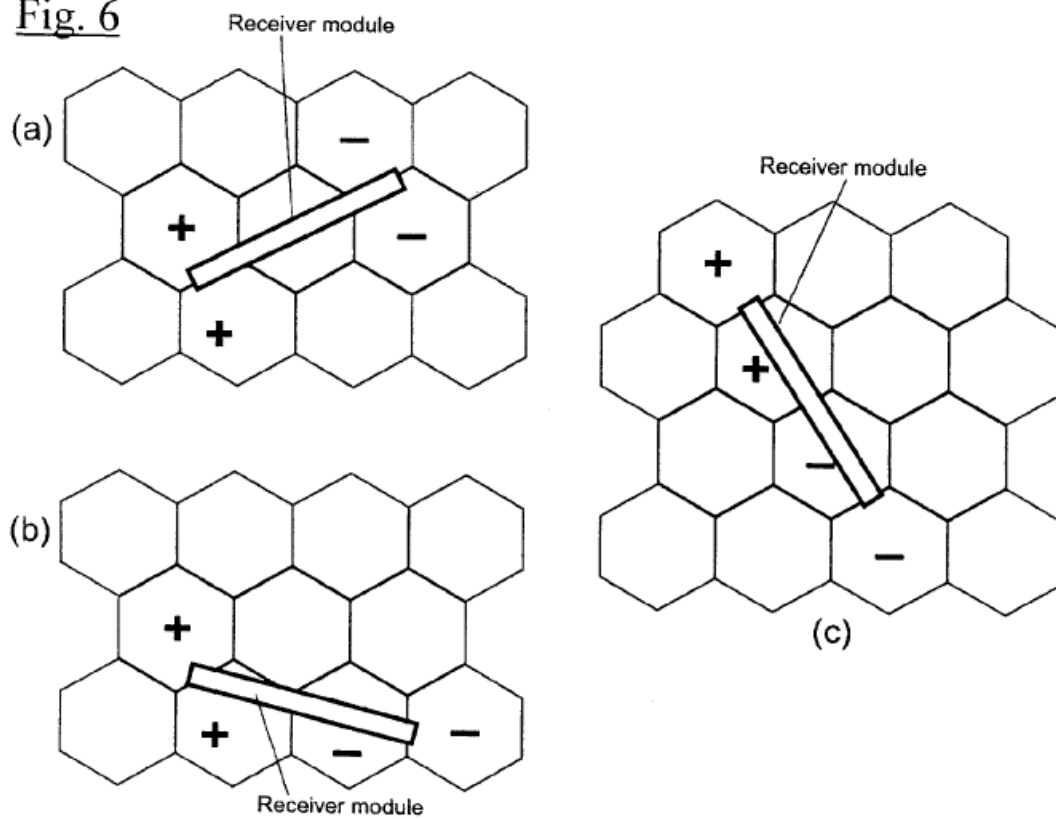
(*Id.*, FIG. 5.) As Fells discloses:

FIG. 5 illustrates how a power receiver can be powered in different positions by activating just two coils on the pad. For the case of energising only 1 pair of coils (one positive and one negative), there are two distinct geometries, shown in FIGS. 5(a) and 5(b). The range of permutations of negative coils to energise with any given positive coil is limited to a maximum of twelve ‘second nearest neighbour’ cells.

(*Id.*, 7:43-59.)

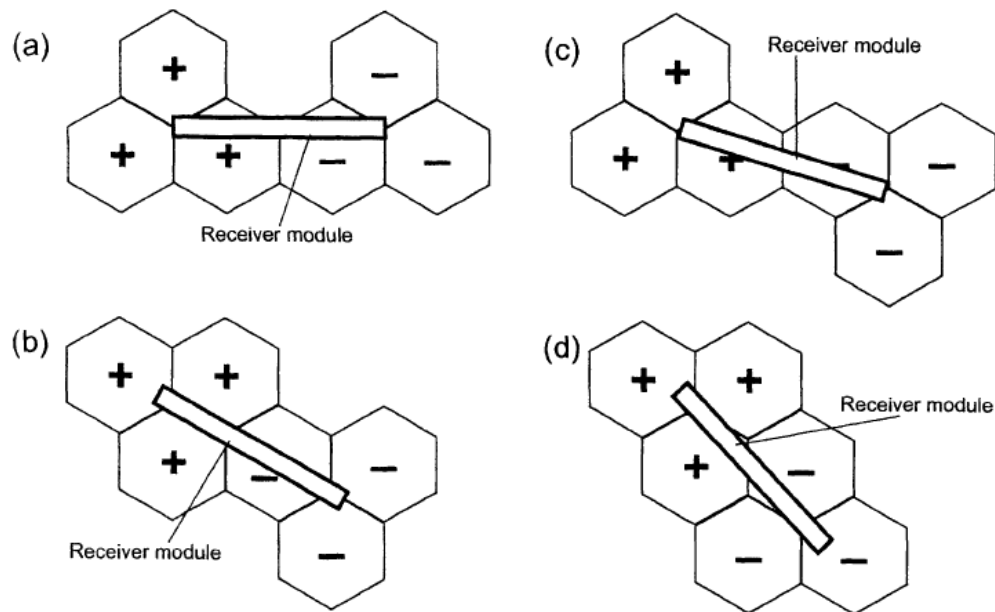
132. Similarly, figures 6 and 7 below show selectively driving power to two or three pairs of coils in order to provide power to a receiver.

Fig. 6



(*Id.*, FIG. 6.)

Fig. 7



(*Id.*, FIG. 7.) As Fells discloses:

FIG. 6 illustrates how a power receiver can be powered using two pairs of coils. Using two pairs, there are 10 distinct geometries, though only 5 or 6 are practical. Three of these are shown in FIGS. 6(a), 6(b) and 6(c).

FIG. 7 illustrates how a power receiver can be powered using three pairs of coils. With three pairs there are 4 distinct geometries, shown in FIGS. 7(a), 7(b), 7(c) and 7(d). In practice only 7(a) and 7(b) give good coupling.

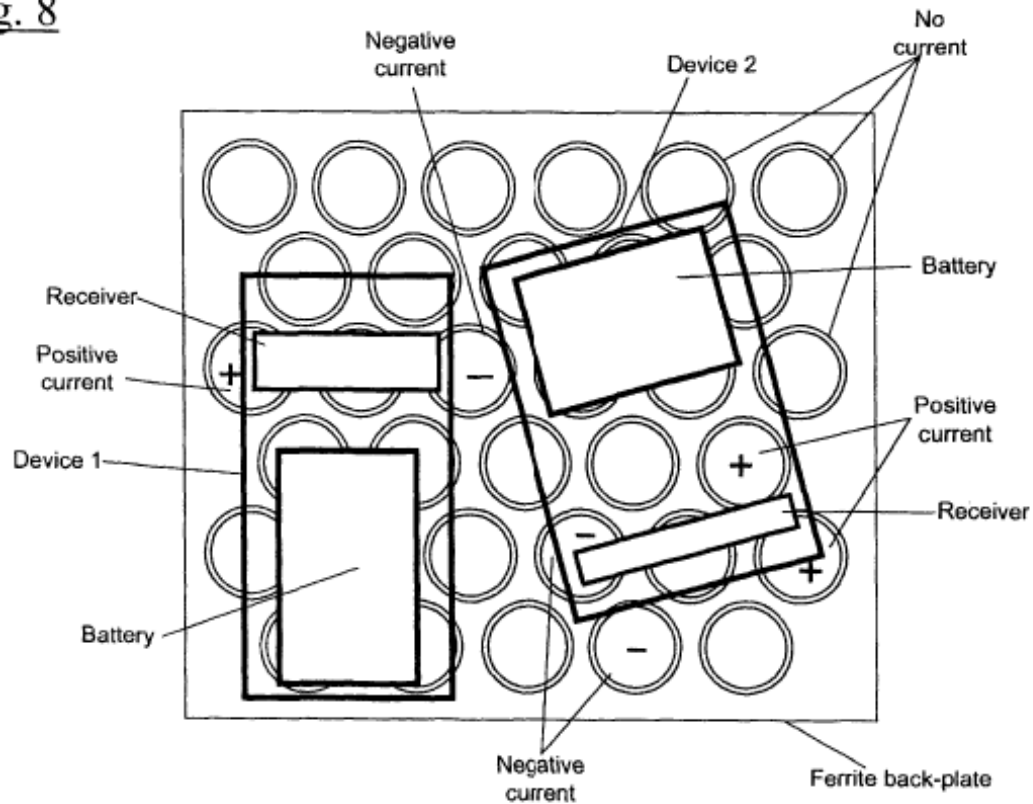
For a given position of the power receiver on the charging surface, there are a number of possible driving

arrangements that can be used. As more pairs of coils are used, the maximum coupling coefficient goes down, but the variation in coupling gets less. It is possible to keep the number of pairs used fixed, or it is possible to use a different number of pairs, depending on the precise position and orientation of the power.

(*Id.*, 7:50-65.)

133. *Fells* also discloses that multiple coils can be driven by the drive circuitry on the charger in order to provide power to multiple receiver devices simultaneously, where an example of such a configuration is shown in figure 8 below.

Fig. 8

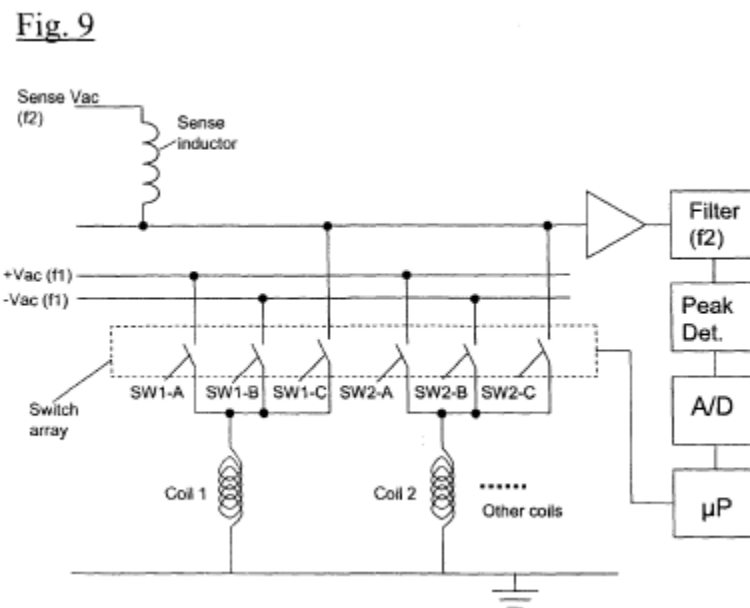


(*Id.*, FIG. 8.) As disclosed by *Fells*:

FIG. 8 shows portable devices with integrated power receivers receiving power from the charging pad. The pad is large enough for multiple devices to be charged simultaneously. In the example one device is being charged by 1 pair of coils and another device is charged by 2 pairs. The two devices also have different sized receivers and may have different power requirements. Importantly, the field is localised in the region of the active coils, such that the battery is not substantially within the magnetic field.

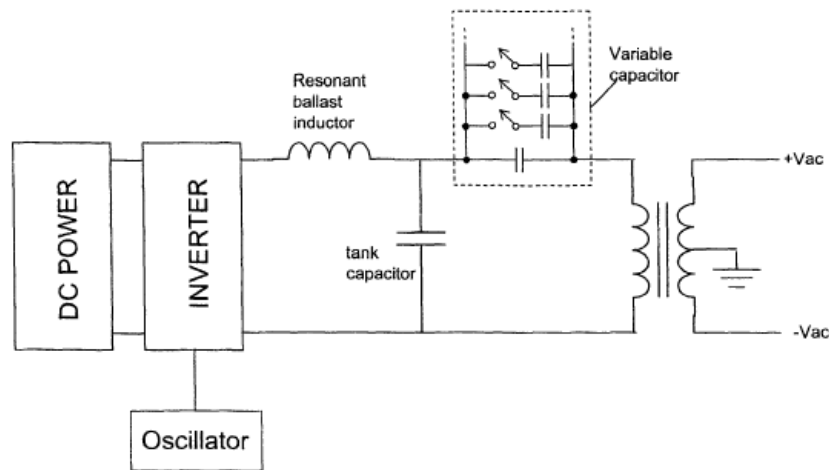
(*Id.*, 8:1-9.)

134. *Fells* describes, with respect to figures 9 and 13 shown below, that the “charger” can include driver circuitry including components for sensing the position of the device coil and switching/activating appropriate primary coils on the charging pad. (*Id.*, 8:10-13 (“FIG. 9 shows an arrangement for sensing the position of the device coil and switching the appropriate coils on the charging pad. The array of coils on the charging pad are represented electrically (coil 1, coil 2, etc.).”), 6:27, 31-32.) *Fells* further discloses that “[t]he arrangement of FIG. 9 requires AC voltage signals,” where “FIG. 13 shows a means of generating these signals.” (*Id.*, 9:46-48.)



(*Id.*, FIG. 9.)

Fig. 13



(*Id.*, FIG. 13.)

135. Each charger coil of the charger may be connected to switches controlled by a microprocessor, where, as shown in figure 9 above, the switches can include SW_x-A, SQ_x-B, SW_x-C. (*Id.*, 8:13-15 (“Connected to each coil, there are 3 switches (SW_x-A, SQ_x-B, SW_x-C) controlled by a microprocessor (μP).”).) Fells further discloses that some of the switches are used to drive the coil, whereas another switch is used for sensing coils to be activated:

The first two switches (SW_x-A and SW_x-B) are used to drive the coil. Switch SW_x-A is used to connect the coil to a ‘positive’ alternating current, supplied by alternating supply +Vac. Switch SW_x-B is used to connect the coil to a ‘negative’ alternating supply (−Vac). The third switch (SW_x-C) is used for sensing which coils are to be activated. When SW_x-C is closed, an inductance

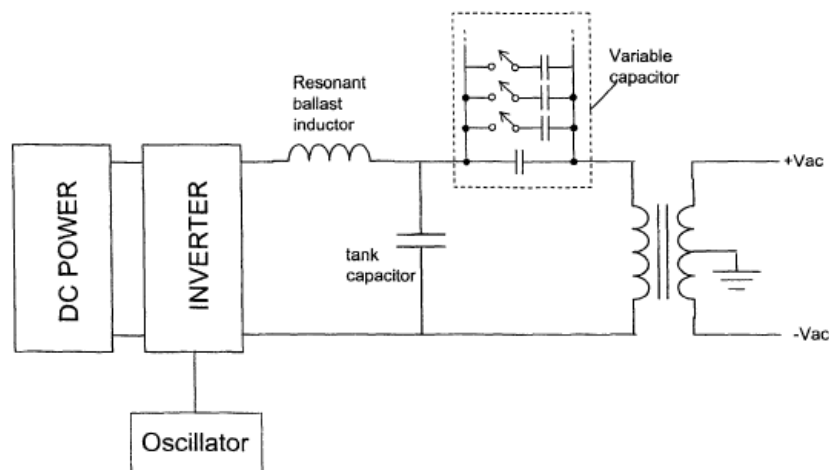
bridge is formed across a sense voltage source (V_{sense}), a sense inductor and the coil. A peak detector is used to determine the magnitude of the voltage at the midpoint of the bridge. This is in turn converted to a digital signal for the microprocessor with the analogue to digital converter (A/D). When a power receiver is placed on the pad, the self-inductance of the pad coils in the vicinity of the receiver will increase. This is because the presence of the ferrite in the receiver reduces the reluctance of the magnetic circuit compared to air. This increase in coil inductance results in a higher ac voltage from the inductive bridge and a higher signal at the microprocessor.

The AC voltage used for the sensing (Sense Vac) is preferably at a different frequency to the power transmission. It is preferably at a submultiple of the power transmission frequency, such that the harmonics overly those of the power transmission. It is possible that there may be some 'breakthrough' of power at the power transmission frequency into the sense circuit. This arises because of stray coupling between individual coils in the system. This can be prevented by inserting a filter in the sense path after the peak detector.

(*Id.*, 8:15-41.)

136. As shown in FIG. 13, an inverter is used in conjunction with a DC power source to generate an AC signal having a reference frequency, where the inverter output is coupled to an inductor and capacitor that are resonant at the oscillator frequency. (*Id.*, 9:46-63.) That circuitry is coupled to the transformer via a variable capacitor, where the ends of the transformer provide the positive and negative polarity inputs to the circuit of figure 9. (*Id.*)

Fig. 13



(*Id.*, FIG. 13.) As disclosed by Fells:

The arrangement of FIG. 9 requires AC voltage signals with high power and opposite polarity. FIG. 13 shows a means of generating these signals. **There is a DC power source which is coupled to an inverter to generate an AC signal at a reference oscillator frequency. This is in turn coupled to an inductor and capacitor resonant at the oscillator frequency. This is**

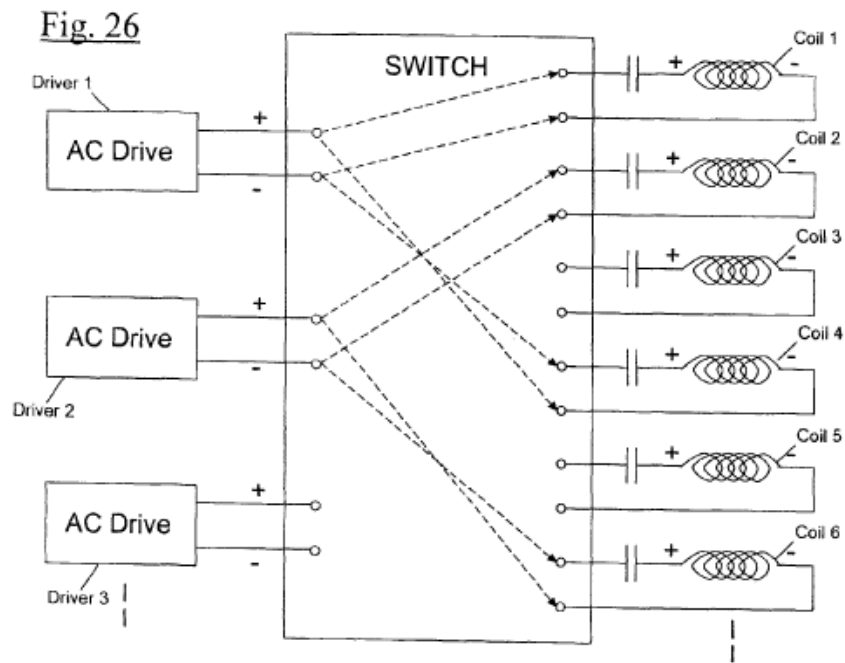
in turn coupled to a transformer, via a variable capacitor. The output of the transformer has a centre-tap referenced to ground. The two ends of the transformer output provide the positive and negative polarity inputs to the circuit of FIG. 9. A variable capacitor is required because the inductance of the load on the transformer will vary as different coils are switched in and out. It may also varied with different device loads or at different device positions on the pad. The variable capacitor is therefore adjusted to ensure that the system is resonant at the oscillator frequency. In this system, the variable capacitor has been implemented using a switch network, though there are many methods of achieving this.

(*Id.*, 9:46-63.)

137. *Fells* further discloses that the microprocessor can execute an algorithm to determine which coils should be activated to ensure that the appropriate coils are driven when needed. (*Id.*, 8:57-9:16, 9:17-45, 11:26-44; *see also id.*, 12:60-13:22, FIG. 23.) For example, “the microprocessor determines the position of the secondary coils within each device” and “uses this information to determine which pairs of coils to activate.” (*Id.*, 9:1-4.) Moreover, the microprocessor can also determine when a device is further charged such that coils that would be used to charge that devices are not turned on. (*Id.*, 9:10-16 (“Once there is a valid

configuration, each coil pair (that is not already powered up) is momentarily powered up to see how much power is taken. Coil pairs which take power above a certain threshold are powered. Coil pairs which take power below this threshold are switched off. This means that devices which are on the pad but do not require power (e.g. because they are fully charged) are switched off.”); *see also id.*, 9:17-45, 11:26-44 (“drive pairs of coils in the charger,” “‘drivers’ switched off”), FIGS. 11-12.)

138. *Fells* explains alternative arrangements can be used “for providing the power for the coils and switching this power to the required coils.” (Ex.1005, 13:23-25 (“There are a number of alternative arrangements for providing the power for the coils and switching this power to the required coils.”), 13:26-14:35, FIGS. 24-27, 14:36-22:32.) For example, “FIG. 26 shows a system for driving multiple devices which is particularly good for when the devices have different power requirements.” (*Id.*, 13:53-55.)



(*Id.*, FIG. 26.)

139. Similar to the arrangements shown in figures 9 and 13, figure 26 includes switches connected to AC drivers that can be “used to drive a pair of coils” (positive and negative polarities). (*Id.*, 13:55-14:15.) The drivers may connect to more than one pair of coils, and can use separate/dual sources:

Each driver can be regulated independently from the others, to match the load seen the device. Further it may be desirable to allow the drivers to selectively connect to more than one pair of coils, depending on how the device is positioned on the charging surface, or the device's load requirements. Instead of using the same driver for both positive and negative current, it is also possible to use 2 separate sources or a dual source (for

example as in FIG. 13 or 24). This may reduce the complexity of the switching arrangement.

(*Id.*, 14:5-14.)

140. *Fells* further discloses that “[a] **resonant capacitor** may be placed at either the driver side or the coil side of the switch.” (*Id.*, 13:57-59.) *Fells* also explains that different types of switches can be used, including “MOSFET” (i.e., “FET”) switches. (*Id.*, 14:32-35 (“[s]witches can be constructed from **FETs**...or other electronic switches well-known to those skilled in the art”), 9:42-56 (“MOSFET switches”), 12:66-13:13.)

141. A person of ordinary skill in the art would have understood that *Fells*’s teachings are consistent with known use of resonant circuits in charging devices. For example, figure 1 of Stoner shows a similar resonant circuit for a charging device that is consistent with the state of the art at the time of the alleged invention.

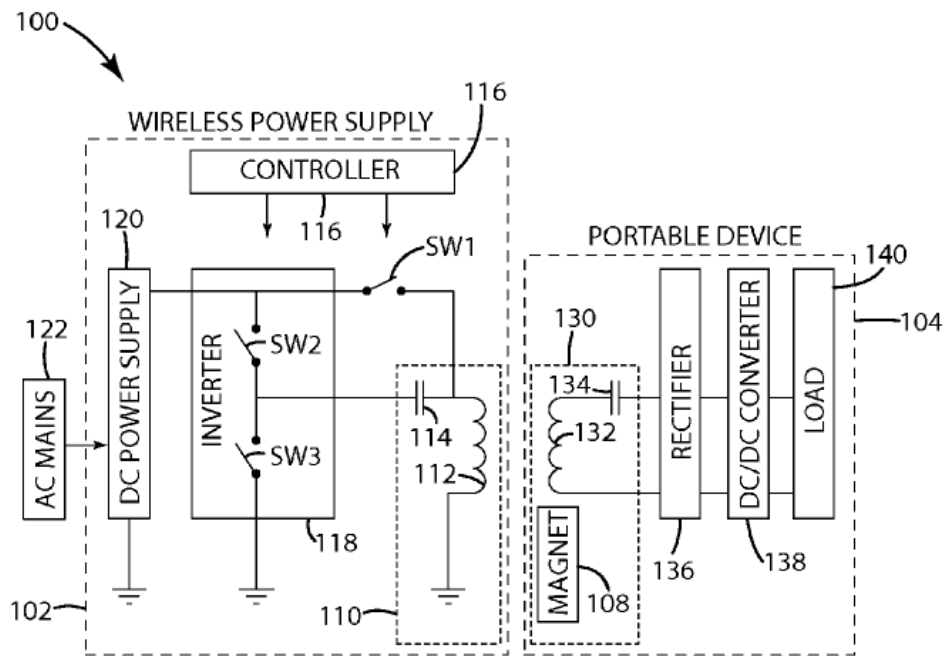


Fig. 1

(Ex.1011, FIG. 1.)

142. As disclosed by Stoner:

Tank circuit 110 includes a primary resonant capacitor 114 and primary inductor 112. FIG. 1 shows a series arrangement of the primary resonant capacitor 114 and primary inductor 112, but alternative embodiments may include a parallel arrangement or another arrangement suitable for transferring power wirelessly to an electronic portable device 104.

(*Id.*, 7:3-9.)

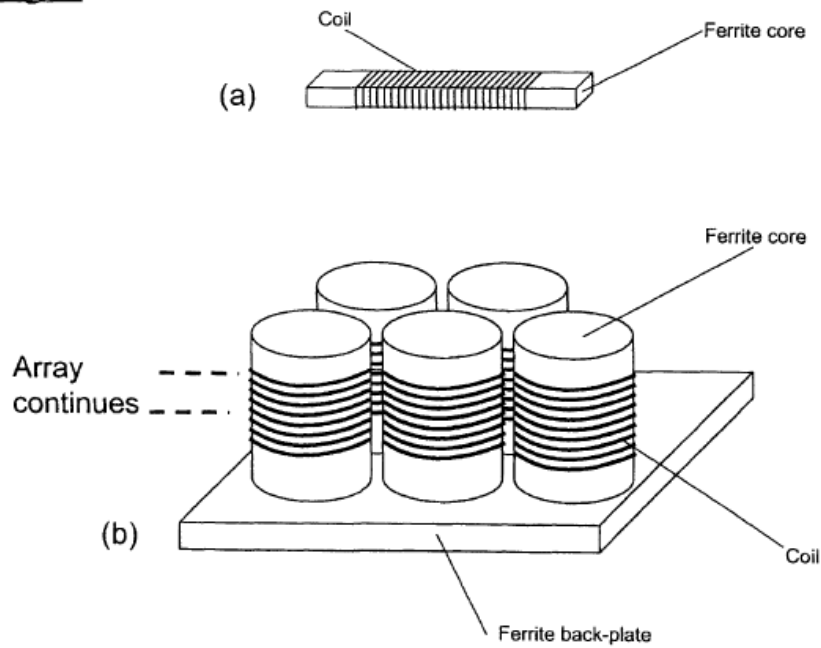
143. Therefore, in my opinion, *Fells* discloses a “**charger**” that includes driving circuitry (“**charger drive circuit**”) that includes “**FET**” switch(es) and a “**resonant capacitor**” (e.g., positioned before/after the switch) that “**apply an alternating voltage**” to selected “**charger coil(s)**,” as claimed.

f) Limitation 1(f): a first mobile device that includes a receiver to inductively receive power for the first mobile device, wherein the receiver includes:

144. In my opinion, *Fells* discloses this limitation. (*See* my analysis and discussions below in this section; *see also* my analysis and discussions in Sections IX.A.1(a)-(e), IX.A.1(g)-(q); *see also* my analysis and discussions in Section VIII.A.)

145. As I explained above, the inductive power transfer system of *Fells* is configured to inductively charge a mobile device via a power receiver in the mobile device. (*See* my analysis and discussions above in Sections IX.A.1(a)-(e); *see also e.g.*, Ex.1005, FIGS. 1-2, 5-8, 18-23, 1:3-16, 6:57-60, 6:25-26, 7:9-21, 8:1-9, 10:38-67, 11:15-21 (horizontal secondary “convenient for integration either on the base or back of a mobile device”), 11:45-55, 12:60-65.) For example, *Fells* discloses that “FIG. 1(a) shows a power receiver suitable for embedding in a portable device.” (*Id.*, 6:58-60.)

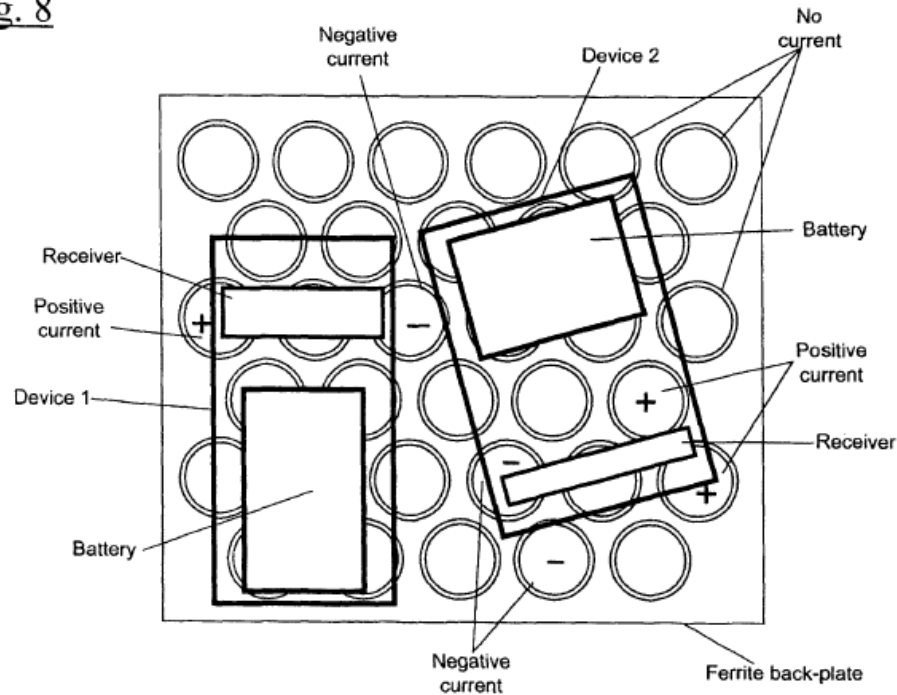
Fig. 1



(*Id.*, FIG. 1.)

146. Similarly, figure 8 of Fells shows two receivers included in mobile devices being charged on the charging pad. (*Id.*, 6:25-26 (“FIG. 8 shows portable devices being charged...”), 8:1-4 (“FIG. 8 shows portable devices with integrated power receivers receiving power from the charging pad. The pad is large enough for multiple devices to be charged simultaneously.”).)

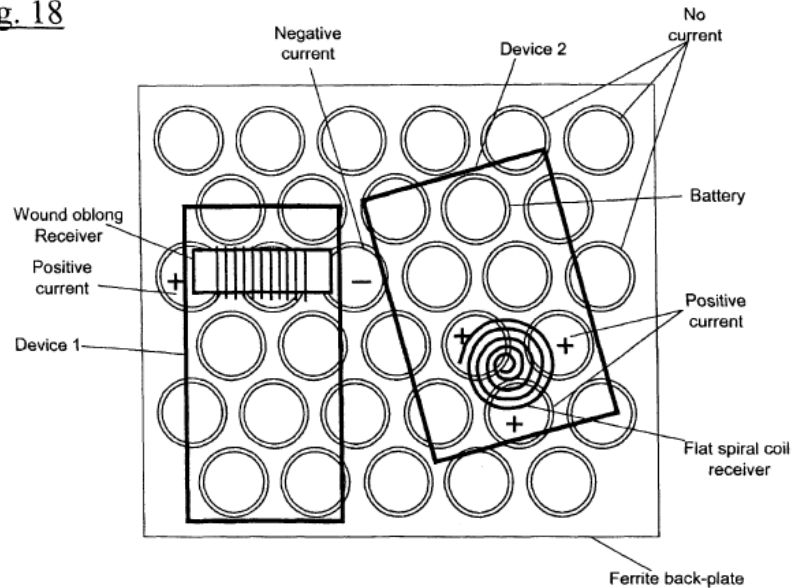
Fig. 8



(*Id.*, FIG. 8.)

147. Figure 18 of Fells shows a charger system that “allows two different types of receivers within the portable device to be used, where, as shown in figure 18, device 1 has a horizontal coil axis wound around magnetic material for its power receiver and device 2 has a flat spiral coil for its power receiver. (*Id.*, 10:38-42.)

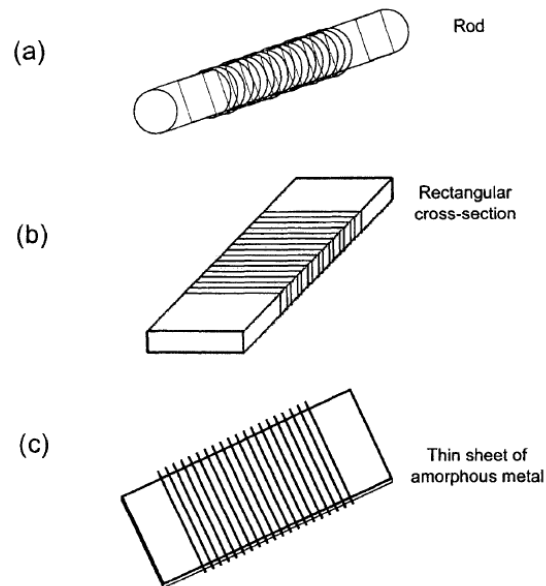
Fig. 18



(*Id.*, FIG. 18.)

148. Figure 19 of Fells “shows a range of different types of receiver,” including a cylindrical rod structure in figure 19(a), a rectangular rod structure in figure 19(b), and a thin sheet of amorphous metal with a coil wrapped around it in figure 19(c). (*Id.*, 10:60-65.)

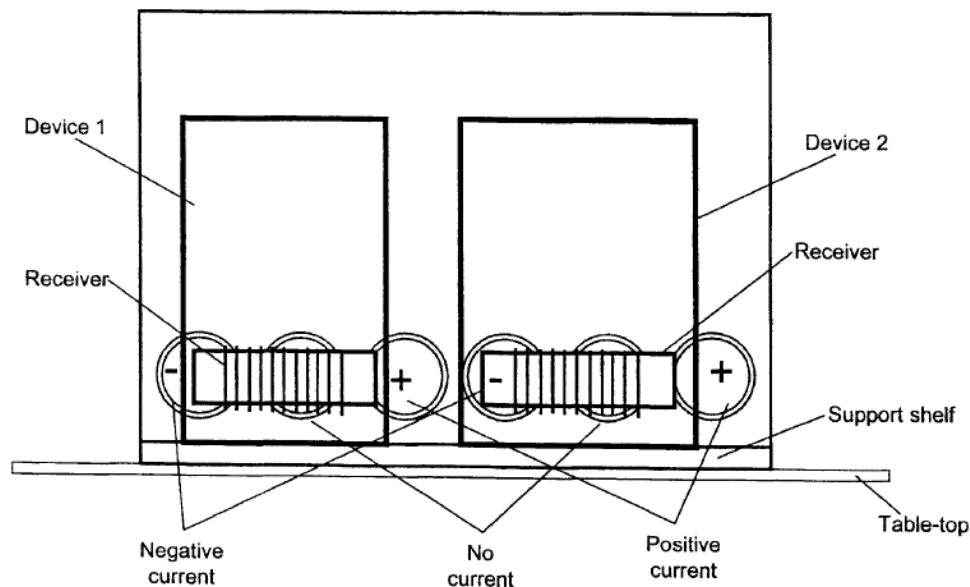
Fig. 19



(*Id.*, FIG. 19.)

149. Figure 23 of *Fells* shows a “simpler and lower cost alternative to a flat pad charger” that is in the form of a shelf, where the devices to be charged stand upright on a ledge. (*Id.*, 11:45-48.) As *Fells* discloses, “[t]he receiver is positioned in the portable device a set distance away from the bottom edge.” (*Id.*, 11:49-50.)

Fig. 23



(*Id.*, FIG. 23.)

150. Therefore, in my opinion, *Fells* discloses a “**receiver**” that is included in a portable device (“**first mobile device**”/”**mobile device**”), where the receive is to “**inductively receive power for the mobile device**” in *Fells* inductive power transfer system.

g) Limitation 1(g): a solenoid, wherein the solenoid includes:

151. In my opinion, *Fells* discloses this limitation. (*See* my analysis and discussions below in this section; *see also* my analysis and discussions above in Sections IX.A.1(a)-(f); *see also* my analysis and discussions below in Sections IX.A.1(h)-(q); *see also* my analysis and discussions in Section VIII.A.)

152. As an initial matter, the '349 patent describes a receiver "solenoid" in non-limiting ways. For example, the '349 patent states "a receiver coil can be generally shaped as a ***blade or thin solenoid.***" (Ex.1001, 2:30-31.) (*See also id.*, 2:54-55, 8:63-65 ("As shown 172 in FIG. 7, Litz wire can be wrapped around the core to create a solenoid type receiver..."), FIG. 7, 9:21-27 ("***solenoid*** can be provided...such that ***it is shaped as or otherwise resembles a blade***, with the contact area being the thin edge of the blade"), 21:65-22:2, 2:58-63, FIGS. 9-10.) As shown in figures 7, 9, and 10 below, the '349 patent discloses different types of solenoids, where a person of ordinary skill in the art reading the '349 patent would have understood that the plain meaning of the term "solenoid" as recited in the claims encompasses these types of solenoids.

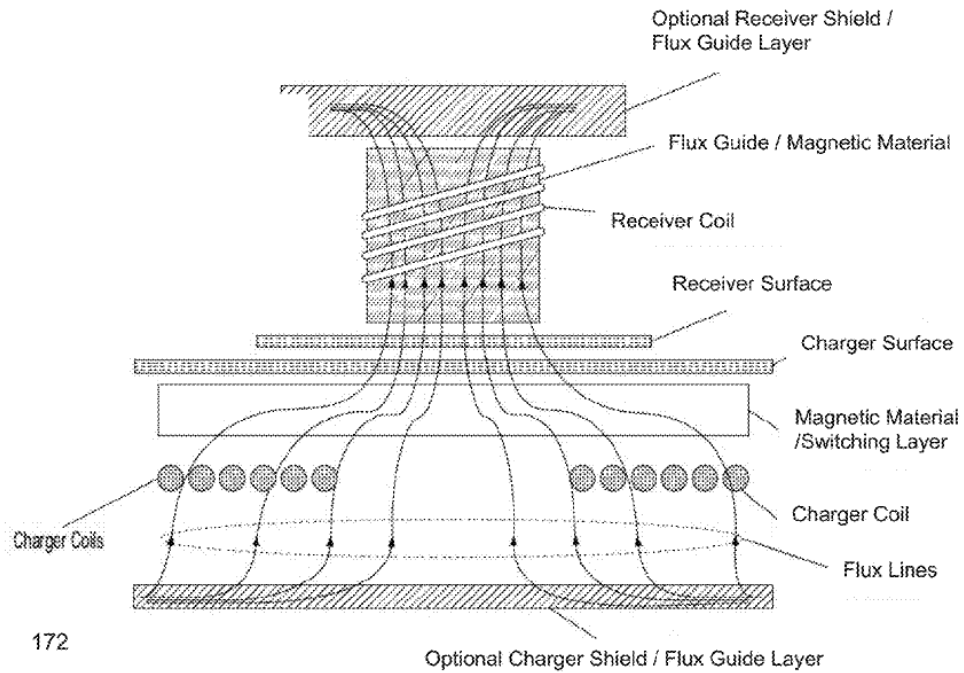


FIGURE 7

(Ex.1001, FIG. 7.)

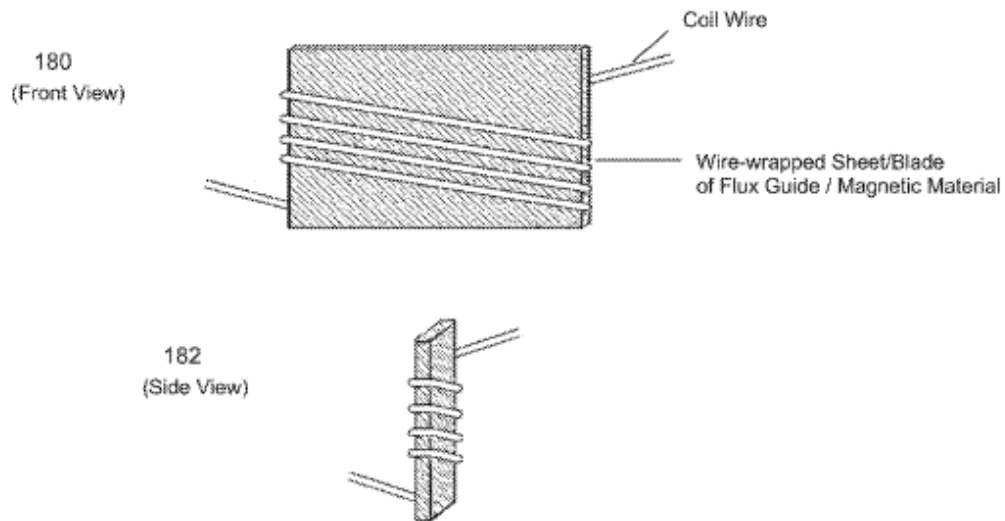


FIGURE 9

(*Id.*, FIG. 9.)

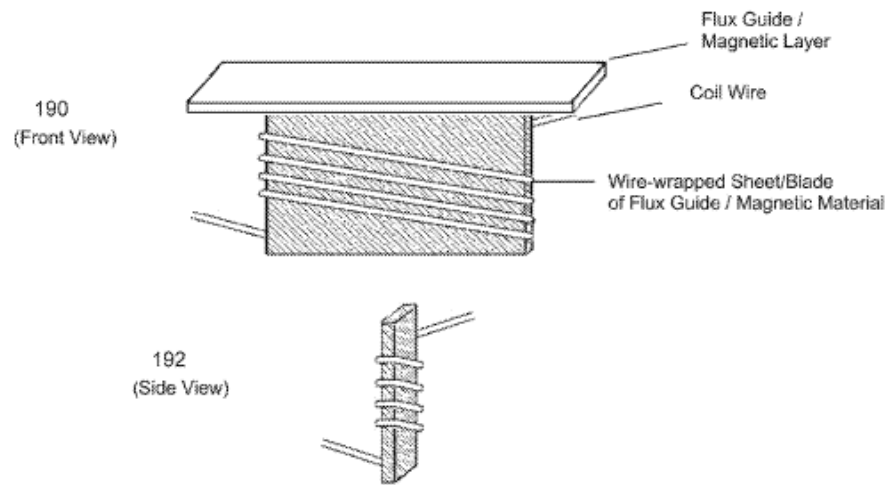


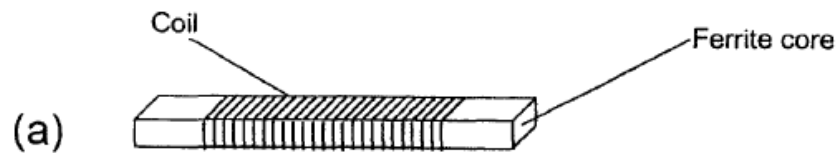
FIGURE 10

(*Id.*, FIG. 10.)

153. *Fells* discloses that the power receiver in the mobile device can be configured in different ways, including as a “**solenoid**” like that claimed and consistent with the solenoids described in the ’349 patent. (Ex.1005, 6:57-7:7, 6:39, 10:60-63, 11:9-21, FIGS. 1(a), 19, 21; *see also* my discussion below in Sections IX.A.1(h)-(q).)

154. For example, figure 1(a) of *Fells* illustrates a solenoid like those depicted in figures 9 and 10 of ’349 patent above. (Ex.1005, 6:58-60 (“FIG. 1(a) shows a power receiver suitable for embedding in a portable device. It has a ferrite core and coil wound around the core.”))

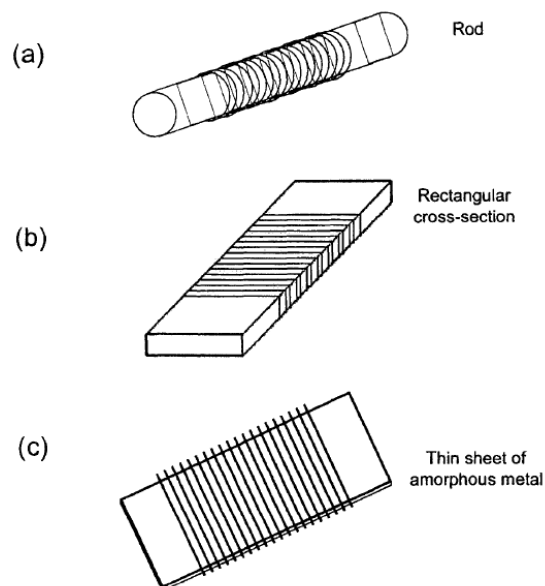
Fig. 1



(*Id.*, FIG. 1(a).)

155. Similarly, figure 19 of Fells “shows a range of different types of receiver,” including a cylindrical rod structure in figure 19(a), a rectangular rod structure in figure 19(b), and a thin sheet of amorphous metal with a coil wrapped around it in figure 19(c). (*Id.*, 10:60-65.) Such configurations, which include a magnetic core, are consistent with the disclosure of a “solenoid” in the ’349 patent.

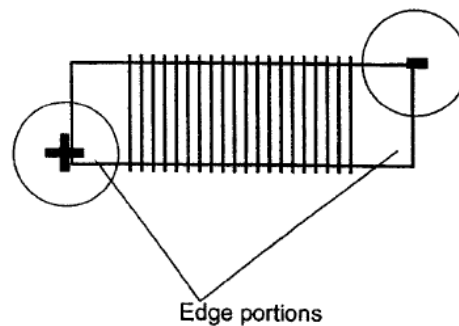
Fig. 19



(*Id.*, FIG. 19.)

156. Fells discloses that figure 20 shows “a plan view of a receiver, which could relate to any of the configuration in FIG. 19,” where, consistent with the solenoids depicted in the ’349 patent, “the coil winding does not go all the way to the ends of the magnetic material.” (*Id.*, 11:1-4.)

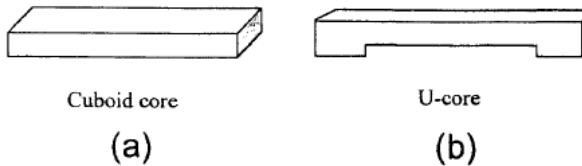
Fig. 20



(*Id.*, FIG. 20.)

157. Figure 21 shows two differently-shaped magnetic cores that can be used in the solenoids of Fells’ receivers, including a cuboid core and a U-shaped core. (*Id.*, 11:9-14.)

Fig. 21



(*Id.*, FIG. 21.)

158. Therefore, in my opinion, Fells discloses a “**solenoid**” included in the “**receiver**” as claimed.

h) Limitation 1(h): a magnetic core having a relative magnetic permeability exceeding 1 and having first and second ends; and

159. In my opinion, *Fells* discloses this limitation for the reasons discussed above and below. (See my analysis and discussions below in this section; *see also* my analysis and discussion in Sections IX.A.1(a)-(g), IX.A.1(i)-(q); *see also* my analysis and discussions in Section VIII.A.)

160. For example, as I explained above, the mobile device receiver includes a secondary coil formed of a solenoid including a magnetic core (*see* my analysis and discussion above in Section IX.A.1(g)) that has first and second ends and facilitates the inductive charging of the mobile device as described by *Fells*. (*See*

my analysis and discussion above in Sections IX.A.1(a)-(g); *see also* Ex.1005, FIG. 1(a), 6:57-60 (receiver “has a ferrite core and coil wound around the core”), FIG. 2, 7:19-16 (“FIG. 2 illustrates the magnetic circuit formed when the power receiver is placed on the charging surface”), 8:26-32 (“presence of *the ferrite in the receiver* reduces the reluctance of the magnetic circuit compared to air” causing the “self-inductance of the pad coils in the vicinity of the receiver [to] increase”), 11:1-4 (“FIG. 20 shows a plan view of a receiver, which could relate to any of the configurations in FIG. 19. It is preferable that *the coil winding does not go all the way to the ends of the magnetic material.*”).)

161. A person of ordinary skill in the art would have understood that the ferrite core(s) used for the secondary coil would also be “permeable material” as known in the art. Such an understanding would have been confirmed by *Fells*’ disclosure that the “permeable material” of the primary coils can be “Mn—Zn ferrite, but other magnetic materials...could be used.” (*Id.*, 12:3-8.) Indeed, *Fells* explains that “use of a horizontal secondary is advantageous” because, *e.g.*, “the form factor is convenient for integration either on the base or back of a mobile device” and “the elongated shape enables concentration of the magnetic field,” which “relates to the *high effective permeability* due to high shape-factor/low self-demagnetisation.” (*Id.*, 11:15-21.)

162. A person of ordinary skill in the art would have understood that that such a magnetic core with “high effective permeability” necessarily discloses a “magnetic core having a relative magnetic permeability exceeding 1,” because it was known that ferrite material-based cores would have relative permeability greater than 1, especially given the permeability of air is close to 1. Such an understanding is supported by Tegner (Ex.1006), which relates to wireless power transfer (*id.*, 1:10-45), and discloses that “[t]he magnetic permeability of a material is described by the relative magnetic permeability, which is the ratio between the magnetic permeability of the material and a vacuum,” where “[t]he relative magnetic permeability of air is close to 1.” (*Id.*, 5:49-52.) Tegner further describes the “relative permeability” of a receiving core in inductive power system “is high in comparison to the surrounding air” (e.g., “between 100-20000”). (*Id.*, 5:52-57; 2:4-11, 2:26-31 (“referring to core with “high magnetic permeability” like *Fells*), 2:37-39 (“relative magnetic permeability of more than 5”), 2:40-45 (receiving core made of a “so-called soft ferrite”), 2:46-48.)

163. Additional contemporaneous references confirm the knowledge of a person of ordinary skill in the art at the relevant time, where such a skilled person would have understood that ferrite material-based cores would have relative permeability greater than 1. (Ex.1007, Abstract, 3:26-40, 4:50-56 (“magnetic permeability >1”), 5:45-6:23, 15:21-16:58; Ex.1008, Abstract, ¶¶0012, 0013-0018,

0032-0035, 0051-0053, 0073-0075; Ex.1009, Abstract (6), 51 (“permeability (μ) refers to the ability of a material to concentrate magnetic lines of flux”, “materials that can be easily magnetized are considered to have a high permeability” and “[r]elative permeability is the ratio of the permeability of a material to the permeability of a vacuum.” “[f]errites are made of ceramic material and have a relative permeabilities that range from 50-200”). (See also my analysis and discussion below in Sections IX.A.1(i)-(q).)

164. Based on *Fells*’ disclosure that the magnetic core of the solenoid in the receiver can be ferrite, a person of ordinary skill in the art would have understood that *Fells* necessarily discloses the core being of material having a permeability greater than 1. Indeed, as I discuss above and below, *Fells* discloses how a magnetic field flows through the receiver magnetic core to “complete the magnetic circuit” with the charger coils and magnetic layer, instead of going around it (which a person of ordinary skill in the art would have understood would have occurred if the magnetic core was made of material with a relative permeability less than 1. (Ex.1005, 8:26-32 (“When a power receiver is placed on the pad, the self-inductance of the pad coils in the vicinity of the receiver will increase. This is because the presence of the ferrite in the receiver reduces the reluctance of the magnetic circuit compared to air. This increase in coil inductance results in higher ac voltage from the inductive bridge and a higher signal at the microprocessor.”)); see my analysis

and discussion in Sections IX.A.1(d), IX.A.1(p)-(q); Exs. 1006-1009.) Moreover, Fells discloses concentrating the magnetic field, which a person of ordinary skill in the art would have understood would only happen with a material having a permeability greater than 1, since it was known a relative permeability greater than 1 allows an easier path for flux to flow than air.

i) Limitation 1(i): Litz wire wrapped around a section of the magnetic core forming a wire wound section around the magnetic core, with the magnetic core extending beyond the wire wound section; and

165. In my opinion, *Fells* discloses this limitation. (*See* my analysis and discussions below in this section; *see also* my analysis and discussions in Sections IX.A.1(a)-(h), IX.A.1(j)-(q); *see also* my analysis and discussions in Section VIII.A.)

166. For example, *Fells* discloses that the magnetic core of the receiver “solenoid” is wrapped with a wire wound section, where the magnetic core extends beyond the wire wound section. Fells discloses that figure 20 shows “a plan view of a receiver, which could relate to any of the configuration in FIG. 19,” where “the coil winding does not go all the way to the ends of the magnetic material.” (*Id.*, 11:1-4; *see also* my analysis and discussions above in Section IX.A.1(g).)

Fig. 19

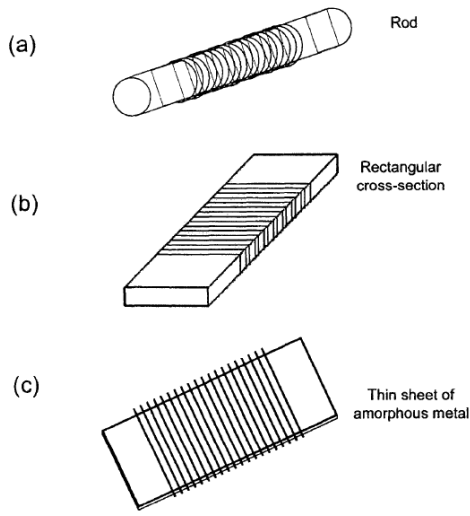
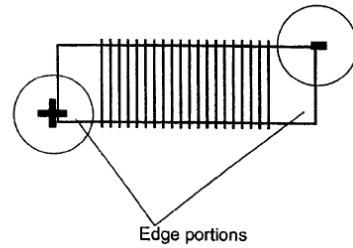


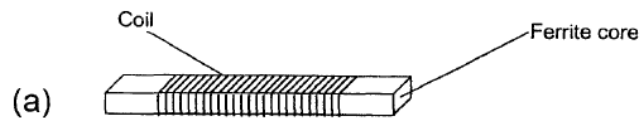
Fig. 20



(Ex.1005, FIGS. 19, 20.)

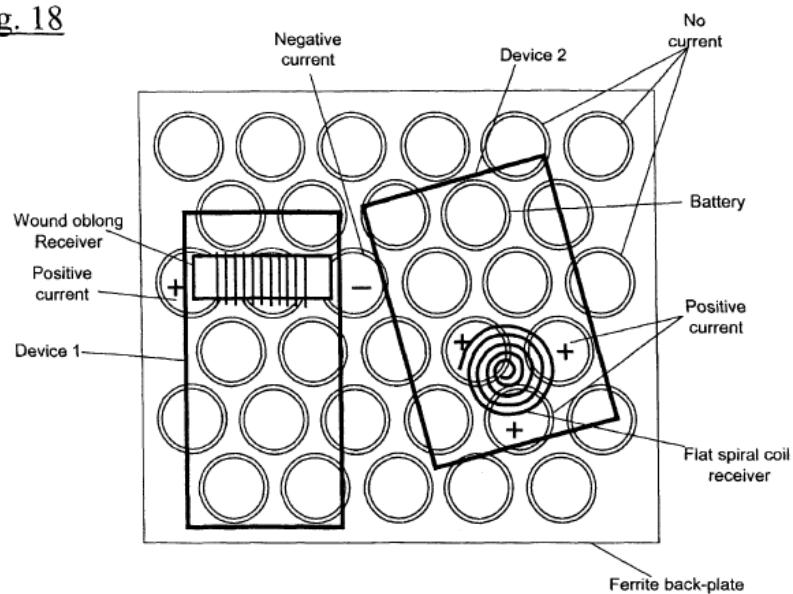
167. Figures 1, 18, and 23 of Fells also show such receivers with coils with a **“wire wound section around the magnetic core”** where **“the magnetic core extend[s] beyond the wire wound section”** as recited in claim 1.

Fig. 1



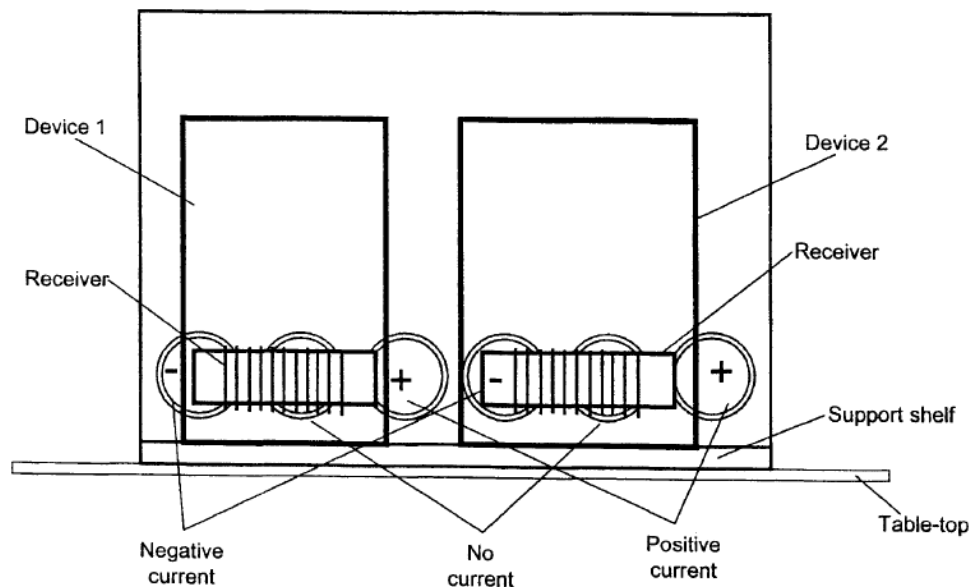
(*Id.*, FIG. 1.)

Fig. 18



(*Id.*, FIG. 18.)

Fig. 23



(*Id.*, FIG. 23.)

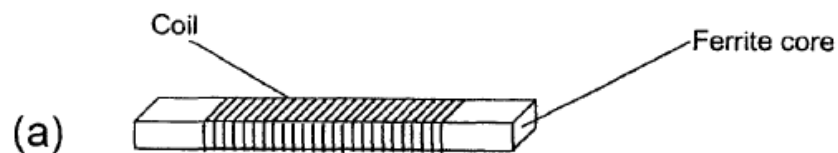
168. As demonstrated above, *Fells* discloses that the magnetic core of the receiver “solenoid” is wrapped with a wire wound section. (Ex.1005, FIGS. 18-20, 22-23, 1:51-57 (“secondary coil”), 2:12-21, 2:43-46, 3:12-17, 3:47-53, 4:8-11, 4:38-47, 5:2-16, 5:57-64.) *Fells* further discloses that Litz wires, which include many separate strands that are insulated from each other, are preferably used for the coil wound around the ferrite core of the receiver:

FIG. 1(a) shows a **power receiver** suitable for embedding in a portable device. It **has a ferrite core and coil wound around the core. ... Preferably Litz wire is used for both the primary and secondary coils.** Litz wire has many

strands of copper, each insulated from one another. This allows the copper losses to be reduced as at high frequencies the skin effect means that current is only carried in the outer skin of the conductors.

(*Id.*, 6:58-7:8.)

Fig. 1



169. Notably, while *Fells* discloses that it is preferable to use Litz wires for for the primary and secondary coils, a person of ordinary skill in the art would have understood that, depending on the application, Litz wires can be used for the primary coil, the secondary coil, or for both coils. For example, *Fells* discloses that while Litz-wire coils are good for avoiding primary losses, planar coil technologies (e.g. PCB coils) can be used to reduce cost:

Wound Litz-wire primaries are the ultimate solution for low primary losses. Wound components with or without ferrite cores can be used. Ferrite cores can be added to give a small shape-factor benefit (if cost-effective) and to produce an even flatter coupling factor. However, overall cost and manufacturability is less attractive. Other planar coil technologies such as PCB coils or watch-spring coils

can be used to reduce cost, but typically exhibit higher losses (lower coil Qs).

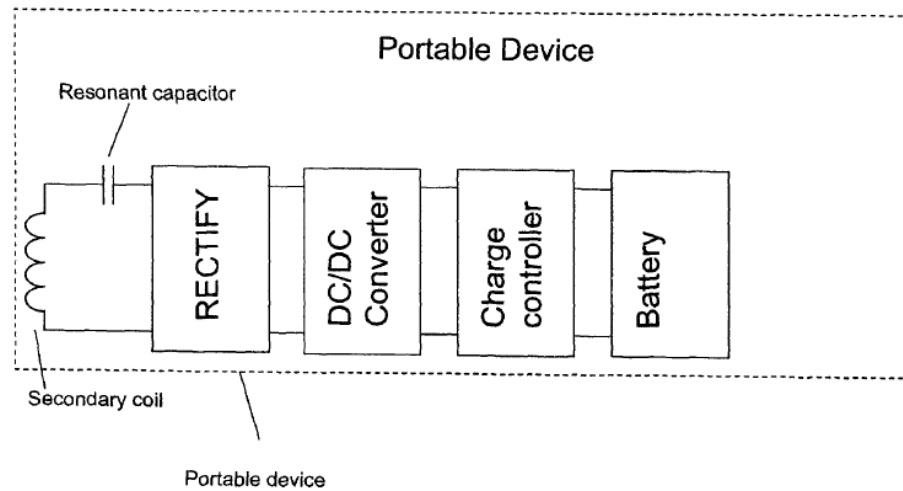
(*Id.*, 11:56-64.)

j) Limitation 1(j): a receiver electronic circuit, wherein the receiver electronic circuit includes a resonant capacitor and a rectifier; and

170. In my opinion, *Fells* discloses this limitation. (*See* my analysis and discussions below in this section; *see also* my analysis and discussions in Sections IX.A.1(a)-(i), IX.A.1(k)-(q); *see also* my analysis and discussions in Section VIII.A.)

171. For example, *Fells* discloses that the mobile device includes an electronic circuit that is configured to facilitate the reception of the power transferred by the charger (“**receiver electronic circuit**”). (Ex.1005, FIG. 14, Abstract, 6:33-34 (“FIG. 14 shows a block diagram of the electronics within the portable device.”), 9:64-10:12 (“FIG. 14 shows an electrical equivalent diagram of a portable device for use with the charging pad”).)

Fig. 14



(*Id.*, FIG. 14.)

172. The circuit of the mobile device includes a rectifier (for converting the received AC signal to DC), a DC/DC converter (for converting the voltage to “required voltage level”), and a charge controller coupled to the battery of the mobile device:

FIG. 14 shows an electrical equivalent diagram of a portable device for use with the charging pad. There is a secondary coil (represented by the inductor), a capacitor such that the combination is resonant at the oscillator frequency. This signal is converted to a DC voltage using a rectifier (which may be a bridge rectifier). The voltage is then converted to the required voltage level using a DC/DC converter. This is coupled to a charge controller, which is in turn coupled to a battery. It is sometimes

possible to combine the DC/DC converter and charge-controller into a single element.

(*Id.*, 9:64-10:6.)

173. As shown in figure 14, the circuit also includes a “**resonant capacitor**” that ensures “the combination is resonant at the oscillator frequency.” (*Id.*, FIG. 14, 9:65-67.) Therefore, in my opinion, *Fells*’ mobile device includes a “**receiver electronic circuit**” including “**a resonant capacitor and a rectifier,**” as claimed (e.g., resonant capacitor and rectifier (shown in FIG. 14), alone or in combination with one or more of DC/DC converter and/or charge controller).

k) Limitation 1(k): the charger further includes a means for positioning the receiver in a power transfer position, proximate to the charger surface, to inductively transfer power to the receiver of the first mobile device;

174. In my opinion, *Fells* discloses and/or suggests this limitation under its plain meaning and as a means-plus-function term as I was asked to consider in Section VII. (*See* Section VII; *see also* my analysis and discussions below in this section; *see also* my analysis and discussions in Sections IX.A.1(a)-(j), IX.A.1(l)-(q); *see also* my analysis and discussions in Section VIII.A.)

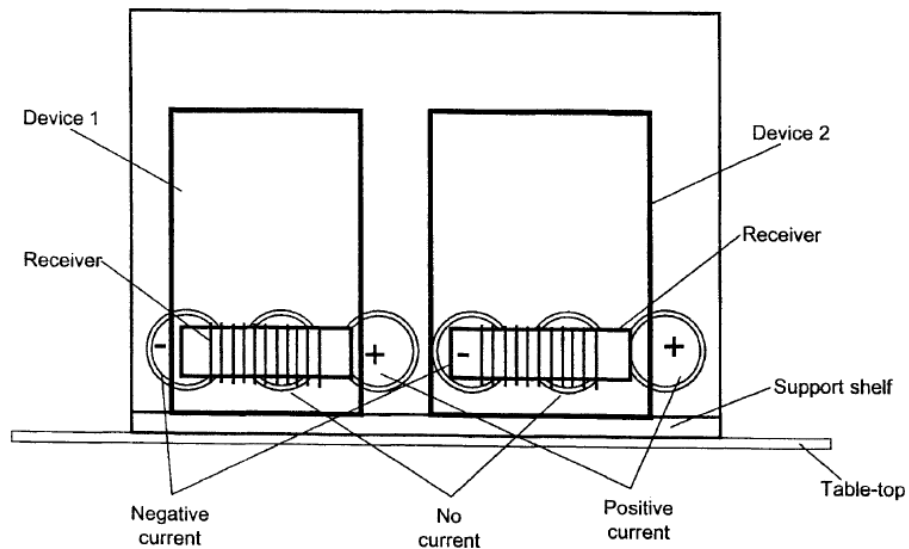
175. For example, *Fells* discloses charger configurations that ensure the mobile device(s) placed proximate to the charger surface are aligned to facilitate the inductive transfer of power to the “receiver” (*see also* my analysis and discussions

above in Sections IX.A.1(f)-(j)) of the mobile device. For instance, with respect to FIG. 23, *Fells* describes a configuration that is a variation to a horizontal flat pad charger. (Ex.1005, FIG. 23.) Instead of lying flat, the charger can be configured to sit upright (and at a slight angle) to allow mobile device(s) to be placed thereon (**“proximate to the charger surface”**). (Ex.1005, FIG. 23 (below), 11:45-5:19, 1:58-63 (“secondary device may be placed anywhere on or in *proximity to the power transfer surface* to receive power”) 2:21-26 (same), 2:58-63 (same), 3:19-34, 3:54-59, 4:17-22, 4:48-53, 5:9-23, 5:43-48, 5:65-6:3, 7:9-13, 8:57-9:45, FIGS. 10-12, 14:16-23.) For example, *Fells* explains:

FIG. 23 shows a simpler and lower cost alternative to a flat pad charger. This system requires only a single line of coils. The **charger is in the form of a shelf, such that device stand upright on a ledge**. The ledge may tilt back slightly to prevent the devices from falling off. The receiver is positioned in the portable device a set distance away from the bottom edge. **Thus there is always alignment in one dimension**. Depending on which part of the shelf the device is placed, different coils are accordingly activated. **The shelf allows devices to be placed anywhere along a line**. Further, it allows multiple devices to be charged simultaneously.

(*Id.*, 11:45-55.)

Fig. 23



(*Id.*, FIG. 23.)

176. Fells discloses that the disclosed inductive power transfer systems, including that in figure 23, “provide[] a scalable system that can be extended to almost any pad size by tessellation of the selectable driver coils.” (*Id.*, 12:12-14.) Accordingly, the charger includes an alignment mechanism for positioning the receiver “**in a power transfer position**” as claimed since it ensures a mobile device is positioned “**proximate to the charger surface**” for receiving power transferred from the charger’s coil(s), and aligned with the charger’s coil(s). Thus, in at least this configuration, *Fells* discloses the “**charger**” including a “**means for positioning**” (e.g., “support shelf” (FIG. 23) or “ledge” (11:46-51) is a physical

mechanism/means to assist the user in alignment of the mobile devices on the charger) as claimed and construed above.

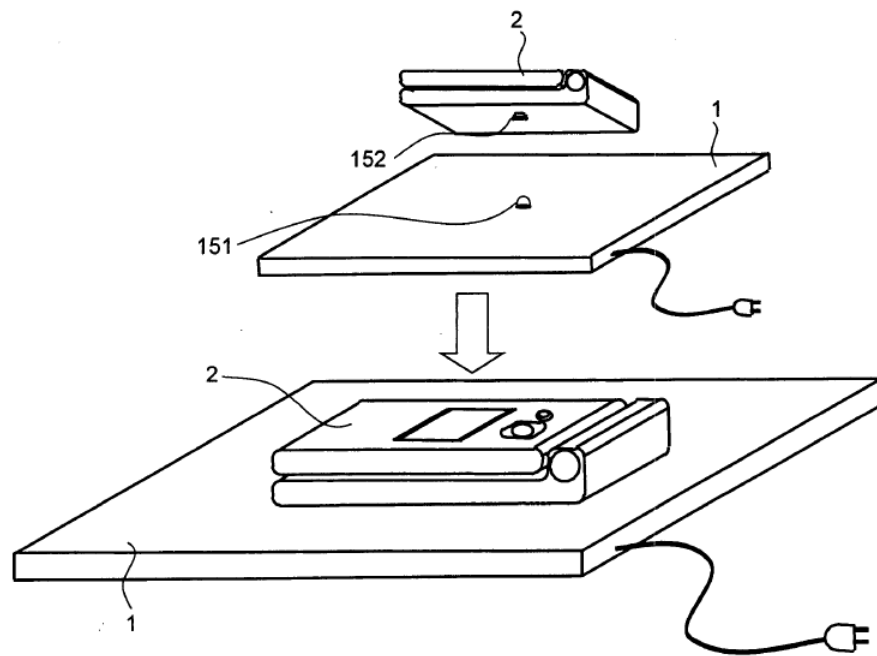
177. I have been asked to assume a scenario in which Fells does not disclose such a physical means to assist the user in alignment of the mobile device to the charger. Under such an assumption, it is my opinion that, based on their state of the art knowledge at the time, a person of ordinary skill in the art would have been motivated to modify *Fells*' charger (even flat pad or other configurations) with other forms of physical or visual mechanisms to assist such alignment for facilitating the inductive transfer of power.

178. In my opinion, a person of ordinary skill in the art would have been aware that ensuring proper relative positioning of the receiving device to a charger in an inductive power transfer system would improve the ability to efficiently charge the receiving device. Indeed, it was well known to use mechanical, magnetic, or visual-based mechanisms to guide a user's placement of power receiving devices (e.g., mobile devices) on an inductive charging system to maximize magnetic coupling and power transfer. (Ex.1010, FIGS. 8-9, ¶¶0102-0103; Ex.1011, Abstract, FIGS. 1-4, 8, 11, 1:6-46, 2:14-4:62, 5:38-7:34, 10:46-12:35.)

179. For example, with respect to figure 8 below, Nakamura discloses that the power transmission apparatus 1 includes a protrusion 151, whereas the portable telephone 2 includes a corresponding depression 152. (Ex.1010, ¶0102.) As

disclosed by Nakamura, “[t]he protrusion 151 and the depression 152 are engaged with each other to thereby enable positioning of the power transmission apparatus 1 and the portable telephone 2 to be established.” (*Id.*) Nakamura further discloses that similar depressions can be formed in various types of power reception equipment, “thereby enabling positioning of each type of equipment with the power transmission apparatus 1 to be established.” (*Id.*)

FIG. 8

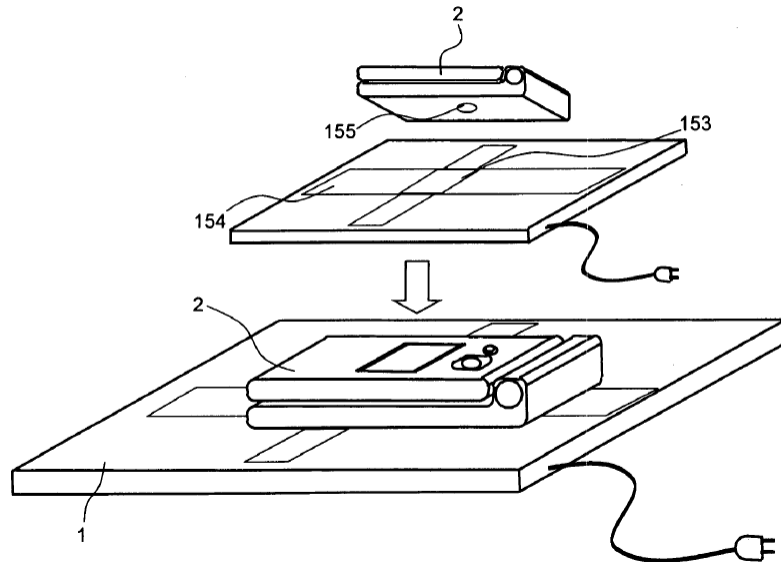


(*Id.*, FIG. 8.)

180. Nakamura discloses another alignment mechanism with respect to figure 9 below, where marks are provided on the power transmission apparatus 1 and the portable telephone 2 (or other power reception equipment) in order to enable

proper positioning of the power reception equipment to facilitate charging. (*Id.*, ¶0103.)

FIG. 9



(*Id.*, FIG. 9.)

181. Stoner also demonstrates that it was well-known at the relevant time to use alignment mechanisms to properly position devices being charged with the chargers providing power to those devices. (Ex.1011, 1:6-8 (“The present invention relates to systems and methods for aligning a portable device with an inductive wireless power supply”)). Stoner discloses that known methods for achieving such alignment included “geometrically matched surfaces, permanent magnets, magnetic attractors, multiple coil arrays, nested coils, and movable coils.” (*Id.*, 1:40-44.) Stoner discloses a “self-aligning inductive wireless power system and method in which a wireless induction coil and an external DC electromagnetic field may be

used to attract the wireless induction coil toward a desired locatin for more efficient wireless power transfer.” (*Id.*, 2:60-64.)

182. Therefore, in my opinion, a person of ordinary skill in the art would have known that it was advantageous to provide a means for positioning the receiver in a power transfer position that is close to the charger surface in order to allow the inductive transfer of power to the receiving device. Indeed, *Fells* discloses that just by providing alignment in one direction using a shelf or ledge as depicted in figure 23, the number of charging coils can be reduced to a single line of coils.

183. In my opinion, in view of a person of ordinary skill in the art’s state of art knowledge, such a skilled person would have been motivated to consider and implement well-known mechanisms for aiding a user in aligning the mobile device(s) onto the charger of *Fells*’ system (*e.g.*, for flat pad configurations), given the guidance in *Fells* associated with the shelf application of FIG. 23, and the skilled person’s knowledge of such known use and benefits of having mechanical or visual aids for facilitating the same purpose in inductive power transfer systems. Modifying such charger configurations with such known alignment aids (*e.g.*, visual markings or magnet-based mechanisms (*e.g.*, as demonstrated by Nakamura (Ex.1010) and Stoner (Ex.1011))) would have expanded the benefits/advantages of such alignment features to applications/configuration beyond the shelf applications like that described with respect to FIG. 23 in *Fells*. In my opinion, such a

modification would have thus improved *Fells*' system by providing mechanisms (e.g., visual, magnetic, physical) that assist in alignment of a mobile device receiver to the primary coils of the charger (and charger surface) to maximize magnetic coupling and inductive power transfer.

184. In my opinion, a person of ordinary skill in the art would have had the skills, knowledge, rationale, and capability to implement such a modification with a reasonable expectation of success given the above-discussed teachings/suggestions in *Fells* and their state of art knowledge. In my opinion, implementing such a modification would have involved applying known technologies (e.g., known alignment aid mechanism (e.g., visual markings (e.g., Ex.1010) consistent with those taught by *Fells* (e.g., Ex.1005, FIG. 23)) according to known methods (e.g., using such position aid mechanisms to align a mobile device in an optimize charging position with the charger coils)) to yield an inductive charging system consistent with that contemplated by *Fells*. (See my analysis and discussions above in this section; see also my analysis and discussions in Sections IX.A.1(l)-(q).)

Therefore, in my opinion, *Fells* discloses and/or suggests limitation 1(k)/26(e) under both its plain meaning and as a means-plus-function term noted in Section VII. (*Id.*; see also Section VII.)

- l) **Limitation 1(l): the charger drive circuit is configured to drive the charger coil at one or more operating frequencies to inductively transfer power from the charger to the receiver when the receiver is positioned in the power transfer position, wherein when the receiver is positioned in the power transfer position, a tuned circuit, including the charger coil and the resonant capacitor of the charger drive circuit and the solenoid and the resonant capacitor of the receiver electronic circuit, has a resonant frequency that allows the charger to transfer the power to the receiver at the one or more operating frequencies;**

185. In my opinion, *Fells* (including as modified above) discloses and/or suggests this limitation. (*See* my analysis and discussions in Sections IX.A.1(a)-(k), IX.A.1(m)-(q); *see also* my analysis and discussions below in this section and above in Section VIII.)

186. For example, as I explained above, *Fells* discusses activating relevant charger coils based on the position of the secondary coil of the mobile device. (*See, e.g.,* my analysis and discussions in Sections IX.A.1(a)-(k); *see also* Ex.1005, FIG. 10, 8:57-9:16; FIGS. 11-12, 9:18-45.) As I also demonstrated above, *Fells* discloses a “**charger drive circuit**” configured to “**drive the [one or more] charger coil[s]...to inductively transfer power from the charger to the receiver when the receiver is positioned in the power transfer position**” (*See, e.g.,* my analysis and discussions in Sections IX.A.1(e), IX.A.1(k); *see also* my analysis and discussions in Sections IX.A.1(a)-(d), 1(f)-(j).) As I also discuss above, *Fells* discloses “**charger**

driver circuit” that includes a **“resonant capacitor,”** which is used to provide an alternating voltage to selected one or more **“charger coil(s)”** (*see, e.g.,* my analysis and discussions in Section IX.A.1(e)) and the receiver electronic circuit” includes a **“solenoid”** and **“resonant capacitor”** that respectively work to allow the **“transfer [of] the power”** from the **“charger”** **“to the receiver”** (*See, e.g.,* my analysis and discussions in Sections IX.A.1(e)-(i).)

187. In my opinion, a person of ordinary skill in the art would have understood based on the disclosures of *Fells* (*see* my analysis and discussion above in Sections IX.A.1(a)-(k)) that the **“resonance capacitor”** in the **“charger”** would have caused the **“charger driver circuit”** to **“drive the charger coil at one or more operating frequencies to inductively transfer power”** to the mobile device receiver in *Fells*’s system. (*See* my analysis and discussion above in Section IX.A.1(e).) This is because, consistent with that known in the art, *Fells*’ resonant capacitor allows the charger to provide power signals at an operating frequency via the voltage source used in the charger’s “drive[r] circuit.” (*See* my analysis and discussion above in Section IX.A.1(e); Ex.1005, 9:46-67, 13:53-14:14.) As *Fells* discloses:

The arrangement of FIG. 9 requires AC voltage signals with high power and opposite polarity. FIG. 13 shows a means of generating these signals. There is a

DC power source which is coupled to an inverter to generate an AC signal at a reference oscillator frequency. This is in turn coupled to an inductor and capacitor resonant at the oscillator frequency. This is in turn coupled to a transformer, via a variable capacitor. The output of the transformer has a centre-tap referenced to ground. The two ends of the transformer output provide the positive and negative polarity inputs to the circuit of FIG. 9. A variable capacitor is required because the inductance of the load on the transformer will vary as different coils are switched in and out. It may also varied with different device loads or at different device positions on the pad. The variable capacitor is therefore adjusted to ensure that the system is resonant at the oscillator frequency. In this system, the variable capacitor has been implemented using a switch network, though there are many methods of achieving this.

FIG. 14 shows an electrical equivalent diagram of a portable device for use with the charging pad. There is a secondary coil (represented by the inductor), a capacitor such that the combination is resonant at the oscillator frequency.

(Ex.1005, 9:46-67.)

FIG. 26 shows a system for driving multiple devices which is particularly good for when the devices have

different power requirements. There is a switch matrix which can connect any input to any output. At the inputs (in pairs) there are a number of AC drivers. Each coil is connected to a pair of outputs. A resonant capacitor may be placed at either the driver side or the coil side of the switch. Each driver is used to drive a pair of coils: one coil in the positive polarity and the other in the negative polarity. To drive the positive coil, the positive terminal of the AC driver is connected to the positive terminal of the coil (and likewise the negative source terminal is connected to the negative coil terminal. To drive the negative coil, the positive driver terminal is connected to the negative coil terminal (and likewise the negative driver terminal is connected to the positive coil terminal). There can be a much lower number of drivers than coils. Also it is not necessary to have all drivers connected. In the example illustrated in FIG. 26, driver 1 provides positive current to coil 1 and negative current to coil 4, while driver 2 provides positive current to coil 2 and negative current to coil 6. Each driver can be regulated independently from the others, to match the load seen the device. Further it may be desirable to allow the drivers to selectively connect to more than one pair of coils, depending on how the device is positioned on the charging surface, or the device's load requirements. Instead of using the same driver for both positive and negative current, it is

also possible to use 2 separate sources or a dual source (for example as in FIG. 13 or 24). This may reduce the complexity of the switching arrangement.

(Ex.1005, 13:53-14:14.)

188. Therefore, in my opinion, a person of ordinary skill in the art would have understood that the power is transferred from the charger to the receiver at the resonant frequency designed for efficient power transfer consistent with that disclosed by *Fells*. Such an understanding is supporting by *Fells* disclosure that, in some configurations, the frequency of the AC voltage that is used for sensing the presence of a receiver is different from the frequency used for power transmission:

The AC voltage used for the sensing (Sense Vac) is preferably at a different frequency to the power transmission. It is preferably at a submultiple of the power transmission frequency, such that the harmonics overly those of the power transmission. It is possible that there may be some ‘breakthrough’ of power at the power transmission frequency into the sense circuit. This arises because of stray coupling between individual coils in the system. This can be prevented by inserting a filter in the sense path after the peak detector.

(*Id.*, 8:33-41.)

189. In my opinion, *Fells*' system operates such that **“a tuned circuit”** is formed from the “[selected/activated] **charger coil[s] and the resonant capacitor of the charger drive circuit**” (*see* my analysis and discussions in Section IX.A.1(e)) **“and the solenoid and the resonant capacitor of the receiver electronic circuit”** (*see* my analysis and discussions in Sections IX.A.1(f)-(j)), which **“has a resonant frequency that allows the charger to transfer the power to the receiver at the one or more operating frequencies”** as claimed. Indeed, *Fells* explains how the receiver circuit in the mobile device has a resonant capacitor that is “resonant at the oscillator frequency” of the charger’s resonant capacitor circuit (thus forming such a **“tuned circuit”**). (Ex.1005, 9:46-67; *see* my analysis and discussions in Sections IX.A.1(f)-(j); *see also* Ex.1005, 25:40-26:32 (reciting a “primary unit and secondary device having a resonant frequency” (*e.g.*, a tuned circuit) and the primary unit (*e.g.*, charger) including driver circuitry with switching circuitry and variable impedance circuitry that can be “adjusted to affect the resonant frequency of the system” (claim 21), where the primary unit includes control circuitry used to control “switching circuitry” to “selectively activate a field generator” (*e.g.*, charger coil) “to transfer power inductively to the secondary device (*e.g.*, mobile device) (claim 22), and the control circuitry “maintains inductive power transfer at or near the resonant frequency” (claim 23).) (*See also* Ex.1005, 22:37-23:26 (similar), 23:57-24:40 (similar), 24:63-25:33, 25:12-15 (“inductive coupling [between field generators and

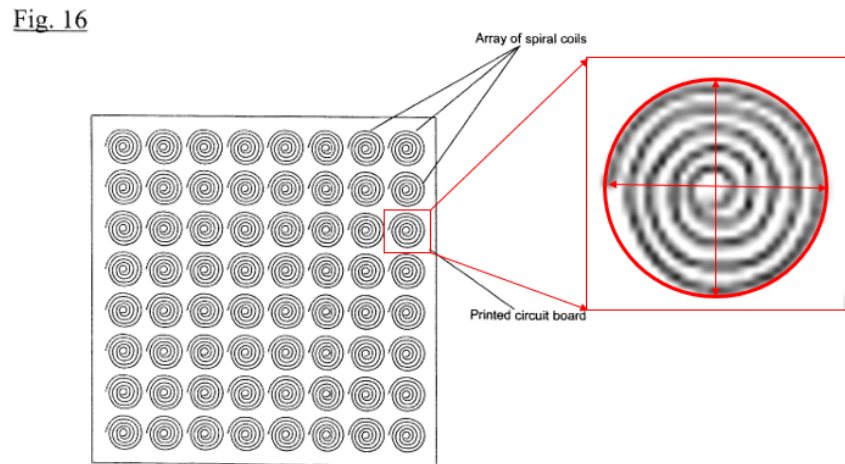
secondary device] has a resonant frequency”); *see also* my analysis and discussions in Sections IX.A.1(m)-(q).)

- m) **Limitation 1(m): the charger coil includes a conductor patterned to include multiple, substantially concentric turns for generating a magnetic flux through a first end of the solenoid when the receiver is placed in the power transfer position, wherein an outermost of the concentric turns defines a perimeter of a charger coil area;**

190. In my opinion, *Fells* (including as modified above) discloses and/or suggests this limitation. (*See* my analysis and discussions in Sections IX.A.1(a)-(l), IX.A.1(n)-(q); *see also* my analysis and discussions below in this section and above in Section VIII.)

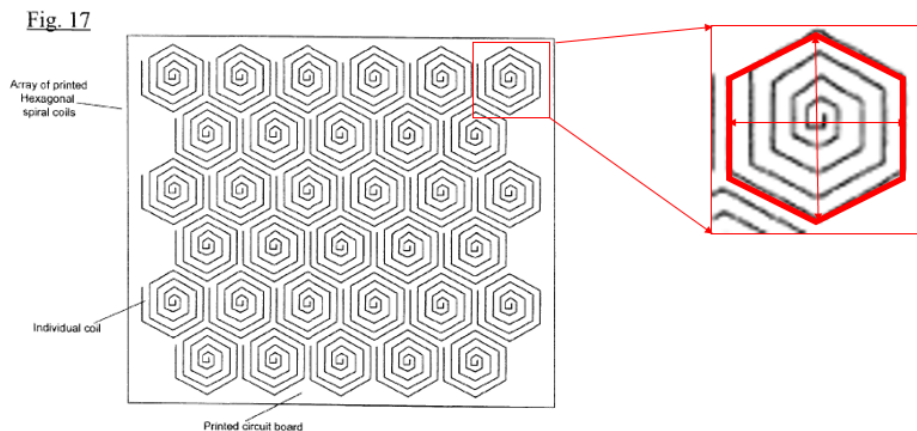
191. For example, as I explained above, *Fells* discloses that the “**charger coil(s)**” can be configured as planar spiral coils, which includes a “**conductor patterned to include multiple, substantially concentric turns.**” (*See*, my analysis and discussions in Sections IX.A.1(c); Ex.1005, 10:26-36, FIGS. 16-17, 11:45-64; *see also* my analysis and discussions in Sections IX.A.1(a)-(l).) As exemplified below, and consistent with the disclosures in *Fells*, “**an outermost of the concentric turns**” of the conductor in a charger coil “**defines a perimeter of a charger coil area**” as claimed. (Ex.1005, FIGS. 16-17, 23 (annotated below); *see* my analysis and discussions of *Fells* immediately below and above in Sections IX.A.1(a)-(l).)

For example, the red circle around the outermost turn of the spiral coil shown below in figure 16 defines a perimeter of the charger coil area.



(Ex.1005, FIG. 16 (annotated).)

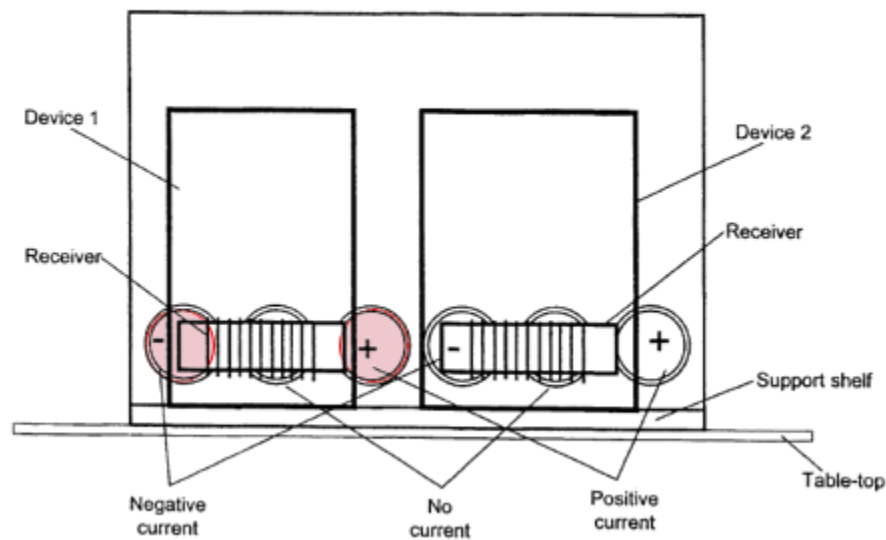
192. Similarly, the red hexagon around the outermost turn of the hexagonal coil shown below in figure 17 defines a perimeter of the charger coil area.



(*Id.*, FIG. 17 (annotated).)

193. In annotated figure 23 below, the perimeter of the charger coil area corresponds to the outermost turn of each of the coils in the same manner as in figures 16 and 17 above.

Fig. 23



(*Id.*, FIG. 23 (annotated).)

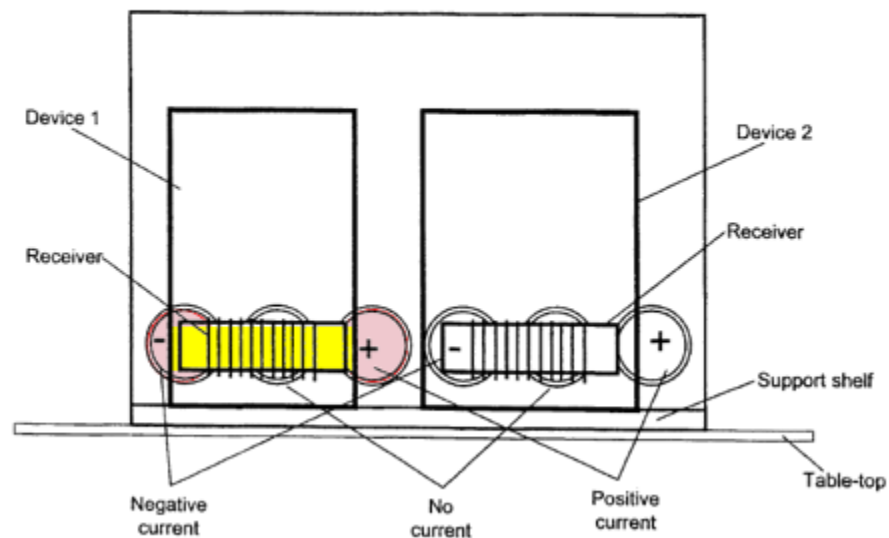
194. A person of ordinary skill in the art would have understood that such charger coil(s) **“generat[es] a magnetic flux through a first end of the solenoid when the receiver is placed in the power transfer position.”** For example, Fells discloses that in a system for transferring power from a primary unit (“charger”) to a secondary device (“receiver”), magnetic flux generated by at least one of the field generators (e.g., coils) flows through the secondary coil. (Ex.1005, 1:41-57; *see also id.*, 2:16-20 (“wherein the sensing means determines the position of the power

receiver, and in dependence the switching means acts to activate at least one field generator such that a magnetic flux flows through the secondary coil, supplying power to the secondary device.”), 4:12-16 (same), 2:54-56 (“wherein magnetic flux from the first and second field generators flow through the secondary coil, supplying power to the secondary device.”), 3:26-28 (same), 3:51-53 (“wherein the current generator supplies current to at least one primary coil such that a magnetic flux flows through the secondary coil, supplying power to the secondary device.”), 5:15-16 (“wherein magnetic flux flows through the secondary coil, supplying power to the secondary device.”), 5:37-42 (“wherein the sensing means determines the position of the power receiver, and in dependence the switching means activates a field generator such that a magnetic flux flows through the secondary coil in a direction substantially parallel to the power transfer surface, thereby transferring power to the secondary device.”), 5:61-64 (“activating at least one field generator such that a magnetic flux flows through the secondary coil in a direction substantially parallel to the power transfer surface thereby supplying power to the secondary device”), 11:61-12:2 (disclosing that a ferrite back-plate acts as a flux return path for the magnetic circuit formed), 14:57-65 (“magnetic flux”), 15:49-54 (same), 16:29-36 (same), 17:9-17 (same), 17:53-62 (same), 18:29-35 (same), 19:9-17 (same), 19:62-20:2 (same), 20:47-51 (same), 21:4-18 (same), 22:37-45 (“primary unit comprising:

a power transfer surface capable of enabling inductive coupling with said secondary device...).

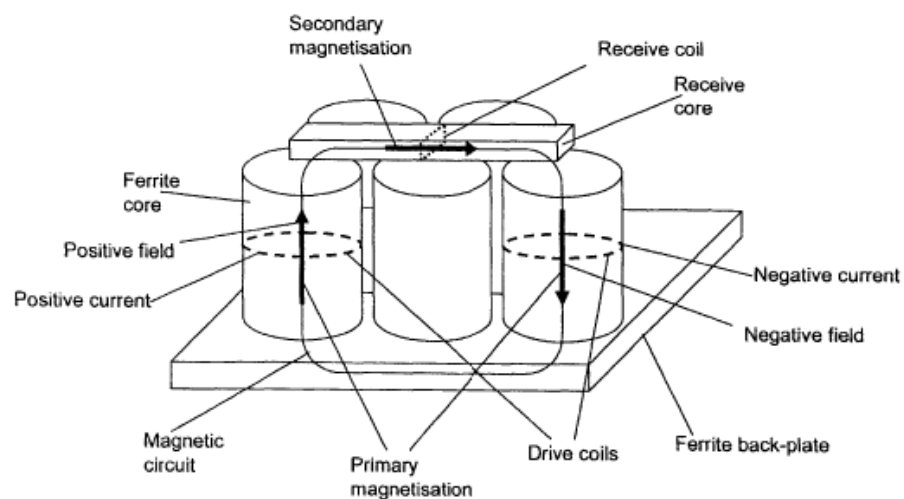
195. Indeed, *Fells* explains how different charger coils can be activated such that magnetic flux flows through the end of the mobile device's receiver, which occurs whether the charger coils are configured as planar spiral-type coils or are configured otherwise as contemplated by *Fells*. (*Id.*, FIGS. 2, 5, 8 (below), 23 (annotated below), 1:3-6:3, 6:56-8:9, 10:26-11:8, 11:26-12:19; *see also id.*, 8:10-10:25, 11:9-25, 13:26-22:35; *See my analysis and discussions below in Sections IX.A.1(n)-(q).*)

Fig. 23



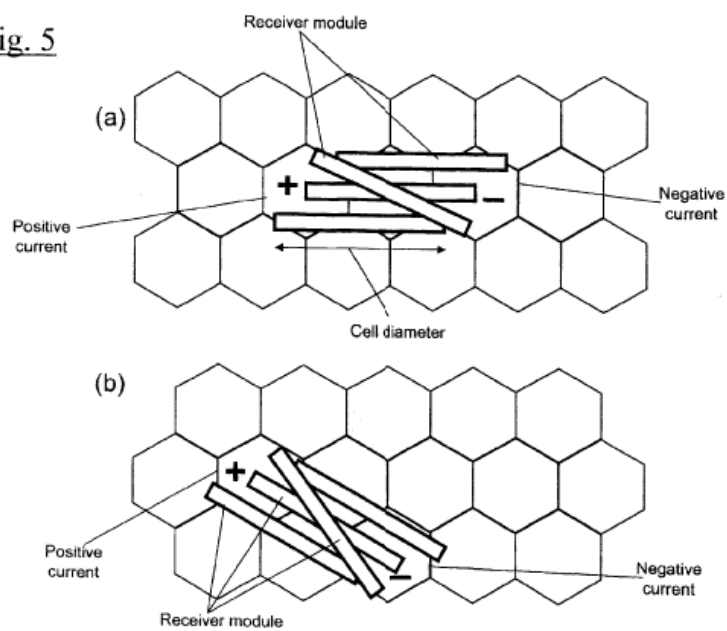
(*Id.*, FIG. 23 (annotated).)

Fig. 2



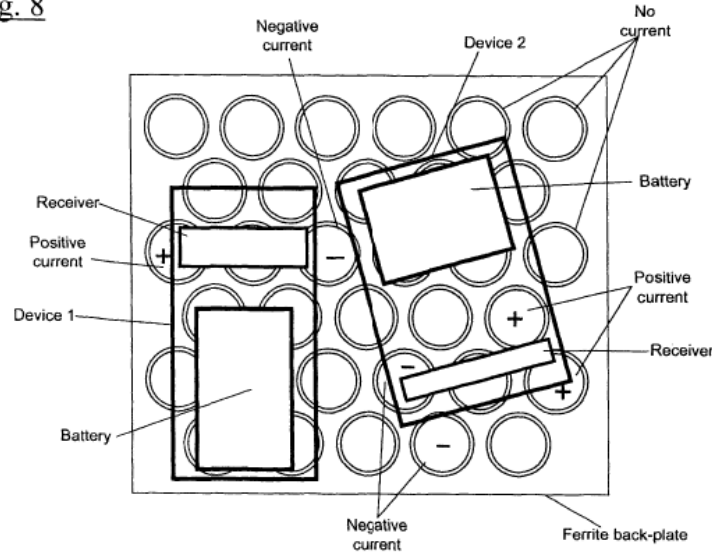
(*Id.*, FIG. 2.)

Fig. 5



(*Id.*, FIG. 5.)

Fig. 8



(*Id.*, FIG. 8.)

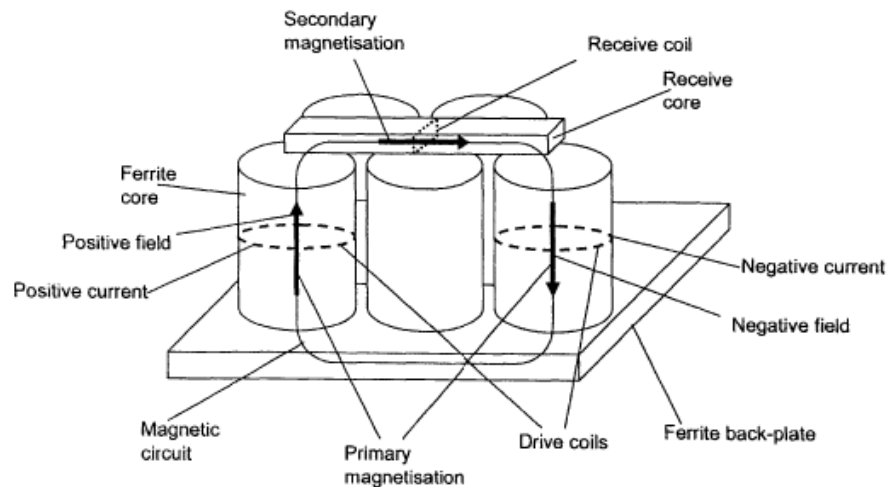
- n) **Limitations 1(n): the multiple concentric turns, when driven by the charger drive circuit, generate a magnetic field that is substantially perpendicular to the charger surface at a geometric center of the charger coil area,**

196. In my opinion, *Fells* (including as modified above) discloses and/or suggests this limitation. (See my analysis and discussions in Sections IX.A.1(a)-(m), IX.A.1(o)-(q); see also my analysis and discussions below in this section and above in Section VIII.) As an initial matter, the plain language of this claim element does not require all magnetic fields to be generated at the geometric center of the charger coil area. Instead, the claim language only requires that *a* magnetic field be so generated at the geometric center of the charger coil area.

197. For example, as I explained above, each activated charger coil in *Fells*' charger is **"driven by the charger drive[r] circuit"** in accordance with the various configurations contemplated by *Fells*, including those employing planar spiral type coils with **"substantially concentric turns."** (See my analysis and discussions in Sections IX.A.1(1)-(m); see also my analysis and discussions in Sections IX.A.1(a)-(k).) When driven, **"a magnetic field that is substantially perpendicular to the charger surface"** is generated. For instance, consistent with that discussed above (see my analysis and discussions in Sections IX.A.1(a)-(m)), *Fells* describes system configurations where power is transferred "from a primary unit to a secondary device, separable from the primary unit, by electromagnetic induction" where the primary unit comprises **"a power transfer surface"** (e.g., "charger surface") and "a plurality of field generators" (e.g., charger coils) that are "each able to generate a field *substantially perpendicular to the power transfer surface.*" (Ex.1005, 1:41-49.) "[M]agnetic flux from at least one field generator flows through the secondary coil, supplying power to secondary device." (*Id.*, 1:55-57; see also *id.*, 6:66-7:1 ("[c]urrent is applied to the coils so as to generate a magnetic field in a direction perpendicular to the charging surface").)

198. As shown in figure 2 below, a magnetic field (e.g., "positive field") flows through the center of a charger core/coil in a direction that is perpendicular to the surface of the charger. (*Id.*, FIG. 2, 7:9-21.)

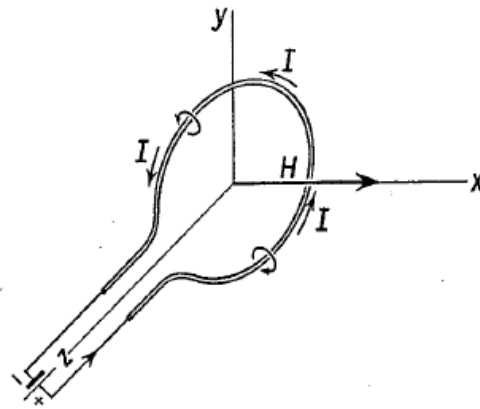
Fig. 2



(*Id.*, FIG. 2)

199. A person of ordinary skill in the art would have understood that planar spiral type charger coils (like those taught by *Fells*) would likewise generate magnetic field lines substantially perpendicular to the surface of the charger and flowing through the geometric center of the coil surface area, similar to that in a loop type coil. Indeed, consistent with that discussed in 1958 by *Semat* (Ex.1012), 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.1012, 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.1012, 559, FIG. 30-4.)

200. Moreover, a person of ordinary skill in the art knew how to determine the magnetic field intensity “at the center of a singular circular loop of wire carrying a current,” and likewise, the magnetic field at center of such a single conductor loop coil, which is perpendicular to the center loop and in the positive z direction as shown in figure 30-8 below. (*Id.*, 562.)

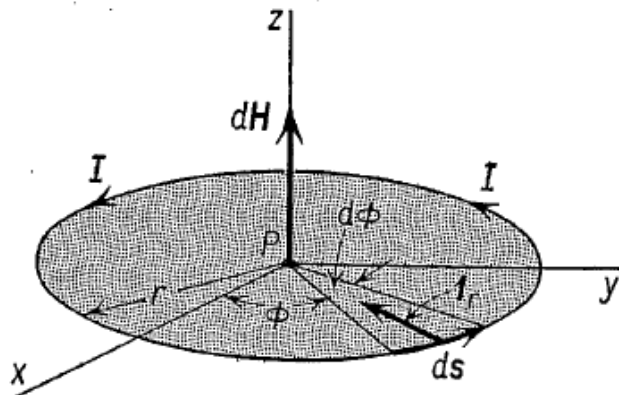


Fig. 30-8

(Ex.1012, 562 (explaining the “direction of the magnetic field dH ...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.)

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

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

201. Therefore, a person of ordinary skill in the art would have understood that the substantially perpendicular magnetic field generated by each of the planar spiral charger coils in the *Fells*’ charger would include a field “**at a geometric center of the charger coil area**” consistent with conventional operations of planar spiral type coils like those described by *Fells*. (Ex.1013, 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 (“region of interest can cover a portion of, or all of the area of the coil” including “the area enclosed by the outermost turn of the coil”), 5:23-6:15, claims 1-88; Ex.1014, Abstract, FIGS. 1, 5-6, 9, 11-12, 24-26, ¶¶0008-0010, 0044-0050,

0051 (peak intensity of magnetic field at the center of the inductor), 0065-0066, 0070, 0073 (tuning for resonant frequency matching between primary and second sides), 0078 (resonant frequency is controllable depending on coil design and secondary side capacitance); Ex.1015, 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). (*See also* my analysis and discussions below in Sections IX.A.1(o)-(q).)

o) Limitation 1(o): the charger coil area is larger than an area of the first end and larger than an area of the second end of the magnetic core of the solenoid;

202. In my opinion, *Fells* (including as modified above) discloses and/or suggests this limitation. (*See* my analysis and discussions in Sections IX.A.1(a)-(n), IX.A.1(p)-(q); *see also* my analysis and discussions below in this section and above in Section VIII.)

203. For example, *Fells* discloses configurations with various applications and arrangements of its inductive power transfer system. (*See, e.g.*, my analysis and discussions in Sections IX.A.1(a)-(l).) *Fells* discusses many aspects relating to the system (*see e.g.*, Ex.1005, 1:50-6:3, 14:36-22:33) including for example, varying gap spacing between charging surface and power receiver (*id.*, 7:16-21), coil and receiver configurations (*id.*, 7:22-24 (coils can have a diameter and height of 12.7 mm with 15 mm pitch, where the receiver is 25 mm long)), 10:60-11:44 (exemplary

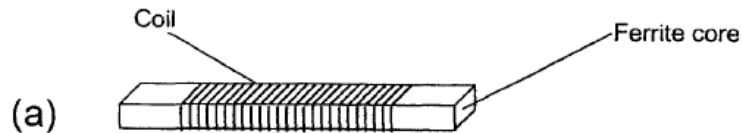
types of receivers), 12:15-19), charger configurations (*id.*, 11:45-12:8, 13:14-14:31), dimensional relationships between charger coils and power receiver (*id.*, 7:31-8:9), and different components (*id.*, 8:42-56, 12:66-14, 14:32-35).

204. As I discuss above in section IX.A.1(g), the claimed “**solenoid**” is not limited to a rod shaped structure, and the solenoid may be shaped as a “blade or thin solenoid.” (*See* my analysis and discussions in Section IX.A.1(g); Ex.1001, 2:30-31, 2:54-55, 8:63-65, 9:21-27, 21:65-22:2, 2:58-63, FIGS. 7, 9-10.) Likewise, *Fells* discloses similar blade and thin types of “solenoids” that include two ends. (*See* my analysis and discussions in Section IX.A.1(g); Ex.1005, FIGS. 1(a), 19(a)-(b), 21, 6:57-7:7, 10:60-63, 11:9-21.) *Fells* explains that the “coils themselves could physically be a range of different structures as will be become apparent later” and exemplifies that “[d]imensions which give good performance for powers of 2-5 W are: ***a power receiver which is 30 mm long with a cross section of 2 mm x 6 mm;*** and a ***charging surface with a cell diameter of 15 mm.***” (Ex.1005, 7:37-42.)

205. A person of ordinary skill in the art would have understood such dimensions to reflect a charging cell having a circular shaped coil (since it has a surface cell “diameter”), and a power receiver “solenoid” with a magnetic core having rectangular shaped ends (since it has a “cross section” with a length and width), similar to those described by *Fells*. (Ex.1005, FIGS. 1(a), 16-17, 19(b), 21(a), 23 (below); *See* my analysis and discussions in Sections IX.A.1(c), IX.A.1(f)-

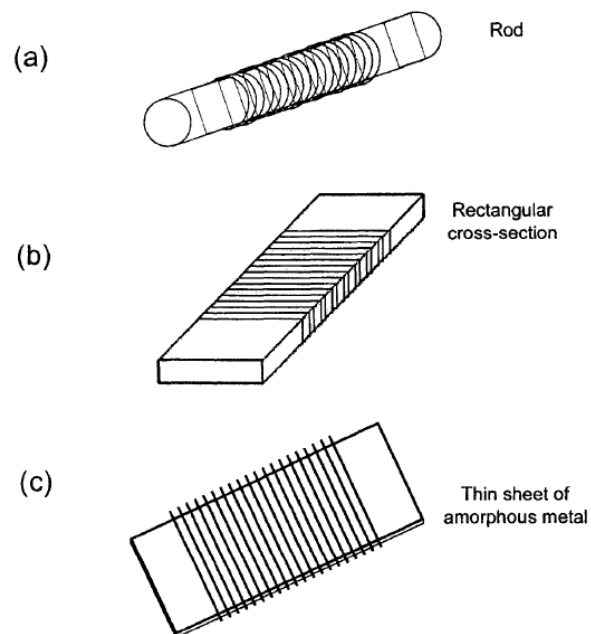
(i), IX.A.1(m)-(n).) For example, solenoids with rectangular ends are shown in figures 1(a) and 19(b) below, where the cuboid core corresponding to such solenoids is shown in figure 21.

Fig. 1



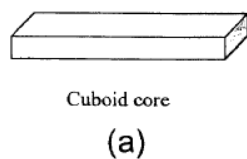
(Ex.1005, FIG. 1(a).)

Fig. 19



(*Id.*, FIG. 19.)

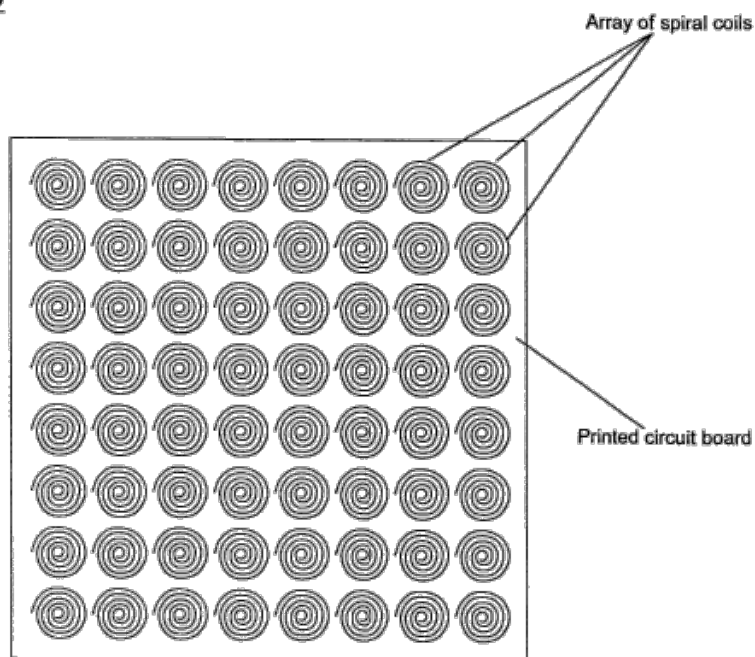
Fig. 21



(*Id.*, FIG. 21.)

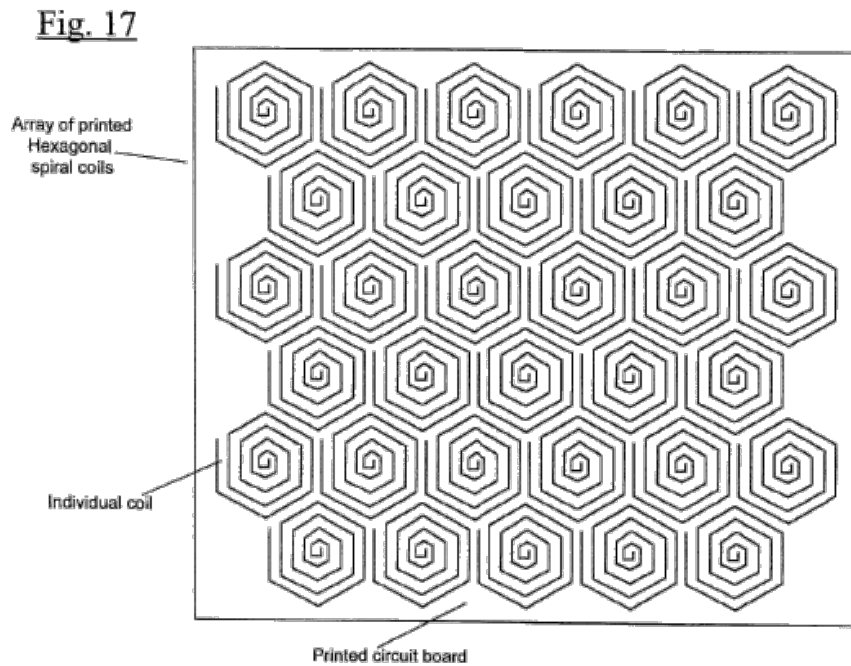
206. Figure 16 below shows an array of charging cells, each of which includes a spiral coil having the same diameter.

Fig. 16



(*Id.*, FIG. 16.)

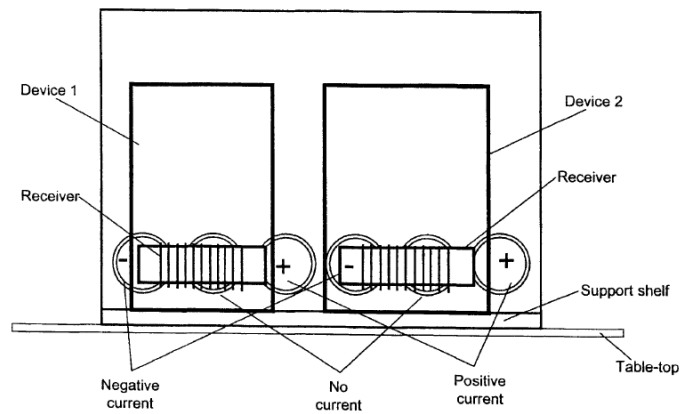
207. Figure 17 below shows a similar array of charging cells, where the coils are hexagonal.



(*Id.*, FIG. 17.)

208. The charger in figure 23 below includes charging cells with coils placed in a single row with an alignment corresponding to the positioning of the receivers that are charged by the coils. (Ex.1005, 11:45-55.)

Fig. 23



(*Id.*, FIG. 23.)

209. For the exemplary circular shaped charging cell (*e.g.*, a spiral coil) with a 15 mm diameter (7.5 mm radius), the coil would have an area approximately 176.6 mm² (area = πr^2 , where $r = 7.5$ mm).⁵ In the example provided, the ends of the magnetic core of the solenoid in the exemplary power receiver have an area that is 2 mm times 6 mm = 12 mm², which corresponds to the 2 mm by 6 mm cross section.⁶

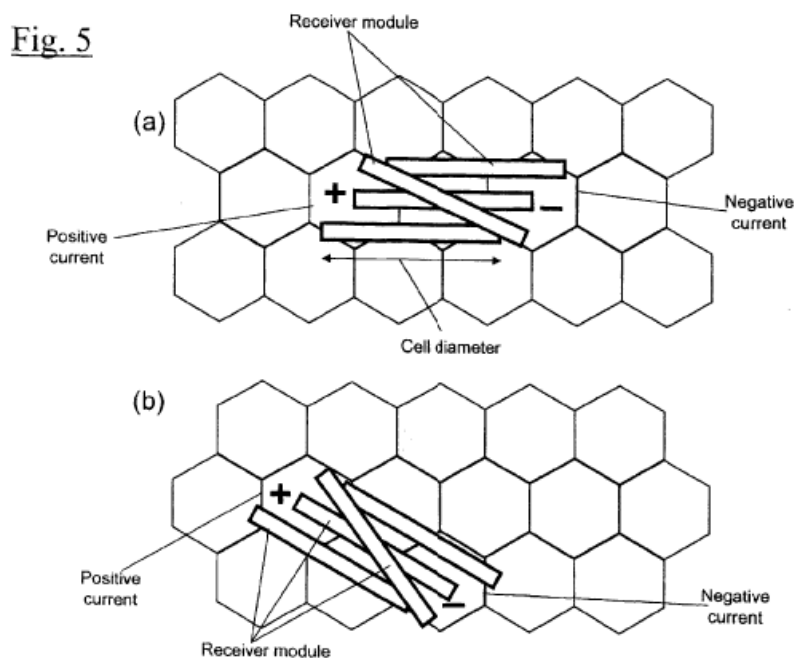
⁵ A person of ordinary skill in the art would have been able to determine the area of other charging cell areas, like a hexagon, where the area (A) = $((3\sqrt{3})/2) * (\text{side-length})^2$.

⁶ A person of ordinary skill in the art would have understood that the rectangular prism/cuboid-shaped magnetic cores taught by *Fells* (Ex.1005, FIGS. 19(b), 21(a)) would have opposite faces that are equal—a known property of a cuboid.

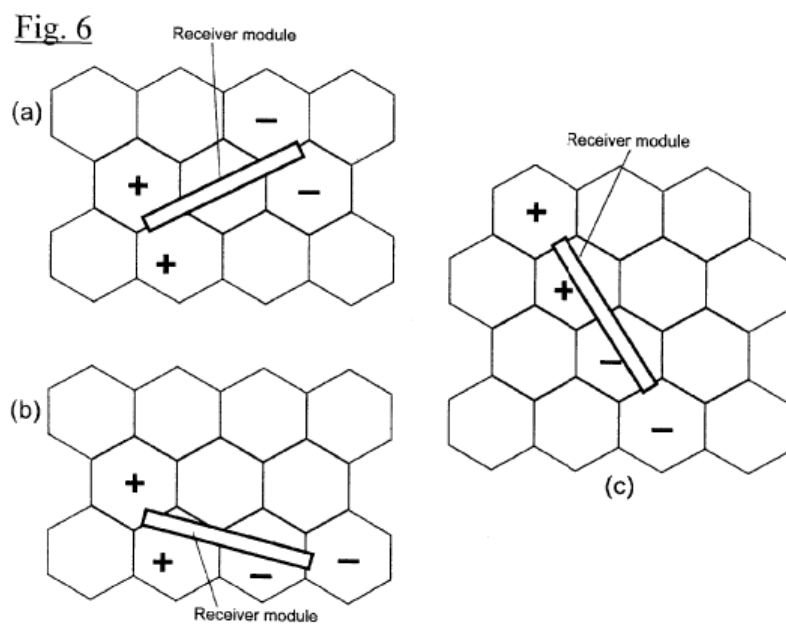
Accordingly, *Fells* discloses configurations where “**the charger coil area**” in the above-discussed charger (*See, e.g.,* my analysis and discussions in Sections IX.A.1(b)-(c), (m)-(n)) (*e.g.,* $\sim 176.6\text{mm}^2$) “**is larger than an area of the first end and larger than an area of the second end of the magnetic core of the solenoid**” (*e.g.,* $\sim 12\text{mm}^2$ each).

210. I have been asked to assume a scenario in which *Fells* does not expressly disclose dimensions for both ends of the solenoid’s magnetic core, etc., including for a rod/cylindrical shaped solenoid magnetic cores and therefore does not expressly disclose claim limitations 1(o) and 26(m). With such a scenario in mind, it is my opinion that a person of ordinary skill in the art would have been motivated to configure and implement a mobile device with a power receiver having a solenoid with a magnetic core with ends each having an area smaller than the charging coil area of the coil(s) in the charger. Such a person of ordinary skill in the art would have been motivated to consider and implement such receiver solenoid magnetic cores (whether rod/cylindrical or rectangular/cuboid shaped, etc.) to be consistent with the configurations disclosed by *Fells*. (*See* my citations/discussions above in this section regarding *Fells*.) A person of ordinary skill in the art would have had reasons to consider and implement various types of components, having various dimensions, given *Fells* contemplates variations in the types of materials, sizes, arrangements, and the like in the inductive charging system, as noted above.

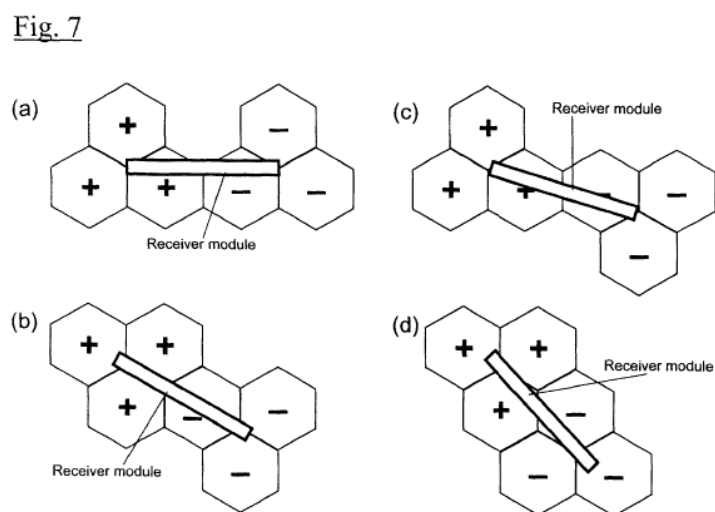
Moreover, as shown in figures 5-8, 18, and 23 below, a person of ordinary skill in the art would have recognized that *Fells* exemplifies in its figures receivers with cores that have ends with smaller widths than exemplary charging cell sizes. (See e.g., Ex.1005, FIGS. 5-8, 18, 23.) Note that while the exemplary figures show “receiver” modules, a person of ordinary skill in the art would have understood the solenoid magnetic core contained therein would be no larger than the receiver module.



(Ex.1005, FIG. 5.)

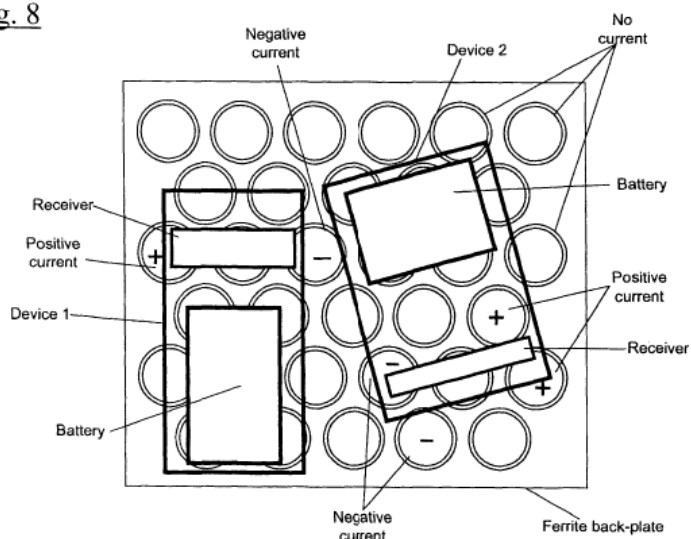


(*Id.*, FIG. 6.)



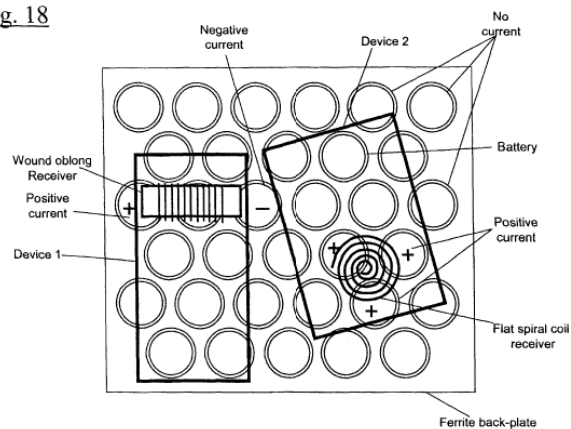
(*Id.*, FIG. 7.)

Fig. 8



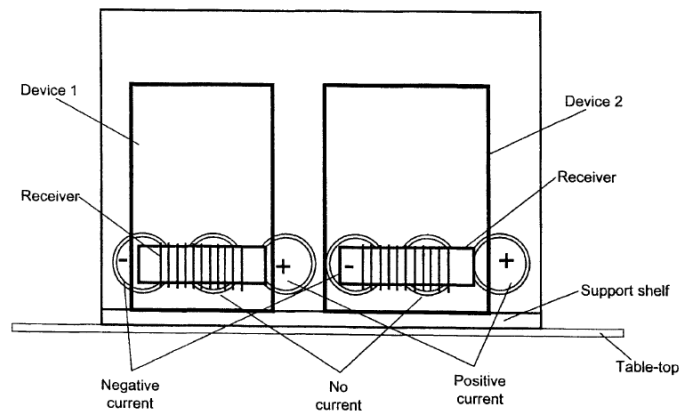
(*Id.*, FIG. 8.)

Fig. 18



(*Id.*, FIG. 18.)

Fig. 23



(*Id.*, FIG. 23.)

211. While a person of ordinary skill in the art would have appreciated that such figures are exemplary, and do not expressly convey actual dimensions of the receiver (length, width, height), or the dimensions of the magnetic cores in those receivers, such a skilled person would have been guided by such depictions in context of *Fells*' other teachings providing exemplary dimensions (Ex.1005, 7:9-42), to consider designs that track similar area relationships disclosed in *Fells* (e.g., Ex.1005, 7:38-42) that would have resulted in dimension/area relationships like those recited in limitation 1(o)/26(m). Therefore, in light of such teachings and suggestions in *Fells*, it is my opinion that a person of ordinary skill in the art would have been motivated to consider and implement various types of magnetic cores for the receiver's solenoid (*see* my analysis and discussions in Sections IX.A.1(f)-(h))

including those have ends with an area smaller than the charging cell area (*See my analysis and discussions in Sections IX.A.1(c), IX.A.1(l)-(o).*)

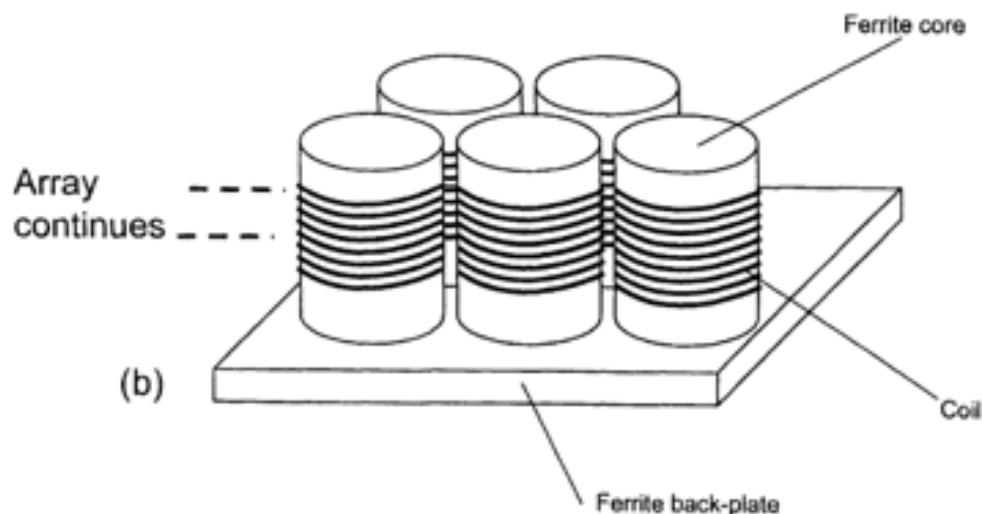
212. In my opinion, a person of ordinary skill in the art would have had the skills, knowledge, and rationale in light of the teachings/suggestions of *Fells* and a such a skilled person's state-of-art knowledge as noted above, to implement such a magnetic core and charger cell size arrangement, while taking into account design tradeoffs and techniques/technologies associated with the configurations. It is also my opinion that such a person of ordinary skill in the art would have a reasonable expectation of success in implementing such a system with the area of the ends of the magnetic core of the solenoid being smaller than the charger coil area. Indeed, implementing the above-modification would have involved applying known technologies/techniques (*e.g.*, using various shaped/sized magnetic cores for a mobile device receiver and charging coils, consistent with those taught by *Fells*) to predictably provide an inductive charging system that provides power transfer functionalities consistent with those discussed by *Fells*. (*See my analysis and discussions in Sections IX.A.1(a)-(n), IX.A.1(p)-(q).*)

p) Limitation 1(p): the magnetic layer of the charger extends beyond the charger coil area; and;

213. In my opinion, *Fells* (including as modified above) discloses and/or suggests this limitation. (*See my analysis and discussions in Sections IX.A.1(a)-(o),*

IX.A.1(q); *see also* my analysis and discussions below in this section and above in Section VIII.)

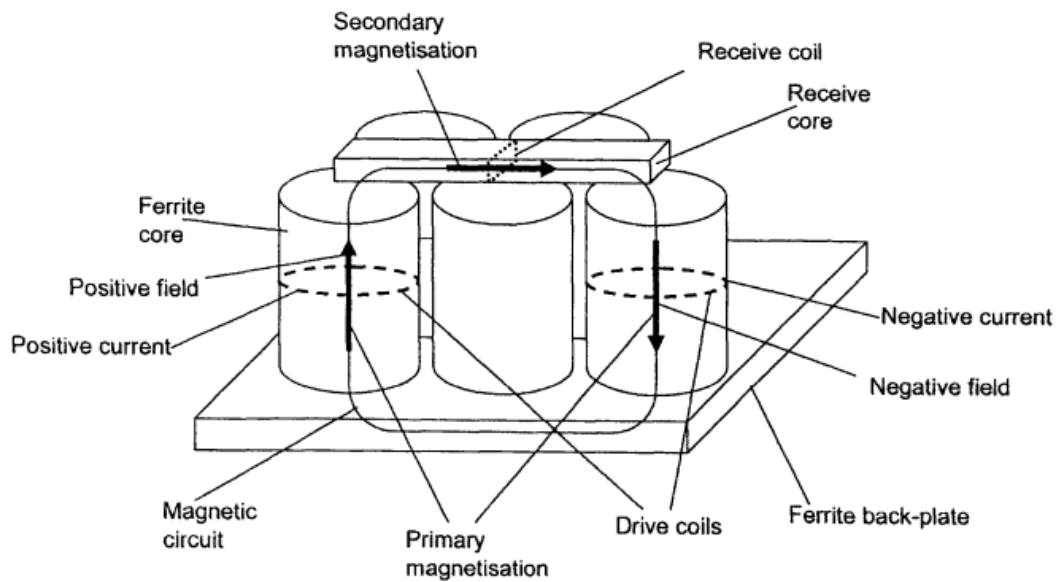
214. For example, as I explained above, *Fells* discloses a ferrite backplate, which is a “**magnetic layer**” as claimed in limitation 1(d)/26(c). (*See* my analysis and discussions in Section IX.A.1(d).) While *Fells* does not expressly state the size/dimensions of the magnetic backplate, *Fells* shows examples of the backplate that are clearly beyond the charger coil area (of not just one charger coil, but others in the charger). For example, figure 1(b) below shows an “array of coils, each wound around a ferrite core,” where the “cores are attached to ferrite backplate.” (Ex.1005, 6:60-63.)



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

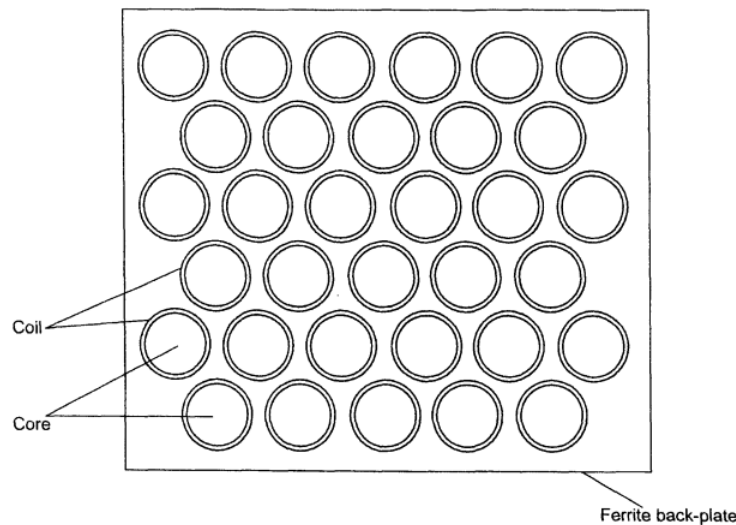
215. Similarly, figures 2 and 3 below show the ferrite back-plate extending beyond the area occupied by the charger coils. (*Id.*, 7:9-21 (discussing FIG. 2 and “the *ferrite backplate*” used “to complete the circuit”), 7:25-29.)

Fig. 2



(*Id.*, FIG. 2.)

Fig. 3



(*Id.*, FIG. 3.)

216. In my opinion, to the extent not evident or disclosed, a person of ordinary skill in the art would have been motivated to consider and implement a ferrite back-plate that extends beyond the “charger coil area” (*see* my analysis and discussions in Sections IX.A.1(m)-(o)) to ensure the charger coil(s) has a magnetic layer to “complete the [magnetic] circuit” that is “formed when the power receiver is placed on the charging surface” including the charger coil(s), consistent with that discussed by *Fells*. As *Fells* discloses:

FIG. 2 illustrates the magnetic circuit formed when the power receiver is placed on the charging surface. A coil in proximity to one end of the receiver is driven with current in a positive sense and a coil in proximity to the other end is driven in a negative sense. The field is

concentrated in the ferrite and **forms a magnetic circuit** from the first coil, through the receiver coil, through the second coil and **through the ferrite backplate to complete the circuit.**

(Ex.1005, 7:9-16.)

217. In my opinion, such a modification would have been a predictable application of *Fells*' teachings and configurations that would have been within the capabilities, knowledge, and skills of a person of ordinary skill in the art and motivated by the teachings/suggestions in *Fells*. It is also my opinion that, in light of such guidance and knowledge/skills, a person of ordinary skill in the art would have had a reasonable expectation of success that implementing such a modification, which would have resulted in an inductive power transfer system that operated as intended and in a manner consistent with that contemplated by *Fells*.

- q) **Limitation 1(q): when the receiver is in the power transfer position, the first end of the magnetic core is located proximate to the charger coil area above the charger surface to receive magnetic flux from the charger coil area and guide the magnetic flux in a closed magnetic loop from the charger coil area through the solenoid and return through the charger magnetic layer to the charger coil area to form the closed magnetic loop.**

218. In my opinion, *Fells* (including as modified above) discloses and/or suggests this limitation. (See my analysis and discussions in Sections IX.A.1(a)-(p);

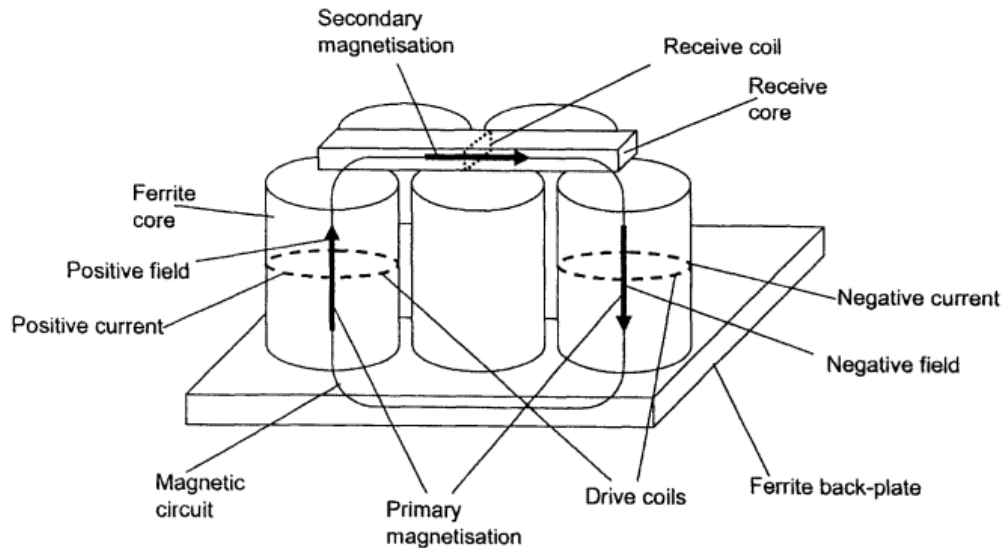
see also my analysis and discussions below in this section and above in Section VIII.)

219. For example, as I explained above in Section IX.A.1(k), the charger in *Fells*' system includes an alignment mechanism for positioning the receiver "**in a power transfer position**" to ensure the mobile device is positioned "**proximate to the charger surface**" for receiving power transferred from the charger's coil(s). (*See* my analysis and discussions in Section IX.A.1(k).) A person of ordinary skill in the art would have understood in light of *Fells*' teachings noted above (*see* my analysis and discussions in Sections IX.A.1(a)-(p)), that when the receiver is in the "**power transfer position**," inductive power transfer takes place between the charger coil(s) and the secondary coil in the mobile device, consistent with that known in the art. The inductive power transfer is accomplished using magnetic flux flowing between the charger coils and the magnetic core of the device's receiver solenoid.

220. *Fells* explains with respect to FIG. 2 (below) that a "magnetic circuit [is] formed when the power receiver is placed on the charging surface" such that "[a] coil in proximity to **one end of the receiver** is driven with current in a positive sense and a coil in proximity to the **other end** is driven in a negative sense," where "[t]he field is concentrated in the ferrite and forms a magnetic circuit from the first coil,

through the receiver core, through the second coil and through the ferrite backplate to complete the circuit.” (Ex.1005, 7:9-21.)

Fig. 2



(*Id.*, FIG. 2.)

221. Similarly, regarding FIG. 23, *Fells* explains that “vertical cores can be hollow, to reduce cost and weight, as the overall **flux** density is not high enough to require a solid part” and that “[a] **ferrite back-plate** may be used behind the vertical cores to **act as a flux return path**, and this improves the coupling factor.” (*Id.*, 11:65-12:2.) As I explained above, *Fells* discusses how magnetic flux would flow in a manner that is consistent with a person of ordinary skill in the art’s understanding of such inductive power transfer system arrangements. (See my analysis and discussions in Section IX.A.1(m) (discussing *Fells* “magnetic flux” and

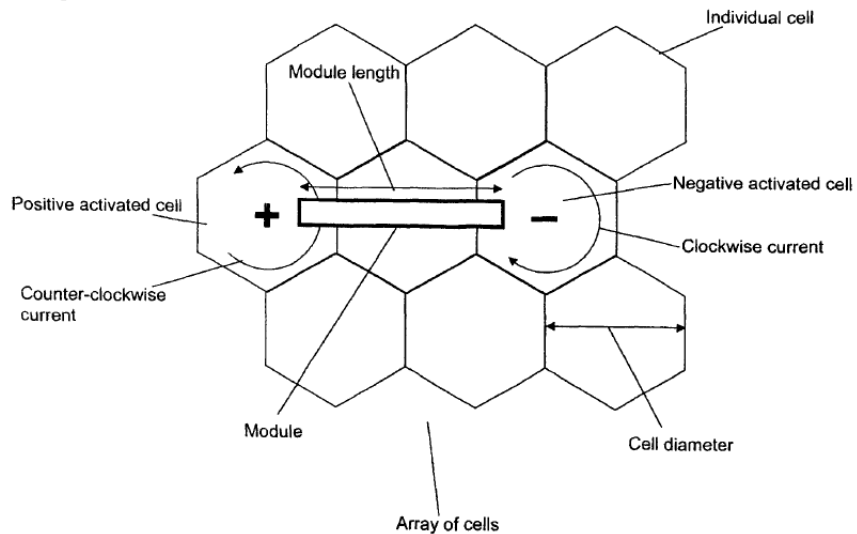
how it would flow); Ex., 1005, 1:3-6:3 (*e.g.*, 1:55-57 (“magnetic flux from at least one field generator flows through the secondary coil, supplying power to secondary device”)), 6:56-8:9, 10:26-11:8, 11:26-12:19, 14:57-65, 15:49-54, 16:29-36, 17:9-62, 18:29-35, 19:9-17, 19:62-20:2, 20:47-51, 21:4-18); *see* my analysis and discussions in Section IX.A.1(h); Ex.1009, 51; Ex.1012, 592 (magnetic flux ϕ being total number of lines pass perpendicularly through an element of area).))

222. A person of ordinary skill in the art would have thus understood the similar operation/characteristics would occur between planar spiral charger coils and a solenoid’s magnetic core in a receiver placed proximate to the charger coil(s) in context of *Fells*. (Ex.1005, FIGS. 4-8, 16-18, 23, 7:31-8:11, 10:26-58, 11:45-12:8; *see* my analysis and discussions in Section IX.A.1(m) (discussing how different charger coils can be activated such that magnetic flux flows through the end of the mobile device’s receiver (and thus its solenoid’s magnetic core), even where the charger coils are configured as planar spiral-type coils or in other configurations contemplated by *Fells*); *see also* my analysis and discussions in Section IX.A.1(h).)

223. A person of ordinary skill in the art would have thus understood that *e.g.*, the flow of flux from a first activated charger coil (*e.g.*, “-”) through the magnetic core of the receiver’s solenoid (*e.g.*, receiver module), to another activated charger coil (*e.g.*, “+”) and through the backplate to the first activated coil would

form a **“closed magnetic loop”** like that claimed in order to **“complete the magnetic circuit.”** (Ex.1005, 7:9-16, 7:31-36, FIGS. 2, 4.)

Fig. 4



(*Id.*, FIG. 4.)

224. Therefore, it is my opinion that Accordingly, *Fells* discloses/suggests **“when the receiver is in the power transfer position”** (*see* my analysis and discussions in Section IX.A.1(k)), **“the first end of the magnetic core”** (of the receiver solenoid (*see* my analysis and discussions in Sections IX.A.1(f)-(h), IX.A.1(o)) **“is located proximate to the charger coil area above the charger surface to receive magnetic flux from the charger coil area”** (*see* my discussions above; *see also* my analysis and discussions in Section IX.A.1(m)-(o)) **“and guide the magnetic flux in a closed magnetic loop from the charger coil area through the solenoid and return through the charger magnetic layer to the charger coil**

area to form the closed magnetic loop” (*see* my discussions above; *see* my analysis and discussions in Sections IX.A.1(m)-(p)), as claimed.

2. Claim 17

- a) **The system of claim 1, wherein: the receiver and the charger include communication and control electronics circuits to communicate, between the receiver and the charger, information associated with the transfer of power to the first mobile device; and**
- b) **the communication is through a charger antenna that includes the charger coil and a receiver antenna that includes the solenoid.**

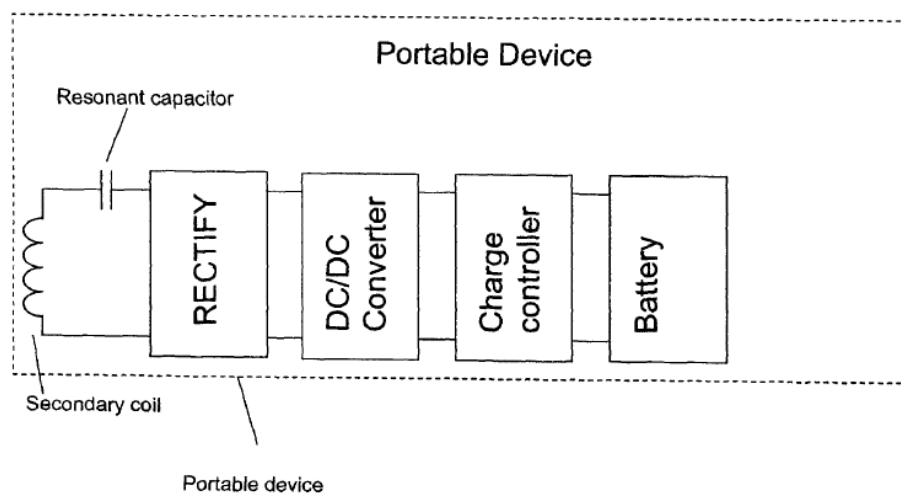
225. In my opinion, *Fells* (including as modified above) discloses and/or suggests this limitation. (*See* my analysis and discussions below in this section; *see also* my analysis and discussions in Sections IX.A.1(a)-(q).)

226. For example, *Fells* discloses configurations where the charger and the receiver in the mobile device each include electronic circuits that communicate and control the communication of information associated with the inductive power transfer processes disclosed by *Fells* (e.g., transfer of power to the mobile device). As *Fells* explains, “[s]ensing of the ***location and orientation of one or more receiver coils within a portable device*** may be accomplished, for example, by one of [a number of] methods[.]” (Ex.1005, 12:20-22.) The methods listed by *Fells* include “5. ***Inductive communications using the primary and secondary coils. For***

example, [the] secondary [coil] has dual use as an RFID tag antenna, and the position is detected using the RFID channel.” (Id., 12:37-40.)

227. A person of ordinary skill in the art would have understood that in such a configuration, the electronic circuitry associated with the secondary coil (“**solenoid**”) in the mobile device that receives power transferred from the charger’s coil(s) (e.g., circuitry included in the circuits described for e.g., FIG. 14) would form a “**communication and control electronic circuit**” in the “receiver.” (See my analysis and discussion above in Sections IX.A.1(f)-(j).)

Fig. 14



(Ex.1005, FIG. 14.)

228. A person of ordinary skill in the art would have understood that such circuitry in the mobile device would work with the receiver’s coil (“**solenoid**”) in the same way *Fells* discloses (*id.*; Ex.1005, 9:64-10:12), but, in addition, the

secondary coil serves as a “dual use as an RFID tag antenna” that would communicate with the charger “over the RFID channel” formed by “inductive communications using the primary and secondary coils” for purposes of sensing location/position of the “receiver coil.” (Ex.1005, 12:20-22, 12:37-40.) Because the location of the receiver coils is used by the charger to activate selected coils in *Fells*’ system, the communication would have necessarily included “**information associated with the transfer of power to the first mobile device**” as recited in claim 8. (See my analysis and discussion above in Sections IX.A.1(a)-(g); Ex.1005, 1:41-6:3, 6:56-9:45, 12:60-61 (“[t]he *position of the secondary is sensed and then power is transferred by switching on the appropriate primaries.*”), 12:61-13:25.).

229. In addition, while *Fells* does not expressly state the primary coil also functions as an antenna that facilitates the communication of information, it is my opinion that a person of ordinary skill in the art would have been motivated to configure the *Fells* system as discussed above, to utilize the charger coil as an RFID antenna to facilitate the exchange of information over the “RFID channel” like the mobile device’s secondary coil (“solenoid”). (*Id.*, 12:37-40 (“**Inductive communications using the primary and secondary coils.** For example, [the] secondary [coil] has dual use as an RFID tag antenna, and the position is detected using the RFID channel.”).) In my opinion, a person of ordinary skill in the art would have understood that the electronic circuitry associated with the charger

coil(s) in the charger that activate and control coil(s) to transfer power to the mobile device coil (e.g., circuitry included in the circuits described for *e.g.*, FIGS. 9, 12- 13, 23, 26) would form a “**communication and control electronic circuit**” in the “**charger**” for reasons similar to that discussed above. Such circuitry in the charger would have worked with the charger coil(s) in the same way *Fells* discloses (*see e.g.*, my analysis and discussion above in Sections IX.A.1(b)-(e), IX.A.1(k)-(q)), but the charger coil is also used to communicate with the receiver. Such communication can be, for example, done using the “RFID channel” that utilizes the secondary coil (having “dual use as an RFID tag antenna”), where, as disclosed by *Fells*, the communication can be used for purposes of sensing location/position of the “receiver coil” and facilitating transfer of power to the mobile device (Ex.1005, 12:20-22, 12:37-40, 12:60-61.) Therefore, it is my opinion that a person of ordinary skill in the art would have been motivated to configure the charger primary coil to have “dual use” as an antenna to receive the information used to detect the position of the receiver coil of the mobile device consistent with the processes discussed by *Fells*.

230. A person of ordinary skill in the art would have had reasons to consider such a predictable configuration given *Fells* describes implementations that involve the exchange of information between the charger and mobile device to control the transfer of power. (*See e.g.*, Ex.1005, 12:41-43 (“The resonance of the secondary

circuit (e.g. a tuned LC resonator) produces a detectable response to a pulse from the primary (e.g. by a ringing oscillation)”), 10:55-59 (“It may be necessary for the portable device to communicate what type of receiver it is to the charger, so that the charger can correctly determine which coils should be activated and with what polarity configuration”).) In such a configuration, a person of ordinary skill in the art would have understood the communication between the charger and mobile device receiver would have been “**through a charger antenna that includes the charger coil and a receiver antenna that includes the solenoid**” as claimed since the coils are used to provide the RFID channel (and *Fells* refers to the secondary coil as an “RFID antenna”), where the charger coil would form the “**charger antenna**” (see my analysis and discussion above in Sections IX.A.1(b)-(c)) to receive RFID communication information from the secondary coil, which forms the “**solenoid**” (see my analysis and discussion above in Sections IX.A.1(f)-(i)).

231. A person of ordinary skill in the art would have had reasons to consider such a predictable configuration given *Fells* describes the exchange of information between the charger and mobile device to control the transfer of power. (See, e.g., Ex.1005, 12:41-43 (sensing method 6 where tuned resonator features are used between the coils), 10:55-59 (“[i]t may be necessary for the portable device to communicate what type of receiver it is to the charger, so that the charger can correctly determine which coils should be activated and with what polarity

configuration”).) In such a configuration, a person of ordinary skill in the art would have understood the communication between the charger and mobile device receiver would have been “**through a charger antenna that includes the charger coil and a receiver antenna that includes the solenoid**” as claimed since the coils are used to provide the RFID channel (and *Fells* refers to the secondary coil as an RFID antenna (Ex.1005, 12:39)) and the secondary coil forms the “**solenoid**” (see my analysis and discussion above in Sections §IX.A.1(f)-(i)) and the charger coil would form the “**charger antenna**” to receive such RFID communication information (see my analysis and discussion above in Sections §IX.A.1(b)-(c)).

B. Ground 2: *Fells*, *Silva*, and *Jung* Disclose and/or Suggest the Features of Claim 8

232. In my opinion, *Fells* in view of *Silva* and *Jung* discloses and/or suggests all of the features of claim 8 of the ’349 patent.

1. Claim 8

a) The system of claim 1, wherein the Litz wire is selected for operation at a frequency of greater than 205 kHz.

233. In my opinion, *Fells* in view of *Silva* and *Jung* 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.) My analysis and discussion above in Section IX.A.1 for claim 1 demonstrates how *Fells* discloses that the “solenoid” comprises a “Litz wire wrapped around a section of the magnetic core,” as recited

in limitation 1(i). (*See* my analysis and discussions above in Section IX.A.1(i).)

While *Fells* does not expressly state that the *Litz* wire is selected for operation at a frequency greater than 205 kHz, in my opinion, a person of ordinary skill in the art would have been motivated to configure the “receiver” in *Fells*’ system to use a “solenoid” with a *Litz* wire selected for operation at a frequency greater than 205 kHz in view of the teachings/suggestions of *Silva* and *Jung*.

234. As I discuss above for claim 1, *Fells* discloses different aspects relating to the inductive power transfer system, including various configurations of the coil and receiver, different solenoid configurations, different charger configurations, various dimensions, components, etc. (*See e.g.*, my analysis and discussions above in Section IX.A.1(o); Ex.1005, FIGS. 1(a), 19(a)-(b), 21, 1:50-6:3, 6:57-7:7, 7:16-8:9, 8:42-56, 10:60-11:44, 12:66-13:22, 13:23-22:33.) (*See also* my analysis and discussions above in Sections IX.A.1(a)-(n), IX.A.1(p)-(q).) In my opinion, a person of ordinary skill in the art would have had reasons to consider various components and related circuit designs to accommodate the various implementations contemplated by *Fells*, and would have known how to select, and been capable of designing/implementing an inductive power transfer system based on particular components depending on the application. Among those choices was the type of wire to use for the receiver’s “solenoid,” including the type of litz wire used in applications where the receiver coil includes litz wire.

235. A person of ordinary skill in the art was aware of the properties and design characteristics associated with coils used in inductive power transfer systems, and in particular, how types of material, and dimensions of that material, affect the operation of the system and its circuits. In particular, a such a skilled person would have considered the type of Litz wire used in the receiver coils as disclosed by *Fells* (Ex.1005, 7:3-8; *see* my analysis and discussion above in IX.A.1(i)) to accommodate the particular power transfer system being designed and implemented. As I discuss below, such an understanding is supported by *Silva*, which demonstrates that a person of ordinary skill in the art had knowledge relating to the design and implementation of circuits/systems that use Litz wire.

236. As disclosed by *Silva*:

Many electronic components such as power converters utilize wires or cables to carry voltage and/or current from one point in a circuit to another. Generally, these wires may be constructed from a conductive material (e.g., copper), which has a resistance to current flow that may contribute to power loss (sometime called “copper loss”) in an electronic component. Therefore, it may be desirable to minimize the power loss in the conductors in order to provide more efficient components.

(Ex.1019, 1:14-21.)

237. Silva also demonstrates that the “skin effect” and “skin depth” were known issues with which circuit designers were concerned:

For AC current, a phenomenon known as the “skin effect” causes that resistance to increase substantially with increasing frequency of current.

The skin effect is the tendency of an AC electric current to distribute itself within a conductor such that the current density (i.e., current per cross-sectional area) near the surface of the conductor is greater than at its core. In other words, the current tends to flow at the “skin” of the conductor. The skin effect is due to eddy currents formed by the AC current. The decline in current density verses depth from the surface is often quantified by a measure of the distance from the surface of the conductor over which the current density decays to $1/e$ (or about 37%) of its value at the surface. This measure is generally referred to as “skin depth.”

For low frequencies, the skin effect may be negligible. For AC current at frequencies high enough that the skin depth is small compared to the conductor diameter, the skin effect causes most of the conduction to happen at the conductor's surface. At high enough frequencies, the interior of a large conductor does not carry much current.

(*Id.*, 1:27-47.)

238. *Silva* further discloses litz wires can be used to mitigate the skin effect, where an example of a litz wire is shown in figure 1. (*Id.*, 1:54-57 (“A type of cable called bunched wire or litz wire (from the German litzendraht, braided wire) may be used to mitigate the skin effect for current with relatively high frequencies, such as a few kilohertz, a few megahertz, or more.”).)

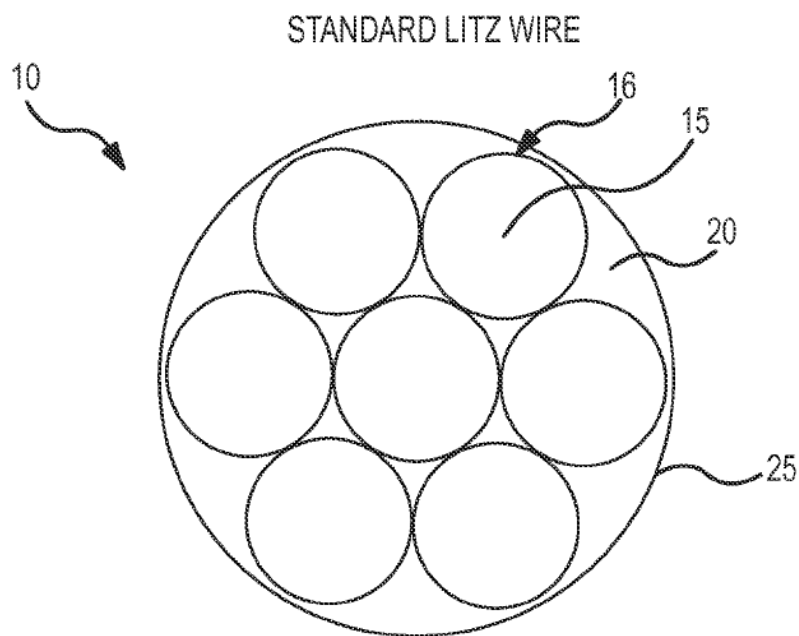


FIG.1
(PRIOR ART)

(*Id.*, FIG. 1.)

239. As disclosed by *Silva*:

A cross-sectional view of a litz wire 10 is shown in FIG. 1. The litz wire 10 includes a **number of insulated wire strands 15 woven together in a pattern (e.g., twisted, braided, or the like), so that the overall magnetic field acts substantially equally on all the strands and causes the total current to be distributed equally among them.** Further, the **radius of the individual strands may be chosen to be less than a skin-depth for a particular application, so the individual strands do not suffer an appreciable skin effect loss.** The individual strands generally include an outer layer of insulation 16 to electrically insulate them from each other, such that the strands in a bundle are not shorted together. Further, the entire bundle of strands 15 may include an outer insulation layer 25.

(*Id.*, 1:57-2:3.)

240. *Silva* further discloses that “Litz wire may be used in the windings of high-frequency transformers, to increase their efficiency by mitigating both skin effect and...proximity effect, which is caused by an interaction of magnetic fields between multiple conductors.” (*Id.*, 2:4-8.) *Silva* further teaches that “[t]he weaving or twisting pattern of litz wire ***may be selected*** so that individual wires will reside for short intervals on the outside of [the] cable and for short intervals on the inside

of the cable, which may allow the interior of the litz wire to contribute to the cable's conductivity." (*Id.*, 2:8-13.)

241. While *Silva* recognizes the tradeoff in terms of cross-sectional area between standard wires and litz wires (*id.*, 2:14-25), where litz wire is implemented (as in *Fells*), a person of ordinary skill in the art would have appreciated the teachings/suggestions in *Silva* regarding various ways to configure and use litz wires to accommodate given applications, including those involving high frequencies. (*Id.*, 4:26-30 ("relatively higher switching frequencies (e.g., 50 kHz to 300 kHz)"), 5:4-6 ("the switching frequency of the transistor Switch Q1 may be in the range of 10 kHz, 50 kHz, 250 kHz, and the like"), *see also id.*, 2:29-42, 2:43-55, 2:56-63, 3:40-4:20, 5:27-6:46.) For example, *Silva* discloses that "[i]t will be ***appreciated that the gauge selected for the various stands of [a Litz wire] may be chosen dependent upon the frequency and magnitude of the current intended for the application.***" (Ex.1019, 6:16-19.)

242. *Silva*'s teachings regarding litz wires are consistent with *Fells*' discussion of litz wires. (Ex.1005, 7:4-8 ("Litz wire has many strands of copper, each insulated from one another" to "allow[] the copper losses to be reduced as at high frequencies the skin effect means the current in only carried in the outer skin of the conductors").) Therefore, in my opinion, a person of ordinary skill in the art would have had reasons to consider the guidance offered by *Silva* when

contemplating the design/implementation of the “receiver” (and its “solenoid”) in *Fells*’ inductive power transfer system. (See my analysis and discussion above in Sections IX.A.1(f)-(j).) In light of the teachings/suggestions of *Silva* in context of *Fells* (which contemplates high frequencies), a person of ordinary skill in the art would have been motivated to select a Litz wire for operation at various high frequencies to accommodate particular applications, including applications where the operation is at a frequency “greater than 205 kHz,” as claimed. Indeed, as shown in Table 3 below, *Jung* confirms that it was known to select Litz wire for a wireless charging coil operating at 100-250 kHz, which includes frequencies that are “greater than 205 kHz.”

TABLE 3			
Comparison with Convention Litz Core			
Items	Litz core	PSR PTPCB core	EGPI-PTPCB core
Material	Copper (99.99%)	Copper (70 μ m) + PSR Coating	Copper (70 μ m) + Electroless plating (0.03 μ m)
Thickness	0.35 mm	0.4 mm	0.4 mm
Size	32 $\times$ 32 mm	32 $\times$ 32 mm	32 $\times$ 32 mm
Shape	Rectangular	Planar rectangular	Planar hexagon
Number of turns	20 (Litz shape)	24/(1Layer)	24/(2Layer)
Number of threads per turn	7	1	1
Thickness of wire	0.15 Φ	1 mm/2 oz	1 mm/2 oz
Inductance	7.7 μ H	11 μ H	7.8 μ H
Q (no shield)	27	9	20
DCR (Internal resistance)	230 m Ω	850 m Ω	350 m Ω
Efficiency@2.5 W (5 V $\times$ 500 mA)	61%	53%	60%
Temp@2.5 W (5 V $\times$ 500 mA)	40	42	40
Rate of change of inductance	1.5%	0.5%	0.5%
Operation frequency	100~250 kHz	100~250 kHz	100~250 kHz
Cost	Middle (Facility investment required)	Low	Middle (Facility investment not required)
Performance	Average	Average	Good

(Ex.1016, 15:1-25, Table 3 (annotated); *id.*, 2:4-14 (known use of Litz coil for “primary and *secondary cores*”), 4:51-55 (“The primary core can be configured as a single-layer or multiple-layer structure since it is a thin power transmission PCB core instead of a Litz core. This as a result can ensure a portable device to be constantly and stably charged even if it is displaced to any position.”), 11:63-67 (“In the meantime, the core of the station part 30 of the non-contact charging station 10 in accordance with the present invention is implemented with a thin film-like power transmission PCB core, instead of a Litz core, using bond wires according to the related art.”), 14:64-67, 15:28-34, 16:40-41.)

243. In my opinion, a person of ordinary skill in the art would have had reasons to consider the teachings/suggestions of *Jung* in context of *Fells*. *Jung* describes an inductive power transfer system including techniques/technologies/configurations similar/related to those of *Fells*. (See my analysis and discussion above in Sections IX.A.1(a)-(q); Ex.1016, Abstract, FIGS. 1-18, 1:9-24.) Therefore, *Jung* is in the same field of endeavor as the '349 patent and *Fells*. (See *e.g.*, Ex.1001, 1:53-58. 3:28-6:14; Ex.1016, Abstract, FIGS. 1-18, 1:9-23, 3:24-5:17, 6:22-8:67; see my analysis and discussion above in Sections IX.A.1(a)-(q).) Further, *Jung*, like *Fells*, discloses features that were reasonable pertinent to one or more particular problems the '349 patent discusses and a skilled person was trying to solve. (Ex.1001, 1:53-2:38. 3:28-6:14; see *e.g.*, Ex.1016, 2:35-

5:18; Ex.1005, 1:3-6:3; *see* my analysis and discussion above in Sections IX.A.1(a)-(q).) Similarly, as I discuss above, *Silva* discloses features pertinent to known issues relating to the use of Litz wire for high frequency applications, consistent with *Fells*. In my opinion, such teachings thus would have been consulted by a person of ordinary skill in the art looking to address/solve such issues and others relating to the design/implementation of an inductive power transfer system, like that described by *Fells*. Therefore, such a person of ordinary skill in the art would have consulted teachings/suggestions like those in *Jung* and *Silva*, and consequently would have been motivated to configure the above-discussed *Fells* system to select Litz wire for the “solenoid” (*see* my analysis and discussion above in Sections IX.A.1(g)-(i)) for operation at a frequency above 205 kHz.

244. In my opinion, a person of ordinary skill in the art would have been motivated to implement such a modification, because, for example, it would add versatility in the types of implementations contemplated by *Fells* by providing receivers adapted for operation at relatively high frequencies. (Ex.1005, 7:3-8, 13:9-19 (“each coil could have its own high frequency power MOSFET”), 9:64-67 (“the combination is resonant at the oscillator frequency”). A person of ordinary skill in the art would have known that Litz wire can be used “*to mitigate the skin effect for current with relatively high frequencies*” (Ex.1019, 1:54-57), “*may be chosen dependent upon the frequency and magnitude of the current intended for the*

application” (*id.*, 6:16-19), and had been used for applications operating at frequencies, such as 100-250 kHz (Ex.1016, 15:1-27). As such, in my opinion, a person of ordinary skill in the art would have had the rationale, capabilities, skills, and reasonable expectation of success to select the Litz wire for the “solenoid” in *Fells*’ receiver “for operation at a frequency of greater than 205 kHz,” as claimed.

245. Notably, the ’349 patent lacks disclosure regarding the selection of *Litz* wire for a receiver’s solenoid for operation at any particular frequency. (*See generally* Ex.1001.) The only mention of “205 kHz” in the specification is in context of the prior art charging protocols and standards—not a “solenoid” in a system as recited in claims 1 and 8. (*Id.*, 20:43-46 (“An example of such a protocol or standard is the Wireless Power Consortium (WPC) or Chi, A4WP, PMA or other standard which is designed to provide tight receiver coil output voltage tolerances and also requires charger frequency range of 110 to 205 kHz or higher.”).)

C. Ground 3: *Fells* in Combination with *Sagoo* Discloses and/or Suggests the Features of Claims 13, 15 and 16

246. In my opinion, *Fells* in view of *Sagoo* discloses and/or suggests all of the features of claim 13, 15, and 16 of the '349 patent.

1. Claim 13

a) The system of claim 1, wherein, the charger is incorporated into a second mobile device;

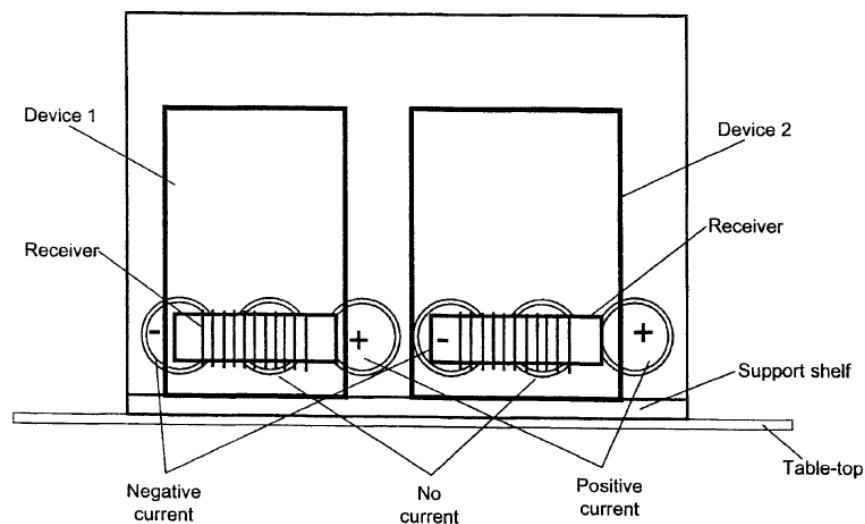
247. In my opinion, *Fells* in view of *Sagoo* discloses and/or suggests this limitation. (See my analysis and discussions below in this section; see also my analysis and discussions in Sections IX.A.1; see also my analysis and discussions below in Sections IX.C.1(b)-(d).) My analysis and discussion above in Section IX.A.1 for claim 1 demonstrates how *Fells* discloses an inductive power transfer system that includes a charger as recited in claim 1.

248. *Fells* does not disclose any particular limits on the type of device into which the charger can be incorporated. (See generally Ex.1005.) The exemplary “aspect[s] of the invention” provided by *Fells* broadly describes a “primary unit” (e.g., charger) that includes a power transfer surface, field generators (e.g., charger coils), and other components. (*Id.*, 1:41-6:3, 14:42-22:13.) *Fells* explains that “[i]n any of the aspects disclosed here, the various features may be implemented in hardware, or as software modules running on one or more processes,” the methods may be carried out via computer programs, and the invention extends to “system

aspects, and corresponding primary unit aspects, method aspects, and computer-program aspects.” (*Id.*, 22:14-32.)

249. In addition, *Fells* discloses that the FIG. 23 charger configuration is described in the form of a “shelf” that is placed on table-top surface. (*Id.*, FIG. 23 (below), 11:45-12:19.)

Fig. 23



(*Id.*, FIG. 23.) Therefore, a person of ordinary skill in the art would have understood that *Fells* contemplates charger implementations that are compatible with portable applications. For example, a charger mat or a shelf like that shown in figure 23 can be moved and is portable. (e.g., a charger mat, or shelf can be moved (portable).)

250. While *Fells* does not expressly disclose the charger being **“incorporated into a second mobile device,”** in my opinion, a person of ordinary

skill in the art would have been motivated to implement a charger as disclosed by *Fells* in such a mobile device in view of the teachings/suggestions in *Fells* and in *Sagoo*.

251. *Sagoo* discloses an inductive power sharing system that addresses potential limitations with chargers that are “mostly fixed or semi-fixed to power sockets,” such as a charging pad coupled to an AC power source. (Ex.1048, Abstract, 1:15-63, FIG. 1.) *Sagoo* teaches configurations to “maximize the portability of a mobile device” by sharing power supplies of mobile devices. (*Id.*, 1:64-67 (“In order to maximize the portability of a mobile device, a non-contact charging method is required. Further, a charging method in which power supplies of mobile devices are shared with those of other mobile devices is required.”), 2:1-54.) For example, *Sagoo* describes mobile device(s) that are configured to inductively transfer power to another mobile device using known primary/secondary coil arrangements. (*Id.*, 3:52-5:39.) *Sagoo* discloses a mobile device may operate in source mode (provides energy to another device) and a load mode (charged by energy of another device). (*Id.*, 4:30-33 (“Hereinafter, a mode in which a mobile device provides energy to another device is referred to as a source mode, and a mode in which the battery of the mobile device is charged by energy from another device is referred to as a load mode.”).) Depending on the mode in which the mobile device

is operating, the inductive coil either serves as a primary coil to deliver energy or as a secondary coil to receiver energy. For example, Sagoo discloses:

An inductive coil 180 serves as the primary coil or the secondary coil according to whether the mobile device supplies energy or is supplied with energy, as described with reference to FIG. 2.

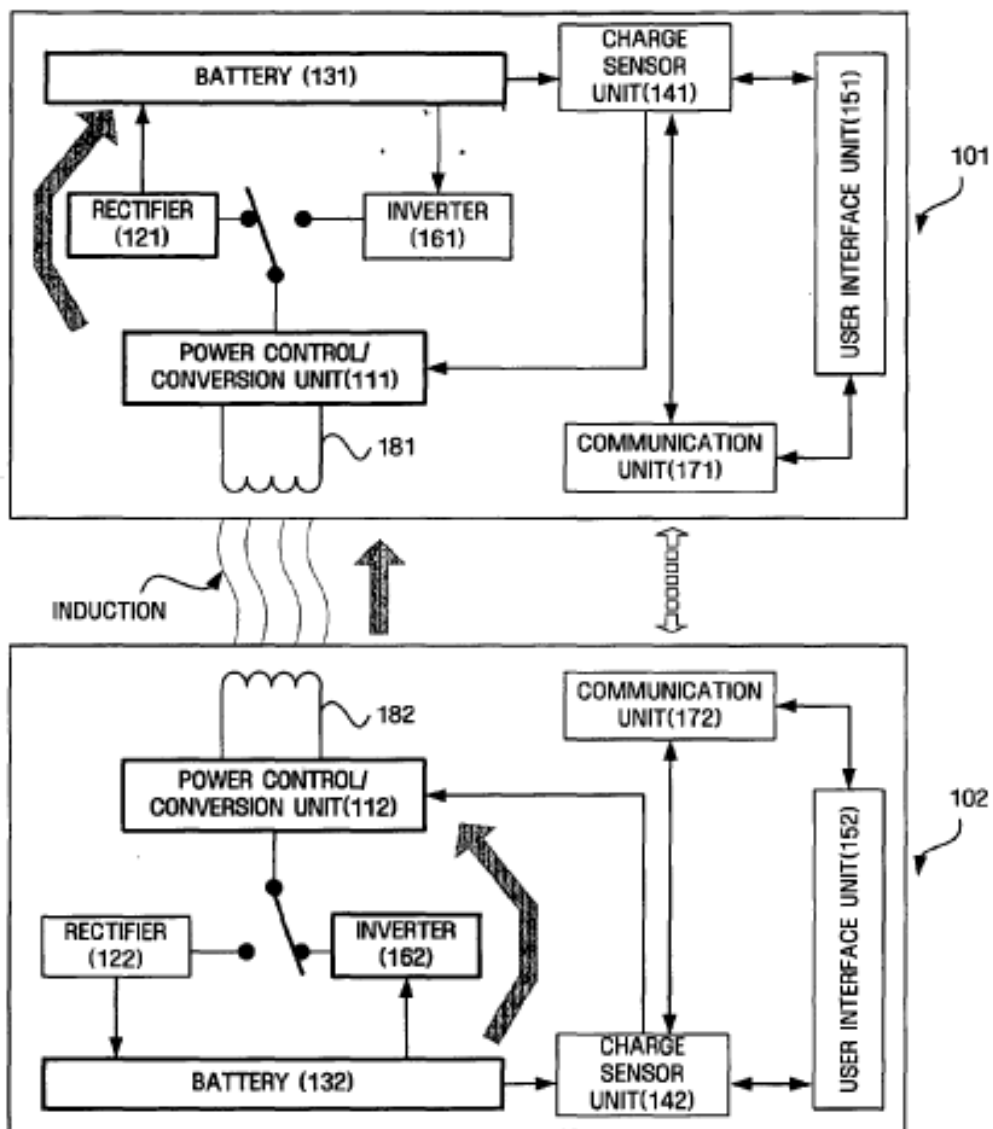
The inductive coil 180 performs the function of the secondary coil when the mobile device is in the load mode, and performs the function of the primary coil when the mobile device is in the source mode.

The user interface unit 150 outputs information received through the charge sensor unit 140 and the communication unit 170. The user interface unit 150 may receive input about whether the mobile device will be set to the source mode or the load mode or which device will be selected in the load mode. When a plurality of mobile devices are in the source mode, it is possible to select a specific mobile device on the basis of the amount of charge in the individual mobile devices.

(*Id.*, 5:23-39.)

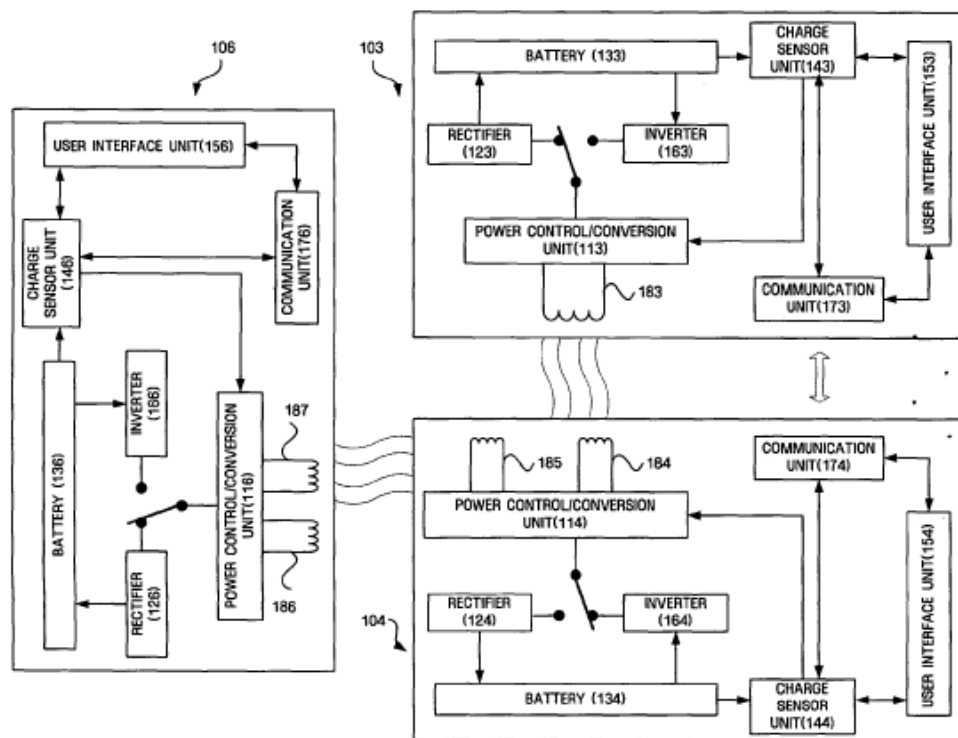
252. As shown in figures 4, 5, and 8 below, *Sagoo* provides examples of various arrangements for inductive power transfer systems. (*Id.*, 5:40-8:41, FIGS. 4-8; see my analysis and discussion below in Sections IX.C.1(b)-(d).)

FIG. 4



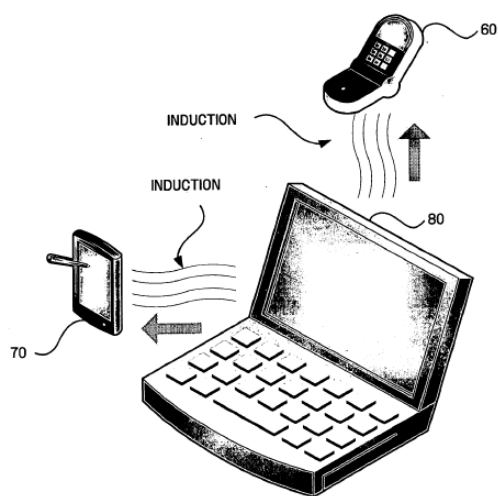
(Id., FIG. 4.)

FIG. 5



(Id., FIG. 5.)

FIG. 8



(Id., FIG. 8.)

253. *Sagoo*'s systems include rechargeable batteries within each mobile device that are used to operate that mobile device, where the batteries also act as a source of power to be inductively transferred to another mobile device (in source mode) when the mobile device is acting as a "charger." (*Id.* 4:10-11, 7:9-8:3) and *Sagoo*'s systems also provide a Bluetooth communication system for communication between the mobile devices (Ex.1048, 5:5-22, 7:4-8:4.)

254. Therefore, *Sagoo* describes an inductive power transfer system including techniques/technologies/configurations similar/related to those of *Fells* (see my analysis and discussion above in Sections IX.A.1(a)-(q)), and, in my opinion, a person of ordinary skill in the art would have had reasons to consider the teachings/suggestions of *Sagoo* in context of *Fells*. A person of ordinary skill in the art would have understood that *Sagoo* is in the same field of endeavor as the '349 patent and *Fells*. (See e.g., Ex.1001, 1:53-58. 3:28-6:14; see my analysis and discussion regarding *Sagoo* above and below; see my analysis and discussion in Sections IX.A.1(a)-(q).) In addition, like *Fells*, *Sagoo* discloses features that were reasonably pertinent to one or more particular problems the '349 patent discusses and a skilled person was trying to solve. (Ex.1001, 1:53-2:38. 3:28-6:14; see e.g., Ex.1048, 1:15-2:54; see my analysis and discussion in Sections IX.A.1(a)-(q).) In my opinion, such teachings would have been consulted by a person of ordinary skill

in the art looking to address/solve such issues and others relating to the design/implementation of an inductive power transfer system, like that described by *Fells*.

255. Therefore, in my opinion, a person of ordinary skill in the art would have consulted teachings/suggestions like those in *Sagoo*, and consequently would have been motivated to configure the above-discussed *Fells* system such that the “charger” is implemented in “a second mobile device,” including functionalities/features similar to those taught by *Sagoo*. Such a skilled person would have recognized that a “charging pad [may be] fixed in a state of being connected to an AC power supply,” would limit the “mobility of a mobile device requiring charging” (e.g. like *Fells*’ “first mobile device” I discuss above in Section IX.A.1(f)), as taught/suggested by *Sagoo*. (Ex.1048, 1:53-58.) As such, a person of ordinary skill in the art would have appreciated the benefits/advantages that such a modification would have provided to *Fells*’ system (e.g., expanding applications to include a portable charger thus “maximiz[ing] the portability of [the first] mobile device,” as suggested by *Sagoo* (Ex.1048, 1:64-2:8)). Moreover, given *Fells* does not restrict implementations of the disclosed charger such that it would be somehow incompatible with portable chargers (such as another mobile device), a POSITA would have had reasons, and been motivated, to leverage the teachings/suggestions of *Sagoo* to implement the above-discussed modification to *Fells*’ system.

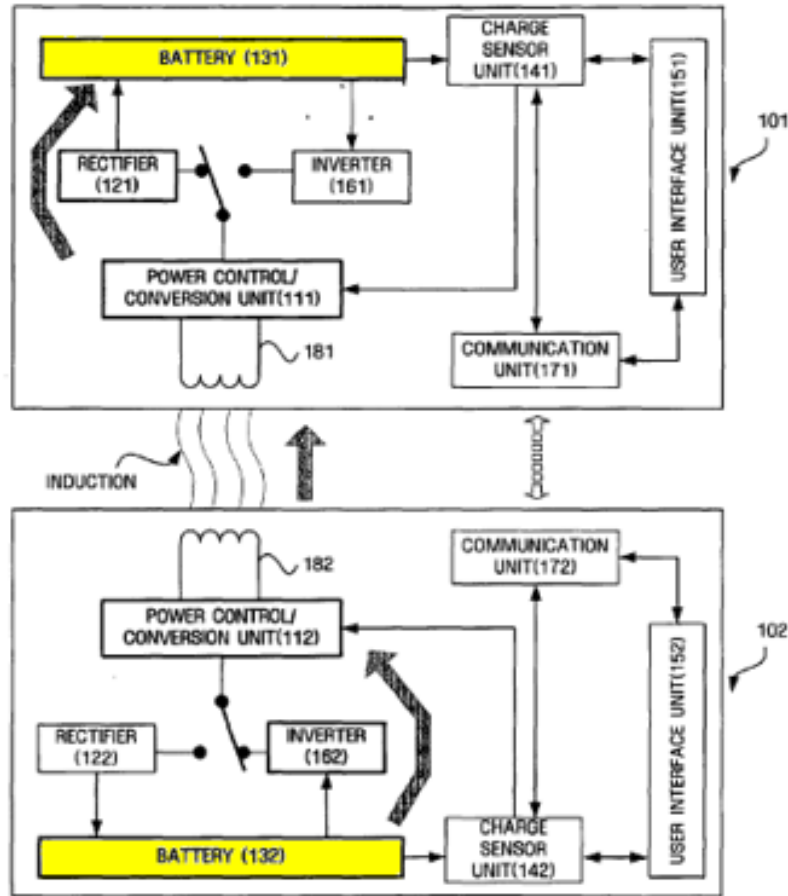
256. In my opinion, a person of ordinary skill in the art would have had the skills, knowledge, and rationale in light of the teachings/suggestions of *Fells* and *Sagoo* to implement such a modification while taking into account design tradeoffs and techniques/technologies, with a reasonable expectation of success. Such a skilled person would have appreciated that the benefits of providing portability with respect to the charger would have offset any additional costs, size, and other design factors or using a fixed charger, as noted by *Sagoo* (Ex.1048, 1:21-2:8). Indeed, implementing the above-modification would have simply involved applying known technologies (*e.g.*, known use of mobile device components and inductive power transfer technologies, consistent with those taught by *Fells* and *Sagoo*), according to known methods (*e.g.*, inductive power transfer between devices using such known technologies) to yield the predictable result of providing a portable charger that is configured to charge the battery of another mobile device, consistent with that contemplated by *Sagoo* and *Fells*.

b) the second mobile device includes an internal, rechargeable battery;

257. In my opinion, *Fells* in view of *Sagoo* 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; *see also* my analysis and discussions in Sections IX.C.1(a), IX.C.1(c)-(d).) As I explained above in Section IX.C.1(a),

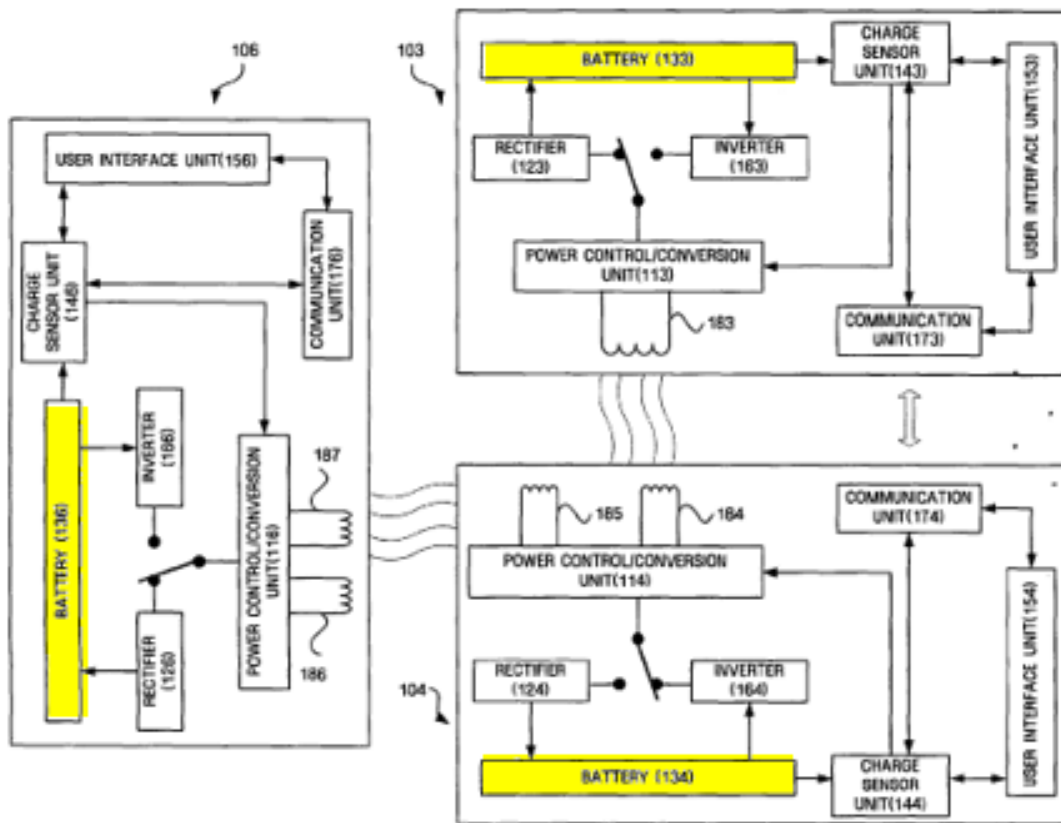
Sagoo discloses the mobile device can operate as a charger (in source mode) and as receiver of power (in load mode), where when operating in the load mode, a battery in the mobile device is rechargeable by power received from another mobile device operating in a source mode. (See my analysis and discussions above in Section IX.C.1(a); Ex.1048, 4:30-33, 5:22-39, 6:26-55, 7:4-8:6, FIGS. 4-5, 8; *see also id.*, 6:4-16 (“rechargeable batteries such as battery 131 of the first device 101 can be installed in devices, such as a notebook computer” and “can be formed of a...(NiMH) battery or a lithium-ion battery”).) The battery in the mobile devices is highlighted in annotated figures 4 and 5 below.

FIG. 4



(Ex.1048, FIG. 4 (annotated).)

FIG. 5



(*Id.*, FIG. 5 (annotated).)

258. Accordingly, for reasons I discussed above, it is my opinion that a person of ordinary skill in the art would have been motivated (and had the same rationale and expectation of success) to configure the modified *Fells'* charger, which has been configured as a second mobile device, to include a rechargeable battery so that the second mobile device could operate portably (*e.g.*, using the battery as an internal source of power to power the circuitry on the mobile device) and so that the mobile device could also use the battery as a source of power to be transferred to the

first mobile device (when the second mobile device operates as a charging device), similar to the charger mode features discussed by *Sagoo*. (See my analysis and discussion in Sections IX.C.1(a), IX.C.1(c)-(d), IX.C.2-C.3.)

- c) **the second mobile device uses the internal battery to transfer power to and operate the charger for a period of time; and;**

259. In my opinion, *Fells* in view of *Sagoo* 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; *see also* my analysis and discussions in Sections IX.C.1(a)-(b).) As I explained above in Sections IX.C.1(a) and IX.C.1(b), the modified system based on the combined teachings/suggestions of *Fells-Sagoo* would have included a charger mobile device (“**second mobile device**”) that uses the “**internal**” rechargeable “**battery**” as an internal power source “**to transfer power to and operate the charger**” mobile device for a period of time (consistent with known portable device battery operations) (*see e.g.*, my analysis and discussions in Sections IX.C.1(a)-(b); Ex.1048, 4:10-11 (battery “installed in order to operate the portable device”), and also to act as a source of power to be “**transferred to**” the first mobile device when the charger mobile device (“second mobile device”) operates as a charger similar to the source mode discussed by *Sagoo*, and as a recipient of power “**transferred to**” the charger mobile device from another power source to recharge the internal battery, consistent with features like the “load

mode” discussed by *Sagoo* (*see* my analysis and discussions in Sections IX.B.1(a)-(b); Ex.1048, FIGS. 6-7, 4:30-5:30).

260. A person of ordinary skill in the art would have understood that by having an internal rechargeable battery, the modified charger mobile device in the *Fells-Sagoo* combination discussed above for limitations 13(a)-(b) would have been configured to allow power to be used to operate the modified charger mobile device, but also receive power for recharging (*e.g.*, power “transferred to” the charger). Therefore, in my opinion, the *Fells-Sagoo* combination discloses/suggests this limitation. (*See also* my analysis and discussion below in Sections IX.C.1(d); IX.C.2-C.3.)

d) the first and second mobile devices comprise Bluetooth communication systems to communicate with each other during non-power transfer operations.

261. In my opinion, *Fells* in view of *Sagoo* 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; *see also* my analysis and discussions in Sections IX.C.1(a)-(c).) For example, in my opinion, a person of ordinary skill in the art would have been motivated to configure the modified *Fells*’ system I discuss above in Section IX.C.1(a)-(c) such that both the first mobile device and the second mobile device include a Bluetooth communication system, which would have allowed the devices to communicate using well known wireless

technologies/techniques, consistent with known mobile device operations and configurations in the art at the time. Indeed, *Fells* indicates that the charger and portable device (mobile device) can both comprise Bluetooth communication components (systems) that enable communications to facilitate sensing of the location/orientation of receiver coil(s) with the charger, which would occur at times **“during non-power transfer operations”** (e.g., before power transfer operations commence). (Ex.1005, 12:20-22, 12:34-36 (portable device “reports back the signal strength via a separate communications channel (e.g., *Bluetooth*), which reveals its location”).) Therefore, a person of ordinary skill in the art would have been motivated to implement such features in the modified *Fells*’ system in order to support this functionality.

262. Moreover, a person of ordinary skill in the art also would have found motivation to implement such features in light of *Sagoo*’s teachings/suggestions that demonstrate the known use of Bluetooth communication component(s) (systems) in multiple mobile devices to facilitate wireless communications of information. (Ex.1048, FIGS. 3-5, 5:5-21 (communication unit 170 in mobile device “performs communications” and “receives information” using e.g., “Bluetooth...and other communication techniques”), 5:55-65 (“[c]ommunication units 171 and 172 of the two mobile devices perform information exchange”), 6:17-25 (communication unit 171 receives information).)

263. In light of such teachings of *Fells* and *Sagoo*, coupled with a person of ordinary skill in the art's knowledge that it was known at the time to implement Bluetooth communication systems in mobile devices (e.g., laptops, cellphones, PDAs, etc.) to facilitate communication of information between such devices (Ex.1048, 1:56-60, 4:14-55, 5:45-59, 6:13-21, 14:5-14, 15:51-61), a person of ordinary skill in the art would have been motivated to configure the mobile devices implemented in the above modified *Fells*' system to include similar technologies/techniques. Such a modification would have been a predictable application of known technologies/techniques (Bluetooth communication as demonstrated by *Sagoo* and *Fells*) for known purposes (e.g., communication of information between remote devices), that would have been within the skills, knowledge, and capabilities of a person of ordinary skill in the art at the time. In my opinion, a person of ordinary skill in the art would have had a reasonable expectation of success in implementing Bluetooth technology in the mobile devices, as including Bluetooth technology in such portable devices was routinely done at the time. (Ex.1048, 1:56-60, 4:14-55, 5:45-59, 6:13-21, 14:5-14, 15:51-61; *see also* my analysis and discussion below in Sections IX.C.2-C.3.)

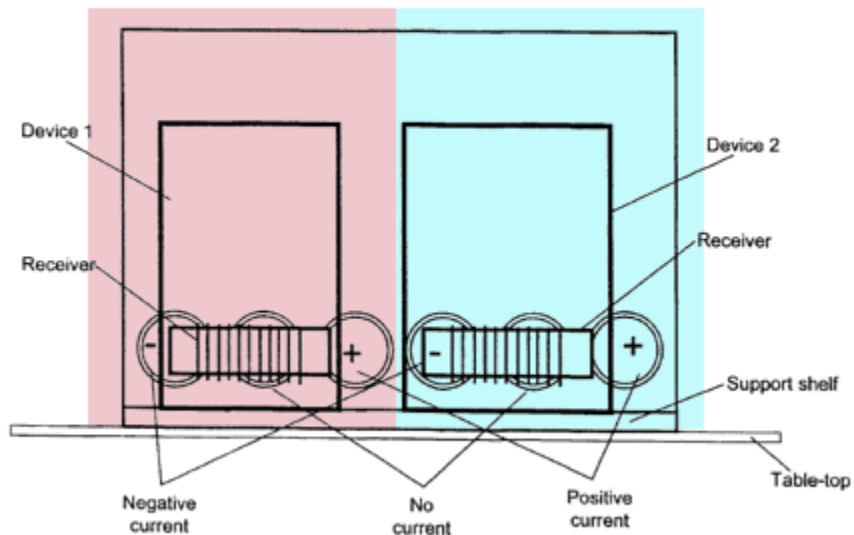
2. Claim 15

- a) The system of claim 13, wherein the second mobile device further includes: an additional inductive charger, wherein the additional inductive charger includes an additional charger coil to transfer power to additional mobile devices.**

264. In my opinion, *Fells* in view of *Sagoo* 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; *see also* my analysis and discussions in Section IX.C.1.) As an initial matter, the '394 patent does not disclose a system that includes all of the features as recited in claims 1, 13, and 15. (*See generally* Ex.1001.)

265. My analysis and discussion above in Section IX.A.1 for claim 1 demonstrates how *Fells* discloses a charger, which can include a plurality of charging coils that allow the system to transfer power to multiple mobile devices beyond the “first mobile device.” (*See* my analysis and discussions in Sections IX.A.1(a)-(q).) For example, my analysis and discussion for claim limitation 1(b) explains how in addition to the primary unit representing the “charger” recited in claim 1, one or more portions of the primary unit’s charging coils constitutes a “charger,” such as shown below using FIG. 23 as a non-limiting example. (*See* my analysis and discussions in Section IX.A.1(b).)

Fig. 23



(Ex.1005, FIG. 23 (annotated).)

266. Such configurations, which provide for charging multiple mobile devices, demonstrate examples of a “**charger**” and an “**additional inductive charger**” with an “**additional charger coil to transfer power to additional mobile devices**” as recited in claim 15. For example, using the example above, either the red/blue portion exemplifies a “**charger**” and the other blue/red portion exemplifies an “**additional inductive charger,**” as recited in claim 15. Other multiple-device charging configurations provide additional examples of a “**charger**” and an “**additional inductive charger.**” For example, figure 8 below is annotated in two different ways to show exemplary, non-limiting examples of a charger (outlined in red) and additional charger (outlined in blue).

Fig. 8

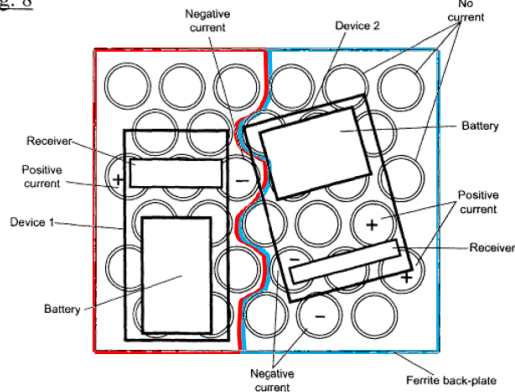
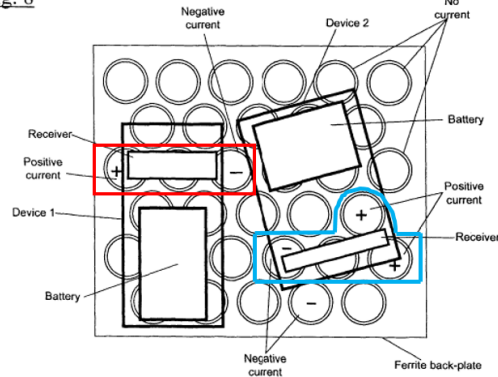


Fig. 8



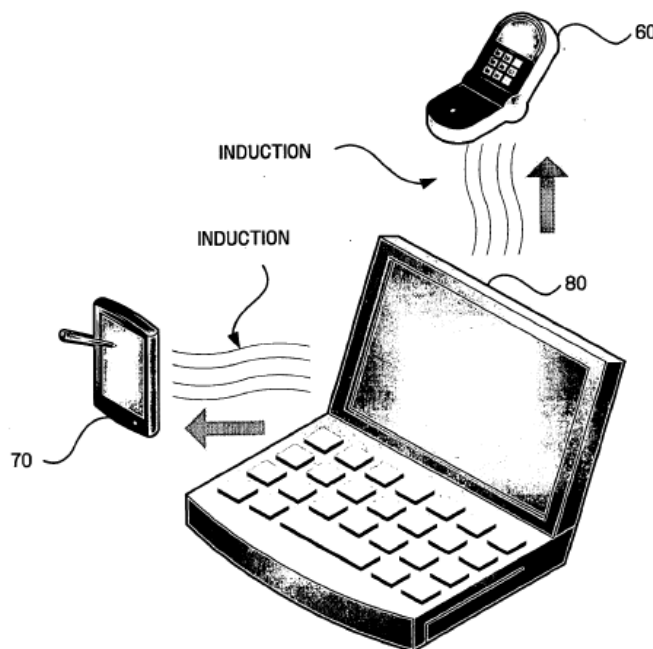
(Ex.1005, FIG. 8 (annotated).)

267. In my opinion, a person of ordinary skill in the art would have had the same motivation, skills, capabilities, knowledge, and expectation of success to modify the *Fells-Sagoo* combined system discussed above for claim 13 to include an array of charging coils (and related components) in the “**second mobile device**” (see my analysis and discussions in Sections IX.C.1(a)-(d)) that form a “**charger**” and “**additional inductive charger**” like that recited in claim 15. (See my analysis and discussions in Section IX.C.1.) The resulting combination would have predictably resulted in a “**system**” including a first mobile device and a second mobile device that includes multiple “chargers” for inductively powering other mobile devices consistent with the features disclosed/suggested by *Fells* and *Sagoo*.

268. For example, in one non-limiting example, a person of ordinary skill in the art would have been motivated, for the above-discussed reasons, to configure the modification to include a laptop computer (“**second mobile device**”) that has a

plurality of charging coils (that operate in a manner consistent with that disclosed by *Fells* as modified by the teachings/suggestions of *Sagoo*) positioned in the cover of the laptop. Notably, this example is also applicable to my rationale for the combination discussed above for claim 13. Figure 8 of *Sagoo*, replicated below, provides an illustration that helps understand the non-limiting example.

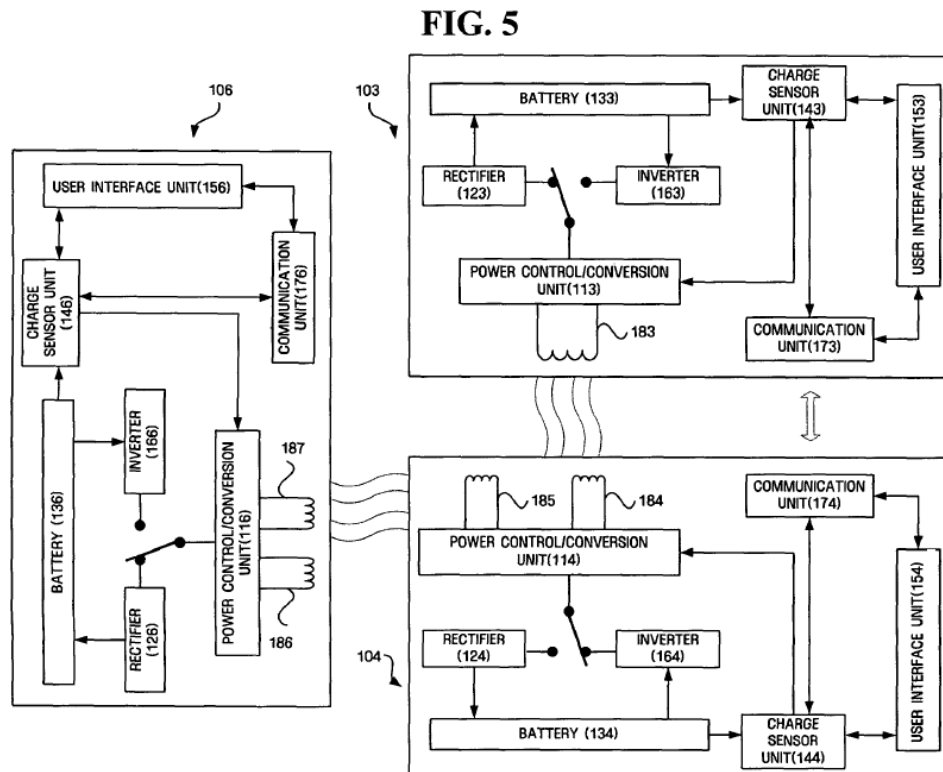
FIG. 8



(Ex.1048, FIG. 8.)

269. Including a plurality of charging coils in the cover of the laptop would enable multiple additional mobile devices, including the “**first mobile device**” and “**additional mobile device(s)**,” to be positioned on the closed cover of the laptop so they can be inductively powered in a manner consistent with the

operations/functionalities discussed above for the *Fells-Sagoo* modified system.
(See my analysis and discussions in Sections IX.A.1, IX.C.1; Ex.1048, FIGs. 5, 8, 6:49-7:3.) For example, figure 5 of Sagoo shows a third device 104 with multiple coils that can operate in load or source mode.



(Ex.1048, FIG. 5.)

270. As disclosed by Sagoo:

FIG. 5 is a view showing a case in which a plurality of mobile devices are charged by one mobile device according to an exemplary embodiment of the invention.

A first device 103 and a second device 106 receive energy from a third device 104. The second

device 106 and the third device 104 each have two inductive coils, and can operate in the load mode or the source mode.

An inductive coil 184 of the third device 104 is coupled with an inductive coil 183 of the first device 103 so as to supply energy, and an inductive coil 185 of the third device 104 is coupled with an inductive coil 187 of the second device 106 so as to supply energy.

In order for the devices to share energy by inductive coupling, the inside of each device needs to be shielded from an electric field or a magnetic field. The distance between the devices sharing energy is narrowed in order to minimize the effect of electromagnetic waves on the human body. For example, the distance within which the communication units communicate with each other can be equal to or more than 1 m. However, when the device shares energy in the source or load mode with a specific device, the distance between the two devices may be 10 cm or less.

(*Id.*, 6:49-7:3.)

3. Claim 16

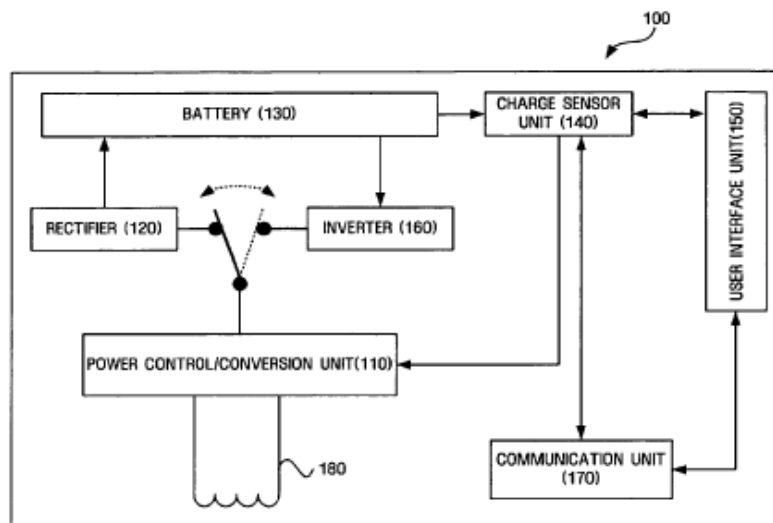
- a) **The system of claim 13, wherein the receiver of the first mobile device is a first receiver, and the second mobile device includes a second receiver to inductively receive power to charge the internal, rechargeable battery of the second mobile device.**

271. In my opinion, *Fells* in view of *Sagoo* 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; *see also* my analysis and discussions in Sections IX.C.1-C.2.) As an initial matter, as was the case with respect to claim 15, the '394 patent does not disclose a system that includes all of the features as recited in claims 1, 13, and 16. (*See generally* Ex.1001.)

272. My analysis and discussion above for claim 1 shows how *Fells* discloses the claimed “receiver” (*see* my analysis and discussions in Sections IX.A.1(f)-1(j)), which for the same reasons constitutes a “**first receiver**” as recited in claim 16. My analysis and discussion above for claim 13 demonstrates how the *Fells-Sagoo* combination discloses and/or suggest the “**second mobile device.**” (*See* my analysis and discussions in Section IX.C.1.) As I also explained above for claim 13 a person of ordinary skill in the art would have been motivated to configure the modified system such that the “rechargeable battery” included in the second device can operate as an internal power source for the second mobile device, and also can be configured to receive power for charging the battery, such as when the second

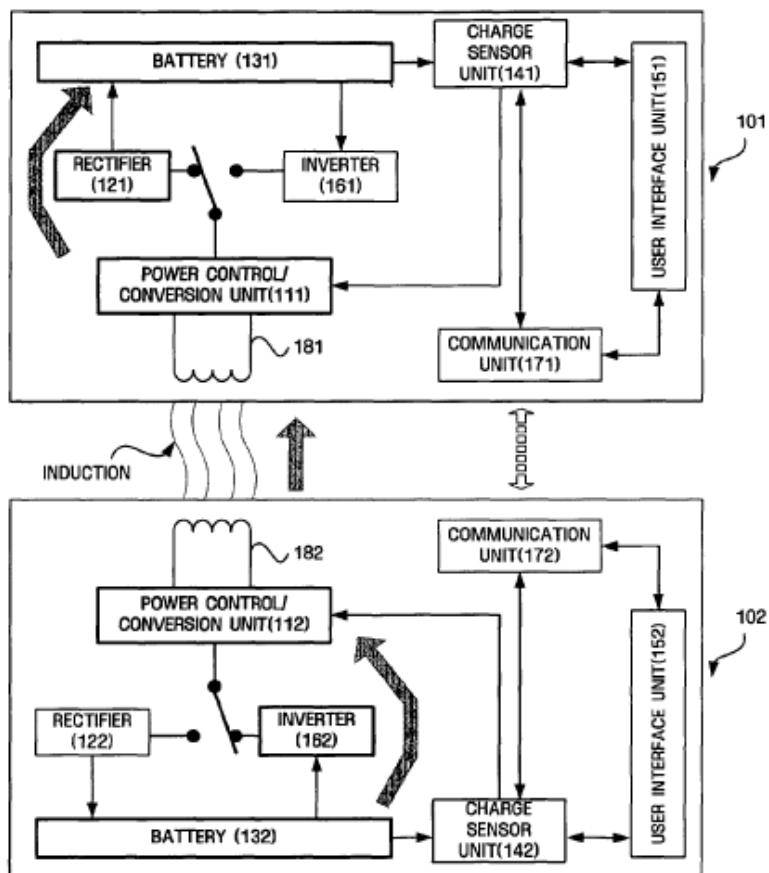
mobile device is configured to operate in a mode similar to the load mode discussed by *Sagoo*. (See my analysis and discussions in Sections IX.A.1(b)-(c); Ex.1048, FIGS. 3-5, 4:30-7:3 (providing mechanisms to switch between rectifier and inverter operations to respectively charge the battery (load mode) or provide power to charge other mobile device(s) (source mode).)

FIG. 3



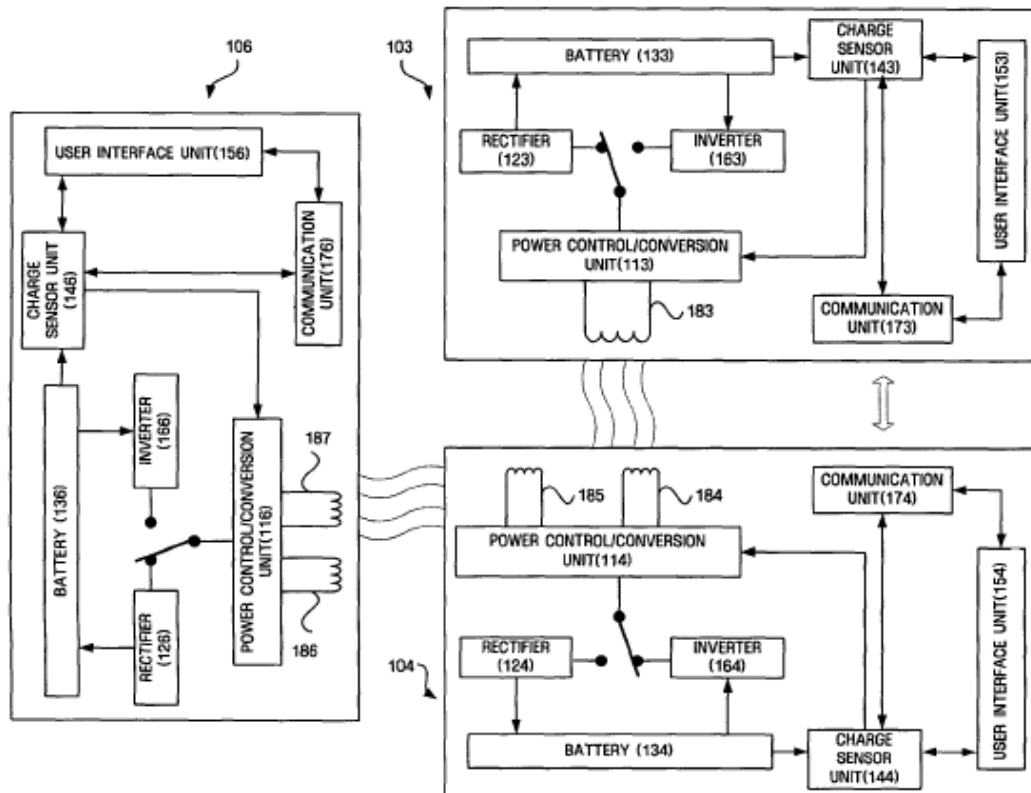
(Ex.1048, FIG. 3.)

FIG. 4



(Id., FIG. 4.)

FIG. 5



(*Id.*, FIG. 5.)

273. For reasons similar to those I discuss above for claim 13, in my opinion, a person of ordinary skill in the art would have been motivated to configure the “second mobile device” in the *Fells-Sagoo* combination to include a component/components that operate as a receiver (e.g., “a second receiver”) that “inductively receive[s] power to charge the internal, rechargeable battery of the second mobile device.” (See my analysis and discussions in Sections IX.C.1(a)-(c).) In my opinion, a person of ordinary skill in the art would have appreciated that such a modified *Fells-Sagoo* system would have been configured to allow the

“second mobile device” to have its internal battery charged (as explained above and in Section IX.C.1). In order to do so, the mobile device would include a component that receives the inductive power via the coil(s) in the “second mobile device” to facilitate and implement such operations. Such a component/component(s) would have been understood to constitute a “**second receiver**” as claimed. In my opinion, a person of ordinary skill in the art would have had the same motivation, skills, rationale, knowledge, and expectation of success in implementing such features as explained above for modifying *Fells* in light of *Sagoo* for claim 13. (See my analysis and discussions above in Sections IX.C.1(a)-(d).)

D. Ground 4: *Fells* in Combination with *Walley* Discloses and/or Suggests the Features of Claim 17

274. In my opinion, *Fells* in view of *Walley* discloses and/or suggests all of the features of claim 17 of the '349 patent.

1. Claim 17

- a) **The system of claim 1, wherein: the receiver and the charger include communication and control electronics circuits to communicate, between the receiver and the charger, information associated with the transfer of power to the first mobile device; and**
- b) **the communication is through a charger antenna that includes the charger coil and a receiver antenna that includes the solenoid.**

275. In my opinion, *Fells* in view of *Walley* discloses and/or suggests these limitations. My analysis and discussion above in Section IX.A.2 demonstrates how

Fells discloses an inductive power transfer system as recited in claim 17. (See my analysis and discussions above in Section IX.A.2.) In my opinion and as explained below, a person of ordinary skill in the art would also have motivated to configure *Fells*' system to operate the charger and mobile device coils as antennas with associated communication/control electronic circuits to communicate information between the device's receiver and the charger to facilitate the inductive power transfer operations taught by *Fells* in view of the teachings/suggestions of *Walley*.

276. *Walley* describes inductive power transfer system configurations that include components and perform charging operations similar to that described by *Fells*. Therefore, a person of ordinary skill in the art would have understood that *Walley* is in the same field of endeavor as *Fells* and the '349 patent. (Ex.1049, Abstract, 1:23-25, see also my discussion of *Walley* below.) Also like *Fells*, *Walley* discloses features that were reasonably pertinent to one or more particular problems the '349 discusses and a skilled person was trying to solve. (Ex.1001, 1:53-2:38. 3:28-6:14; see e.g., Ex.1049, 1:23-2:4; Ex.1005, 1:3-6:3; see my analysis and discussion above in Sections IX.A.1(a)-(q).) In my opinion, *Walley* would have been consulted by a person of ordinary skill in the art looking to address/solve similar issues and others relating to the design/implementation of an inductive power transfer system, like that described by *Fells*. Therefore, in my opinion, a person of ordinary skill in the art would have consulted teachings/suggestions like those in

Walley when designing/configuring/implementing an inductive power transfer system consistent with that described by *Fells*.

277. It is also my opinion that a person of ordinary skill in the art would have appreciated that *Walley* discloses wireless power transfer system technologies/techniques similar to those taught by *Fells*, such as a charger (e.g., transmitter unit) and a receiver (e.g., mobile device), and related power transfer components (e.g., driver and receiver circuitry, inductor coils, etc.) (See e.g., Ex.1049, 3:35-7:13.) In particular, *Walley* explains the transmitter unit can communicate with mobile devices “via the control channel to facilitate efficient wireless power transfer from the WP TX unit 10 to the power RX circuit 22, 28 of the devices 12-14.” (Ex.1049, 5:60-63.) The “communication” is associated with the transfer of power and allows tuning components to provide desired performance levels of energy transfer and in some configurations uses the coil for both power and information communications (acting as an antenna). (*Id.*, 5:63-6:6 (“For example, the communication may be to determine which frequency to use, to reposition the device 12-14 to improve magnetic coupling, to tune the components of the power TX circuit 16 and/or the power RX circuit 22, 28, to indicate desire power levels, to adjust power levels, etc. As such, during the wireless transfer of energy from the power TX circuit 16 to the power RX circuit 22, 28 of one or more devices 12-14, the WP TX unit 10 and the devices 12-14 communicate to provide a desired

performance level of wireless energy transfer.”), 8:8-22, 9:18-58, 11:1-56
(indicating the figure 8 has a shared wireless power (WP) and communication (NFC)
coil), 12:27-35, 16:42-18:23, 23:47-54, FIGS. 5, 8, 18.)

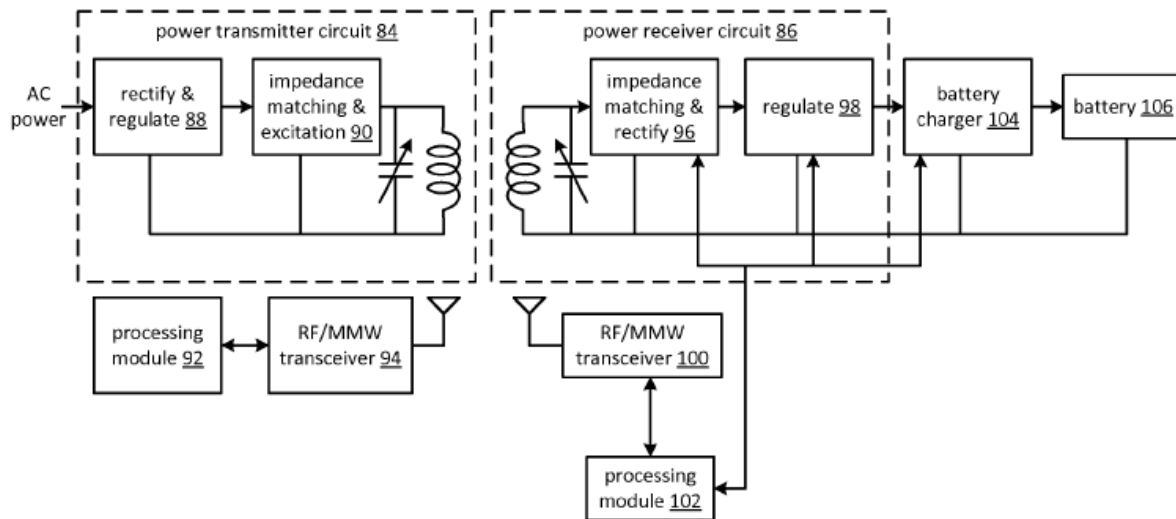


FIG. 5

(*Id.*, FIG. 5.)

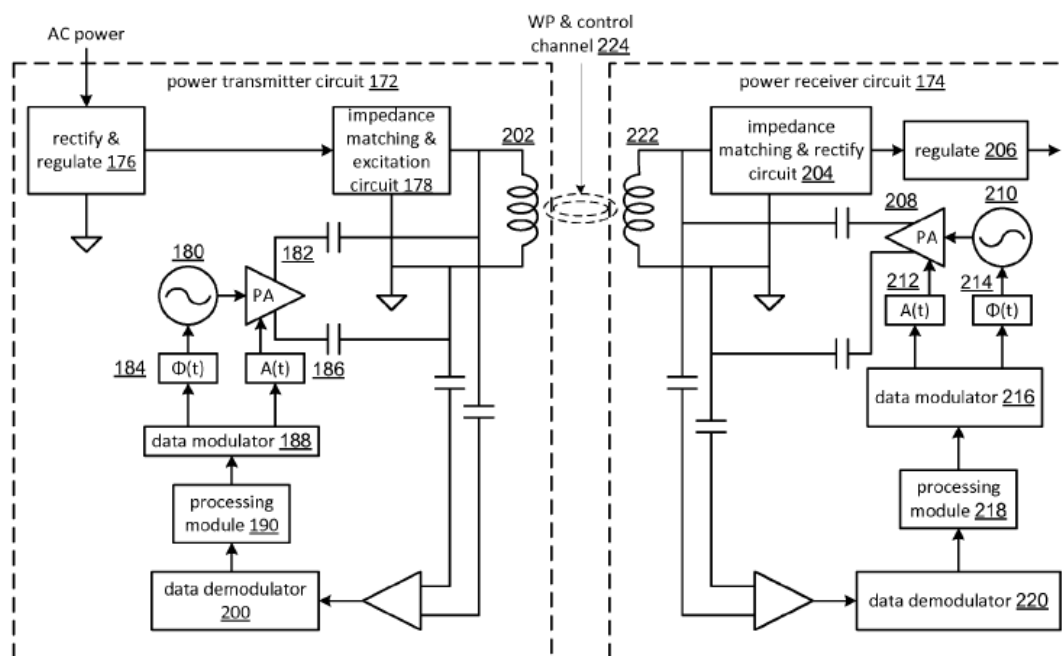


FIG. 8

(Id., FIG. 8.)

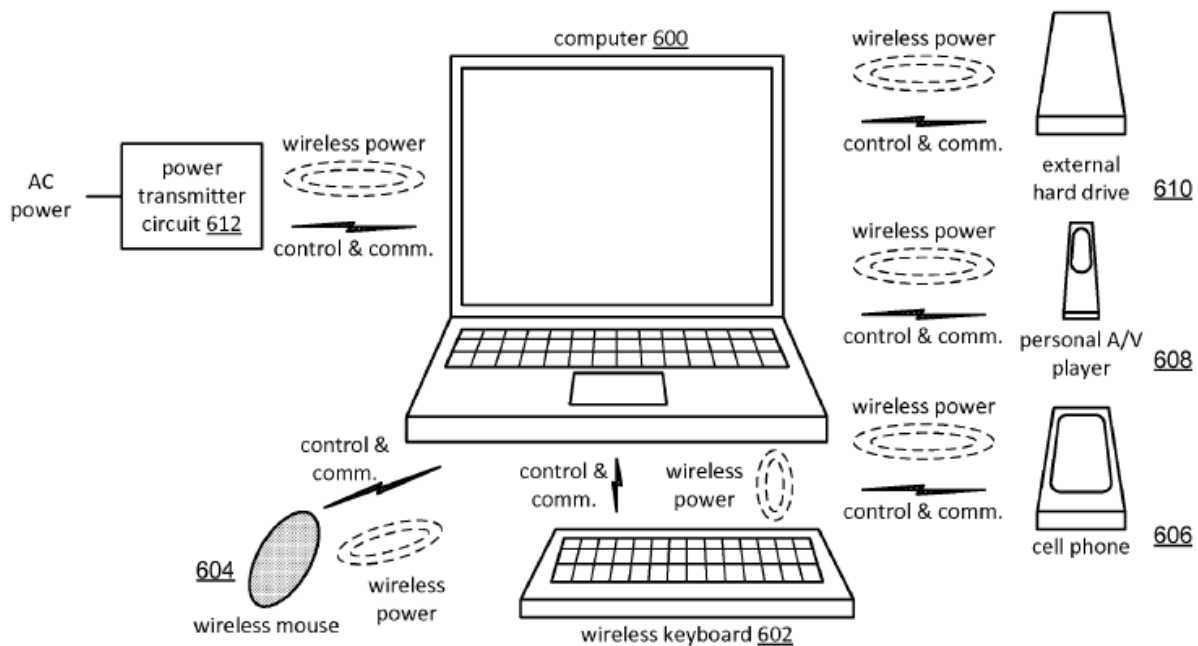


FIG. 18

(*Id.*, FIG. 18.)

278. For example, *Wally* discloses:

In an example of operation, after the WP TX unit and the device 1050 have established communication, the WP TX unit generates a magnetic field that is received by the power RX circuit 1052 of the device 1050. The power RX circuit 1052 generates an AC voltage from the magnetic field, rectifies the AC voltage to produce a rectified voltage, and filters to the rectified voltage to produce a DC voltage rail (e.g., V+ and V-). The power RX circuit 1052 may be tuned based on control signals

provided by the processing module 1060. The tuning includes adjusting the quality factor of the circuit, adjusting impedance, current limiting, etc.

(*Id.*, 8:8-22.)

279. Therefore, *Walley* discloses a charger unit and receiver unit including communication and control circuitry that communicates information associated with the transfer of power to a mobile device, via respective shared coils acting as power transfer coils and antenna for information transfer. In light of such teachings, it is my opinion that a person of ordinary skill in the art would have been motivated to configure *Fells*' system with similar features, especially since *Fells* contemplates configurations that communicate information concerning the transfer of power. (Ex.1005, 12:21-23, 12:41-43 ("resonance of the secondary circuit (e.g. a tuned LC resonator) produces a detectable response to a pulse from the primary (e.g. by a ringing oscillation)"), 10:55-59 ("[i]t may be necessary for the portable device to communicate what type of receiver it is to the charger, so that the charger can correctly determine which coils should be activated and with what polarity configuration").) Such suggestions in *Fells* coupled with *Walley*'s teachings (and a the knowledge and skills of a person of ordinary skill in the art) would have motivated a person of ordinary skill in the art to implement communication and control electronic circuits (like that claimed) in *Fells*' charger and mobile device

receiver, and done so with a reasonable expectation of success that the modified system would operate as intended and consistent with the features discussed by *Fells* and *Walley* to provide efficient and effective wireless transfer of power. (*See also* my analysis and discussion regarding the rationale for modifying *Fells* above in Section IX.A.2.)

280. In addition, to the extent *Fells* does not disclose the resonant capacitors and tuned circuit features of claim 1 (*e.g.*, limitations 1(e), 1(j), 1(l)) (incorporated in dependent claim 17), it is my opinion that a person of ordinary skill in the art would have found it obvious in view of *Walley* to configure *Fells*' system to use impedance matching circuitry with a resonant capacitor in the charger driver circuit and the receiver circuit to provide a tuned circuit that would facilitate the efficient transfer of power and information between the charger and mobile device.

281. A person of ordinary skill in the art would have been motivated to modify *Fells* in such a manner based on, for example, *Walley*'s teachings of impedance matching that "allows the LC circuit of the capacitor and coil to be tuned to a desired resonant frequency and to have a desired quality factor" for the transmitter (TX) and receiver (RX) coils, to provide desired efficient energy transfer. (Ex.1049, FIGS. 5, 7-8, 18, 5:63-6:6, 8:8-21, 9:38-58, 10:38-53, 11:13-32, 12:27-35, 17:35-42, 23:47-54.) For reasons similar to those explained above, a person of ordinary skill in the art would have appreciated the benefits of implementing

impedance matching and tuning features similar to those disclosed by *Walley* to “facilitate efficient wireless power transfer” as suggested by *Walley*. (Ex.1049, 5:60-6:6.) Such suggestions coupled with *Fells*’ teachings (and the knowledge and skills of a person of ordinary skill in the art) would have motivated a person of ordinary skill in the art to configure/implement resonant capacitors and impedance matching features in the circuits of the charger and receiver of *Fells*’ system (as discussed above for claim 1), and done so with a reasonable expectation of success that the modified system would operate as intended and consistent with the features discussed by *Fells* and *Walley*.

E. Ground 5: *Fells* in View of *Ben-Shalom* Discloses and/or Suggests the Features of Claim 18

282. In my opinion, *Fells* in view of *Ben-Shalom* discloses and/or suggests all of the features of claim 18 of the ’349 patent.

1. Claim 18

- a) The system of claim 1, wherein the charger is incorporated into an enclosed volume for placement of the receiver in the power transfer position to receive inductive power.**

283. In my opinion, *Fells* in view of *Ben-Shalom* discloses and/or suggests these limitations. As an initial matter, the ’349 patent only includes a single statement that the charger can include “an open or enclosed volume or part.” (Ex.1001, 4:20-23.) The ’349 patent does not provide any description of a volume

for placement of a receiver in the power transfer position as recited in claims 1 and 18.

284. While *Fells* does not expressly describe the charger being incorporated into an enclosed volume for placement of the receiver in the power transfer position to receive inductive power (see my analysis and discussion above in Section IX.A.1(k)), it is my opinion that a person of ordinary skill in the art would have been motivated to configure *Fells*' charger with such features in light of the teachings/suggestions of *Ben-Shalom*.

285. *Ben-Shalom* describes inductive power transfer system configurations that include components and perform charging operations similar to that described by *Fells* and thus is in the same field of endeavor as *Fells* and the '349 patent. (Ex.1050, Abstract, 1:5-7 ("The embodiments disclosed herein relate to inductive power transfer systems. In particular the embodiments relate to inductive power transfer systems operable to transfer power to items within a container."), 2:3-5:5, see my analysis and discussion of *Ben-Shalom* below.) Also like *Fells*, *Ben-Shalom* discloses features that were reasonably pertinent to one or more particular problems the '349 patent discusses and a skilled person was trying to solve. (Ex.1001, 1:53-2:38. 3:28-6:14; see e.g., Ex.1050, 1:5-5:5; Ex.1005, 1:3-6:3; see my analysis and discussion above in Sections IX.A.1(a)-(q).) In my opinion, *Ben-Shalom* would have been consulted by a person of ordinary skill in the art looking to address/solve

similar issues and others relating to the design/implementation of an inductive power transfer system, like that described by *Fells*. Therefore, in my opinion, a person of ordinary skill in the art would have consulted teachings/suggestions like those in *Ben-Shalom* when designing/configuring/implementing an inductive power transfer system consistent with that described by *Fells* as discussed herein.

286. It is also my opinion that a person of ordinary skill in the art would have appreciated that *Ben-Shalom* discloses wireless power transfer system technologies/techniques similar to those taught by *Fells*, such as a charger (*e.g.*, power transmitter) and a receiver (*e.g.*, power receiver), and related power transfer components (*e.g.*, driver and receiver circuitry, inductor coils, etc.) (*See e.g.*, Ex.1050, FIG. 1, 6:16-7:15, 8:1-11:12, 11:14-14:6 (selected coil activation), 14:9-30 (data communications), 14:31-17:6 (receiver, and resonance circuits), 17:7-22:13.)

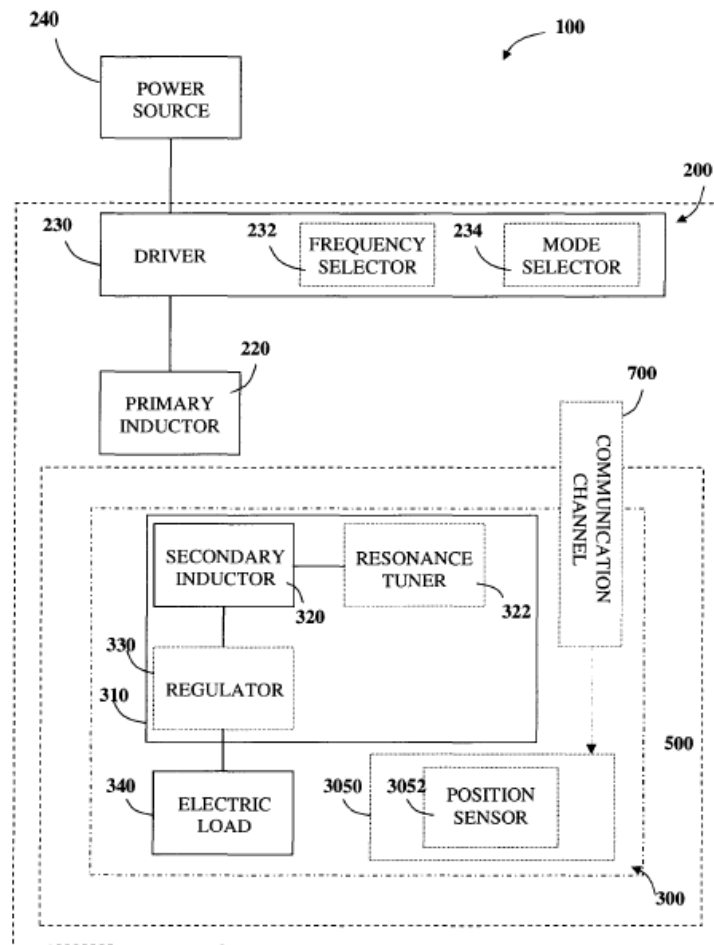


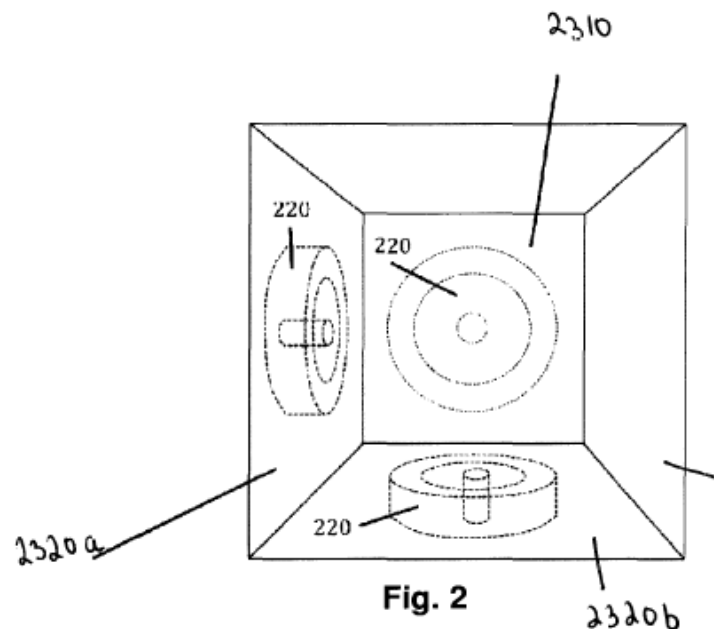
Fig. 1

(*Id.*, FIG. 1.)

287. In particular, *Ben-Shalom* explains that the power transmitter can be in the shape of a box or container having a volume for receiving the power receiver in a position for receiving power inductively (“**enclosed volume for placement of the receiver in the power transfer position to receive inductive power**”). For example, *Ben-Shalom* discloses:

The inductive power transmitter 200, or a portion thereof, may be in the shape of a container. A container shape may be any shape that creates a three dimensional space therewithin, such as an indentation, chamber, recess, cavity or the like. Such an interior space that may serve as a power transmission space in which to place one or more inductive power receivers. Examples of container shapes include a sphere, a cube, a cuboid, a cylinder, a cone, a pyramid, a prism, and the like. Other examples of container shapes include a cup-like shape, a bucket-like shape, a box-like shape, and the like. The container may be open, closed, or capable of alternating between an open and closed state, e.g., with a lid or door.

(*Id.*, 7:17-37; *see also id.*, 8:15-11:12.)



(*Id.*, FIG. 2.)

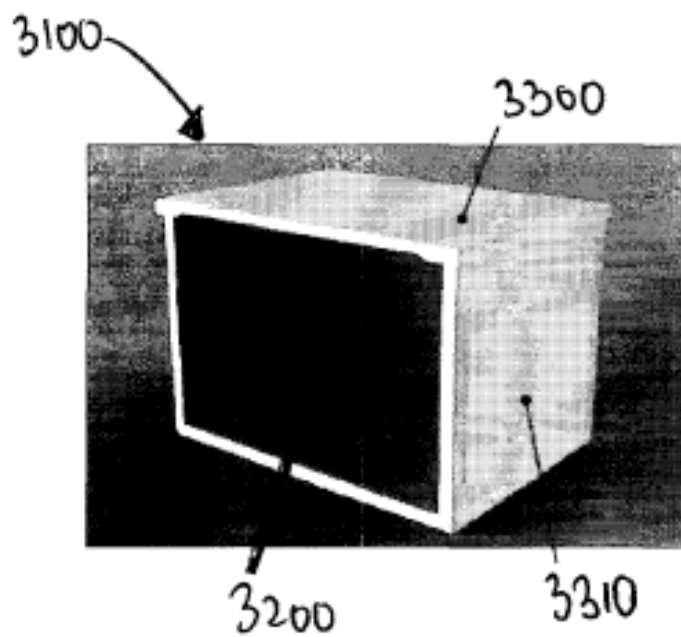


Fig. 3

(*Id.*, FIG. 3.)

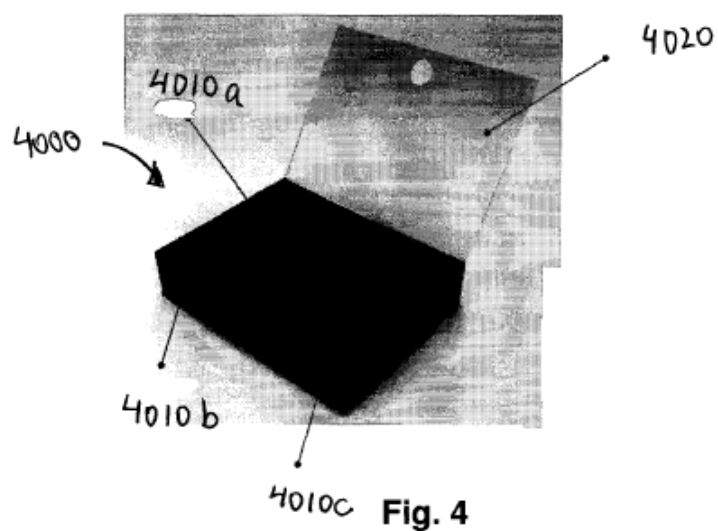


Fig. 4

(*Id.*, FIG. 4.)

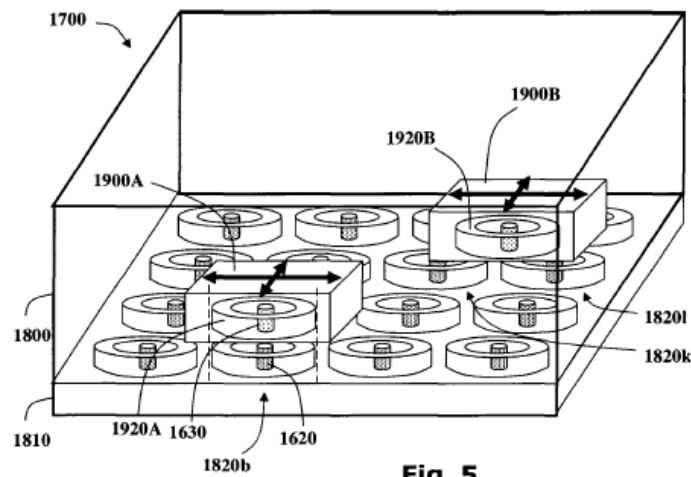


Fig. 5

(*Id.*, FIG. 5.)

288. In light of such teachings, it is my opinion that a person of ordinary skill in the art would have been motivated to configure the charger in *Fells*' system with a housing having a container with an enclosed volume that allows placement of the mobile device's receiver so that the power transfer position (see my analysis and discussion in Section IX.A.1(k) regarding "means for positioning the receiver") is achieved for inductive power transfer. In my opinion, a person of ordinary skill in the art would have appreciated the benefits of providing an enclosed volume to help guide the placement of the receiver in order to maximize the inductive transfer of power to the mobile device, as suggested by *Ben-Shalom*.

289. Indeed, like *Fells*, *Ben-Shalom* discloses configurations where an array of coils in a surface may be used to charge “multiple inductive power receivers” that

are placed in “disparate locations and orientations in the interior of the inductive power transmitter.” (Ex.1050, 10:1-5, 8:37-11:12, FIG. 5.) In my opinion, a person of ordinary skill in the art would have had the reasons, skills, and capabilities to design and implement a charger incorporated within a “volume” similar to that described/suggested by *Ben-Shalom* and like that claimed in claim 18, especially since *Fells* itself contemplates versatility in the design/configurations of the charger (see my analysis and discussion in Sections IX.A.1(a), IX.A.1(k); Ex.1005, FIGS. 1-8, 15-18, 22-23) and *Ben-Shalom* offers guidance on a wide range of possible containers for incorporating such a charger (Ex.1050, 7:18-37 (open, closed, cube, cuboid, cylinder, cup, box, integrated in other enclosed items (appliances, computer, vehicles, etc.))).) Furthermore, such a modification would have been a predictable application of known technologies/techniques (as demonstrated by *Ben-Shalom* and *Fells*) for known purposes (e.g., providing a charger in a contained volume for receiver placement), that would have been within the skills, knowledge, and capabilities of a person of ordinary skill in the art at the time. Therefore, it is also my opinion that a person of ordinary skill in the art would have had a reasonable expectation of success of implementing such a modification for the reasons explained.

F. Ground 6: *Fells* in Combination with *Stoner* and *Nakamura* Discloses and/or Suggests the Features of Claim 17

290. In my opinion, *Fells* in view of *Stoner* and *Nakamura* discloses and/or suggests all of the features of claim 17 (and claim 1 as incorporated therein) of the '349 patent.

291. As I explained above for Ground 1, *Fells* discloses and/or suggests the limitations of claim 17 for the reasons presented in Sections IX.A.2. Regarding limitation 1(k), I demonstrated in Section IX.A.1(k) how *Fells* discloses the claimed “**means for positioning**” and alternatively how and why a person of ordinary skill in the art would have been motivated to configure *Fells*' charger to include such a mechanism. (See my analysis and discussions above in Section IX.A.1(k).) In that analysis, I reference the teachings/suggestions of *Stoner* (Ex.1011) and *Nakamura* (Ex.1010) as state-of-art evidence supporting my opinions regarding the knowledge of a person of ordinary skill in the art at the time.

292. It is also my opinion that a person of ordinary skill in the art would have been motivated to consider and implement teachings/suggestions from *Stoner* and *Nakamura* to modify *Fells* to include magnetic and/or visual-based mechanism for assisting a user to align/position the receiver of the mobile device (“means for positioning”). (See my analysis and discussions above in Section IX.A.1(k) (including citations of *Stoner*/*Nakamura*).) In my opinion, a person of ordinary skill

in the art would have had the same motivation, rationale, skills, knowledge, and expectation of success as explained above in Section IX.A.1(k) to modify *Fells* to include mechanism similar to those taught by *Stoner* and *Nakamura* (e.g., magnetic or visual-based means for positioning (Ex.1010, FIGS. 8-9, ¶¶0102-0103; Ex.1011, Abstract, FIGS. 1-4, 8, 11, 1:6-46, 2:14-4:62, 5:38-7:34, 10:46-12:35).)

293. Therefore, to the extent *Fells* does not disclose/suggest the claimed “**means for positioning**” like that recited in limitation 1(k) (as I discuss above in Section IX.A.1(k)), it is my opinion that a person of ordinary skill in the art would have been motivated to configure *Fells*’ “charger” to include such a mechanism in light of the teachings/suggestions of *Stoner* and *Nakamura*, complimented by such a person of ordinary skill in the art’s knowledge of the state of the art, for similar reasons explained above. (See my discussions above in Section IX.A.1(k).)

294. A person of ordinary skill in the art would have had reasons to consider *Stoner* and *Nakamura* given they disclose inductive power transfer technologies/techniques similar to those disclosed by *Fells* (thus in the same field of endeavor as *Fells* and the ’349 patent) and address similar problems as those addressed in the ’349 patent and *Fells*. (See my citations/discussions of *Fells* in Sections IX.A.1; e.g., Ex.1010, Abstract, ¶¶0002-0022, 0062-0124; Ex.1011, Abstract, 1:5-4:62, 5:38-8:3, 8:26-9:42.) Upon consideration, and in light of the teachings of *Fells*, a person of ordinary skill in the art would have been motivated to

modify *Fells*' charger to include similar alignment assistance mechanisms to ensure proper and efficient coupling occurs when the mobile device is placed on the charger surface. (See my analysis and discussion above in Section IX.A.1(k).) A person of ordinary skill in the art would have considered tradeoffs in such design options when contemplating ways to design and implement a charger with such a mechanism with *Fells*' system, including e.g., cost, weight, efficiency, etc., and the benefits provided by such alignment/positioning features/mechanisms for given applications. Thus, for similar reasons explained above for limitation 1(k), it is my opinion that a person of ordinary skill in the art would have been motivated to configure *Fells*' system with a "means for positioning" as claimed, (and had a similar expectation of success in its implementation). (See my analysis and discussion above in Section IX.A.1(k).) Accordingly, for the reasons here and referenced above, in my opinion, the *Fells-Stoner-Nakamura* combination discloses or suggests limitation 1(k), and claim 17. (See my analysis and discussion above in this Section; see also my analysis and discussion above in Section IX.A.)

295. Moreover, I have been asked to consider the scenario where *Fells* does not disclose the resonant capacitors and tuned circuit features of claim 1, as I discuss above in Section IX.A.1 (e.g., see limitations 1(e), 1(j), 1(l)) (which I understand are incorporated in claim 17 since claim 17 depends from claim 1). In that scenario, it is my opinion that a person of ordinary skill in the art would have been motivated in

view of the teachings of *Stoner* to configure the above-discussed *Fells*' system to use resonant technologies (including resonant capacitor(s)) in the charger driver and receiver circuits to provide a tuned circuit to facilitate an efficient transfer of power/information between the charger and device. In my opinion, such a skilled person would have been guided by *Stoner*'s teachings relating to the known use of resonant circuitry (capacitors 110, 134) to provide a tuned circuit to facilitate power/data transfer between coils (Ex.1011, FIG. 1, 7:3-8:3), in context of *Fells*' similar disclosures (*see* Sections IX.A.1(e), 1(j), 1(l).) Such a skilled person would have appreciated and recognized the benefits of implementing such resonant-based features similar to those disclosed by *Stoner* to facilitate efficient wireless power transfer in the above-discussed *Fells*' modified system. Therefore, in my opinion, in light of the teachings of *Stoner* in context of those of *Fells*, a person of ordinary skill in the art would have been motivated configure/implement resonant capacitors to allow the charger in the modified system to transfer power via a resonant frequency to the mobile device. Such a person would have implemented such features with a reasonable expectation of success, especially since such modification would have involved use of known technologies and techniques, like those described by *Fells* and *Stoner*.

G. Ground 7: *Fells* in View of *Stoner*, *Nakamura*, *Silva* and *Jung* Discloses and/or Suggests the Features of Claim 8

296. In my opinion, *Fells* in view of *Stoner*, *Nakamura*, *Silva* and *Jung* discloses and/or suggests all of the features of claim 8 of the '349 patent.

297. As I explained above in Ground 6, *Fells*, as modified in view of *Stoner* and *Nakamura*, discloses and/or suggests the limitations of claim 1. (See my discussions in Section IX.F; *see also* my discussions in Section IX.A.1.) Also, my discussions in Ground 2 explain how and why the *Fells-Silva-Jung* combination discloses and/or suggests the limitations of claim 8. (See my discussions in Section IX.B.)

298. Thus, in my opinion, for the same/similar reasons, rationale, and teachings/suggestions that I discussed and explained in Grounds 1-2, and 6 it is my opinion that a person of ordinary skill in the art would have been further motivated to configure and modify the above-discussed *Fells-Stoner-Nakamura* system to use Litz wire selected for operation at a frequency of greater than 205 kHz as recited in claim 8 for similar reasons discussed in light of the teachings/suggestions of *Silva* and *Jung* (and state of art knowledge) explained in Ground 2. (See my discussions in Section IX.B.) Also, in view of the teachings of *Stoner*, it is my opinion that a person of ordinary skill in the art would have been motivated to configure the *Fells* modified system to use resonant capacitors (for providing a “tuned circuit”) as

recited in claim 1 for the same reasons that I explained above for Ground 6. (*See* my discussions relating to *Stoner* in Section IX.F above.)

299. In my opinion, a person of ordinary skill in the art would have had the same motivation, rationale, skills, knowledge, and reasonable expectation of success to consider and modify the *Fells-Stoner-Nakamura* system (as explained for Ground 6) based on the additional teachings/suggestions in *Silva* and *Jung* (consistent with the state of art knowledge and as explained above) to implement features like those recited in claim 8 as those I explained above in Sections IX.B and IX.F (and IX.A as incorporated therein). (*See* Sections IX.A-B, IX.F.) Therefore, in my opinion, for similar reasons explained here and above, the combined teachings/suggestions of *Fells*, *Stoner*, *Nakamura*, *Silva* and *Jung* disclose and/or suggest all of the recited features of claim 8. (*Id.*)

H. Ground 8: *Fells* in View of *Stoner*, *Nakamura*, and *Sagoo* Discloses and/or Suggests the Features of Claims 13, 15, and 16

300. In my opinion, *Fells* in view of *Stoner*, *Nakamura*, and *Sagoo* discloses and/or suggests the limitations of claims 13, 15, and 16 of the '349 patent. (*See* my discussions below in this section; *see also* my discussions in Sections IX.A, IX.C, IX.F.)

301. As I explained above in Ground 6, *Fells*, as modified in view of *Stoner* and *Nakamura*, discloses and/or suggests the limitations of claim 1. (*See* my

discussions in Section IX.F; *see also* my discussions in Sections IX.A.) Also, my discussions in Ground 3 explain how and why the *Fells-Sagoo* combination discloses and/or suggests the limitations of claims 13, 15, and 16. (*See* my discussions in Section IX.C.) Also, in view of the teachings of *Stoner*, it is my opinion that a person of ordinary skill in the art would have been motivated to configure the *Fells* modified system to use resonant capacitors (for providing a “tuned circuit”) as recited in claim 1 for the same reasons that I explained above for Ground 6. (*See* my discussions relating to *Stoner* in Section IX.F above.)

302. Thus, in my opinion, for the same/similar reasons, rationale, and teachings/suggestions that I discussed and explained in Grounds 1, 3, and 6, it is my opinion that a person of ordinary skill in the art would have been further motivated to configure and modify the above-discussed *Fells-Stoner-Nakamura* system (that discloses or suggests claim 1 as I explain in Section IX.F) based on *Sagoo* (as I discuss for claims 13, 15, and 16 (and limitations 1(e), 1(j), 1(l), etc.) in Sections IX.A. IX.C, IX.F), where the resulting *Fells-Stoner-Nakamura-Sagoo* combination discloses or suggests the features of claims 13, 15, and 16 (and claim 1). (*See* my discussions in Sections IX.A, IX.C, IX.F.)

303. In my opinion, a person of ordinary skill in the art would have had the same motivation, rationale, skills, knowledge, and reasonable expectation of success to consider and modify the *Fells-Stoner-Nakamura* system (as explained for Ground

6) based on the additional teachings/suggestions in *Sagoo* (consistent with the state of art knowledge) to implement features like those recited in claims 13, 15, and 16 as I explained above in Sections IX.C and IX.F (and IX.A as incorporated therein). (See Sections IX.A, IX.C, IX.F.) Therefore, in my opinion, for similar reasons explained here and above, the combined teachings/suggestions of *Fells*, *Stoner*, *Nakamura*, and *Sagoo* disclose and/or suggest all of the recited features of claims 13, 15, and 16.

I. Ground 9: *Fells* in View of *Stoner*, *Nakamura*, and *Walley* Discloses and/or Suggests the Features of Claim 17

304. In my opinion, *Fells* in view of *Stoner*, *Nakamura*, and *Walley* discloses and/or suggests the limitations of claim 17 of the '349 patent. (See my discussions below in this section; *see also* my discussions in Sections IX.A, IX.D, IX.F.)

305. As I explained above in Ground 6, *Fells*, as modified in view of *Stoner* and *Nakamura*, discloses and/or suggests the limitations of claim 1. (See my discussions in Section IX.F; *see also* my discussions in Sections IX.A.) Also, my discussions in Ground 4 explain how and why the *Fells-Walley* combination discloses and/or suggests the limitations of claim 17 (and claim 1). (See my discussions in Section IX.D.)

306. Thus, in my opinion, for the same/similar reasons, rationale, and teachings/suggestions that I discussed and explained in Grounds 1, 4, and 6, it is my

opinion that a person of ordinary skill in the art would have been further motivated to configure and modify the above-discussed *Fells-Stoner-Nakamura* system (that discloses or suggests claim 1 as I explain in Section IX.F) based on *Walley* (as I discuss for claim 17 in Section IX.D), where the resulting *Fells-Stoner-Nakamura-Walley* combination discloses or suggests the features of claims 13, 15, and 16. (See my discussions in Sections IX.A, IX.D, IX.F.)

307. In my opinion, a person of ordinary skill in the art would have had the same motivation, rationale, skills, knowledge, and reasonable expectation of success to consider and modify the *Fells-Stoner-Nakamura* system (as explained for Ground 6) based on the additional teachings/suggestions in *Walley* (consistent with the state of art knowledge) to implement features like those recited in claim 17 (and limitations 1(e), 1(j), 1(l), etc.) as I explained above in Sections IX.D and IX.F (and IX.A as incorporated therein). (See Sections IX.A, IX.D, IX.F.) Therefore, in my opinion, for similar reasons explained here and above, the combined teachings/suggestions of *Fells*, *Stoner*, *Nakamura*, and *Walley* disclose and/or suggest all of the recited features of claim 17.

J. Ground 10: *Fells* in View of *Stoner*, *Nakamura*, and *Ben-Shalom* Discloses and/or Suggests the Features of Claim 18

308. In my opinion, *Fells* in view of *Stoner*, *Nakamura*, and *Ben-Shalom* discloses and/or suggests the limitations of claim 18 of the '349 patent. (See my discussions below in this section; *see also* my discussions in Sections IX.A, IX.E, IX.F.)

309. As I explained above in Ground 6, *Fells*, as modified in view of *Stoner* and *Nakamura*, discloses and/or suggests the limitations of claim 1. (See my discussions in Section IX.F; *see also* my discussions in Sections IX.A.) Also, my discussions in Ground 5 explain how and why the *Fells-Ben-Shalom* combination discloses and/or suggests the limitations of claim 18. (See my discussions in Section IX.E.) Also, in view of the teachings of *Stoner*, it is my opinion that a person of ordinary skill in the art would have been motivated to configure the *Fells* modified system to use resonant capacitors (for providing a “tuned circuit”) as recited in claim 1 for the same reasons that I explained above for Ground 6. (See my discussions relating to *Stoner* in Section IX.F above.)

310. Thus, in my opinion, for the same/similar reasons, rationale, and teachings/suggestions that I discussed and explained in Grounds 1, 5, and 6, it is my opinion that a person of ordinary skill in the art would have been further motivated to configure and modify the above-discussed *Fells-Stoner-Nakamura* system (that

discloses or suggests claim 1 as I explain in Section IX.F) based on *Ben-Shalom* (as I discuss for claim 18 in Section IX.E), where the resulting *Fells-Stoner-Nakamura-Ben-Shalom* combination discloses or suggests the features of claim 18 (and claim 1). (See my discussions in Sections IX.A, IX.E, IX.F.)

311. In my opinion, a person of ordinary skill in the art would have had the same motivation, rationale, skills, knowledge, and reasonable expectation of success to consider and modify the *Fells-Stoner-Nakamura* system (as explained for Ground 6) based on the additional teachings/suggestions in *Ben-Shalom* (consistent with the state of art knowledge) to implement features like those recited in claims 1 and 18 as I explained above in Sections IX.E and IX.F (and IX.A as incorporated therein). (See Sections IX.A, IX.E, IX.F.) Therefore, in my opinion, for similar reasons explained here and above, the combined teachings/suggestions of *Fells*, *Stoner*, *Nakamura*, and *Ben-Shalom* disclose and/or suggest all of the recited features of claim 18.

X. CONCLUSION

312. In summary, it is my opinion that all of the features recited in claims 8, 13, and 15-18 of the '349 patent are disclosed and/or suggested by the prior art.

313. 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 20, 2023

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