

INDUCTEV INC.,
Petitioner,
v.
WITRICITY CORPORATION.,
Patent Owner

IPR2024-00140
Patent 8,466,654

Petitioner's Demonstratives
March 5, 2025

The '654 Patent

Claim Construction – “[transmitting/receiving] antenna”

Ground 1a: Odachi Invalidates Cls. 13 and 15

Ground 1b: Odachi and Wang invalidate Cls. 1, 7, and 18

Ground 1c: Odachi, Wang and Partovi Cls. 4-6

Ground 2: Ross and Wang Invalidate Cls. 8-10, 12-14, 16, and 19

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The '654 Patent (Ex. 1001)

US08466654B2

(12) **United States Patent**
Cook et al.

(10) **Patent No.:** US 8,466,654 B2
(45) **Date of Patent:** Jun. 18, 2013

(54) **WIRELESS HIGH POWER TRANSFER UNDER REGULATORY CONSTRAINTS**

(75) **Inventors:** Nigel Cook, El Cajon, CA (US); Hanspeter Widmer, Schaffhausen (CH); Eshon Weber, Orem (UT); David Alfred, Rancho Santa Fe, CA (US)

(73) **Assignee:** QUALCOMM Incorporated, San Diego, CA (US)

(*) **Notice:** Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 731 days.

(21) **Appl. No.:** 12/096,189

(22) **Filed:** Jul. 6, 2009

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Related U.S. Application Data
(60) **Provisional application No. 61/078,812, filed on Jul. 8, 2008.**

(51) **Int. Cl.**
H02J 5/00 (2006.01)
H02J 7/04 (2006.01)

(52) **U.S. Cl.**
520/559, 520/108, 520/104

(56) **Field of Classification Search**
CPC V827 0014
USPC 520/106, 109
See application file for complete search history.

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ABSTRACT
Improved battery-charging system for a vehicle. Primary and secondary coils are located in places where the vehicle can receive power from the primary coil by pulling into a parking space, for example. The parking space may have a coil embedded in the ground, or may have an array of coils embedded in the ground. A guidance system is disclosed. Fine positioning is also disclosed. The secondary coil in the vehicle can also be raised or lowered to improve coupling.

19 Claims, 5 Drawing Sheets

InventEV, Inc.
Exhibit 1001
Page 001

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(45) **Date of Patent:** Jun. 18, 2013

Related U.S. Application Data

(60) **Provisional application No. 61/078,812, filed on Jul. 8, 2008.**

(57) ABSTRACT

Improved battery-charging system for a vehicle. Primary and secondary coils are located in places where the vehicle can receive power from the primary coil by pulling into a parking space, for example. The parking space may have a coil embedded in the ground, or may have an array of coils embedded in the ground. A guidance system is disclosed. Fine positioning is also disclosed. The secondary coil in the vehicle can also be raised or lowered to improve coupling.

The '654 Patent – Independent Claims 1, 8, and 13

1. A transmitter system for wireless power, comprising:
a transmitting antenna including an inductive element and a capacitor, said transmitting antenna being resonant at a first frequency, said transmitting antenna being configured to generate a wireless field for charging a device including a receiving antenna;
a charging control system coupled to said transmitting antenna and configured to generate a signal at said first frequency and provide said signal to said transmitting antenna; and
an alignment controller configured to test coupling of said transmitting antenna to the receiving antenna in the first alignment position and based on a degree of the coupling, the alignment controller further configured to adjust an x-y alignment of the transmitting antenna relative to the receiving antenna from the first alignment position to a second alignment position having a finer alignment between the receiving antenna and the transmitting antenna than the first alignment position to improve said coupling.

Ex. 1001 ('654 Patent) at Claim 1

8. A receiver system for wireless power, comprising:
a receiving antenna coupled to a device, the receiving antenna including a coil and capacitor that are resonant at a first frequency;
a guidance controller configured to guide the receiving antenna of the device to a first alignment position relative to a transmitting antenna that is not physically connected to said device coupled to the receiving antenna;
a lifting device for said receiving antenna configured to lift and lower said receiving antenna; and
an alignment controller configured to sense a degree of coupling of said receiving antenna and the transmitting antenna based on a detection of the coupling that is measured at the receiving antenna, the alignment controller being further configured to move said receiving antenna from the first alignment position to a second alignment position to better align the receiving antenna with the transmitting antenna.

Ex. 1001 ('654 Patent) at Claim 8

13. A method, comprising:
guiding a receiving antenna of a vehicle to a first alignment position relative to a transmitting antenna;
responsive to detecting a degree of coupling in the first alignment position between the receiving antenna and the transmitting antenna that is measured at the receiving antenna, moving one of the receiving antenna and the transmitting antenna from the first alignment position to a second alignment position to improve alignment of the receiving antenna with the transmitting antenna and improve the degree of coupling.

Ex. 1001 ('654 Patent) at Claim 13

The '654 Patent

Claim Construction – “[transmitting/receiving] antenna”

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Ground 2: Ross and Wang Invalidate Cls. 8-10, 12-14, 16, and 19

Claim Construction

Claim Term	Petitioner's Construction	Patent Owner's Construction
<i>"transmitting antenna"</i> (all challenged claims)	an antenna that transmits energy	a primary coil that produces a near-field component of flux into free space that is intercepted by a secondary coil to effect resonant inductive coupling
<i>"receiving antenna"</i> (all challenged claims)	an antenna that receives energy	a secondary coil that intercepts and receives a near-field component of flux in free space that is generated by a primary coil to effect resonant inductive coupling

Antennas Are Claimed Broadly

13. A method, comprising:
guiding a receiving antenna of a vehicle to a first alignment position relative to a transmitting antenna;
responsive to detecting a degree of coupling in the first alignment position between the receiving antenna and the transmitting antenna that is measured at the receiving antenna, moving one of the receiving antenna and the transmitting antenna from the first alignment position to a second alignment position to improve alignment of the receiving antenna with the transmitting antenna and improve the degree of coupling.

Ex. 1001 ('654 Patent) at Claim 13

Antenna Requirements Are Separately Claimed

1. A transmitter system for wireless power, comprising:
a transmitting antenna including an inductive element and a capacitor, said transmitting antenna being resonant at a first frequency, said transmitting antenna being configured to generate a wireless field for charging a device including a receiving antenna;
a charging control system coupled to said transmitting antenna and configured to generate a signal at said first frequency and provide said signal to said transmitting antenna; and
an alignment controller configured to test coupling of said transmitting antenna to the receiving antenna in the first alignment position and based on a degree of the coupling, the alignment controller further configured to adjust an x-y alignment of the transmitting antenna relative to the receiving antenna from the first alignment position to a second alignment position having a finer alignment between the receiving antenna and the transmitting antenna than the first alignment position to improve said coupling.

Ex. 1001 ('654 Patent) at Claim 1

8. A receiver system for wireless power, comprising:
a receiving antenna coupled to a device, the receiving antenna including a coil and capacitor that are resonant at a first frequency;
a guidance controller configured to guide the receiving antenna of the device to a first alignment position relative to a transmitting antenna that is not physically connected to said device coupled to the receiving antenna;
a lifting device for said receiving antenna configured to lift and lower said receiving antenna; and
an alignment controller configured to sense a degree of coupling of said receiving antenna and the transmitting antenna based on a detection of the coupling that is measured at the receiving antenna, the alignment controller being further configured to move said receiving antenna from the first alignment position to a second alignment position to better align the receiving antenna with the transmitting antenna.

Ex. 1001 ('654 Patent) at Claim 8

Specification Uses Antenna Broadly

Claim Term	Petitioner's Construction
"transmitting antenna"	an antenna that transmits energy
"receiving antenna"	an antenna that receives energy

Transmitter 104 further includes a transmit antenna 114 for providing a means for energy transmission and receiver 108 further includes a receive antenna 118 for providing a means for energy reception. The transmit and receive antennas are sized according to applications and devices to be associated therewith. As stated, an efficient energy transfer occurs by

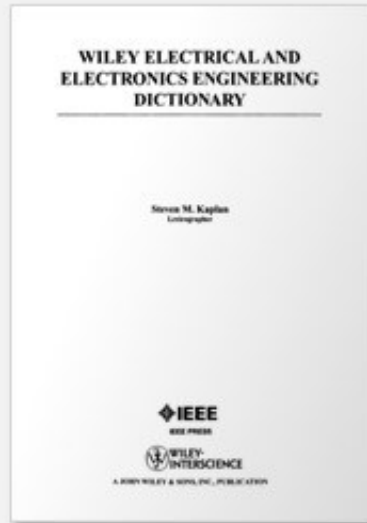
Ex. 1001 ('654 Patent) at 2:26-31

Wireless Power is Broadly Defined

The words “wireless power” is used herein to mean any form of energy associated with electric fields, magnetic fields, electromagnetic fields, or otherwise that is transmitted from a transmitter to a receiver without the use of physical electromagnetic conductors.

Ex. 1001 ('654 Patent) at 2:5-9

Extrinsic Evidence Support Petitioner's Construction



Wiley Electrical and Electronics Engineering Dictionary

antenna A device that radiates and/or receives radio waves.

The same antenna can usually be used for both transmission and reception. There are many types of antennas, their selection depending on the uses and operating frequencies desired. Also known as **aerial**.

Ex. 2003 (Wiley Dictionary) at 29

Serway – Principles of Physics

24.5 • PRODUCTION OF ELECTROMAGNETIC WAVES BY AN ANTENNA

Electromagnetic waves are radiated by *any* circuit carrying an alternating current. The fundamental mechanism responsible for this radiation is the acceleration of a charged particle. **Whenever a charged particle undergoes an acceleration, it must radiate energy by electromagnetic radiation.**

Ex. 1043-005 (Serway)

PO's "Near-Field" Requirement Is Overly Narrow

Claim Term	Patent Owner's Construction
"transmitting antenna"	a primary coil that produces a near-field component of flux into free space that is intercepted by a secondary coil to effect resonant inductive coupling
"receiving antenna"	a secondary coil that intercepts and receives a near-field component of flux in free space that is generated by a primary coil to effect resonant inductive coupling

1. A transmitter system for wireless power, comprising:
a transmitting antenna including an inductive element and
a capacitor, said transmitting antenna being resonant at a
first frequency, said transmitting antenna being configured to generate a wireless field for charging a device
including a receiving antenna;

Ex. 1001 ('654 Patent) at Claim 1

PO Improperly Imports Limitations From Exemplary Embodiments

Exemplary embodiments of the invention include coupling power between two antennas that are in the near-fields of each other. As stated, the near-field is an area around the antenna in which electromagnetic fields exist but may not propagate or radiate away from the antenna. They are typically confined to a volume that is near the physical volume of the antenna. In

Ex. 1001 ('654 Patent) at 3:43-48

Evolution Concepts, Inc. v. HOC Events, Inc.

“We have repeatedly held that ‘it is not enough that the only embodiments, or all of the embodiments, contain a particular limitation to limit claims beyond their plain meaning.’”

Evolution Concepts, Inc. v. HOC Events, Inc., 22 F.4th 1361, 1367 (Fed. Cir. 2022), quoting *Unwired Planet, LLC v. Apple, Inc.*, 829 F.3d 1353, 1359 (Fed. Cir. 2016)

PO's "Free Space" Requirement Contradicts The Specification

Claim Term	Patent Owner's Construction
"transmitting antenna"	a primary coil that produces a near-field component of flux into free space that is intercepted by a secondary coil to effect resonant inductive coupling
"receiving antenna"	a secondary coil that intercepts and receives a near-field component of flux in free space that is generated by a primary coil to effect resonant inductive coupling

As stated, efficient transfer of energy between the transmitter 104 and receiver 108 occurs during matched or nearly matched resonance between the transmitter 104 and the receiver 108. However, even when resonance between the transmitter 104 and receiver 108 are not matched, energy may be transferred at a lower efficiency. Transfer of energy occurs by coupling energy from the near-field of the transmitting antenna to the receiving antenna residing in the neighborhood where this near-field is established rather than propagating the energy from the transmitting antenna into free space.

Ex. 1001 ('654 Patent) at 3:14-23

PO's No-Core Argument Excludes Embodiments

Patent Owner's Sur-Reply

Radiating energy in the near and far fields necessarily radiates energy “into free space” (i.e., into the air), rather than containing flux within a core, which is consistent with PO's construction. Petitioner's cherry picking of the term “into free

POSR at 4

As illustrated in FIG. 3, antennas used in exemplary embodiments may be configured as a “loop” antenna 150, which may also be referred to herein as a “magnetic” antenna. Loop antennas may be configured to include an air core or a physical core such as a ferrite core. Using a ferrite core may

Ex. 1001 ('654 Patent) at 2:59-63

Antennas Are Not Defined By Resonance Or Configuration Of Other Coils

Claim Term	Patent Owner's Construction
"transmitting antenna"	a primary coil that produces a near-field component of flux into free space that is intercepted by a secondary coil to effect resonant inductive coupling
"receiving antenna"	a secondary coil that intercepts and receives a near-field component of flux in free space that is generated by a primary coil to effect resonant inductive coupling

1. A transmitter system for wireless power, comprising:
a transmitting antenna including an inductive element and a capacitor, said transmitting antenna being resonant at a first frequency, said transmitting antenna being configured to generate a wireless field for charging a device including a receiving antenna;

Ex. 1001 ('654 Patent) at Claim 1

8. A receiver system for wireless power, comprising:
a receiving antenna coupled to a device, the receiving antenna including a coil and capacitor that are resonant at a first frequency;

Ex. 1001 ('654 Patent) at Claim 8

13. A method, comprising:
guiding a receiving antenna of a vehicle to a first alignment position relative to a transmitting antenna;

Ex. 1001 ('654 Patent) at Claim 13

**Claim 13 does not require
antennas that are "resonant"**

The '654 Patent

Claim Construction – “[transmitting/receiving] antenna”

Ground 1a: Odachi Invalidates Cls. 13 and 15

Odachi taught transmitting/receiving antennas

Odachi taught moving antenna responsive to degree of coupling

Ground 1b: Odachi and Wang invalidate Cls. 1, 7, and 18

Ground 1c: Odachi, Wang and Partovi Cls. 4-6

Ground 2: Ross and Wang Invalidate Cls. 8-10, 12-14, 16, and 19

Odachi Discloses Claims 13 And 15

13. A method, comprising:
guiding a receiving antenna of a vehicle to a first alignment position relative to a transmitting antenna;
responsive to detecting a degree of coupling in the first alignment position between the receiving antenna and the transmitting antenna that is measured at the receiving antenna, moving one of the receiving antenna and the transmitting antenna from the first alignment position to a second alignment position to improve alignment of the receiving antenna with the transmitting antenna and improve the degree of coupling.

* * *

15. The method of claim 13, wherein moving one of the receiving antenna and the transmitting antenna comprises moving the transmitting antenna laterally relative to the receiving antenna.

Ex. 1001 ('654 Patent) at Claims 13, 15

Odachi Discloses Transmitting And Receiving Antennas

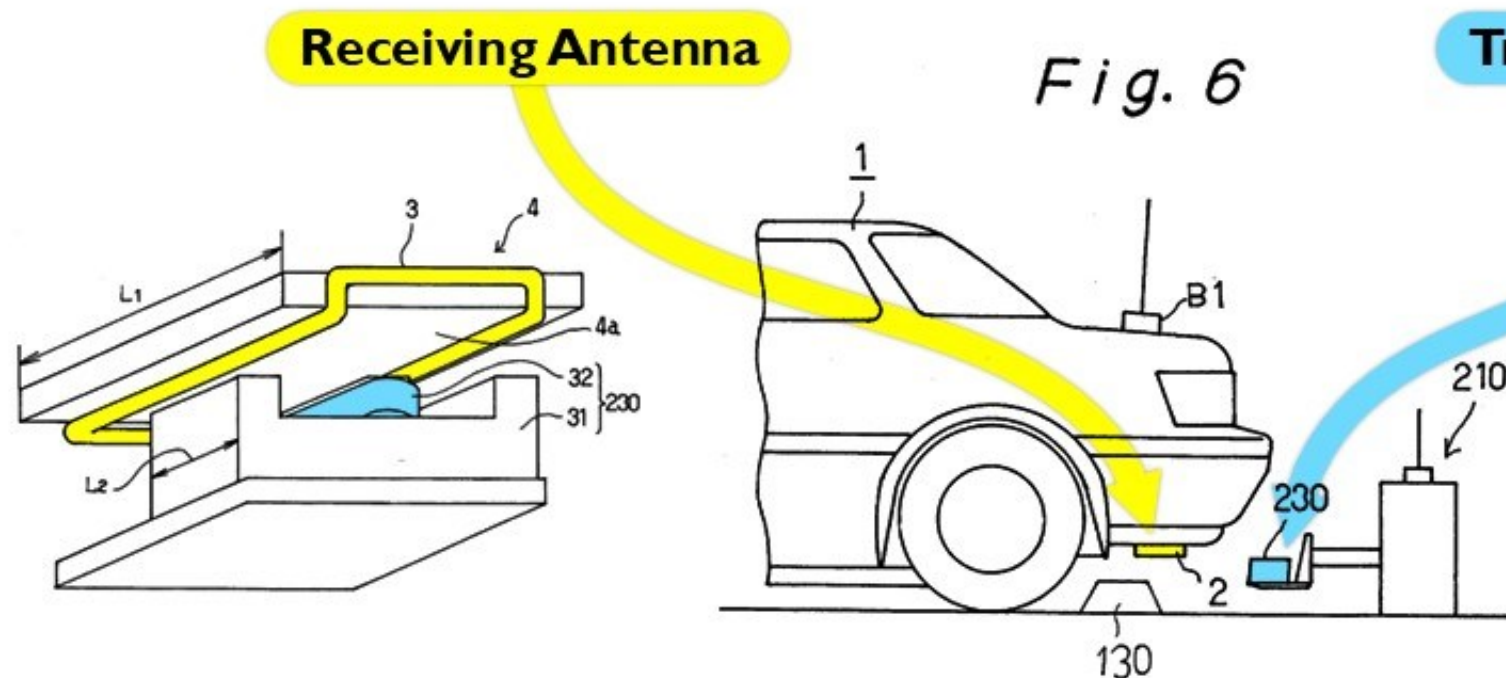
Odachi

Referring to FIGS. 6 and 7, an electric vehicle 1 in a garage 140 has on the bottom adjacent the rear end and thereof a secondary inductive device or receptacle 2 comprised of a core 3 and a coil 4 connected to a battery of the vehicle through an appropriate electric circuit. The second-

Ex. 1005 (Odachi) at 8:1-5

Behind the stops 130 is located a ground battery charger 210 enclosed by a casing 220 and including a primary inductive device or coupler 230 comprised of a core 31 and a coil 32. The primary inductive coupler 230 is mounted on

Ex. 1005 (Odachi) at 8:16-19



Ex. 1005 (Odachi) at Fig. 12 & 6

Odachi Discloses Moving Antennas Responsive To Degree Of Coupling

Odachi

According to one embodiment of the present invention, in an apparatus for charging a battery of an electric vehicle by coupling a primary inductive device having a core and a primary coil connected to a power source, with a secondary inductive device having a core and a secondary coil connected to the battery on the vehicle and then flowing a charging current in the primary coil thereby to induce an electromotive force in the secondary coil, there is provided means for supplying an electric current to the primary coil and means for moving the primary inductive device relative to and past the secondary counterpart. By moving the primary inductive device past the secondary inductive device, a current with variable value is induced in the secondary coil depending on the spaced distance between the primary and secondary inductive devices. That is, as the primary device comes close to the secondary device, the above distance is reduced and electromagnetic induction occurs between the two inductive devices, as a result of which an electric current is induced in the secondary coil. This induced or secondary current is increased with a decrease in the spaced distance and the primary current flowing in the primary coil is reduced by an amount corresponding to the current induced in the secondary coil.

Ex. 1005 (Odachi) at 2:23-45

Odachi Discloses Moving Antennas Responsive To Degree Of Coupling

Odachi

As the carriage 9 is being moved rightward, the spaced distance between the primary inductive coupler 6 and the secondary inductive receptacle 2 is reduced gradually and electromagnetic induction occurs between the coupler and the receptacle when the former coupler comes close to the latter receptacle. As a result, an electromotive force is induced in the secondary coil 4 and this induced force is increased with a decrease in the spaced distance. It is noted that, as the electromotive force due to the electromagnetic induction is increased, the check current I_{RMS} flowing in the primary coil 14 is reduced by the amount corresponding to the current induced in the secondary coil 2, as shown in FIG. 4. Therefore, the value of the current I_{RMS} becomes minimum when the primary inductive coupler 6 is positioned closest to, or in alignment along the X-axis with, the secondary inductive receptacle 2, as indicated at XA in FIG.

Ex. 1005 (Odachi) at 6:1-16

PO Wrongly Focuses Only On When Charging Occurs

Patent Owner's Sur-Reply

Petitioner also ignores the express teachings of Odachi that the two couplers are in contact **when charging occurs**, to manufacture a reason to combine the

* * *

is irrelevant. The issue is whether Odachi couplers produce “a near-field component of flux into free space,” which they do not because of the common core that is formed

when Odachi performs charging. See Horenstein Decl. ¶¶ 29-33, 44; Horenstein

* * *

have separate cores. Rep. 11. First, Odachi is clear that the cores are in contact,

forming a single core, **during charging.** Ex. 1001, 4:34-44, 7:23-26, 9:48-51. But

* * *

evidence that the same benefit would result in Odachi, where there is **no air gap**

between the couplers **during charging.** See Horenstein Supp. ¶¶ 74-75. Petitioner's

POSR at 1, 9, 10, 16

PO Wrongly Focuses Only On When Charging Occurs

Institution Decision

First, we disagree with WiTricity that we should consider Odachi's cores 3 and 31 to be in contact or nearly in contact for the purpose of our analysis. Although Odachi discloses that, at the conclusion of the alignment

Institution Decision at 16

Belden Inc. v. Berk-Tek LLC

"[A] reference must be considered for everything it teaches"

Belden Inc. v. Berk-Tek LLC, 805 F.3d 1064, 1076 (Fed. Cir. 2015)

Odachi's Coils Are Antennas Under The Plain Meaning

Odachi

to set the controller 21 in a battery charging mode. In response to such operation, the controller 21 causes the power circuit 23 to supply a charging AC current to the primary coil 14. In charging the battery, the AC current flowing in the primary coil 14 induces a similar current in the secondary coil 4 under the effect of electromagnetic induction and the AC current thus transferred from the primary to the secondary is rectified by any appropriate circuit into a DC current which is delivered to the battery for charging the same.

Ex. 1005 (Odachi) at 7:29-38

Serway – Principles of Physics

24.5 • PRODUCTION OF ELECTROMAGNETIC WAVES BY AN ANTENNA

Electromagnetic waves are radiated by *any* circuit carrying an alternating current. The fundamental mechanism responsible for this radiation is the acceleration of a charged particle. **Whenever a charged particle undergoes an acceleration, it must radiate energy by electromagnetic radiation.**

Ex. 1043-005 (Serway)

Terman – Radio Engineers' Handbook

18. Loop Antennas.—The loop antenna is essentially a coil of any convenient cross section (see Fig. 49 for examples), carrying a radio-frequency current. The ordinary loop is so designed that its dimensions are small compared with the wave length, in which case the currents are of the same magnitude and phase throughout the loop.¹

Ex. 1044-0821 (Terman)

Odachi's Coils Are Antennas Under PO's Construction

Dr. Horenstein Deposition

Q. And so when the primary coil receives an AC current, what happens?

A. The current flows around the wire.

Q. Does that generate some electromagnetic energy emanating from the primary coil?

A. It does.

Q. Okay. Is that energy in the induction field, the near field, the far field, or all of the above?

A. All of the above.

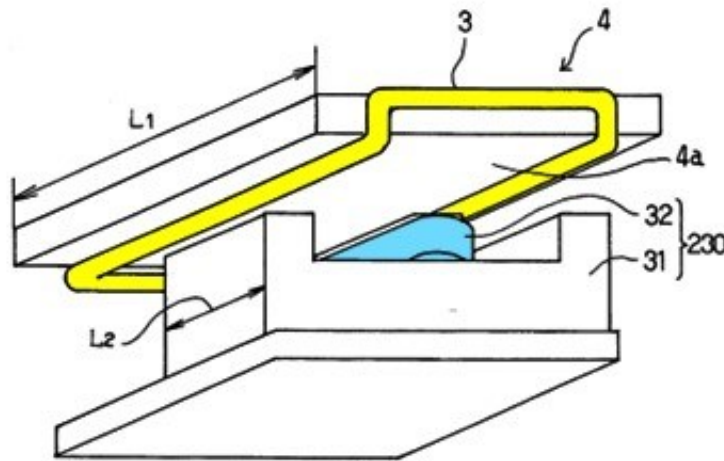
Ex. 1033 (Horenstein Dep.) at 15:3-13 (objection omitted)

Odachi's Coils Are Antennas Under PO's Construction

Patent Owner's Response

Dr. Mark Horenstein ("Horenstein Decl.") ¶21. A transmitting antenna may be formed by one coil of wire (i.e., a primary coil), and a receiving antenna may be formed by another coil of wire (i.e., a secondary coil), with the coils separated by air, without any intervening solid material. Horenstein Decl. at ¶22. The '654 patent
POR at 9

Odachi



and means for moving the primary inductive device relative to and past the secondary counterpart. By moving the primary inductive device past the secondary inductive device, a current with variable value is induced in the secondary coil depending on the spaced distance between the primary and secondary inductive devices. That is, as the primary device comes close to the secondary device, the above distance is reduced and electromagnetic induction occurs between the two inductive devices, as a result of which an electric current is induced in the secondary coil.

Ex. 1005 (Odachi) at Fig. 12, 2:32-41

Odachi's Coils Are Antennas Under PO's Construction

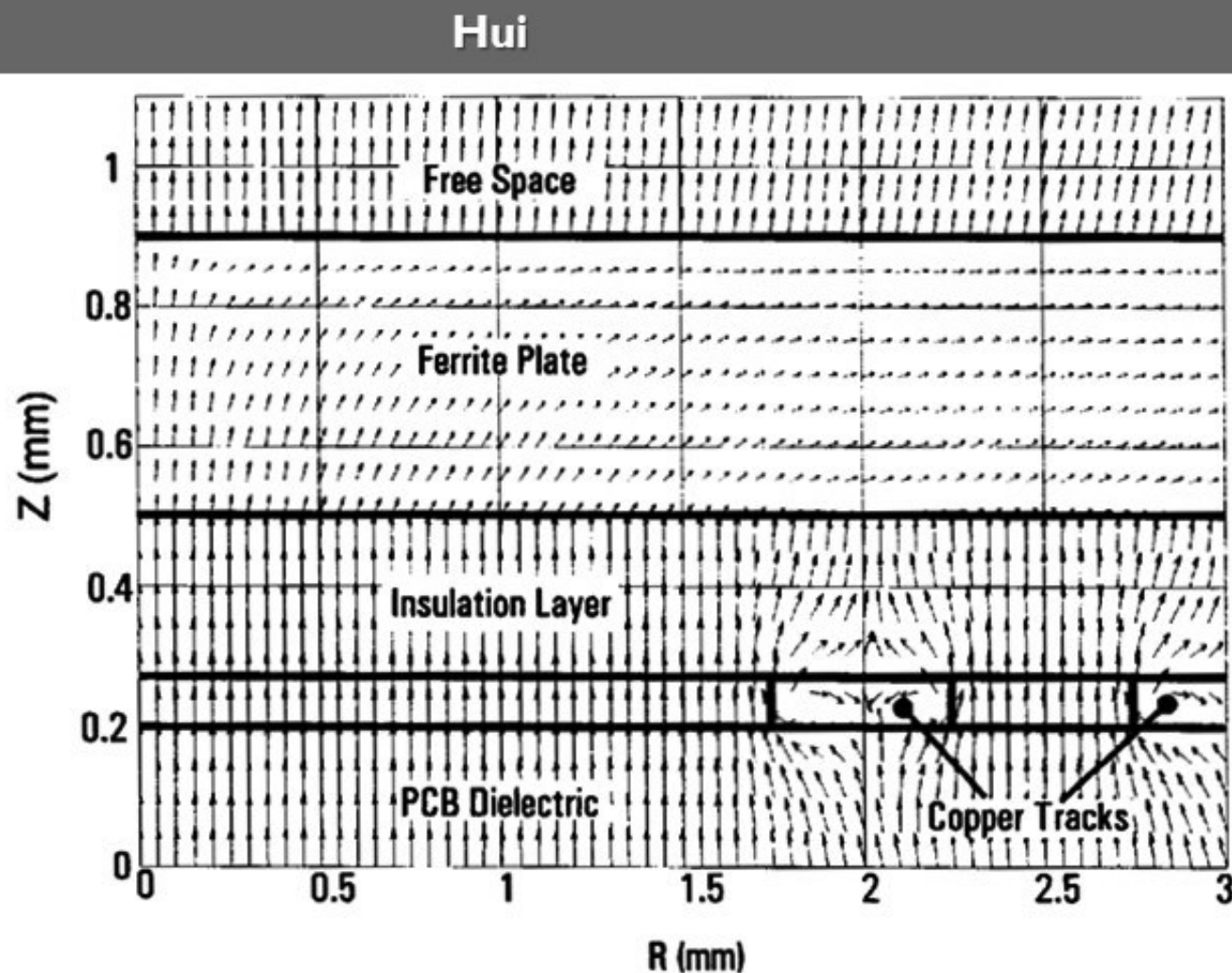
Patent Owner's Response

When an AC power source is applied to the primary coil, a magnetic field is generated by the primary coil. The magnetic field lines circulate around the primary coil, and also pass through the secondary coil of the receiving antenna. According to Faraday's law, the magnetic field passing through the secondary coil induces a voltage in the secondary coil, which may drive a load coupled to the secondary coil. In this way, power is transferred from the primary coil to the secondary coil by inductive coupling. *See Horenstein Decl. at ¶22.*

POR at 9

Coils Radiate Energy Into Free Space Even Near Core Material

FIG.5



Ex. 1041 (Hui) at Fig. 5

Coils Radiate Energy Into Free Space Even Near Core Material

Patent Owner's Sur-Reply

Petitioners' position that a transformer "radiate[s] energy." Hui (Ex. 1041) states that "the use of the ferrite plates helps to confine the magnetic field generated from the transformer windings," but contrary to Petitioner's argument, says **nothing about "radiat[ing] energy."** Rep. 7; Ex. 1041, 3:28-29. If anything, Hui confirms PO's POSR at 7

Hui

FIG. 11

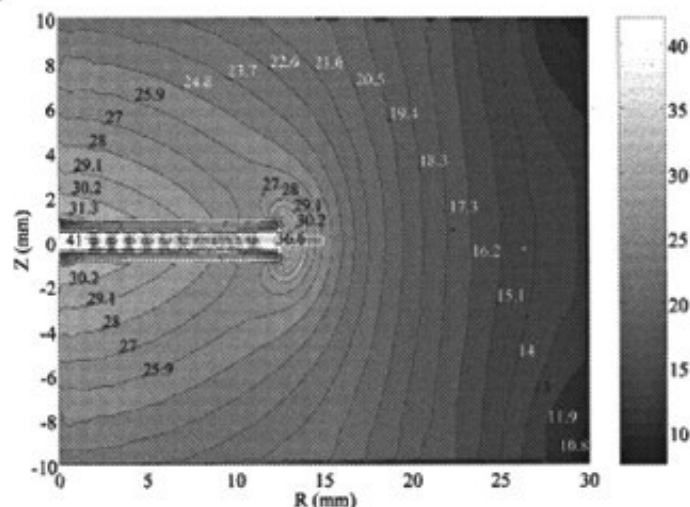


FIG. 11 shows **simulated magnetic field intensity** of a **PCB transformer** with ferrite shielding in accordance with the prior art and in no load condition,

* * *

Both simulation and experimental results shown that the use of the 4F1 ferrite plates can reduce **the magnetic field emitted from the transformer** by 4 dB (about 2.5 times).

Ex. 1041 (Hui) at 2:45-47, 6:35-37, Fig. 11

Coils Surrounded By Core Material Radiate Energy Into Free Space

Dobbs

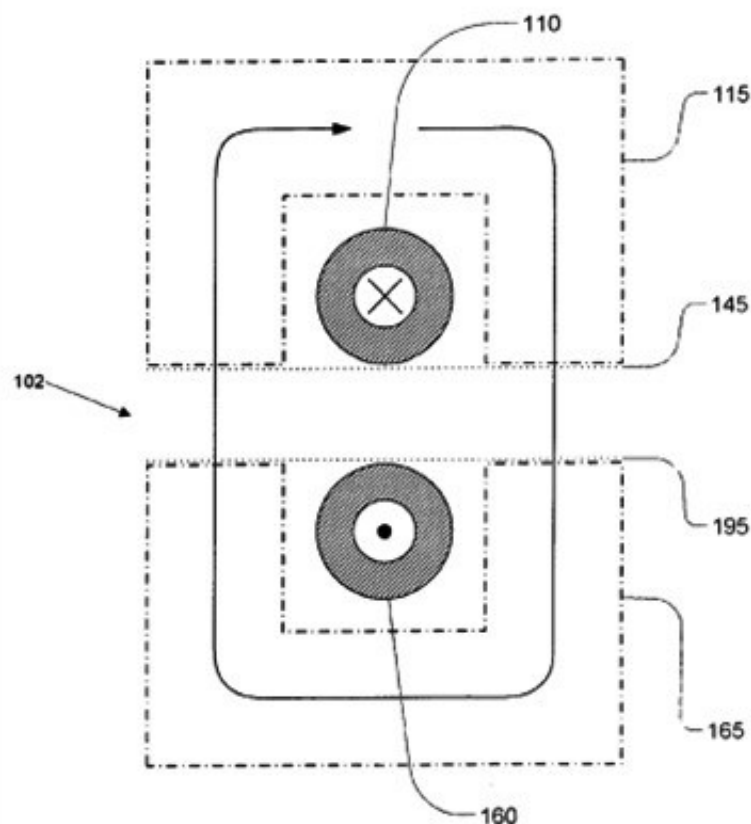


FIG. 2

[0054] Especially because it is preferred for practical operation in accordance with one or more embodiments of the present invention that such power coupling devices be made to operate at frequencies above 20 kHz, it can be expected that the structure of, say, ferrite and copper (to give specific examples of materials that may be used for core half-shells 115, 116 and windings 110, 160) shown in FIG. 2 will generate a dipole field and will radiate strongly to the surrounding space. Where such radiation is undesirable, the ferrite shells might be surrounded by electrically conductive shell(s) serving as shield (see FIG. 4) and designed to carry a current capable of inducing a magnetic field such as will more or less exactly cancel the magnetic field due to the net current in the windings. To the extent that this can be accomplished, escape of radiation to the exterior of such a shield might be expected to be reduced or eliminated.

Ex. 1038 (Dobbs) at Fig. 2, [0054]

Coils Radiate Energy As Flux; Core Shapes Flux Path

Elliott

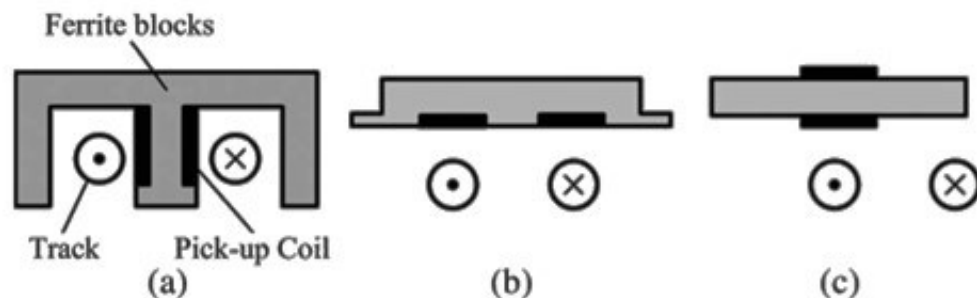


Fig. 2. Common IPT pickups. (a) E-pick-up. (b) Flat-E. (c) Flat pickup.

* * *

As shown, in its most basic form, an IPT pickup consists of a coil of wire to capture magnetic flux around the track conductor. A voltage is induced in this coil as described by Ampere's and Faraday's Laws. Conceptually, this is very similar to a transformer, albeit with a much lower magnetic coupling. As in a transformer design, magnetic material, such as ferrite, is used to direct the magnetic flux and improve the coupling between the track and any pickups.

Bipolar (rather than unipolar) tracks, as shown, are usually preferred in commercial applications, due to the natural return path and consequent limit on radiated fields. The flat pickup

Ex. 1039 (Elliott) at 2

Odachi's Coils Are Antennas Even If Operating Similar To A Transformer

Patent Owner's Response

Therefore, a small gap between the cores in Odachi during one portion of the alignment process does not convert the transformer into an antenna. The primary core of Odachi does not “radiate radio waves,” but instead functions as a traditional transformer in combination with the secondary core.

POR at 29

Cook-765

Antennas with high quality factors can be used. Two high-Q antennas are placed such that they react similarly to a loosely coupled transformer, with one antenna inducing power into the other. The antennas preferably have Qs that are greater than 1000.

Ex. 1036 (Cook-765) at 1:37-45

Chutorash

and 220, respectively). Antennas 218 and 220 may be loop antennas configured to form an air-core transformer when located within each other's near field (e.g., “induction field”, “near zone”, within a small number of wavelengths, etc.).

Ex. 1045 (Chutorash) at 5:4-7

Transformers Transfer Energy In The Near Field

Holcombe

Standard electronic components capacitors, inductors and transformers can be thought of as extreme near-field devices. For these devices the near-fields are used to transfer or store energy with over 90% efficiency. For near-field signal com-

Ex. 1034 (Holcombe) at 7:3-6

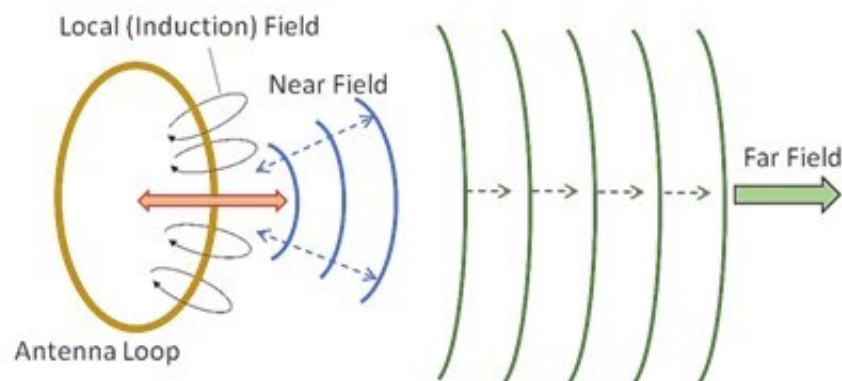
Kurs

Electric transformers and proximity chargers are examples of devices that utilize this known short range, near-field energy transfer scheme.

Ex. 1035 (Kurs) at 2:13-15

PO's "Induction Field" Argument Is Unsupported

Dr. Horenstein 2nd Declaration



Ex. 2005 (Horenstein 2nd Decl.) at ¶16

Dr. Horenstein Deposition

Q. There's a graphic in paragraph 37 of your Exhibit 2010, correct?

A. That's right.

Q. You don't cite anything as the source of that graphic, correct?

A. Well, no.

Q. Where in paragraph 37 is there a citation to a source of that graphic?

A. One does not normally cite one's self when one is making a figure.

Ex. 1033 (Horenstein Dep.) at 59:3-20

654 Patent: “Near Field” Includes Fields That Do Not Radiate

Patent Owner’s Sur-Reply

2010 ¶¶ 37-38, Ex. 2006, 275, 498. The Wiley dictionary provides separate definitions for “induction field” and “near field,” and Dr. Horenstein explains in detail how an induction field behaves “as if permanently associated with” the antenna, whereas the near-field is a radiation field that is propagated outward from the antenna. Ex. 2010 ¶¶ 38-41. Petitioner next notes that Dr. Horenstein could not

POSR at 12

Exemplary embodiments of the invention include coupling power between two antennas that are in the near-fields of each other. As stated, the near-field is an area around the antenna in which electromagnetic fields exist but may not propagate or radiate away from the antenna. They are typically confined to a volume that is near the physical volume of the antenna. In

Ex. 1001 (‘654 Patent) at 3:43-48

654 Patent: “Near Field” Includes The “Induction Field”

Wiley Electrical and Electronics Engineering Dictionary

Induction field 1. The portion of an electromagnetic field that is associated with the AC component, and which is responsible for any self or mutual inductance. 2. For a radiator, such as a transmitting antenna, the portion of the electromagnetic field which behaves as if permanently associated with said radiator. This contrasts with the radiation field, which is the portion that is propagated outward as electromagnetic waves.

Ex. 2012 (Wiley Dictionary – Additional Terms) at 3

Exemplary embodiments of the invention include coupling power between two antennas that are in the near-fields of each other. As stated, the near-field is an area around the antenna in which electromagnetic fields exist but may not propagate or radiate away from the antenna. They are typically confined to a volume that is near the physical volume of the antenna. In

Ex. 1001 ('654 Patent) at 3:43-48



“Near Field” And “Far Field” Definitions Are Consistent

Wiley Electrical and Electronics Engineering Dictionary

near field 1. Same as **near-field region**. 2. The electromagnetic field closer than a given distance from a source of electromagnetic radiation. 3. The sound field close to a sound source. May be, for instance, that within two wavelengths.

* * *

far field 1. Same as **far-field region**. 2. The electromagnetic field further than a given distance from a source of electromagnetic radiation. 3. The sound field further than a certain distance to a sound source. May be, for instance, that extending beyond two wavelengths.

Ex. 2006 (Wiley Dictionary) at 3, 6



The '654 Patent

Claim Construction – “[transmitting/receiving] antenna”

Ground 1a: Odachi Invalidates Cls. 13 and 15

Odachi taught transmitting/receiving antennas

Odachi taught moving antenna responsive to degree of coupling

Ground 1b: Odachi and Wang invalidate Cls. 1, 7, and 18

Ground 1c: Odachi, Wang and Partovi Cls. 4-6

Ground 2: Ross and Wang Invalidate Cls. 8-10, 12-14, 16, and 19

Odachi Moves Antennas Responsive To Detecting A Degree of Coupling

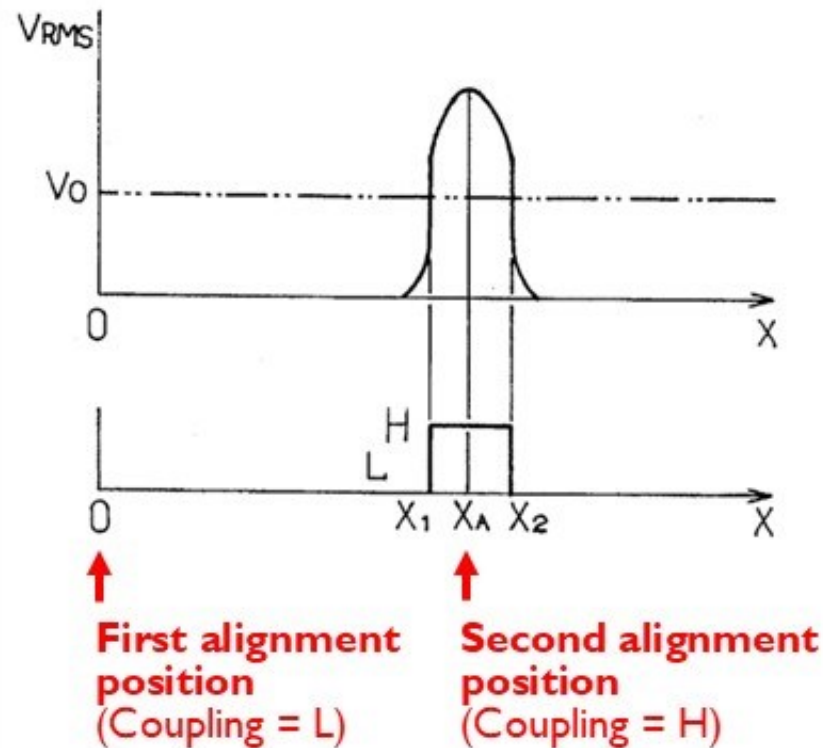
13. A method, comprising:
guiding a receiving antenna of a vehicle to a first alignment position relative to a transmitting antenna;
responsive to detecting a degree of coupling in the first alignment position between the receiving antenna and the transmitting antenna that is measured at the receiving antenna, moving one of the receiving antenna and the transmitting antenna from the first alignment position to a second alignment position to improve alignment of the receiving antenna with the transmitting antenna and improve the degree of coupling.

Ex. 1001 ('654 Patent) at Claim 13

Odachi Moves Transmit Antenna Responsive To Coupling

Odachi

Fig. 5



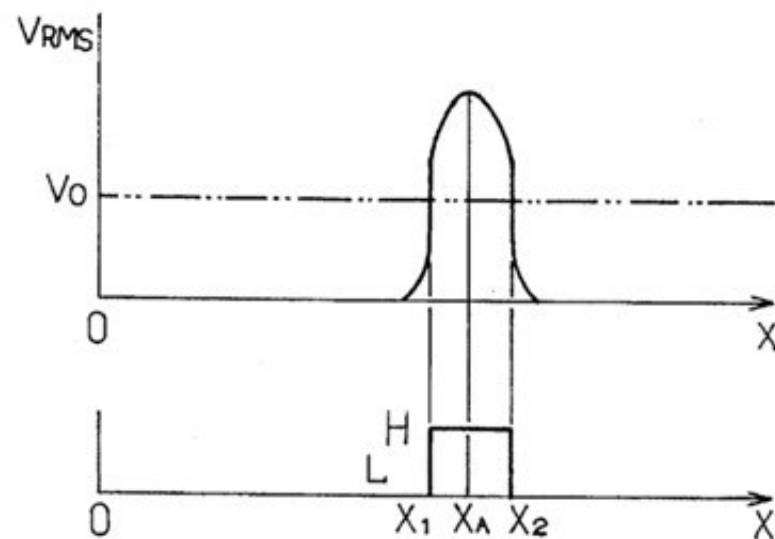
position X_A is calculated. It is noted, however, that the positions X_1 and X_2 may be determined by monitoring a voltage V_{RMS} which is induced across the secondary coil on the vehicle by application of an AC voltage across the primary coil, as indicated in the diagram of FIG. 5. In such an embodiment, the vehicle has an electric circuit connected to the secondary coil for monitoring the voltage V_{RMS} and another circuit connected to the voltage monitoring circuit for generating discriminating signals H and L depending on the magnitude of the voltage V_{RMS} with respect to a predetermined reference voltage V_0 , as shown in the diagram of FIG. 5. Since the above two circuits are installed on the vehicle, the signals H, L are provided to the controller by the wireless transmitter and receiver B_1, B_2 . The controller 21 will determine the positions X_1 and X_2 from the signals H and L and then calculate the position X_A in the same manner as used in the above-described preferred embodiments. As a

Ex. 1005 (Odachi) at Fig. 5, 13:42-58

Odachi's Coupler Can Be Initially Located At Any Stroke Range

Odachi

Fig. 5



**First alignment
position**
(Coupling = L)



**Second alignment
position**
(Coupling = H)

position, as seen in FIG. 11. Furthermore, the stops 130 are arranged at such positions along the X-axis that, when the vehicle 1 is parked against the stops, the secondary inductive receptacle 2 carried by the vehicle is placed within the stroke range of the carriage 41d between E1 and E2, or the range of movement along the X-axis of the primary coupler 230.

Ex. 1005 (Odachi) at 9:60-65

The '654 Patent

Claim Construction – “[transmitting/receiving] antenna”

Ground 1a: Odachi Invalidates Cls. 13 and 15

Ground 1b: Odachi and Wang invalidate Cls. 1, 7, and 18

Motivation To Combine

Claim 7

Claim 18

Ground 1c: Odachi, Wang and Partovi Cls. 4-6

Ground 2: Ross and Wang Invalidate Cls. 8-10, 12-14, 16, and 19

A POSA Would Use Wang's Compensating Capacitors In Odachi

1. A transmitter system for wireless power, comprising:
 - a transmitting antenna including an inductive element and a capacitor, said transmitting antenna being resonant at a first frequency, said transmitting antenna being configured to generate a wireless field for charging a device including a receiving antenna;
 - a charging control system coupled to said transmitting antenna and configured to generate a signal at said first frequency and provide said signal to said transmitting antenna; and
 - an alignment controller configured to test coupling of said transmitting antenna to the receiving antenna in the first alignment position and based on a degree of the coupling, the alignment controller further configured to adjust an x-y alignment of the transmitting antenna relative to the receiving antenna from the first alignment position to a second alignment position having a finer alignment between the receiving antenna and the transmitting antenna than the first alignment position to improve said coupling.

Wang (Ex. 1008)

Ex. 1001 ('654 Patent) at Claim 1

Wang's Capacitors Would Improve Power Transfer Capability

Wang

2-3 COMPENSATION

Both the primary and secondary of the electromagnetic structure are often compensated by capacitors to boost the power transfer capability of the pickup, while minimizing the VA rating of the power supply. This section introduces the basic compensation topologies. The compensation level and the resonant behaviour of the primary and secondary resonant circuits are quantified for each topology.

* * *

2-3.2 SECONDARY RESONANCE

Both series and parallel secondary compensation improve the power transfer capability of the pickup, but present very different characteristics to the load. The circuit equation of the series-compensated pickup (Fig. 2-7) is:

* * *

Secondary compensation is required for boosting power transfer capability, while primary compensation is introduced to minimize the VA rating of the power supply.

Ex. 1008 (Wang) at 20, 21, 28

Compensation Capacitors Were “Basic” Choices And “Fundamental” Topologies

Wang

2-3.5 BASIC COMPENSATION TOPOLOGIES

Three basic compensation choices exist for both the primary and secondary (series compensation, parallel compensation, or uncompensated). Combining the primary and secondary results in nine fundamental compensation topologies [18] as illustrated in Fig. 2-12.

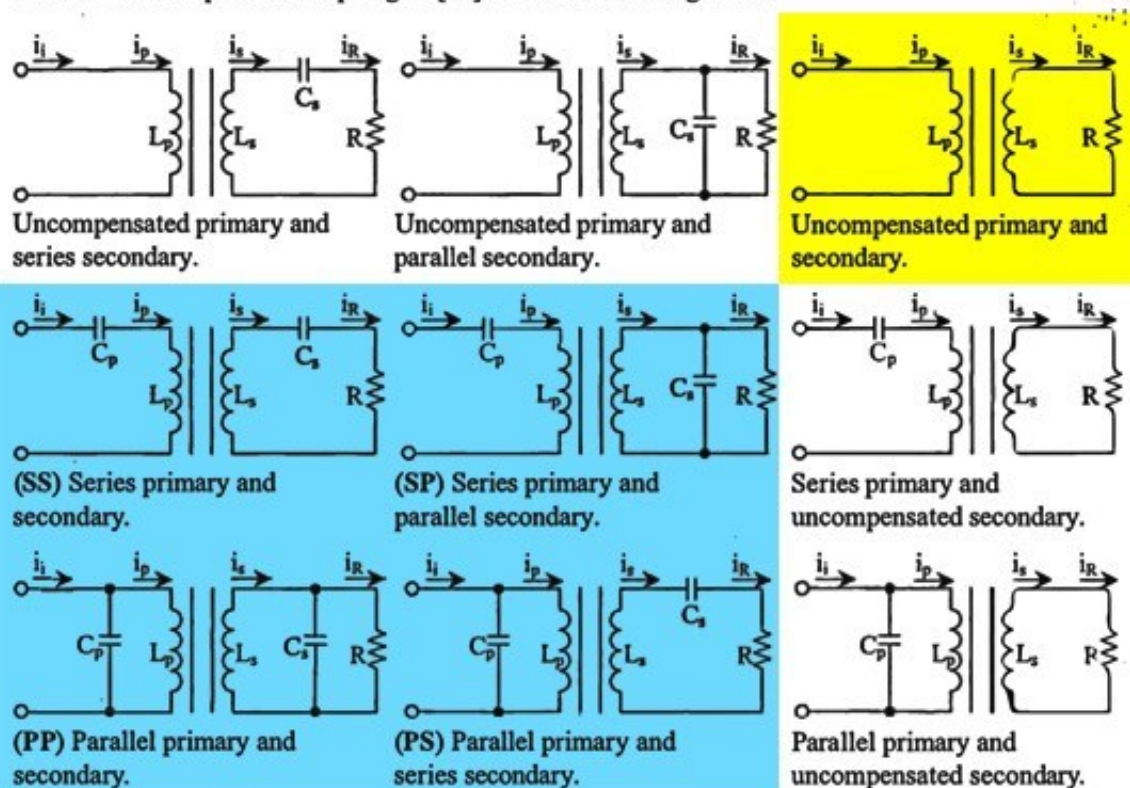


Fig. 2-12. Basic compensation topologies of ICPT systems.

Ex. 1008 (Wang) at 24

POSA Would Have Reasonable Expectation Of Success

Wang

3-2 OVERVIEW OF THE LOAD MODEL

In an ICPT system, the primary and secondary can be either series or parallel compensated or remain un-compensated. This results in nine basic topologies. To simplify the discussion, this thesis only focuses on the analysis and design of the four topologies with both primary and secondary compensations as this reflects the majority of such systems in the medium-high power range. In practice, topologies without primary and/or secondary compensations can be analysed using a similar approach.

Ex. 1008 (Wang) at 47-48

Wang Is Compatible With Odachi's Movable Cores

Wang

2-2 ELECTROMAGNETIC STRUCTURES

Similar to electromagnetic components such as inductors, transformers and induction motors, the electromagnetic structure of an ICPT system is constructed using magnetic cores surrounded by conductor windings. Magnetic cores concentrate the flux, while conductor windings conduct the

* * *

2-2.2 GEOMETRY

In a traditional transformer, the primary and secondary are fixed on a common core for tight coupling. However, the secondary in many ICPT systems is allowed to move freely relative to the primary, and as such the magnetic cores of the primary and secondary need to be separated. The

Ex. 1008 (Wang) at 11, 13

Prosecution History: No Dispute Capacitor Increases Efficiency

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the invention disclosed by KUKI with that of PARTOVI by adopting the inductive element with capacitor structure for primary antenna for the benefit of increasing the efficiency of the energy transfer.

Ex. 1002 ('654 File History) at 118

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the invention disclosed by SCHWIND with that of PARTOVI by adopting the inductive element with capacitor structure for receiver antenna for the benefit of increasing the efficiency of the energy transfer.

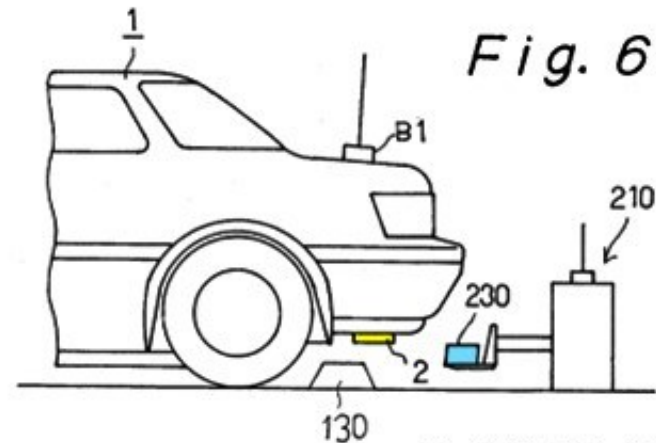
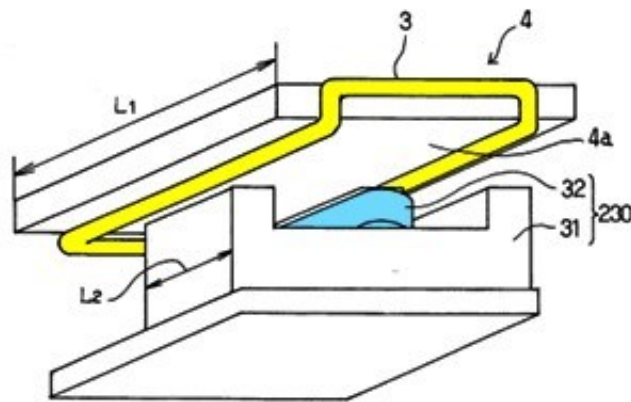
Ex. 1002 ('654 File History) at 121

PO's No Air Gap Argument Is Wrong

Patent Owner's Sur-Reply

Id. 38. Therefore, adding a capacitor may allow for greater efficiency and higher power *as compared to air gap systems without capacitance*, but Petitioner cites no evidence that the same benefit would result in Odachi, where there is no air gap between the couplers during charging. See Horenstein Supp. ¶¶ 74-75. Petitioner's POSR at 15-16

Odachi



Ex. 1005 (Odachi) at Fig. 12 & 6

Undisputed POSA Would Be Motivated To Make Odachi Non-Contact

Hu

Freedom of mechanical movement. Because of the loose coupling between the primary and secondary of an IPT system, the pick-up can move along the track loop while allowing for some lateral displacement from the track centre. This is one of the most outstanding characteristics of IPT and differentiates it from traditional transformers. This freedom makes it possible to deliver power to movable equipment without direct electrical contact.

* * *

Environmentally friendly. Because IPT has two independently enclosed parts, its operation is not affected by dirt, dust, water, or chemicals. Therefore, it can work in very harsh environments.

* * *

Reliable and robust. There is no direct friction in an IPT system so that mechanical wear & tear, and electrical erosion are eliminated. In addition, chemical erosion of the conductors is essentially

Ex. 1020 (Hu) at 6

Lee

In inductive power transfer system, electrical power is transferred from a primary winding in the form of a coil or track, to one or more isolated pick-up coils that may be relative to the primary. The ability to transmit power without contact enables high reliability and easy maintenance that allows inductive power transfer system to be implemented in hostile environments. This technology has found application in many fields such as electric vehicles, PRT(Personal Rapid Transit) etc.

Ex. 1021 (Lee) at 839

The '654 Patent

Claim Construction – “[transmitting/receiving] antenna”

Ground 1a: Odachi Invalidates Cls. 13 and 15

Ground 1b: Odachi and Wang invalidate Cls. 1, 7, and 18

Motivation To Combine

Claim 7

Claim 18

Ground 1c: Odachi, Wang and Partovi Cls. 4-6

Ground 2: Ross and Wang Invalidate Cls. 8-10, 12-14, 16, and 19

Odachi Teaches Transmitting Power To A Remote Receive Antenna

7. The transmitter system of claim 1, wherein said charging control system configured to generate a signal of a type that, when output to said transmitting antenna, transmits power to a remote receiving antenna.

Ex. 1001 ('654 Patent) at Claim 7

Patent Owner's Response

the claimed "remote receiving antenna." As explained in Odachi, the cores of the primary and secondary coils must touch each other (i.e., "abut") to form the magnetic circuit for field coupling. A POSA would not have considered something that physically touches another to be "remote." *See id.* Rather, the primary and secondary cores in Odachi would best be characterized as being "contiguous."

POR at 45

Odachi

As the carriage 9 is being moved rightward, the spaced distance between the primary inductive coupler 6 and the secondary inductive receptacle 2 is reduced gradually and electromagnetic induction occurs between the coupler and the receptacle when the former coupler comes close to the latter receptacle. As a result, an electromotive force is induced in the secondary coil 4 and this induced force is increased with a decrease in the spaced distance. It is noted

Ex. 1005 (Odachi) at 6:1-7

Odachi Teaches Transmitting Power To A Remote Receive Antenna

Dr. Horenstein Deposition

Q. Okay. And at some point during that right-to-left sweep, Odachi's primary coil will induce a voltage in the secondary coil, right?

A. That's right.

Q. And at that time, there will be a distance between the primary coupler and the secondary coupler, right?

A. Distance in what direction?

Q. There will be a distance at least in the Z direction, correct?

A. Well, by "Z direction," you mean perpendicular to the page?

Q. Correct. The distance from the underside of the car to the ground.

A. There will be a space between the primary coupler and the secondary coupler.

Ex. 1033 (Horenstein Dep.) at 70:17-71:10

The '654 Patent

Claim Construction – “[transmitting/receiving] antenna”

Ground 1a: Odachi Invalidates Cls. 13 and 15

Ground 1b: Odachi and Wang invalidate Cls. 1, 7, and 18

Motivation To Combine

Claim 7

Claim 18

Ground 1c: Odachi, Wang and Partovi Cls. 4-6

Ground 2: Ross and Wang Invalidate Cls. 8-10, 12-14, 16, and 19

Measurement During “Actual Power Transfer” Is Not Required

18. The apparatus of claim 1, wherein the coupling test comprises a measurement of the amount of power that is transferred to the receiving antenna.

Ex. 1001 ('654 Patent) at Claim 18

Patent Owner's Response

Odachi probes the primary coil only for the purpose of optimum positioning, but it does so with a “check current” only, i.e. a test current. A POSA would have known a test current to be only a fraction of the current that flows during actual power transfer. See Horenstein Supp. ¶¶ 86-87. Hence, Odachi does not disclose measuring “the amount of power that is transferred to the receiving antenna” as part of the coupling test.

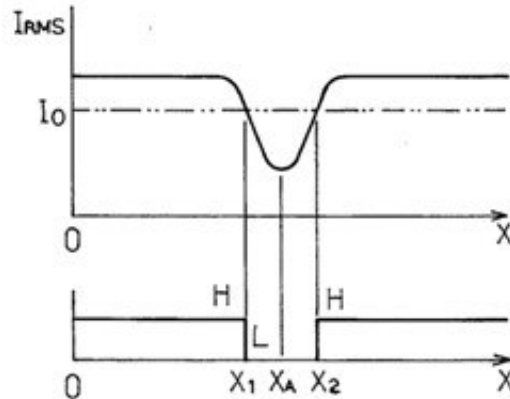
POR 46

Odachi Discloses Claim 18

18. The apparatus of claim 1, wherein the coupling test comprises a measurement of the amount of power that is transferred to the receiving antenna.

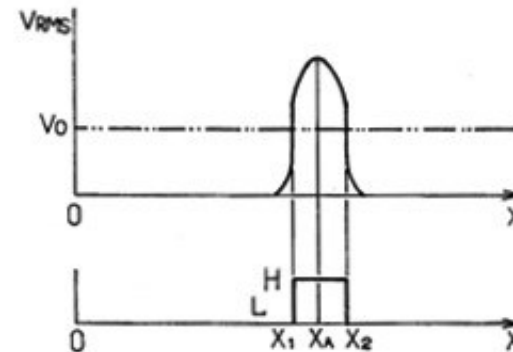
Ex. 1001 ('654 Patent) at Claim 18

Odachi



latter receptacle. As a result, an electromotive force is induced in the secondary coil 4 and this induced force is increased with a decrease in the spaced distance. It is noted that, as the electromotive force due to the electromagnetic induction is increased, the check current I_{RMS} flowing in the primary coil 14 is reduced by the amount corresponding to the current induced in the secondary coil 2, as shown in FIG. 4. Therefore, the value of the current I_{RMS} becomes mini-

Ex. 1005 (Odachi) at Fig. 4, 6:6-13



position X_A is calculated. It is noted, however, that the positions X_1 and X_2 may be determined by monitoring a voltage V_{RMS} which is induced across the secondary coil on the vehicle by application of an AC voltage across the primary coil, as indicated in the diagram of FIG. 5. In such an embodiment, the vehicle has an electric circuit connected to the secondary coil for monitoring the voltage V_{RMS} and another circuit connected to the voltage monitoring circuit for generating discriminating signals H and L depending on

Ex. 1005 (Odachi) at Fig 5, 13:42-48

The '654 Patent

Claim Construction – “[transmitting/receiving] antenna”

Ground 1a: Odachi Invalidates Cls. 13 and 15

Ground 1b: Odachi and Wang invalidate Cls. 1, 7, and 18

Ground 1c: Odachi, Wang and Partovi Cls. 4-6

Ground 2: Ross and Wang Invalidate Cls. 8-10, 12-14, 16, and 19

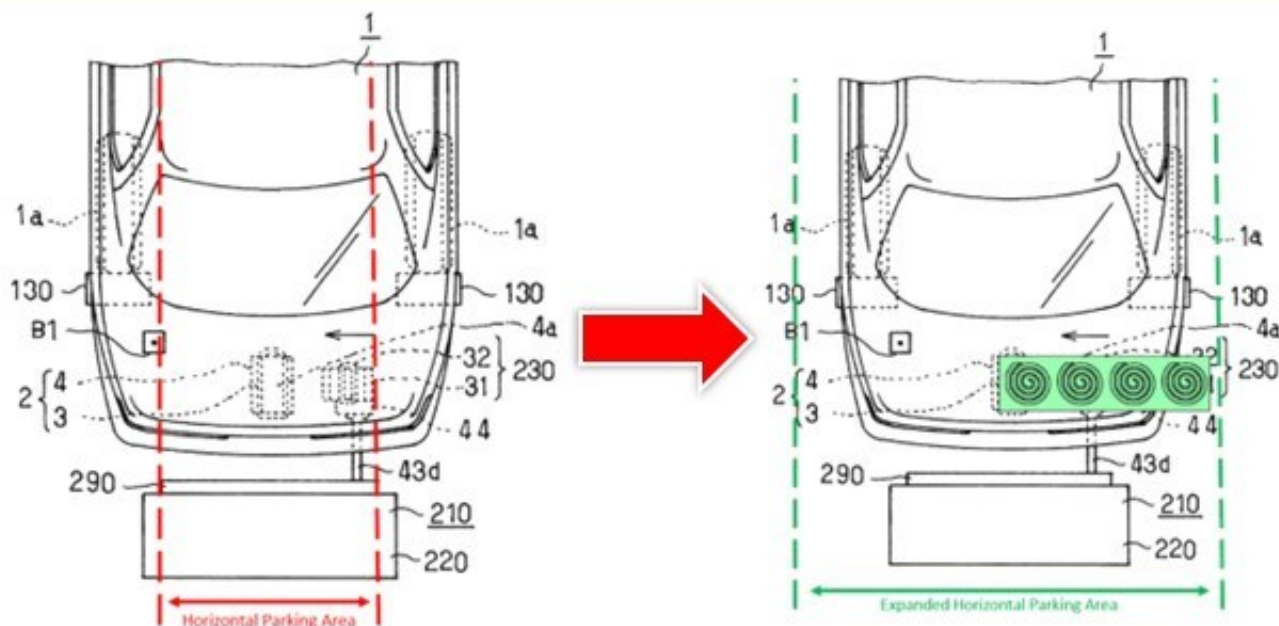
A POSA Would Be Motivated To Expand Odachi's Coil Array

4. The transmitter system of claim 1, wherein said transmitting antenna includes an array of antennas that extend over a specified area of a parking space.

5. The transmitter system of claim 4, wherein said charging control system is further configured to select one of said antennas of said array.

6. The transmitter system of claim 5, further comprising a switching device connected between the charging control system and each of the antennas of the array, the switching device configured to transmit the signal to the selected antenna of the array.

Ex. 1001 ('654 Patent) at Claim 4-6



Ex. 1003 (Declaration of Dr. Mark Allen) at ¶¶183-184

A POSA Would Be Motivated To Expand Odachi's Coil Array

Odachi

ready for the battery charging operation. Because the dimension L1 of the cavity 4a is much greater than the dimension L2 of the primary coil 32 (FIG. 12), as long as the vehicle is parked with its rear wheels 1a in contact with the stops 130, the primary coil 32 can be accommodated safely within the cavity 4a even if the vehicle 1 is parked with a slight error in its longitudinal direction.

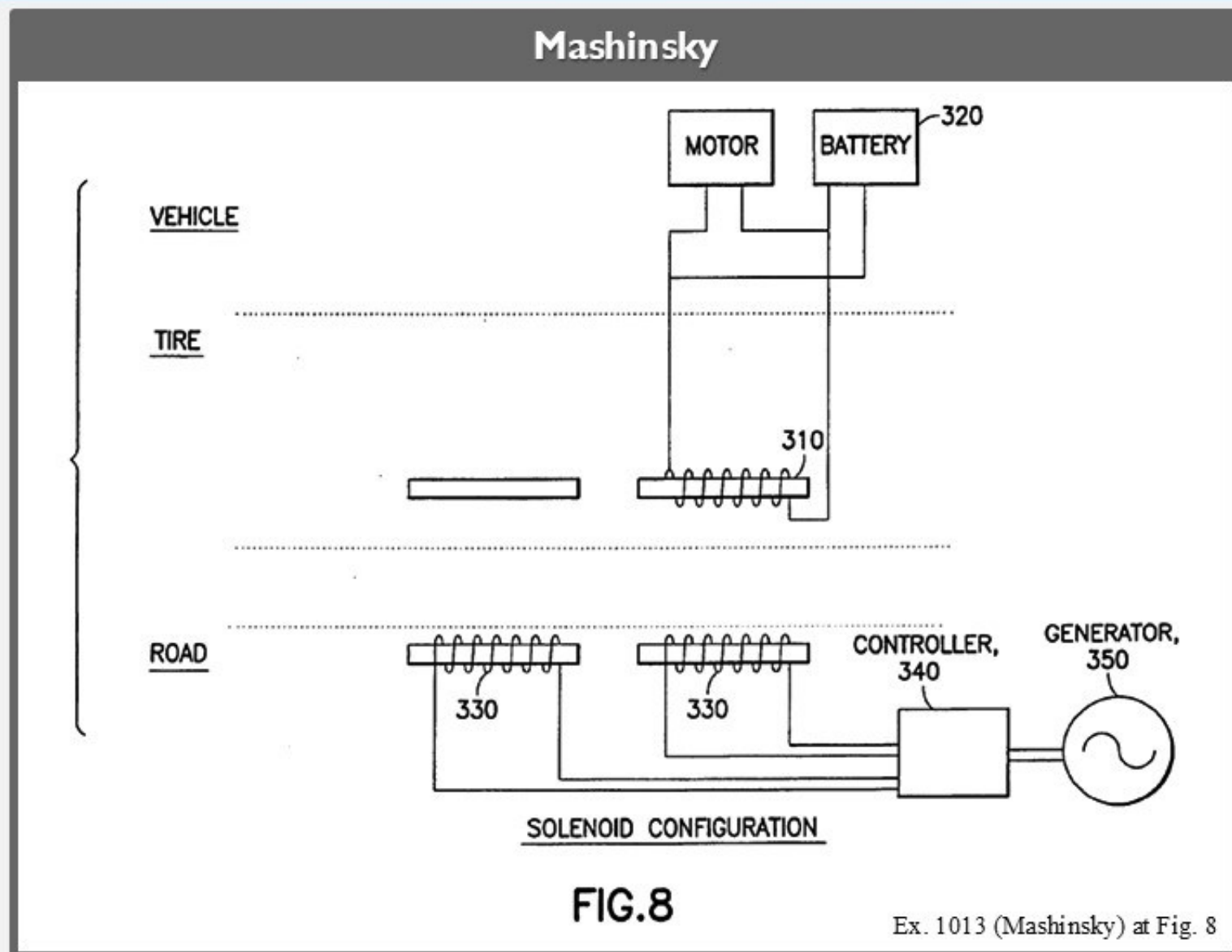
Ex. 1005 (Odachi) at 12:1-7

Partovi

To allow the operation of the mobile device charger regardless of position of the mobile device, the total area of the mobile device charger can be covered by coils or by another wire geometry that creates magnetic field. FIG. 3 shows a charging pad using multiple coils in accordance with an embodiment of the invention. As shown in FIG. 3, the pad 140 is largely covered with individual energizer coils 144.

Ex. 1006 (Partovi) at 8:53-59

Multiple Coil Primaries Were Well Known For Vehicle Charging



Ex. 1013 (Mashinsky) at Fig. 8

PO's Substitution Of Coils Argument Fails

Patent Owner's Response

secondary structures of Odachi into a transformer. In any case, given the depth requirement of Odachi's secondary (and primary as well) and the planar structure of Partovi's pancake coils, a POSA would have found it unfeasible to substitute the "pancake" style coils of Partovi for the E-core primary structure of Odachi:

POR at 50

In re Mouttet

"It is well-established that a determination of obviousness based on teachings from multiple references does not require an actual, physical substitution of elements The test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference."

In re Mouttet, 686 F.3d 1322, 1332 (Fed. Cir. 2012) (quoting *In re Keller*, 642 F.2d 413, 425 (CCPA 1981))

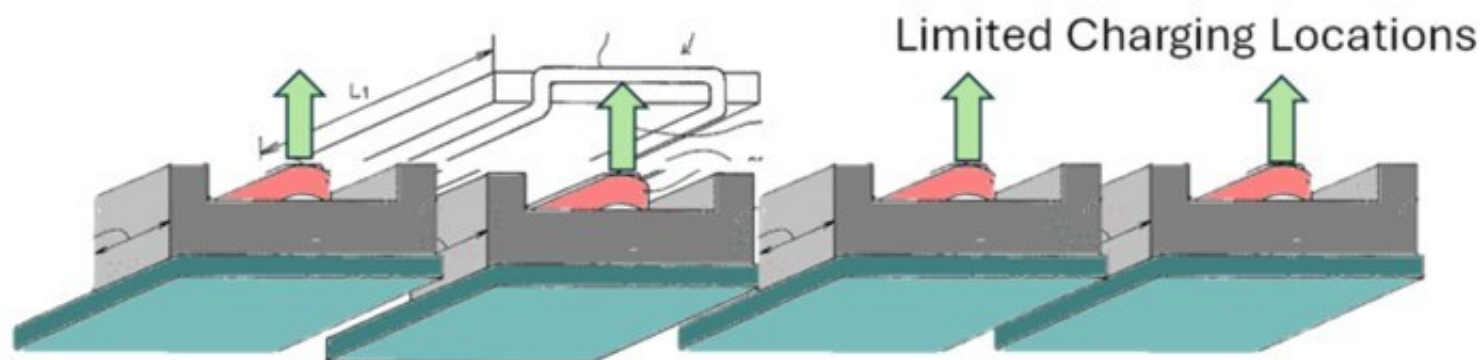
Multiple Odachi Coils Provide Additional Charging Locations

Petition

Although the above annotations show a 1x4 array with the coil shape shown in Partovi, a POSA could and would have implemented Odachi's array with other shapes and sizes, including for example a 4x4 array of coils, or coils sized like Odachi's original coil, for interoperability. Allen Decl. ¶185.

Pet. 44

Patent Owner's Response

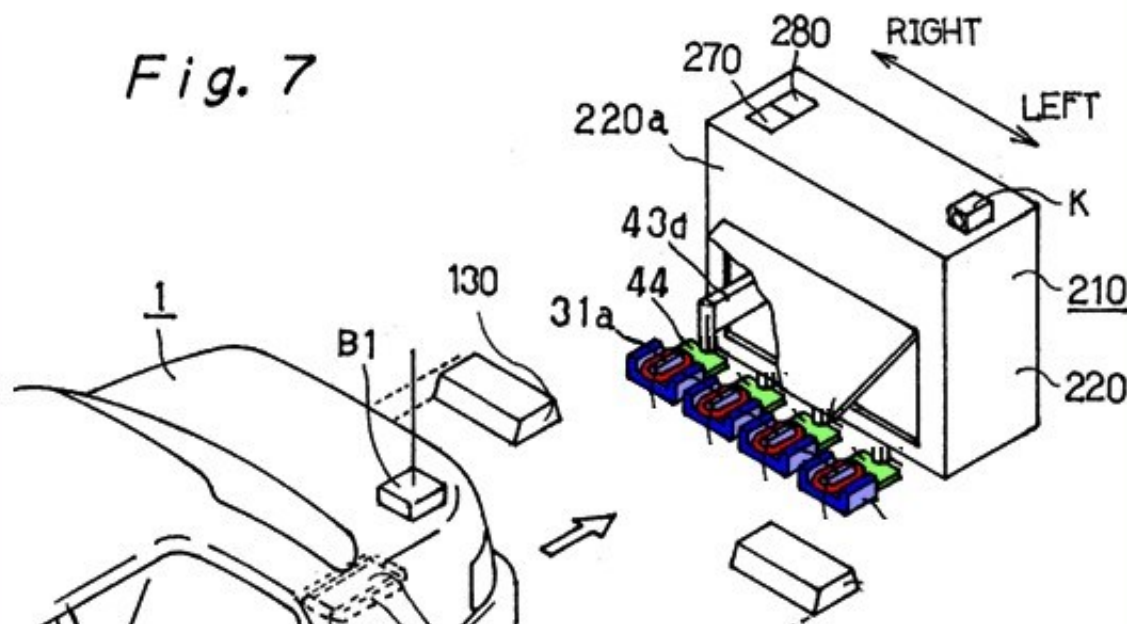


POR 54

PO's Expert Refuted "Not Able To Move" Argument

Dr. Horenstein's Declaration

Fig. 7



Ex. 2010 (Horenstein Supp. Decl.) p. 52

Dr. Horenstein Deposition

Q. So the question is, do you agree that the primary windings that you've shown on Figure 7 on the bottom of page 52 can move relative to the vehicle's secondary coil?

A. In which direction?

Q. Along the x-axis.

A. They can move as an aggregate array along the x-axis.

Ex. 1035 (Horenstein Dep. Tr.) at 102:2-10 (objections omitted)

The '654 Patent

Claim Construction – “[transmitting/receiving] antenna”

Ground 1a: Odachi Invalidates Cls. 13 and 15

Ground 1b: Odachi and Wang invalidate Cls. 1, 7, and 18

Ground 1c: Odachi, Wang and Partovi Cls. 4-6

Ground 2: Ross and Wang Invalidate Cls. 8-10, 12-14, 16, and 19

Motivation To Combine

Petition relies on same embodiment in Ross

Ross taught detecting coupling for alignment

'654 Patent Claims 8-10, 12-14, 16, 19

8. A receiver system for wireless power, comprising:
a receiving antenna coupled to a device, the receiving antenna including a coil and capacitor that are resonant at a first frequency;
a guidance controller configured to guide the receiving antenna of the device to a first alignment position relative to a transmitting antenna that is not physically connected to said device coupled to the receiving antenna;
a lifting device for said receiving antenna configured to lift and lower said receiving antenna; and
an alignment controller configured to sense a degree of coupling of said receiving antenna and the transmitting antenna based on a detection of the coupling that is measured at the receiving antenna, the alignment controller being further configured to move said receiving antenna from the first alignment position to a second alignment position to better align the receiving antenna with the transmitting antenna.

9. The receiver system of claim 8, further comprising an x-y alignment control configured to automatically align said receiving antenna to better align the receiving antenna with the transmitting antenna by moving said receiving antenna in x and y directions based on a degree of coupling between the receiving antenna and the transmitting antenna.

10. The receiver system of claim 8, further comprising circuitry that receives a magnetically induced signal from said receiving antenna and produces power therefrom.

12. The receiver system of claim 8, wherein said receiving antenna and said lifting device are part of a battery operated vehicle.

13. A method, comprising:
guiding a receiving antenna of a vehicle to a first alignment position relative to a transmitting antenna;
responsive to detecting a degree of coupling in the first alignment position between the receiving antenna and the transmitting antenna that is measured at the receiving antenna, moving one of the receiving antenna and the transmitting antenna from the first alignment position to a second alignment position to improve alignment of the receiving antenna with the transmitting antenna and improve the degree of coupling.

14. The method of claim 13, wherein moving one of the receiving antenna and the transmitting antenna comprises moving the receiving antenna laterally relative to the transmitting antenna.

16. The method of claim 13, wherein moving one of the receiving antenna and the transmitting antenna comprises moving the receiving antenna along an axis that is perpendicular to one of a transmitting antenna coil and a receiving antenna coil.

19. The apparatus of claim 8, wherein the sensed degree of coupling comprises a measurement of the amount of power that is transferred to the receiving antenna.

Wang's Compensation Capacitors Would Improve Efficiency

Wang

2-3 COMPENSATION

Both the primary and secondary of the electromagnetic structure are often compensated by capacitors to boost the power transfer capability of the pickup, while minimizing the VA rating of the power supply. This section introduces the basic compensation topologies. The compensation level and the resonant behaviour of the primary and secondary resonant circuits are quantified for each topology.

* * *

2-3.2 SECONDARY RESONANCE

Both series and parallel secondary compensation improve the power transfer capability of the pickup, but present very different characteristics to the load. The circuit equation of the series-compensated pickup (Fig. 2-7) is:

* * *

Secondary compensation is required for boosting power transfer capability, while primary compensation is introduced to minimize the VA rating of the power supply.

Ex. 1008 (Wang) at 20, 21, 28

Wang and Ross Have Compatible Frequencies

Ross-470

When inductive coupling is used to transfer power from the embedded roadway coupling elements (coils) to the EV, the preferred coupling frequency of the ac current is in the 1–10 KHz range (typically around 2–3 KHz). The use of

Ex. 1007 (Ross-470) at 5:40-43

Wang

In ICPT systems, the coupling strength of the electromagnetic structure is normally weak and cannot deliver the required power with reasonable size and cost at the line frequency of 50/60 Hz. It is often necessary to increase the frequency to between several kHz and many MHz, depending on the application requirements.

Ex. 1008 (Wang) pg. 38

PO's "Efficiency" Argument Misreads Ross

Ross-470

Additionally, a high operating efficiency is advantageously achieved when an EMB is used as the energy storage element. For example, in an EMB, the entire generator/motor assembly is ironless. Hence, there are low standby losses (no hysteresis effects). In combination with the frictionless magnetic bearings and windless evacuated chamber wherein the rotor spins, this means that the overall efficiency of EMB exceeds 90%, and may be as high as 95% or 96%. Such high efficiencies result in significantly reduced operating costs of the EV.

Ex. 1007 (Ross-470) at 5:30-38

Wang's Compensation Capacitors Should Be Used At 1-10 KHz Frequency

Wang

In ICPT systems, the coupling strength of the electromagnetic structure is normally weak and cannot deliver the required power with reasonable size and cost at the line frequency of 50/60 Hz. It is often necessary to increase the frequency to between several kHz and many MHz, depending on the application requirements.

The increased reactance of the primary and secondary windings that arises from these increases in the operating frequency often must be compensated by capacitors connected in series or parallel. Secondary compensation is required for boosting power transfer capability, while primary compensation is introduced to minimize the VA rating of the power supply.

Ex. 1008 (Wang) at 38

ICPT At 1-10 KHz Is Safe And Reliable

Wang

Potential applications of ICPT systems are unlimited. Present applications include material handling, public transport and battery charging. ICPT systems are free of sparking, wear, tear and hazard. They are immune to dirt, moisture, water, snow, ice, and can be used in potentially explosive atmospheres. They are also safe, quiet and highly reliable. This low maintenance requirement improves productivity.

More than a hundred years ago, alternating current at approximately 1-2 kHz was proposed by Hutin and Leblanc [3] to supply power from a track to a railway vehicle across an air gap. Multiple secondary coils with independent circuit breakers were used for regulation of the power transferred to the motor.

In 1974, an ICPT system was suggested by Otto [4] to supply power to a moving vehicle. The suggested operating frequency was 4-10 kHz.

In 1994, Boys and Green suggested an ICPT system operating at 10 kHz for electric vehicles [5-6].

Ex. 1008 (Wang) at 1

The '654 Patent

Claim Construction – “[transmitting/receiving] antenna”

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Ground 1c: Odachi, Wang and Partovi Cls. 4-6

Ground 2: Ross and Wang Invalidate Cls. 8-10, 12-14, 16, and 19

Motivation To Combine

Petition relies on same embodiment in Ross

Ross taught detecting coupling for alignment

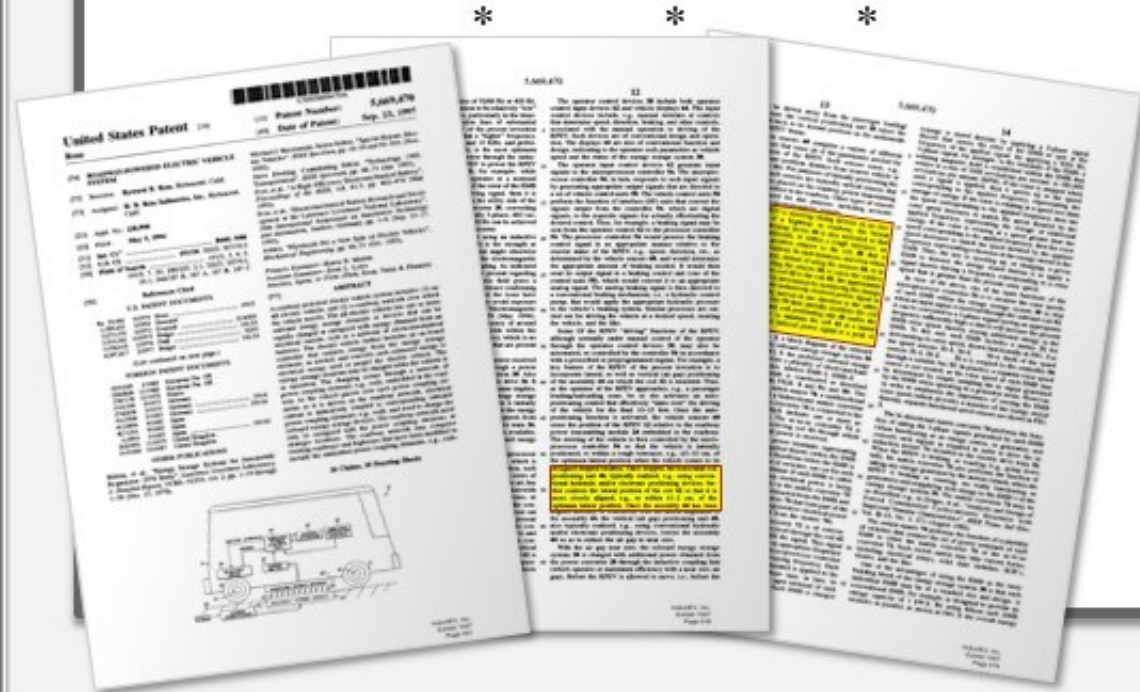
PO's Mixing Embodiments Argument Fails

Ross-470

designed stopped location. Once stopped, the horizontal coil positioning unit 46, typically realized, e.g., using conventional hydraulic and/or electronic positioning devices, further controls the lateral position of the coil 42 so that it is more closely aligned, e.g., to within $\pm 1-2$ cm, of the optimum lateral position. Once the assembly 44 has been

When the RPEV is traveling (being driven) on an electrified portion of a highway or roadway, the lateral (horizontal) positioning device 46 is also activated so that the coil 42 can maintain, to within a rough tolerance, an optimum lateral position relative to the coil 40 that is embedded in the roadway. In such instances, and even when the vehicle is stopped, instead of using the sensors 60, or in combination with using the sensors 60, to sense the relative lateral location of the coil 42 to the coil 40, the approximate lateral position may be determined by monitoring the change in the amplitude of the inductively received power signal as the coil 42 is laterally moved in one direction or the other. The processor controller 56 then laterally positions the coil 42, using the horizontal coil positioning unit 46 and/or the steering of the RPEV, to maintain the coil 42 at a lateral position that keeps the induced power signal at a peak or maximum level.

Ex. 1007 (Ross-470) at 12:52-57; 13:20-31



The '654 Patent

Claim Construction – “[transmitting/receiving] antenna”

Ground 1a: Odachi Invalidates Cls. 13 and 15

Ground 1b: Odachi and Wang invalidate Cls. 1, 7, and 18

Ground 1c: Odachi, Wang and Partovi Cls. 4-6

Ground 2: Ross and Wang Invalidate Cls. 8-10, 12-14, 16, and 19

Motivation To Combine

Petition relies on same embodiment in Ross

Ross taught detecting coupling for alignment

Ross Detects Coupling At A First And Second Alignment Position

Ross-470

When the RPEV is traveling (being driven) on an electrified portion of a highway or roadway, the lateral (horizontal) positioning device 46 is also activated so that the coil 42 can maintain, to within a rough tolerance, an optimum lateral position relative to the coil 40 that is embedded in the roadway. In such instances, and even when the vehicle is stopped, instead of using the sensors 60, or in combination with using the sensors 60, to sense the relative lateral location of the coil 42 to the coil 40, the approximate lateral position may be determined by monitoring the change in the amplitude of the inductively received power signal as the coil 42 is laterally moved in one direction or the other. The processor controller 56 then laterally positions the coil 42, using the horizontal coil positioning unit 46 and/or the steering of the RPEV, to maintain the coil 42 at a lateral position that keeps the induced power signal at a peak or maximum level.

Ex. 1007 (Ross-470) at 13:20-31

CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. § 42.6(e), I certify that on this 3rd day of March, 2025, a true and correct copy of the foregoing **Petitioner's Demonstratives** was served by electronic mail on Patent Owner's lead and backup counsel at the following email addresses:

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