

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

INDUCTEV, INC.
Petitioner,

v.

WITRICITY CORPORATION,
Patent Owner.

Case IPR2024-00140
Patent 8,466,654

PATENT OWNER'S RESPONSE

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EXHIBIT LIST

- Ex. 2001 Declaration of Dr. Mark N. Horenstein
- Ex. 2002 CV of Dr. Mark N. Horenstein
- Ex. 2003 Wiley Electrical and Electronics Engineering Dictionary Excerpts
- Ex. 2004 McGraw-Hill Dictionary of Scientific and Technical Terms Excerpts
- Ex. 2005 Second Declaration of Dr. Mark N. Horenstein
- Ex. 2006 Excerpts from Wiley Electrical and Electronics Engineering Dictionary, IEEE Press, 2004 – Part 2
- Ex. 2007 S. S. Lau, “Practical Design of 13.56MHz Near Field Communication (NFC) and Radio Frequency Identification (RFID) Antenna using Ferrite Sheet on Metallic Surface by Network Analyzer”, *Proceedings of the 2015 IEEE IEEM*. (“Lau”)
- Ex. 2008 X. Chen, Y. Lieu, W. Lu, and Y. Dong, Optimal Simulation Study for Wireless Charging Coils with Magnetizers, DOI 1109/PEDG Conference, Aug, 2019. (“Chen”)
- Ex. 2009 W. Lee et al, " A Simple Wireless Power Charging Antenna System: Evaluation of Ferrite Sheet", *IEEE Transactions on Magnetics*, 53(7) July 2017. (“Lee”)
- Ex. 2010 Supplemental Declaration of Dr. Mark N. Horenstein
- Ex. 2011 September 11, 2024 Transcript of Dr. Mark Allen, PH.D. Deposition
- Ex. 2012 Additional Wiley Dictionary Definitions

I. INTRODUCTION

The invalidity grounds raised by Petitioner fail because Petitioner (1) fundamentally mistakes the traditional transformer structure of the cited Odachi reference (Ex. 1005) for the transmitting and receiving “antennas” recited in the challenged claims, (2) fails to explain why a person of ordinary skill in the art (“POSA”) would have combined Wang (Ex. 1008) or Partovi (Ex. 1006) with Odachi, and (3) fails to show that Ross (Ex. 1007) discloses moving a receiving antenna to a second alignment position in response to a degree of coupling detected at a first alignment position. Odachi utilizes primary and secondary windings wrapped around an E-shaped core to form a traditional transformer that generates a voltage at the secondary winding based on the magnetic flux contained in the core. By contrast, the challenged claims use antennas having a primary coil that produces a near-field component of flux into free space that is intercepted by a second coil to effect wireless power transfer through resonant inductive coupling. Because one skilled in the art would understand the fundamental difference between a transformer and an antenna, Petitioner has failed to show that Grounds 1a-1c present a reasonable likelihood that Petitioner will prevail with respect to at least one claim.

Moreover, Petitioner argues that it would have been obvious to combine a compensating capacitor from Wang with the transformer structure of Odachi to

improve power transfer. But Wang explains that compensating capacitors are beneficial in inductive coupling systems where the primary and secondary devices are not in contact, which is not the case in Odachi. Petitioner further argues that it would have been obvious to combine an array of coils from Partovi with Odachi in order to expand the horizontal range of Odachi. But Odachi explains that it already accomplishes this by using a positioning system that allows for precise positioning regardless of where the vehicle is parked.

Ross, which shares an overlapping disclosure with prior art that was already considered by the Examiner, fails to disclose detecting a degree of coupling between a receiving antenna and a transmitting antenna at a first alignment position, and then moving the receiving antenna or transmitting antenna to a second alignment position to improve the degree of coupling in response to the degree of coupling detected at the first alignment position, as recited in claims 8 and 13. The portion of Ross cited by Petitioner uses optical position sensors to auto-steer a vehicle into a first position in a loading/unloading zone, and uses conventional electronic positioning devices for finer alignment into a designed stop position. But the finer alignment is not “responsive to” a degree of coupling in the first position. Therefore, Petitioner’s challenge should be rejected.

II. OVERVIEW OF THE '654 PATENT

A. The '654 Patent

On June 18, 2013, the '654 Patent, titled "Wireless High Power Transfer Under Regulatory Constraints," was duly and lawfully issued by the United States Patent and Trademark Office. The '654 Patent claims priority to Provisional Application No. 61/078,812, filed on July 8, 2008. WiTricity is the owner of the '654 Patent by assignment. The '654 Patent discloses and claims resonant inductive coupling systems and methods for an improved battery charging system for electric vehicles by, among other things, using transmitting and receiving antennas, a charging control system, and an alignment controller to further align the electric vehicle based on the degree of coupling between the transmitting and receiving antennas. Of the challenged claims, claims 1, 8, and 13 are independent. Independent claim 13 of the '654 Patent is reproduced below:

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.

B. Relevant Prosecution History

During prosecution of the '654 Patent, the Examiner considered and cited prior art containing the same disclosure that Petitioner now relies on in Ground 2 of the Petition. More specifically, in a March 16, 2012 Office Action, the Examiner cited U.S. Patent No. 5,573,090 to Ross (Ex. 1011; "Ross-090") for allegedly disclosing "a guidance control, which automatically provides guidance information for guiding a vehicle to a location where said receiving antenna is better aligned with a transmitting primary antenna," which was recited in original dependent claims 17 and 23. Ex. 1002 at 124. Ross-090 names the same inventor as, and contains overlapping disclosures with, U.S. Patent No. 5,669,470 (Ex. 1007; "Ross") that Petitioner now relies on to allege that claims 8-10, 12-14, 16, and 19 are invalid.

In response to the March 16, 2012 Office Action, Applicant amended independent claims 1, 15, and 27 to recite adjusting the positioning of the transmitting antenna (claim 1), receiving antenna (claim 15), or either the transmitting or receiver antenna (claim 27) based on a measurement indicative of the coupling between the transmitting and receiving antennas, as measured at the receiving antenna. Ex. 1002 at 139-142. Applicant specifically argued that Ross-090 does *not* teach or suggest detecting coupling of the receiving antenna to the transmitting antenna "based on a measurement indicative of the coupling that is

measured at the receiving antenna” and adjusting the position “from the first alignment position to a second alignment position having a finer alignment.” Ex. 1002 at 144-145.

In the next Office Action, the Examiner agreed that Ross-090 does not disclose this feature, but relied on a different reference (U.S. Patent No. 5,821,731 to Kuki et al.) for allegedly disclosing this feature. Ex. 1002 at 155-156. Applicant was able to overcome the rejection by arguing that none of the cited references (including Ross-090) disclose or suggest detecting the degree of coupling in the first alignment position, and adjusting the x-y alignment of the transmitting antenna (or receiving antenna, as recited in issued claim 13) to a second position based on the degree of coupling in order to improve the coupling. Ex. 1002 at 177-180, 212.

In the Petition, Petitioner relies on a portion of Ross disclosing that “the vehicle coil can be ‘laterally moved in one direction or the other’ while ‘monitoring the change in the amplitude of the inductively receiving power signal’ at the vehicle coil.” Pet. at 49 (quoting Ex. 1007 at 13:15-32). But the relied upon portion of Ross is also included in Ross-090, which the Examiner found did not disclose this feature. *Compare* Ex. 1011 at 14:49-65 *with* Ex. 1007 at 13:15-31. As discussed further below, the Examiner correctly determined that the portion of Ross relied upon by Petitioner does not disclose or suggest the claimed feature of

“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,” as recited in claim 13.

III. SUMMARY OF ALLEGED GROUNDS OF UNPATENTABILITY

Petitioner does not challenge claims 2, 3, 11, and 17 of the '654 Patent.

Petitioner asserts that the challenged claims would have been unpatentable on the following grounds:

Claims Challenged	Statutory Basis	Cited References
13 and 15 (Ground 1a)	§102	Odachi ¹
1, 7, and 18 (Ground 1b)	§103	Odachi and Wang ²
4-6 (Ground 1c)	§103	Odachi, Wang, and Partovi ³
8-10, 12-14, 16, and 19 (Ground 2)	§103	Ross ⁴ , alone or with Wang

¹ Ex. 1005.

² Ex. 1008.

³ Ex. 1006.

⁴ Ex. 1007.

Petitioner also supports its challenge with a Declaration of Professor Allen. Ex. 1003.

IV. CLAIM CONSTRUCTION

All claim terms in this proceeding are to be construed according to the *Phillips* standard. *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005); 37 C.F.R. §42.100. Petitioner failed to propose any claim construction for any claim terms in the ‘654 Patent, but in its Preliminary Reply proposes that “transmitting antenna” and “receiving antenna” should be respectively construed to mean “an antenna that transmits energy” and “an antenna that receives energy.” Prelim. Reply at 1. Patent Owner previously proposed that “transmitting antenna” should be construed to mean “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,” and “receiving antenna” should be construed to mean “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.” Prel. Resp. at 10 (quoting Ex. 2001 ¶ 26). For purposes of its institution decision only, the Board adopted Petitioner’s proposed constructions of “an antenna that transmits energy” and “an antenna that receives energy.” Inst. Dec. at 11. However, the Board also preliminarily adopted Patent Owner’s proposed IEEE definition of “antenna” as “a device that radiates and/or receives radio waves.” *Id.* at 10.

Patent Owner respectfully submits that the terms “transmitting antenna” and “receiving antenna” should be construed in a way that further defines the term “antenna” because the definition of “antenna” is relevant to Petitioner’s argument that the transformer of Odachi constitutes an “antenna.” Therefore, Patent Owner proposes that “transmitting antenna” should be construed to mean “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,” and “receiving antenna” should be construed to mean “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.” Patent Owner’s proposed construction is consistent with the ’654 patent specification and the well-understood meaning of the term “antenna.”

For example, the ’654 patent specification explains that an antenna “couples energy from a primary structure (a transmitter) to a distal positioned secondary structure (a receiver) via a magnetic field.” Col. 1:15-20. The specification further explains that a transmitter 104 and a receiver 108 are separate by a distance 112, but that the transmitter 104 generates a radiated field 106 to transfer energy to the receiver 108. Col. 2:10-25, Fig. 1. The transmission losses are minimal when the receiver 108 is “located in the ‘near-field’ of the radiated field 106.” Col. 2:22-25. The ’654 patent explains that energy from the transmitting antenna is generated in

the near field and the far field, but that energy transfer is more efficient in the near field. Col. 2:30-36. The '654 patent specification discusses a certain type of antenna, called a loop antenna. *See e.g.*, Ex. 1001 at Figs. 3-4, 2:59-3:13. Loop antennas are typically formed by a coil of wire. *See id.*; Ex. 2001 (Declaration of 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 specification similarly describes antennas that may be “capacitively loaded wire loops or multi-turn coils.” Ex. 1001 at 1:15-17.

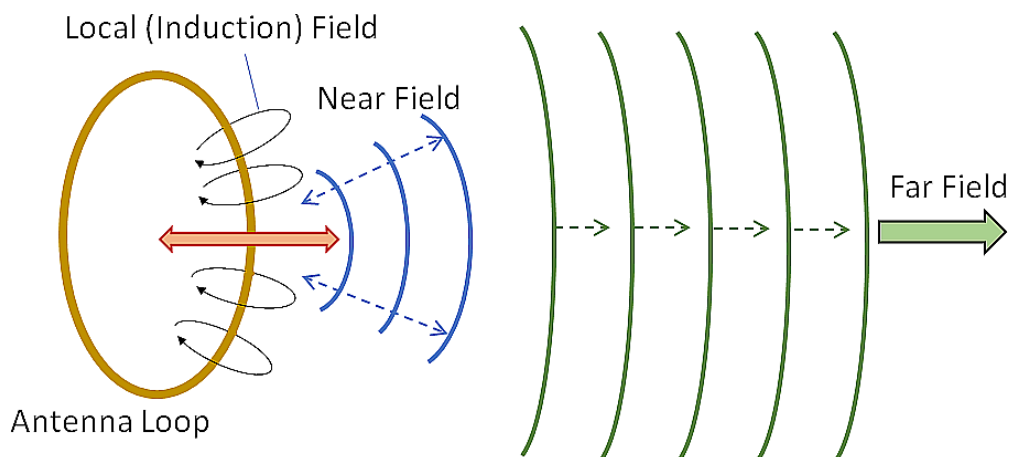
When an AC power source is applied to the primary coil, a magnetic field is generated by the primary coil. The magnetic field lines circulate around the primary coil, and also pass through the secondary coil of the receiving antenna. According to Faraday’s law, the magnetic field passing through the 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.

As referenced in the '654 patent specification, the magnetic field produced by the primary coil includes “near-field” energy, which stays close to the primary coil, and “far-field” energy in the form of radio waves that propagate long distances from

the primary coil. *See* Ex. 1001 at 3:43-48; Horenstein Decl. at ¶¶23-24. As the '654 patent explains, localized wireless power transfer systems couple “a large portion of the energy in the near-field of the transmitting antenna to a receiving antenna rather than propagating most of the energy in an electromagnetic wave to the far field.” Ex. 1001 at 2:31-35; *see also id.* at 3:19-23.

The '654 patent specification's discussion of transmitting and receiving antennas in terms of the near and far fields is consistent with how a POSA understands the term “antenna.” For example, the authoritative IEEE Wiley Electrical and Electronics Engineering dictionary defines an antenna as, “a device that radiates and/or receives radio waves.” *See* Horenstein Decl. at ¶25; Ex. 2006 at 2. As a person of skill would have known, an energized loop antenna produces electromagnetic fields that generally appear over three regions relative to the antenna; these are the *local* or *induction field*⁵, the *near field*, and the *far field*. Horenstein Supp. ¶¶ 37-39. The far field is also known as the “radiation field.” These three regions are depicted in the figure below. *See Id.*

⁵ Sometimes called the “static” or “quasistatic” field. Horenstein Supp. ¶ 37.



These three field regions of the antenna—induction, near field and far field—are defined in detail in the Wiley IEEE Dictionary. *See Horenstein Supp.*

¶ 38. Referring to the diagram above, and moving left to right, these definitions read as follows:

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. *See Ex. 2012 at 3 (emphasis added)*

near-field region

For a transmitting antenna, the electromagnetic field extending no further than a distance of $2D^2/\lambda$ where D is the maximum overall dimension of said antenna, and λ is the wavelength considered. *Beyond this distance, the far-field region begins. See Ex. 2006 at 6 (emphasis added).*

far-field region

The region in which the transmitted energy from an antenna behaves as if it were emanating from a point source in the vicinity of said antenna. Such a region usually begins at a distance of $2D^2/\lambda$ from the antenna, where D is the maximum overall dimension of said antenna, and λ is the wavelength considered. The *region of space closer to the antenna than the far field is the near-field region*. (See *Id.* at 3; emphasis added).

radiation field

For a radiator, such as a transmitting antenna, the portion of the electromagnetic field which is *propagated outward as electromagnetic waves*. This contrasts with the induction field (2), which behaves as if permanently associated with said radiator. See Ex. 2012 at 5 (emphasis added).

The near field and far field, and their relevance to the claimed resonant antennas, are mentioned several times in the '654 patent specification. *See, e.g.*, 2:25, 2:32-3:38, 3:20-22, 4:62.

Based on the '654 patent specification and the well understood definition of “antenna,” one skilled in the art would understand a “transmitting antenna” as used in the wireless power transfer context of the '654 patent to mean “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.” Horenstein Decl. at ¶26. One skilled in the art would similarly understand a “receiving antenna” as used in the wireless power transfer context of the '654 patent means “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.” *Id.*

V. OVERVIEW OF THE PRIOR ART

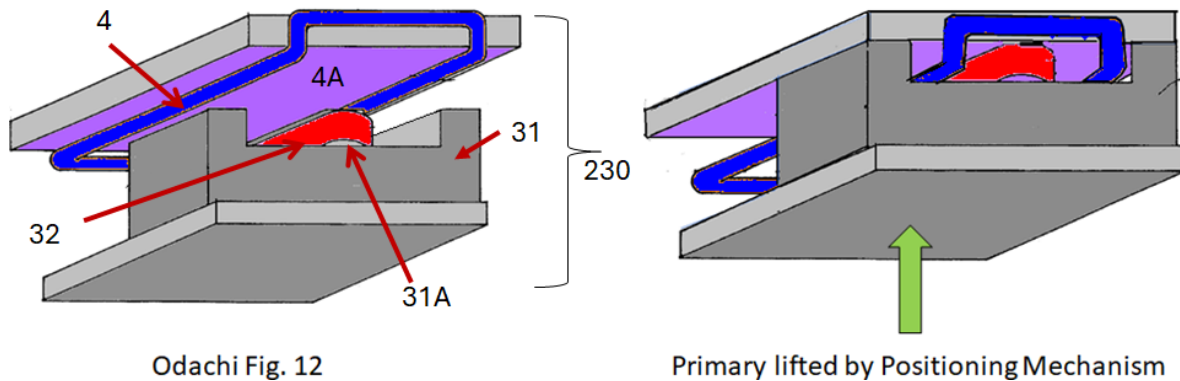
A. Odachi

The focus of Odachi is primarily on a positioning system for charging a battery of an electric vehicle. Odachi discloses a traditional transformer structure in which a primary coil induces a current in a secondary coil by way of a common core. In particular, Odachi includes a primary inductive device 230, which includes a core 31 and a coil 32. Odachi, 8:16-19. As shown in an annotated version of Fig. 12 of Odachi below, the core 31 has an E-shaped cross-section, and the coil 32 is wound around the center projection 31a of the E-shaped primary core 31. A secondary coil 4 is located on the vehicle, and has a cavity 4a that allows the primary coil 32 and the center projection 31a of the primary core 31 to fit within the cavity 4a to “form a magnetic circuit” with both the primary and secondary coils wound around the same core. Odachi, 8:43-48.

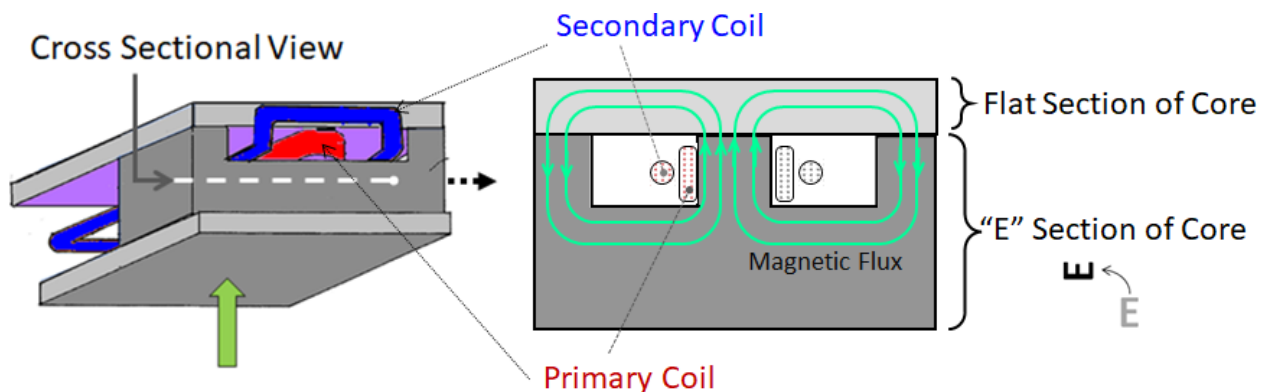
Odachi explains that the vehicle is driven into a garage, which may have a parking stop against which the wheels of the vehicle may abut when the vehicle is in a position for charging. *See e.g.*, 4:6-32, 8:1-28. Once it is determined that the vehicle is authorized to charge its battery, a support arm or carriage is extended from a housing near the parking stop. The primary inductive device, which includes the primary core 31 and the primary coil 32, is affixed to the support arm. A check current I_{RMS} is applied to the primary coil 32, and the support arm is moved laterally

across the front or back of the vehicle. *See e.g.*, 10:64-11:17. As the support arm moves, a controller monitors the check current I_{RMS} , or a check voltage V_{RMS} in the secondary coil. *See e.g.*, 10:64-11:17. The controller determines the position at which the check current I_{RMS} reaches a minimum, or at which the check voltage V_{RMS} reaches a maximum, which indicates maximum coupling between the primary and secondary coil. *See e.g.*, 11:18-32. The controller then moves the support arm to the determined lateral position of maximum coupling, and then activates a z-axis motor to raise the primary inductive device 230 (which includes primary core 31 and primary coil 32) until the primary core 31 is brought into contact with the secondary core 3. *See e.g.*, 9:41-51, 11:33-12:7. After the primary inductive device 230 is in contact with the secondary core of the vehicle, the charging operation is initiated. *See e.g.*, 9:41-51, 11:60-12:13.

The figure below illustrates what happens when the primary (lower) E-core 31 and primary coil 32 (red) of Odachi are lifted up into the secondary coil 4 (blue) and secondary (upper) core 3 by the arm of Odachi's system. Horenstein Supp. ¶¶ 11-12. The entire structure forms a transformer with a completed core that has no air gap. *See id.* The primary coil (red) 32 and secondary coil (blue) 4 both surround the central projection 31a of the primary E-core 31:



The figure below clarifies how the coils and core portions of Odachi come together to form a complete transformer, and how the flux lines circulate around the E-core structure. *See id.* The diagram on the right shows a cross-sectional view through the center of the core. The magnetic flux produced by the primary (green arrows) coil goes through the secondary coil as it circulates around the core structure and generates a current in the secondary coil that is used to charge the battery coupled to the secondary coil. *See id.*



B. Partovi

Partovi is directed to a portable inductive power source, such as a pad, for powering or charging electrical devices. *See Abstract.* The pad (shown in Fig. 1

below) includes multiple primary coils to which an alternating current is applied to create an alternating magnetic field. *See e.g.*, Partovi, col. 4:39-46.

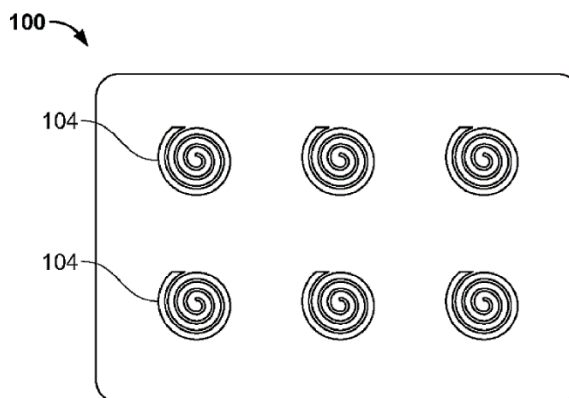


FIG. 1

Partovi, Fig. 1

A receiver includes coils, windings, or any wire that can sense a changing magnetic field, and rectifies it to produce a DC voltage that is used to charge or power the device. *See id.* at col. 4:51-58. By including multiple coils within the pad, multiple devices may be charged, or charging can occur anywhere on the pad. *See id.* at col. 4:49-51.

C. Wang

Wang is generally directed to inductively coupled power transfer (ICPT) systems that “utilize electromagnetic fields to transfer electric power from a stationary primary source to one or more movable loads without contact.” Wang at 1 (emphasis added). The focus of Wang is on resonant power converters, specifically “the design of ICPT systems for high power applications, where both the primary and secondary are compensated. Wang further explains that, “It is

desired to enable increasing air gaps as well as increasing track length and number of pickups, while achieving greater power and better efficiency.” Wang at 4. Wang explains that “[i]n 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.” Wang at 38. According to Wang, “[i]t is often necessary to increase the frequency to between several kHz and many MHz, depending on the application requirements.” *Id.* The increased operating frequency “increase[s] reactance of the primary and secondary windings” that is “compensated by capacitors connected in series or parallel.” *Id.*

D. Ross

Ross is directed to a roadway-powered electric vehicle system that uses a transmitting coil 40 of a roadway power module 24 to transfer energy to a receiving coil 42 located on a vehicle. *See* Ross at col. 9:11-29. Ross explains that as a driver approaches a loading/unloading zone, an auto-positioning feature takes over to automatically steer the vehicle into a position within a rough tolerance of an optimal lateral position. *See id.* at col. 12:40-52. The auto-positioning feature uses vehicle sensors 60 to sense the position of the vehicle relative to the roadway power transmitting module, and typically includes optical sensors that look for markers placed on the roadway power transmitting module 24 embedded in the roadway. *See id.* at col. 12:40-52, 13:5-15.

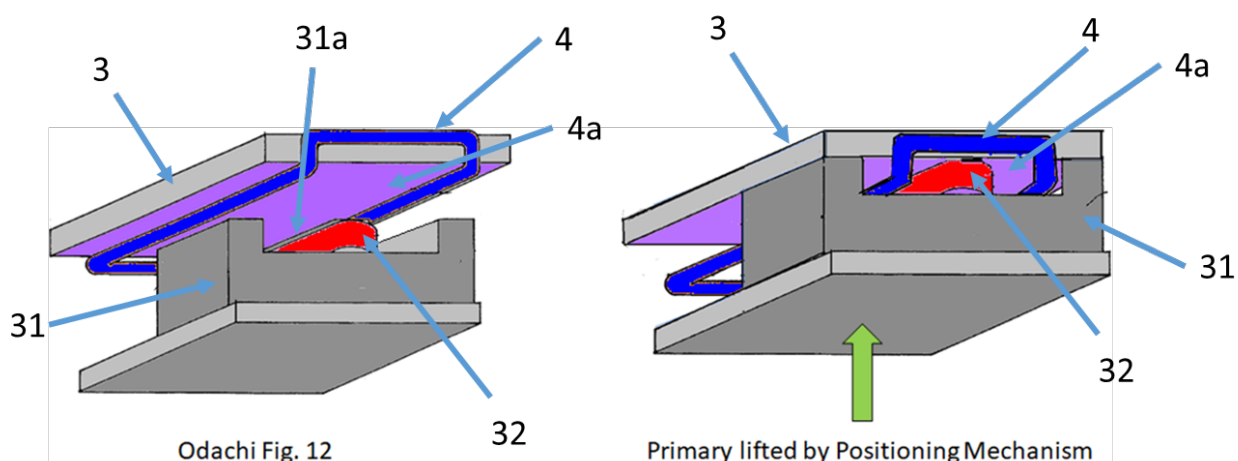
Once the vehicle is stopped within a rough tolerance of the optimal lateral position, a horizontal coil positioning unit 46 further controls the lateral positioning of the coil 42 so it is more closely aligned with the optimal lateral position. *See id.* at col. 12:52-57. Once in the optimal lateral optimal position, a vertical positioning unit 48 lowers the coil 42 toward the coil 40. *See id.* at col. 12:57- 62.

Ross explains that the horizontal coil positioning unit 46 moves the coil 42 to the second position “using conventional hydraulic and/or electronic positioning devices.” *See id.* at col. 12:52-57.

VI. THE PETITION FAILS TO DEMONSTRATE THAT ANY CLAIM OF THE '654 PATENT IS UNPATENTABLE

A. Ground 1a: Odachi Does Not Anticipate Claims 13 (independent) or 15 (dependent on Claim 13) At Least Because Odachi Does Not Disclose a “Transmitting Antenna” or “Receiving Antenna”

Odachi discloses an inductive electric vehicle battery charging system that includes a device for positioning a primary core-coil device relative to a secondary core-coil device. *See* Ex. 1005 at 1:7-13. Odachi discloses a ground battery charger 210 that includes a primary inductive device 230 that includes a core 31 and a coil 32. *See id.* at 8:16-19. The core 31 of the primary inductive device 230 has an E-shaped cross section, and the coil 32 is wound around the center projection 31a (shown in FIG. 7, and annotated FIG. 12 below) of the E-shaped core 31. *See id.* at 8:40-43; Horenstein Supp. ¶¶ 9-12.

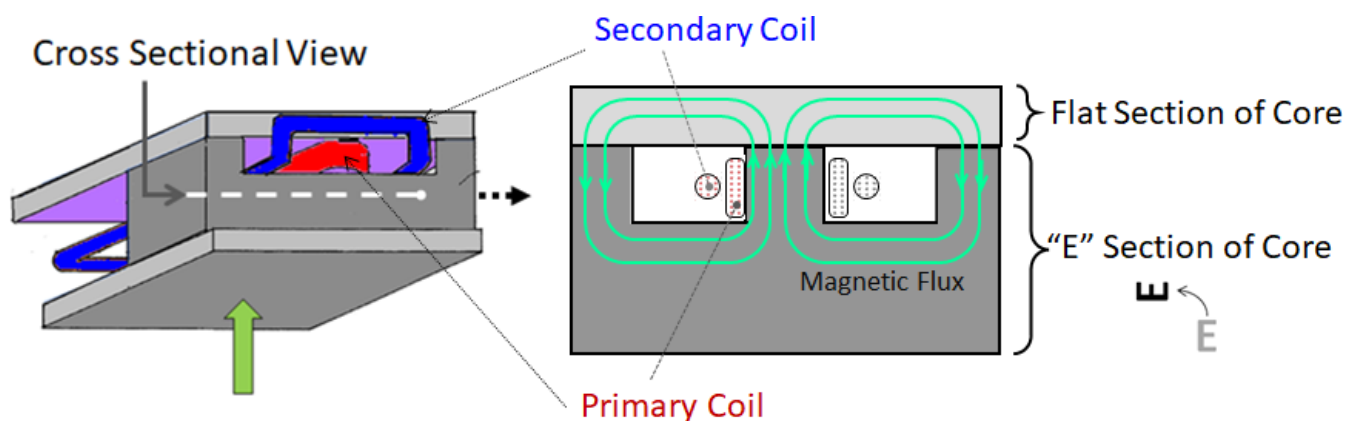


A secondary coil 4 may be located on the vehicle to be charged. The secondary coil has a cavity 4a that is sized so that the primary coil 32 can fit within the cavity 4a when the primary coil 32 engages the secondary core-coil device to “form a magnetic circuit.” *Id.* at 8:43-48. More specifically, once the primary inductive coupler is aligned with the secondary inductive coupler, the primary inductive coupler “is moved upward until the primary core 31 is *brought into contact* with the secondary core 3 and the primary coil 32 [is] placed within the cavity 4a defined by the secondary coil 4.” *Id.* at 9:49-51; *see also id.* at 11:60-12:7. Once the primary core 31 is in contact with the secondary core 3, a charging current is supplied to the primary coil 32, which induces a current in the secondary coil 42. *See id.* at 12:8-19; 7:29-35; Horenstein Supp. ¶¶ 9-12.

The receiving or secondary coil of Odachi is not a “receiving antenna,” as recited in claim 13 of the ’654 patent. As an initial matter, Odachi does not use the word “antenna” even once. But as a substantive matter, Odachi describes a

traditional transformer, not an antenna. As Dr. Horenstein explains, a person of skill in the art would understand that a “transformer” is a device that is utilized to transfer electrical energy from one circuit to another via magnetic or electromagnetic induction. Horenstein Supp. ¶34; Ex. 2006 at 8. A transformer consists of two or more coils of wire **separately wrapped around a magnetic core**, and it has no moving parts. *See* Horenstein Decl. at ¶27; Horenstein Supp. ¶34. Thus, in contrast to inductive coupling via antennas, a transformer achieves inductive coupling by relying on a magnetic core structure, usually made from ferrite composite. The core directs and contains the magnetic flux lines, thus ensuring that nearly all of them reach the secondary winding except for a small amount of leakage flux. *See Id.* In summary, in the field of power transfer, a transformer is a device in which the magnetic flux lines produced by a primary coil are contained within a magnetic core. *See* Horenstein Supp. ¶ 31. The core routes the flux lines from the primary coil through the secondary coil, thereby ensuring that inductive coupling will be localized, and coupling will be at the maximum possible level. No wave propagation is involved in the inductive coupling of the transformer. Rather, inductive coupling in a transformer relies solely on the routing of the magnetic flux which is constrained to remain in the core. *See* Horenstein Supp. ¶31.

As Dr. Horenstein explains, the transformer of Odachi operates in precisely this way. The figure below clarifies how the coils and core portions of Odachi come together to form a complete transformer, and how the flux lines circulate around the E-core structure. *See Horenstein Supp. ¶ 29.* The diagram on the right shows a cross-sectional view through the center of the core. The magnetic flux produced by the primary (green arrows) coil goes through the secondary coil as it circulates around and within the core structure. The magnetic flux lines are not “radio waves” and they are not “radiated” outside the combined primary and secondary cores. Horenstein Supp. ¶ 29



A POSA would have understood the meanings of the terms “antenna” and “transformer” long before the time frame of the ’654 patent. *See Horenstein Supp. ¶ 33.* Transmitting and receiving antennas achieve their coupling without the use of a common magnetic circuit, e.g., shared core material that contains the magnetic field lines. A transformer achieves coupling by way of a solid magnetic core

structure, such as ferrite, that is shared by both coils. This confinement is essential to the transformer coupling of Odachi. *See id.*

A transformer core, which comprises a magnetic circuit, confines and guides lines of magnetic flux produced by the primary coil so that they all can be linked to the secondary coil. Unlike a transformer, the fields from a transmitting antenna are emitted into free space and away from the antenna. *See id.* ¶ 34. The distinction between an antenna and a transformer is best explained by their respective definitions found in the authoritative *Wiley IEEE Electrical and Electronics Engineering Dictionary* (Wiley):

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. *See Ex. 2006 at 2* (emphasis added).

transformer - A component or device which is utilized to transfer electrical energy from one circuit to another via magnetic or **electromagnetic induction**. A transformer has no moving parts and consists of two or more coils of wire separately **wrapped around a magnetic core. The coils are inductively linked by magnetic lines of force**, and do not come into physical contact. (*See Id. at. 8*; emphasis added)

See Horenstein Supp. ¶¶ 34-35. A POSA would similarly have known that a transformer core is a closed magnetic circuit, but an antenna is not:

magnetic circuit - A **closed path** described by magnetic lines of force. A magnetic circuit is analogous to an electric circuit in that the magnetomotive force corresponds to the

electromotive force, reluctance to resistance, and magnetic flux to electric current. Ex. 2006 at 5 (emphasis added).

These definitions show that an antenna operates by field radiation, whereas a transformer operates via field confinement and the linking of coils via a magnetic core. *See Horenstein Supp.* ¶ 36.

In contrast, the terms “near field” and “far field” do *not* appear anywhere in Odachi, because they are completely irrelevant to the transformer structure of Odachi. *See id.* ¶ 40. The near and far fields are relevant only to antenna structures; but they are not even considered when discussing transformers. *See id.* The meaning of the terms “antenna” and “transformer” in electrical engineering would thus have been abundantly clear to a person of skill in the time frame of the ’654 patent. *See id.* Two antennas achieve their coupling without the use of a common magnetic core encircled by both of the coil windings. The field from a transmitting antenna is emitted into the space around the antenna and can either reside in the neighborhood of the antenna (“near field”) or propagate away and detach from the antenna (“far field”). *See id.* The field between two antennas is never an “inductive” field whose field lines are guided by the path of a magnetic circuit in a transformer. *See id.*

Unlike an antenna, a transformer achieves coupling by way of the induction field produced by the primary coil. *See Horenstein Supp.* ¶ 41. These field lines

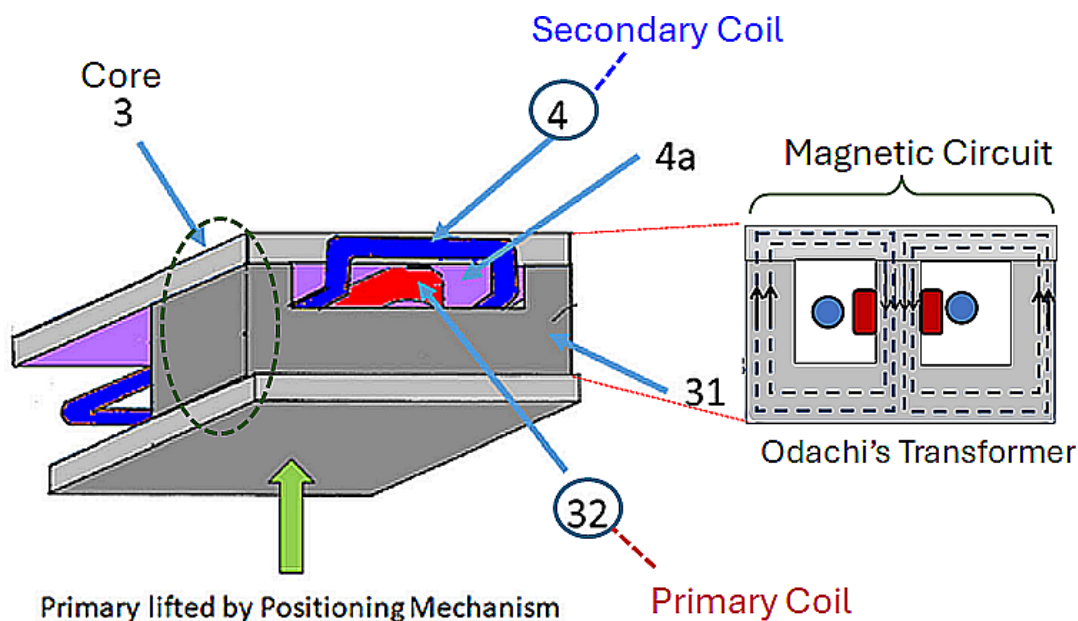
are guided by a core common to both primary and secondary coils. This feature and mode of coupling distinguishes a transformer from a pair of coupled antennas.

See id. A transformer *requires* a core to operate and *cannot* produce a far field.

See id. In contrast, in order to be called an antenna, a transmitting structure such as a wire loop *must be capable* of producing a far field, even if the far field is not used in the transfer of power. *See id.* The far field of an antenna underscores its ability to “radiate” electromagnetic waves.⁶

The structure disclosed in Odachi is an E-core transformer that produces only the induction-field component, but no near field or far field. *See e.g.*, Ex. 2001, ¶¶29-33; Horenstein Supp. ¶ 43. This induction field is shown below in an adaptation of Odachi Fig. 12, where the primary core (31) has been raised until it makes contact with (“abuts”) the secondary core (3) by Odachi’s lifting arm. Horenstein Supp. ¶ 43. As shown in the figure on the right, this abutment completes the magnetic circuit between the primary and secondary coils, thus forming a transformer. The magnetic field lines circulate around the core but cannot leave it, hence no near or far-field radiation is produced. *See id.*

⁶ Sometimes called simply “electro-magnetic fields.” *See* Horenstein Supp. ¶ 42.



Left: Adaptation of Odachi Fig. 12 showing completion of magnetic circuit (transformer) by the lifting mechanism. Right: Cross-sectional view of the Odachi Transformer.

Odachi itself further confirms the distinction between a transformer and an antenna, by referring to the structure of Fig. 12 as a *magnetic circuit*:

“...the axes of their coils 14 and 4 substantially in line with each other so that a **magnetic circuit** is formed thereby.” (Odachi, 4:39-41; emphasis added)

“... thus the coupler positioning being completed and a **magnetic circuit** being formed by the primary coupler and the secondary receptacle.” *Id.*, 7:24-26 (emphasis added)

“...so that the former coil may be accommodated within the cavity when the primary inductive coupler 230 is engaged with the secondary inductive receptacle 230 for form a **magnetic circuit**. *Id.*, 8:45-48 (emphasis added)

Of note, the receiver antenna disclosed in the '654 patent is located “a distal position” from the transmitting antenna, where “distal” means “a distance from.” '654 Patent, col. 1:15-22. The distal relationship between the transmitting and receiving antennas is what enables the receiving antenna to couple to the near field component of the transmitting antenna. Near field coupling is *not possible* when both the primary and secondary coils share a common core, as in a transformer. See Horenstein Decl. ¶ 44. Odachi explains that its primary and secondary cores (e.g., of ferrite material) are brought into abutting closure, thereby forming a transformer. For example, Odachi discloses:

(Explaining that primary and secondary cores are brought into contact to form a magnetic circuit, i.e., transformer):

...the primary coupler 6 is **brought into contact** with the secondary receptacle 2, thus the coupler positioning being completed and **a magnetic circuit being formed** by the primary coupler and the secondary receptacle. 7:23-26 (emphasis added).

...the elevator 42d is moved upward until **the primary core 31 is brought into contact with the secondary core 3** and the primary coil 32 placed within the cavity 4a defined by the secondary coil 4. 9:48-51 (emphasis added).

(Explaining that primary and secondary cores abut each other, thereby forming a magnetic circuit, i.e., transformer):

For battery charging, the movable primary inductive device 6, which will be referred to as a primary inductive charge coupler or the like hereinafter, is **positioned in abutment relation** to the stationary secondary inductive device 2, which will be referred to as a secondary inductive receptacle or the like hereinafter, with the axes of their coils 14 and 4 substantially in

line with each other so that **a magnetic circuit is formed** thereby. In such a position of the primary inductive coupler and the secondary inductive receptacle, an electric current flows in the primary coil 14 to induce a secondary current in the secondary coil 2...” 4:34-44 (emphasis added).

Even the Ross reference relied on by Petitioner (Ex. 1007) distinguishes between a transformer, such as the one disclosed in Odachi, and an antenna:

The coupling between the coils 40 and 42 is referred to as inductive coupling. It is the same type of coupling that occurs in a transformer, except that **in a transformer the two coupled coils are closely physically coupled and are usually on the same magnetic core** so that the coupling efficiency between the two coils is very high (**i.e., all of the magnetic flux generated by the current in one coil cuts through the other coil**). Ross at 9:30-43 (emphasis added).

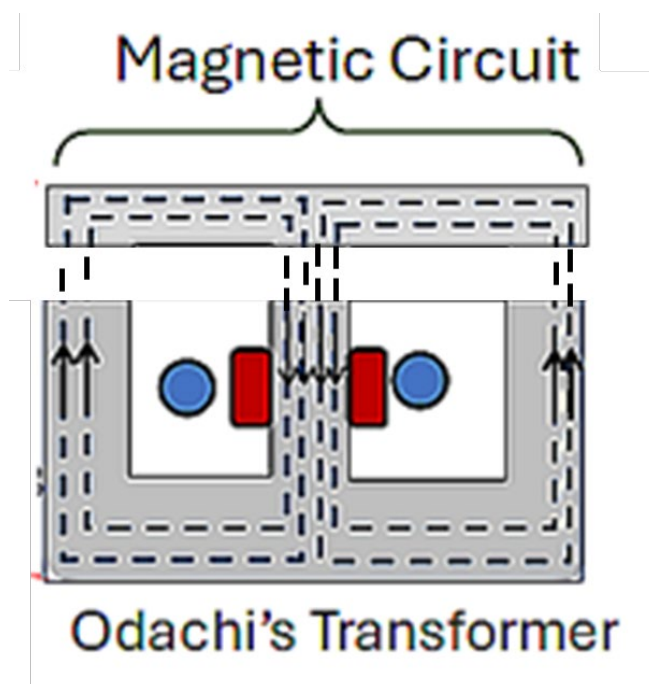
The Wang reference (Ex. 1008) cited by Petitioner also confirms the distinction between a transformer and an antenna, explaining that “[i]n a traditional transformer, the primary and secondary are fixed on a common core for tight coupling...however the secondary in many ICPT systems is allowed to move freely relative to the primary, and as such the magnetic cores for the primary and secondary need to be separated.” Wang at 13. As explained further below, Wang defines inductively coupled power transfer (ICPT) systems as using “electromagnetic fields to transfer electric power from a stationary primary source to one or more movable secondary load ***without contact***.” *Id.* at 1 (emphasis added). In other words, Wang differentiates between an antenna that would be

used in an ICPT system to radiate energy without contact, and a transformer that uses a common core to contain magnetic flux.

Referring again to Odachi, the primary core 31 and the secondary core 3 are brought into contact to create a “magnetic circuit” (i.e., transformer) that induces a current in the secondary coil. Ex. 1005 at 9:49-51, 11:60-12:7, 8:43-48. As one skilled in the art would understand, the secondary coil and the core in Odachi do not comprise a “receiving antenna,” because the current induced in the secondary coil is not “generated by a near-field component of flux in free space,” but is instead induced by flux contained with the shared magnetic core formed by bringing the primary core 31 and secondary core 3 into contact. *See Horenstein Decl.* at ¶¶29-33. Likewise, one skilled in the art would understand that the primary coil and core of Odachi is not a “transmitting antenna” because it does not “produce a near-field component of flux into free space that is intercepted by a secondary coil to effect resonant inductive coupling.” *See id.*

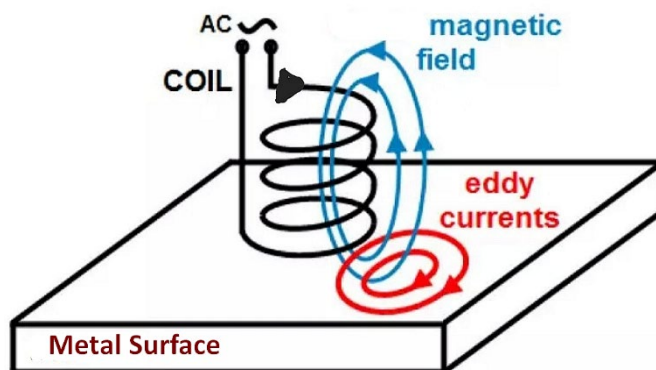
In the Institution Decision, the Board cited to col. 6, lines 1-6 of Odachi as indicating that the primary and secondary inductive devices may be antennas. However, that portion of Odachi says that as the distance between the primary inductive coupler 6 and the secondary inductive receptacle 2 is reduced, electromagnetic induction occurs between the coupler and the receptacle when the former coupler comes close to the latter receptacle. 6:1-6. Even though at this

point the primary core and the secondary core may not be in contact yet, the two cores still act to confine or guide the magnetic flux lines, rather than radiate them into free space. *See* Horenstein Supp. ¶ 69. For example, a modified version of the diagram provided above illustrating the magnetic flux lines of Odachi is shown below when the primary core is close to, but not yet in contact with, the secondary core. *See Id.*



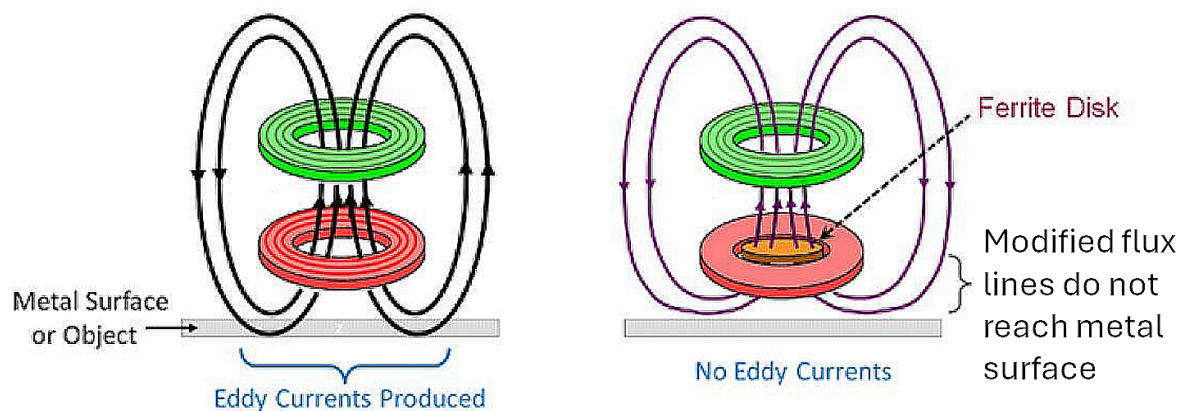
Therefore, a small gap between the cores in Odachi during one portion of the alignment process does not convert the transformer into an antenna. The primary core of Odachi does not “radiate radio waves,” but instead functions as a traditional transformer in combination with the secondary core.

The resonators in the '654 patent are coupled, but they are not a transformer, because they have no common core, and they rely on the near-field magnetic field lines to couple primary to secondary. *See* Horenstein Supp. ¶ 51. In one limited excerpt in the specification, the '654 patent briefly mentions a ferrite core: “Loop antennas may be configured to include an air core or a physical core such as a ferrite core. Using a ferrite core may **decrease the effect of extraneous objects.**” '654 patent 2:62-64 (emphasis added). A POSA would have understood this reference to “decrease the effect of extraneous objects” to mean the known technique of placing a thin ferrite disk beneath or inside the transmitting resonator to limit eddy currents in a mounting structure made from metal. *See* Horenstein Supp. ¶ 51. As the POSA would have known, a time-varying magnetic field incident on a metal or other conducting surface induces unwanted “eddy currents” within in the metal. *See id.* These eddy currents flow in a circular pattern around the metal surface, perpendicular to the incident magnetic field. *See id.* The phenomenon of eddy currents is shown conceptually in the following figure:

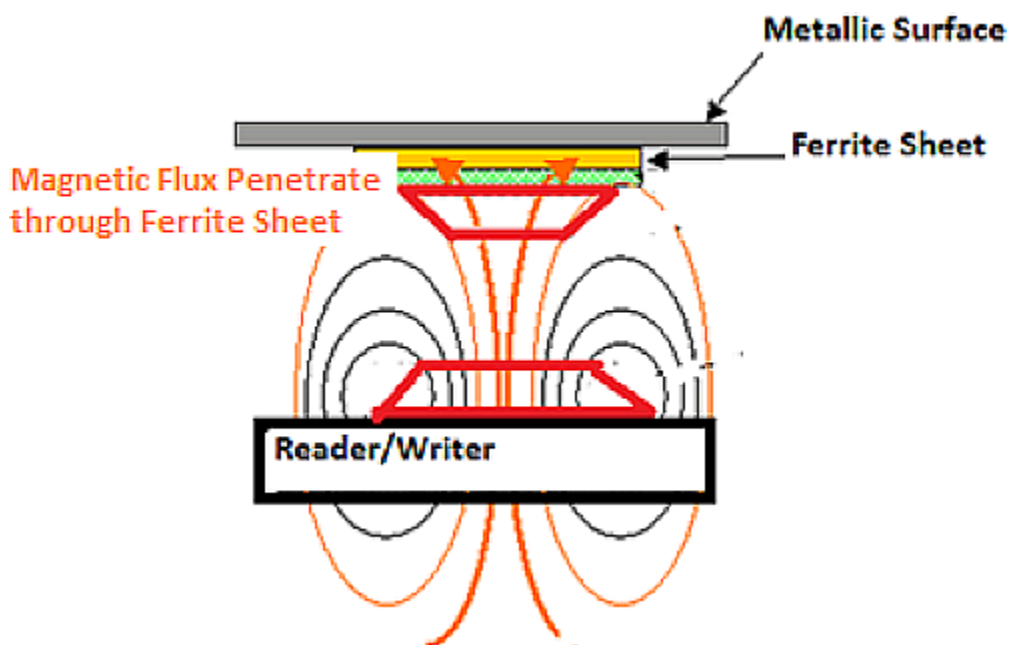


Eddy currents flowing in the metal adjacent to the coil dissipate power and thus contribute to overall power loss and a reduction in wireless transmission efficiency. To help alleviate the eddy-current effect, thin ferrite disks or tiles are often placed inside or under loop antennas to distort and redirect magnetic field lines so that there is no magnetic field penetration into the metal. As Dr. Horenstein explains, this is what the '654 patent means when it says, “Using a ferrite core may decrease **the effect of extraneous objects**” (1:63-64) and “[low frequency] Ferrites may be used as magnetic shield (sic) to **prevent fields generating eddy currents in metallic parts** of the antenna surrounding.” 3:1-3 (emphasis added); Horenstein Supp. ¶ 52.

The figure below illustrates how a ferrite disk placed inside the transmitting antenna distorts the lower part of the magnetic flux, eliminating magnetic field penetration into the underlying metal surface and thus greatly reducing the eddy-current effect. *See* Horenstein Supp. ¶ 53. The receiving and transmitting antennas do not share this ferrite disk, nor does such the eddy-reducing ferrite disk constitute the core of a magnetic transformer. *See id.*



Journal articles in the scientific literature further explain the use of underlying ferrite disks or tiles as a means to reduce the eddy current effect. One such article by Lau (Ex. 2007) shows the following figure which illustrates the use of a ferrite tile to reduce magnetic field penetration into the metal surface supporting a loop antenna:



Lau Figure 3

See Ex. 2007; Horenstein Supp. ¶ 54. The use of ferrite disks (gray) to reduce eddy currents is similarly shown in Chen (Ex. 2008):

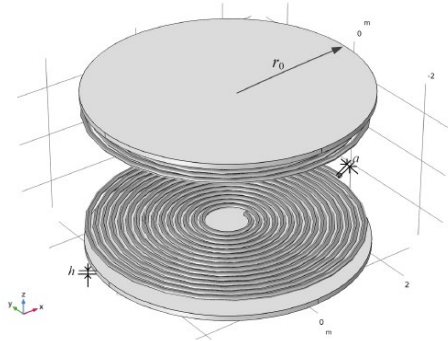


Fig. 3. Planar spiral coil model with disc type magnetizer

Fig. 3. Planar spiral coil model with disc type magnetizer

Chen Fig. 3

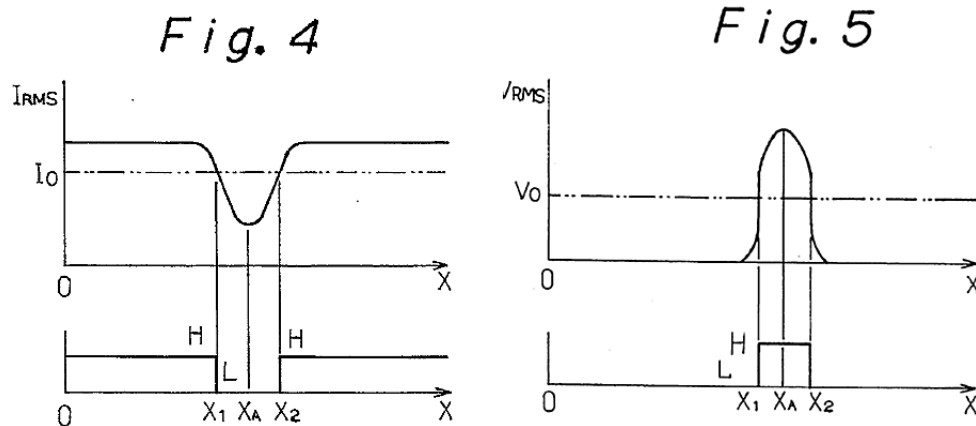
In summary, the reference to a ferrite core in the '654 patent does not mean that a POSA would have understood the term “antenna” to include the transformer structure of Odachi. Horenstein Supp. ¶ 56. In the ferrite core example, the transmitting antenna still radiates energy in the near field, despite the presence of the ferrite core. In contrast, the single core formed by the primary core 31 abutting the secondary core 3 confines the magnetic flux to the core. *Id.* Therefore, the primary inductive device (“coupler 230”) of Odachi becomes the primary coil of a transformer, not a “transmitting antenna,” as recited in claim 1 of the '654 patent.

Therefore, because Odachi does not disclose a “receiving antenna” or “transmitting antenna,” as recited in claim 13, Odachi does not anticipate claim 13.

Because claim 15 depends from claim 13, Odachi also fails to anticipate claim 15 for the same reasons.

B. Ground 1A: Odachi Does Not Disclose Moving the Receiving Antenna or Transmitting Antenna From the First Alignment Position to a Second Alignment Position “Responsive to Detecting a Degree of Coupling in the First Alignment Position”

In the Odachi system, the carriage holding a primary inductive coupler 6 begins at a first position when the vehicle is parked in a garage. Odachi, 5:42. The carriage then proceeds in the x -direction (along the bumper side of the car) monitoring the amount of I_{RMS} current flowing into the primary (transmitting) coil, or alternatively by monitoring the voltage V_{RMS} at the secondary (receiving) coil. Figure 4 shows a plot of the I_{RMS} current in the primary coil versus the x -coordinate, while Fig. 5 shows the voltage in the secondary coil (V_{RMS}) as a function of x -coordinate.



Odachi Figs. 4 and 5

As shown in Fig. 4 of Odachi, current initially stays relatively fixed as the carriage moves from an initial position toward the secondary inductive receptacle 2 that is mounted on the vehicle. *See Id.* at Fig. 4. As the primary inductive coupler 6 gets closer to the secondary inductive receptacle 2, the current I_{RMS} becomes less until the primary inductive coupler 6 reaches a minimum value at the point of maximum coupling. As the primary inductive coupler 6 continues moving in the x -direction and gets further away from the secondary inductive receptacle 2, the current I_{RMS} begins increasing until it eventually reaches a relatively fixed value as the carriage reaches the end of its track. While Fig. 4 shows the relationship between the current I_{RMS} , FIG. 5 shows the relationship between the voltage V_{RMS} in the secondary inductive coupler V_{RMS} and the x -position, which shows the voltage V_{RMS} reaching a maximum value at the point of maximum coupling. Odachi explains that the x -position corresponding to maximum coupling is determined where the primary coil current I_{RMS} reaches its minimum value, which is designated as position X_A in Fig. 4. Col. 6:20-27.

Odachi also discloses that a discriminating circuit 25 is used to generate a high-level signal H while the value of the current I_{RMS} is greater than a predetermined reference value I_0 , and a low-level signal L while the value I_{RMS} is lower than the predetermined reference value I_0 . Col. 6:28-34. As shown in Fig. 4 of Odachi, X_1 denotes the x -position of the carriage when the current I_{RMS} crosses

from above the reference value I_0 to below the reference value I_0 , and X_2 denotes the x -position of the carriage when the current I_{RMS} crosses from below the reference value I_0 to above the reference value I_0 . Odachi explains that a controller 21 tracks a number of pulses generated by an encoder 22 from the time the carriage begins moving to when the carriage reaches position X_1 , and tracks the number of pulses that have occurred when the carriage reaches position X_2 . Col. 6:46-57. The controller 21 then determines the midpoint between positions X_1 and X_2 , which corresponds to the position of maximum coupling X_A . Col. 6:58-7:3. The controller 21 then controls the carriage motor M_1 to move the carriage to position X_A . Col. 7:4-13.

Petitioner and Dr. Allen assert that the primary inductive coupler 6 corresponds to the claimed “transmitting antenna,” and that by moving the primary inductive coupler 6 to the X_A position at which the V_{RMS} value is at its peak, Odachi discloses claim element 13[b], which states “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.”

However, the Odachi system does not move “one of the receiving antenna

and the transmitting antenna from the first alignment position to a second alignment position” “responsive to detecting a degree of coupling in the first alignment position,” as required by Element 13[b]. Dr. Allen opines that when the vehicle is driven to a position such that the wheels are against the wheel stops and parked, the secondary inductive device (i.e., receiving antenna) mounted on the vehicle is in a “first alignment position” relative to the primary inductive device (i.e., transmitting antenna) swung out to its “operative home position.” Ex. 1003 (Allen Dec.) ¶ 108. Dr. Allen further opines that Odachi moves the primary inductive device from its home position (i.e., first alignment position) to a target position X_A (i.e., second alignment position), at which the primary inductive device is better aligned with the secondary inductive device. *Id.* ¶ 110.

But moving of the primary inductive device to position X_A in Odachi is not “responsive to detecting a degree of coupling in the first alignment position,” as recited in element 13[b]. At his deposition, Dr. Allen acknowledged that in Fig. 4 (and Fig. 5), the “first alignment position” corresponds to the far left end of the x -axis. Ex. 2011 (Excerpts from Dr. Allen Dep. Tr.) at 15:13-16:9, 22:24-23:5. But as explained above, Odachi does not use any detected degree of coupling between the first and second inductive devices at the “first alignment position” in order to move the primary or secondary inductive devices to a “second alignment position.” *See* Horenstein Supp. ¶ 62. Odachi instead determines the point X_A of maximum

coupling by detecting the positions X_1 and X_2 at which the voltage and current cross over their respective threshold levels I_0 and V_0 . The location of X_A is then calculated as the midpoint between X_1 and X_2 . This determination of X_A is therefore not “responsive to detecting a degree of coupling in the first alignment position,” as claim 13 requires. *See id.*

Therefore, Patent Owner submits that Odachi fails to disclose this element of claim 13. Because claim 15 depends from claim 13, Odachi also fails to anticipate claim 15 for the same reasons.

C. Ground 1b: Adding a Capacitor From Wang to Odachi Does Not Convert the Transformers of Odachi into Antennas.

For Ground 1b, the Petitioner relies solely on Odachi for allegedly disclosing the “transmitting antenna” of claim 1. Pet. at 25-26. Therefore, Ground 1b of the Petition fails for the same reasons that Ground 1a fails, as discussed above. Moreover, Petitioner’s reliance on Wang for allegedly disclosing coupling a capacitor to a primary winding to form a resonant circuit does not cure the deficient teachings of Odachi, nor would a POSA have been motivated to combine the capacitor of Wang with the transformers of Odachi.

As explained above, the primary inductive device or coupler 230 of Odachi is the primary coil of a transformer—not an antenna—because the primary coil of Odachi is wrapped around a magnetic core and generates magnetic flux lines that

are contained within the core, rather than emitted into free space. *See* Horenstein Decl. at ¶¶29-33. Adding a compensation capacitor of Wang to the transformer coil of Odachi, as proposed by Petitioner, does not convert the transformer of Odachi into an antenna because the magnetic flux lines generated by the primary coil of Odachi are still contained within the magnetic core. *See Id.* at ¶¶35-36. As Dr. Horenstein explains, adding the compensation capacitor to the primary coil of Odachi sets a unity power factor at the driving frequency, but does not affect the containment of the magnetic flux lines within the magnetic core. *See Id.*; Horenstein Supp. ¶ 71. Therefore, the combination of Odachi and Wang fails to disclose an antenna, as recited in claim 1 of the '654 Patent. Because claims 7 and 18 dependent from claim 1, Ground 1b fails to render claims 7 and 18 invalid for the same reasons set forth above for claim 1.

D. Ground 1b: A POSA Would Not Have Combined the Capacitor of Wang With the Transformer of Odachi.

Petitioner contends that a POSA would have considered it obvious to include a capacitor connected to each of Odachi's primary and secondary coils, creating circuits that resonate at a particular frequency. But Petitioner fails to adequately explain why a POSA would have been motivated to do so. Petitioner states that "A POSA would have been motivated to use capacitor-compensated resonant circuits in Odachi, as this design was nothing more than a combination of known elements

(inductive coils and capacitors) arranged according to known methods (connected in series or parallel resonant circuits) to yield predictable results (a resonant power transfer system).” Pet. at 29. As Dr. Horenstein explains, capacitors are indeed very common elements in circuits, but Petitioner fails to provide a rational reason why a POSA would have combined the capacitor of Wang with the Odachi transformers in the manner proposed by Petitioner. Horenstein Supp. ¶ 72.

Wang is directed to ICPT systems that use electromagnetic fields to transfer electric power from a primary coil to a secondary load “**without contact.**” Wang at 1. Wang explains the conditions under which a designer *might* choose to connect capacitors in series or parallel with a primary or secondary coil:

In ICPT systems⁷, 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. Wang at 38 (emphasis added).

Moreover, under the “Motivations of the Research” section of Wang, the reference explains that “[i]t is desired to enable increasing air gaps” between

⁷ Inductively Coupled Power Transfer

primary and secondary coils. Wang at 4. Thus, according to Wang, the reason for connecting capacitors to the primary and/or secondary windings is the need to operate the system at higher frequencies when the coupling is weak, such as when the primary and secondary coils are spaced apart by greater distances. At higher frequencies, the reactance of the coils increases, and capacitors are needed to lower the overall reactance so as to permit the flow of large currents.⁸ Horenstein Supp. ¶ 74.

Odachi discloses nothing to suggest that its transformer primary and secondary suffer from weak coupling that would necessitate operating at higher frequencies for which compensating capacitors would be needed. *See id.* ¶ 75. In fact, Odachi describes a transformer that provides tight coupling between primary and secondary. Odachi repeatedly explains that the positioning system is used to locate the primary and put it “in abutment” with the secondary coil before charging begins. Odachi, 4:34-41; *see also* 7:19-26 (“...the primary coupler 6 is brought into contact with the secondary receptacle”); 9:47-51 (“elevator 42 d is moved upward until the primary 31 is brought into contact with the secondary core 3...”);

⁸ The reactance of a coil is $2\pi fL$ and that of a capacitor is $-1/2\pi fC$, where f is the frequency, L the inductance, and C the capacitance. Inductors (coils) have a positive reactance, whereas capacitors have a negative reactance. When they are connected together, their reactances can cancel each other out. Horenstein Supp. ¶ 74.

11:60-12:1 (“...where the primary inductive coupler 230 is engaged with the secondary receptacle 2...”). Because Odachi already provides strong coupling via its transformer, there would be no need for the compensation capacitor(s) of Wang, and a POSA would not be motivated to include them. *See id.*

Thus, although the Petition says that using compensating capacitors was well known, and resonant circuits were known to increase power transfer, the justification for combining Odachi and Wang is premised on the idea that Odachi suffers from weak coupling. On the contrary, however, Odachi teaches the use of a tightly coupled transformer structure that does not suffer from weak coupling. Odachi specifies that its cores are in physical contact before charging begins:

After this alignment position is attained, the elevator 42d is moved upward **until the primary core 31 is brought into contact with the secondary core 3** and the primary coil 32 placed within the cavity 4a defined by the secondary coil 4. Odachi, 9:47-52 (emphasis added).

The driver then operates on the control panel 17 to drive the motor M3 to move the support arm 12 forward along the Y-axis until **the primary coupler 6 is brought into contact with the secondary receptacle 2**, thus the coupler positioning being completed and **a magnetic circuit being formed by the primary coupler and the secondary receptacle**. *Id.* 7:21-26 (emphasis added).

Therefore, a POSA would not have been motivated to combine Wang with Odachi, because the wireless transfer benefits of using compensating capacitors

discussed in Wang would have not applied or would not have been useful to the Odachi transformer-based system. Horenstein Supp. ¶¶ 76-77.

E. Ground 1b: Odachi and Wang Do Not Disclose 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...Adjust an X-Y Alignment of the Transmitting Antenna”

Petitioner contends that “Odachi teaches a “controller” that moves the primary inductive coupler along the X-, Y-, and/or Z- axis starting at its home position and ending at a “target position XA where the coupler is just aligned with the secondary inductive receptacle.” Pet. at 35 (citing Odachi 11:6-59). As explained above, Petitioner admits that the primary inductive coupler begins at the “home position”, i.e., the first alignment position of the claim. Petitioner fails to show, however, how the system in Odachi bases its adjustment on the degree of coupling at the claimed “first position”. As explained above, the test signal I_{RMS} is zero at the first position. Odachi’s system then seeks out the optimum alignment by automatically moving the coupler in the x-direction until it receives a signal and then detects that the first threshold level has been crossed. Thus, Odachi discloses that only the second position is based on the degree of coupling, *not* the first position.

Additionally, there is nothing in Odachi that teaches or discloses basing the y-axis adjustment on a degree of coupling. There is no y-axis control motor shown

in Fig. 13. Similarly, there is no y-axis adjustment step in the flowchart of Fig. 14.

The latter shows only the steps of self-initiating x-axis movement, then seeking the threshold levels X1 and X2 and calculating the peak alignment position XA.

Odachi fails to disclose any “degree-of-coupling” test for the y-axis adjustment.

Rather, Odachi states that y-axis motion is initiated by the driver: “The driver then operates on the control panel 17 to drive the motor M3 to move the support arm 12 forward along the Y-axis until the primary coupler 6 is brought into contact with the secondary receptacle 2”. A POSA would interpret these instructions to mean that the y-axis adjustment is fixed and based on knowledge of where the secondary coil resides on the vehicle in light of the car having achieved its y-axis position based on the parking blocks 130 shown in Fig. 7. Horenstein Supp. ¶ 81.

Therefore, Petitioner has failed to show that Odachi and Wang disclose this feature.

F. Ground 1b: Odachi and Wang Do Not Disclose Transmitting Power to a “Remote Receiving Antenna,” as Recited in Claim 7

Since claim 7 depends from claim 1, the combination of Odachi and Wang does not render obvious claim 7 at least for the same reasons discussed above in connection with claim 1.

In addition, for the reasons discussed above, Odachi does not disclose a receiving “antenna,” but also does not disclose a receiving antenna that is

“remote.” As Dr. Horenstein explained, the receiving antenna in the ’654 patent is distal to the transmitting antenna and is thus “remote.” Horenstein Decl. ¶ 84.

Petitioner contends that the vehicle-mounted secondary coil disclosed in Odachi is 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.”

Based on the above, Petitioner has failed to show that claim 7 is obvious over Odachi combined with Wang.

G. Ground 1b: Odachi and Wang Do Not Disclose “the Coupling Test Comprises a Measurement of the Amount of Power That is Transferred to the Receiving Antenna,” as Recited in Claim 18

Odachi and Wang do not render claim 18 obvious for at least the reasons discussed above for claim 1, from which claim 18 depends. In addition, Petitioner contends that Odachi’s coupling test, based on an injected current I_{RMS} , is equivalent to measuring the amount of power transferred to the receiving antenna. Odachi discloses only that, “the power circuit is activated to supply a check current I_{RMS} to the primary coil which is then monitored until either a minimum or maximum is reached.

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.

H. Ground 1c: Claims 4-6 Are Not Unpatentable Over Odachi, Wang and Partovi.

Claims 4-6 depend from claim 1, and therefore claims 4-6 are not unpatentable over Odachi, Wang, and Partovi because the Partovi fails to cure the several deficiencies of Odachi and Wang discussed above. For example, as discussed previously, Odachi does not disclose a transmitting antenna, nor would there have been any reason to combine the capacitor of Wang with the transformer of Odachi. In addition, that Petitioner has failed to show how a POSA would have been able, must less motivated, to use the array of Partovi to modify Odachi’s power transfer system.

In addition, claim 4 recites an “array of antennas” extending over an area of a parking space. Petitioner asserts that this claim is obvious over the combination of Odachi, Wang, and Partovi. According to Petitioner, Partovi discloses using an array of antennas that “would have been obvious” to implement with Odachi’s

system, specifically “an array of ‘multiple coils’ as in Partovi, rather than a single coil.” The objective, according to Petitioner, would be to “expand the ‘total area’” covered by the charger...” Pet. at 40.

Partovi discloses a system comprising “...a pad or similar base unit that contains a primary...” Partovi, Abstract. Figure 1 shows a pad of one type disclosed in Partovi. It is the simplest of pad configuration among the various versions of the pad shown in Figs. 1, 3-5, 8, 13-16, and 19-21. All of the aforementioned have the same two-dimensional form as the pad of Fig. 1.

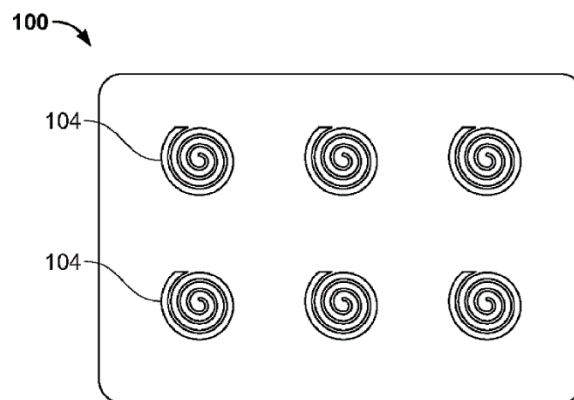


FIG. 1

Partovi, Fig. 1

The fact that Partovi’s pads are two-dimensional (i.e., “flat”, like a mouse pad) is exemplified by the preferred method of fabricating the pads, specifically forming them on printed circuit boards (PCBs) which are flat by nature. Reference to the PCB is found in numerous places in the patent. Eight of the “Other Publications” put before the examiner are on the topic of PCB-based transformers

(see, e.g., Tang, et al. “Characterization of Coreless Printed Circuit Board (PCB) Transformers”, Nov. 2000, IEEE Transactions on Power Electronics, vol. 15, No. 6, pp. 1275-1282... (Partovi at pg. 3). Additionally, reference to the PCB appears 32 times, including the following:

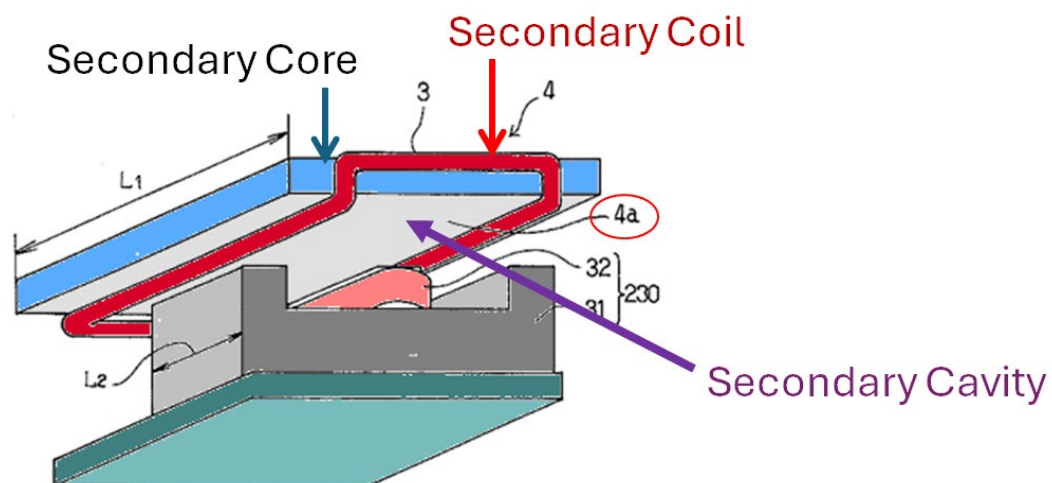
In practice, reduced resistivity can be obtained by using thicker copper-clad **PCBs**. Most common **PCBs** use 1-2 oz copper **PCBs**. In accordance with some embodiments the **coil PCB** used for the wireless charger can be made from **PCBs** clad with between 2 and 4, or even 6 oz copper. The process of manufacture of the **PCB** can also be optimized to achieve higher conductivity. (Partovi 16:33-38; emphasis added.)

The one or more coils or wires can be either printed on one or more **PCBs**, or formed from regular wires. (*Id.*, 10:38-39)

According to the Wiley IEEE dictionary, the common term for this type of coil is:

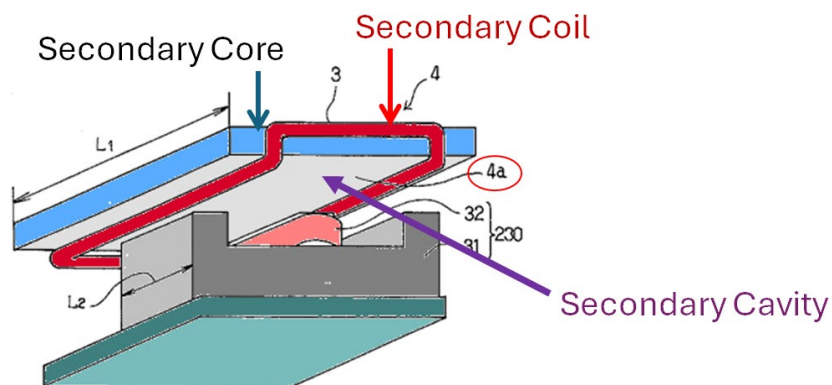
pancake coil - A coil that is in the form of a disk. Its winding is flat, as opposed to cylindrical. Also called pancake winding, or disk coil. (Ex. 2012 at 4).

As such, it would have been clear to a POSA that the primary coils disclosed in Partovi are planar in nature, that is, they are very thin. A POSA would not have considered it feasible to use the pancake coils of Partovi to couple to the 3-D core-based secondary coils of Odachi. *See* Horenstein Supp. ¶ 96. This is particularly true because Odachi discloses that its secondary has the “secondary cavity 4a” best seen in Fig. 12:

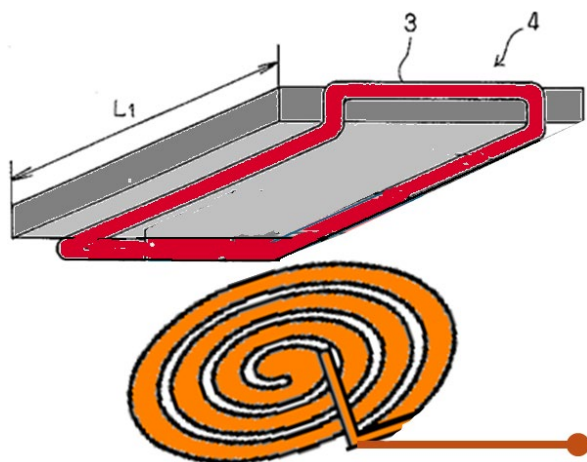


Odachi Fig. 12, annotated

The purpose of this cavity is to allow the primary core to mate with and contact the secondary core when the primary is lifted up by Odachi's lifting arm. (Odachi 9:47-51). Petitioner cites Odachi 8:1-15: "If the car is 'parked' with its coil outside the range of support arm 43d, the primary coil cannot reach the secondary coil, and so may not be able to charge the vehicle, or may do so inefficiently." (Pet at 41) Embedded in the middle of the passage cited from Odachi is the following: "...the secondary coil 4 is formed in an oval shape oriented with its major axis extending in the longitudinal direction of the vehicle 1 and defining an oval-shaped cavity 4a, and fixed to the bottom surface of the secondary core 3." (Odachi 8:7-11; emphasis added). Here Odachi reiterates that the secondary includes an oval shaped cavity 4a that can be readily seen in Fig. 12:



As a POSA would have understood from this diagram, the aforementioned cavity requires considerable space as the primary coil and central portion of the primary core are to fit inside this cavity. *See* Horenstein Supp. ¶¶ 96-98. As discussed previously, this arrangement is what, in fact, turns the primary and 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:



According to Dr. Horenstein, it would have seemed strange to a POSA to try to adapt the structures of Odachi and Partovi so that they would fit compatibly. *See id.* ¶ 99. The figure above, consisting of the secondary core and coil from Odachi Fig. 12 and one of the pancake coils from Partovi, illustrates the physical incompatibility between Partovi's pancake coils and Odachi's E-core structure. *See id.*

Contrary to what Petitioner has asserted, a POSA would not have had a reasonable expectation of success in using Partovi's coil array with Odachi's transformer. Petitioner suggests that "additional 'coils' could be added in the well-known manner already disclosed in Odachi at 4:16-32. Nothing in that section disclosed a "well known manner" for adding coils to Odachi. In fact, the cited passage, reproduced below, emphasizes the need for a primary E-core that mates properly with the secondary, so as to form a transformer:

In the garage 5 is located a stationary vehicle charger including a power source unit 15 connected at the input thereof to a control unit 16 and at the output to a primary coil 14 of a **primary inductive device 6 which also includes a core 13**⁹. The primary inductive device 6 is mounted at the distal end of a movable support arm 12 of a positioning apparatus 7 which will be explained in detail on later part hereof. The control unit 16 has a control panel 17 with various control switches for controlling the operation of the positioning apparatus 7 and a display unit 18 providing various information and operating conditions during

⁹ Partovi coils do *not* have a core, so here Partovi's coils would be incompatible with Odachi. *See* Horenstein Supp. ¶ 100.

positioning and battery charging operations. The vehicle charger further includes a wireless receiver B2 which is communicable with the transmitter B1 on the vehicle 1. As shown in FIG. 1, **the primary coil 14 is wound on the core 13¹⁰** with the axis of the coil winding extending in the same direction as the secondary coil 4. (Odachi 4:16-32; emphasis added).

Irrespective of the above, a POSA would have recognized that Odachi is about charging cars, whereas Partovi is about charging cell phones with a charging pad. This focus of Partovi is exemplified by Fig. 16, which shows two cell phones placed atop a charging pad:

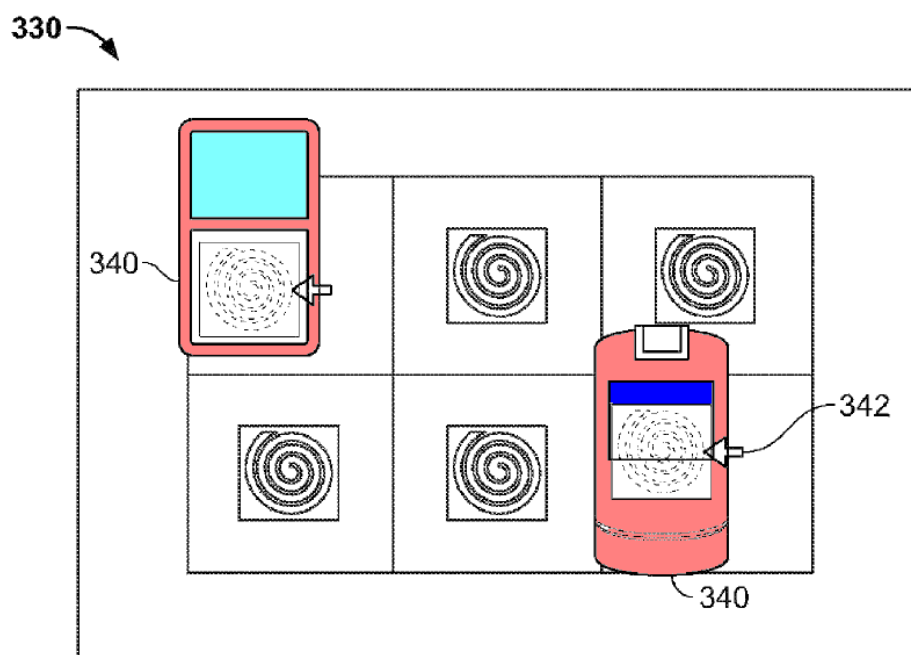


FIG. 16

Partovi Fig. 16, annotated

¹⁰ As in the above example, Partovi's coils would be incompatible with Odachi. See Horenstein Supp. ¶ 100.

1. For example, Partovi describes the invention as,

“A portable inductive power source, power device, or unit, for use in powering or charging electrical, electronic, battery operated, mobile, and other devices is disclosed herein.” (Partovi, 3:18-20)

Similarly,

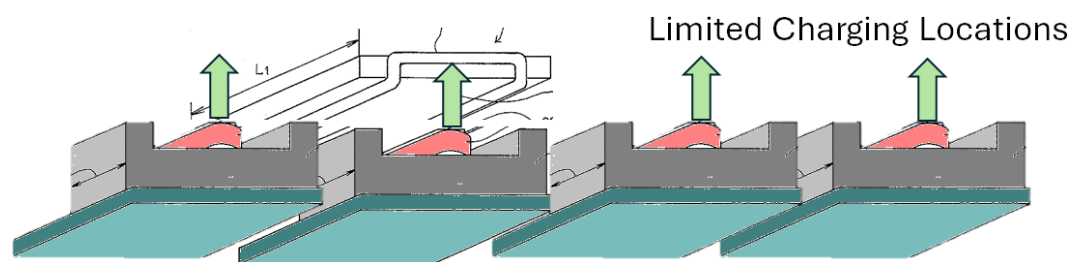
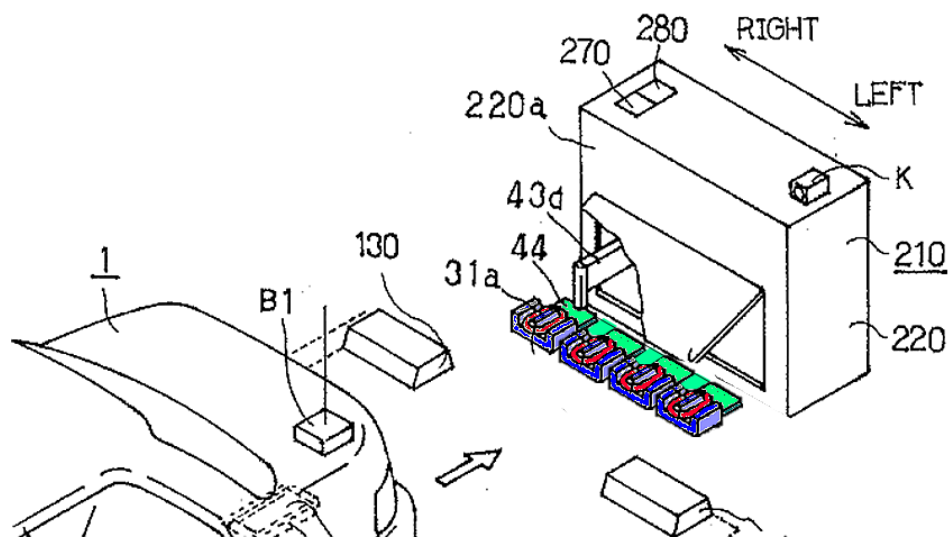
“The pad should be able to charge a number of device[s] with various power requirements efficiently. A typical number would be 1-6 devices, and probably up to 4 low power (**up to 5 W**) devices simultaneously. (*Id.*, 5:41-44; emphasis added)

Partovi also teaches that:

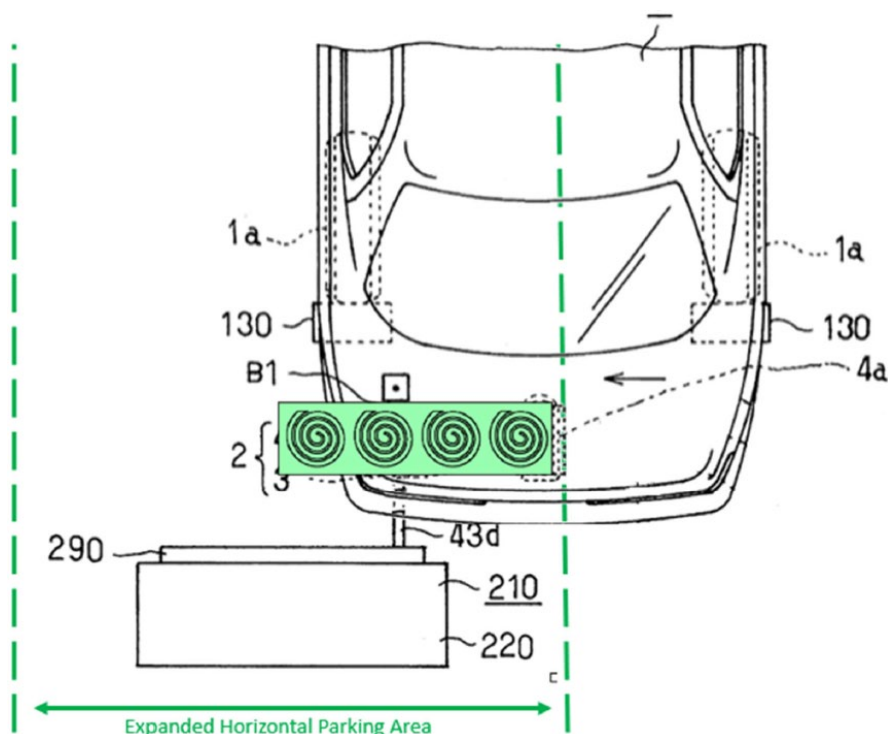
The pad and the receiver should be reasonably simple to construct, and cost effective. Since both parts can be integrated into **mobile devices**, the overall size, weight, and form factor should be minimized. (*Id.*, 6:6-9; emphasis added.)

Petitioner also claims that as one approach, it would have been obvious to duplicate the primary coils of Odachi in an array. Petitioner suggests a drawing with multiple pancake coils placed side by side on Odachi’s apparatus. Doing so with Odachi’s actual primaries, however, would not lead to coverage across the range of the primaries because the primary windings would not be able to move relative to the vehicle’s secondary coil, such that only a few, discrete spots along Odachi’s x-axis would be available for mating with the secondary. *See* Horenstein Supp. ¶ 104. The fault of such an approach is illustrated below using adaptations of the figures from Odachi:

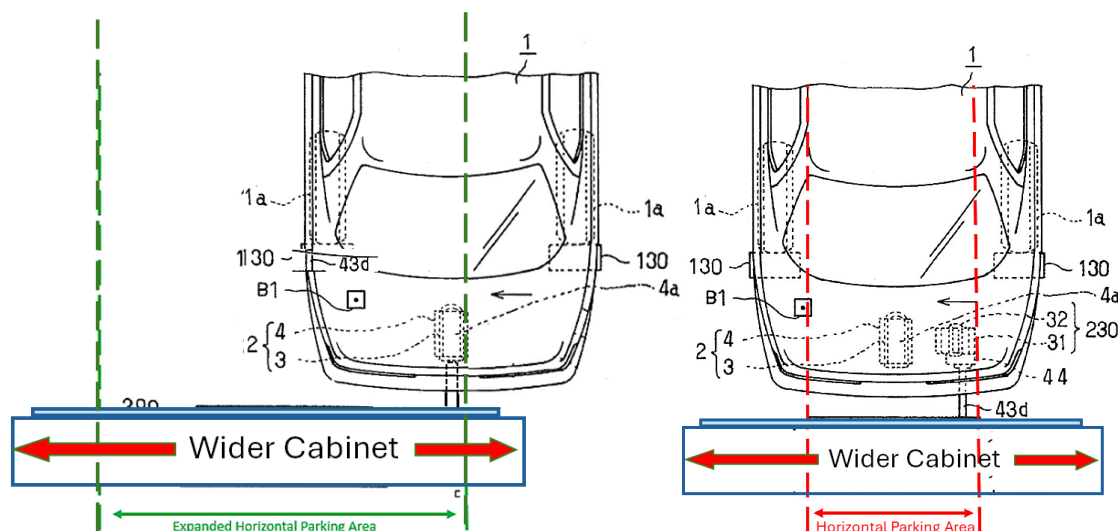
Fig. 7



See Horenstein Supp. ¶¶ 104-105. Petitioner creates a contorted version of Odachi, claiming that it would increase the available range for charging in the event that the vehicle was parked in an offset manner:



Irrespective of the fact that using pancake coils with Odachi would not be feasible, nor would using multiple instances of the primary E-core coils of Odachi, a POSA would have recognized that it would have been a far simpler and much less expensive approach to simply widen the cabinet, i.e., “casing 220”, so as to extend the range of the arm supporting the primary coil. Such an arrangement is shown below (*See Horenstein Supp. ¶¶ 106-107*):



Moreover, Petitioner’s assertion that a POSA would be motivated use the array of Partovi to expand the range of the vehicle charger in Odachi. Odachi explains that in prior art charging systems “the range of permissible crosswise distances within which the vehicle should be parked for successful coupling of the inductive core-coil devices is too small,” and that the driver is required to precisely position the vehicle to initiate charging. Col. 1:59-66. Therefore, an object of Odachi is to “provide a wider range of permissible distances within which the vehicle should be parked for coupling of the inductive core-coil devices.” Col. 2:15-18. Due to the positioning process described above, the Odachi system automatically positions the primary inductive coupler with respect to the secondary inductive receptacle, and therefore frees the driver “from laborious parking operations.” Col. 7:39-45. In other words, Odachi already accomplishes the goal of allowing a greater range of “crosswise distances” that will allow for successful

coupling, such that there would be no need to use the array of Partovi. *See* Horenstein Supp. ¶ 108.

Petitioner argues that Odachi only allows for a “slight error” in parking, such that using a coil array would allow vehicles to be charged with proper alignment even when parked with significantly more error.” Pet. at 42 (citing Odachi 12:1-7). But this portion of Odachi is referring to the dimensions of the cavity 4a formed by the secondary coil 4, which can accommodate the primary coil 32 even if the vehicle 1 is parked with a slight error in its longitudinal direction.” 12:1-7. Adding the coil array of Partovi, as Petitioner proposes, purportedly would expand the range in the x-direction, not the longitudinal direction that is referenced in the portion of Odachi cited by Petitioner. Therefore, this portion of Odachi would not indicate that the Odachi system can only accommodate slight errors in the x-direction, and as discussed above, Odachi explicitly teaches that it expands the range in the x-direction.

I. Ground 2: Ross alone or Ross and Wang Do Not Disclose Moving the Receiving/Transmitting Antenna from a First Alignment Position to a Second Alignment Position Based on a Degree of

Coupling Detected at the Receiving Antenna, as Recited in Independent Claims 8 and 13.¹¹

1. Claims 8-10, 12, and 19

a. A POSA Would Not Have Combined The Capacitor of Wang With the System of Ross

Element 8[a] requires “a receiving antenna coupled to a device, the receiving antenna including a coil and capacitor that are resonant at a first frequency.”.

Petitioner admits that “Ross is silent about a capacitor or resonant frequency,” but asserts that, “a POSA would have considered it obvious to include a capacitor connected to each of Ross’s transmitting coil and receiving coil, creating circuits that resonate at a particular frequency in order to more efficiently transfer energy.” Pet. at 59-60. Indeed, Ross does not add capacitors to turn its coils into resonant circuits, and the word “resonant” does not appear anywhere in Ross.

Ross discloses preferred driving frequencies in the range 1-10 kHz which it calls “significantly higher than the conventional 60 Hz or 400 Hz ac signals that are commonly used in the prior art.” The preferred range in the Ross system is around 2-3 kHz. (Ross at 5:43). Wang, on the other hand, justifies the use of

¹¹ In Ground 2, the Petition addresses Claims 8 (independent), 9-10, 12, and 19 (each dep. on Cl. 8); Claim 13 (independent), 14 and 16 (each dependent on Claim 13).

compensation capacitors to correct power factor at higher frequencies and focuses on driving frequencies up to the megahertz (MHz) range:

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. (Wang at 38).

A POSA would have understood these differences between Ross and Wang and would not have used the compensation capacitors of Wang in the Ross system. Horenstein Supp. ¶¶ 111-112.

Moreover, Wang espouses the use of compensation capacitors as a way to achieve higher efficiency. Ross already addresses the issue of coupling efficiency without the need for compensation capacitors; that is, Ross claims increased efficiency solely by increasing its driving frequency to the kHz range:

“...advantageously **optimizes the coupling efficiency** of the power signal and operation of the EV system.” (Ross 5:45-47; emphasis added.) Ross also claims a high operating efficiency “when an EMB is used as the energy storage element.” (*Id.* 5:29-31) where “...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.” (*Id.*, 5:35-38; emphasis added.) Thus, a POSA would not have been motivated to combine Wang with Ross, as Ross already addresses the issue of increased efficiency without the need for or added expense of compensation capacitors. *See* Horenstein Supp. ¶ 113.

With regard to the use of higher driving frequencies that would, according to Wang, suggest the use of compensation capacitors, Ross teaches against the use of such frequencies:

Moreover, by using an ac signal within this frequency range (1-10 kHz), the magnitude or intensity of any stray magnetic fields that might otherwise penetrate into the vehicle or surrounding areas (as electrical current is inductively coupled into the vehicle) is significantly reduced. **Having the magnetic fields that penetrate into the vehicle or surrounding areas be of low intensity is an important safety issue**, at least from a public perception point-of-view, as there has been much debate in recent years concerning the possible harmful effects of over-exposure to magnetic field radiation. See, e.g., U.S. Pat. No. 5,068,543. It is thus feature of the present invention to provide an efficient, viable, safe, roadway-powered all electric vehicle. (Ross 5:53-60)

For the foregoing reasons, Petitioner has failed to show that it would have been obvious to combine Ross and Wang in the manner proposed by Petitioner.

b. Ross Does Not Disclose Moving the Receiving Antenna From a First Alignment Position to a Second Alignment Position to Better Align the Receiving Antenna With the Transmitting Antenna

Element 8[d] recites “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.” As Dr. Horenstein explains, a POSA would interpret this element to mean that the alignment controller bases the movement of the receiving antenna from the first alignment position to the second alignment position “on a detection of the coupling that is measured at the receiving antenna.” Horenstein Supp. ¶ 116. In particular, the first part of this element states that the alignment controller detects a degree of coupling between the receiving antenna and the transmitting antenna “based on a detection of the coupling that is measured at the receiving antenna.” Then, the alignment controller moves the receiving antenna to a second alignment position “to better align” the two antennas. A POSA would understand the term “to better align” the two antennas as meaning to align the two antennas to achieve a degree of coupling better than that measured at the receiving antenna. A POSA would understand that the plain meaning of the term “better” indicates that there must be an initial alignment or coupling that the second alignment position improves upon. *See id.* A POSA would understand that the initial coupling or alignment that is improved upon in the second alignment position, is the previously degree of coupling measured at the receiving antenna. *See id.* Ross does not disclose moving the receiving antenna to

a second alignment position to achieve an alignment that is better than the alignment detected based on the degree of coupling measured at the receiving antenna.

Ross discloses that as the operator of RPEV 12 approaches, e.g., a passenger loading/unloading zone, an auto positioning control takes over the driving of the vehicle for the final 10-15 feet, and, based on the position of the vehicle determined by vehicle sensors 60, is steered to laterally position the vehicle with a “rough tolerance, e.g., +/- 5-10 cm of an optimum lateral position when the vehicle comes to its designed stopped location.” Col. 12:37-52. That is, there is a designed stopped location of the vehicle that corresponds to the “optimum lateral position,” and the vehicle sensors 60 are used to position the vehicle within a “rough tolerance” of the known optimum position. Ross then discloses that the receiving antenna is moved from the “rough” position at ± 5 -10 cm to a close alignment within ± 1 -2 cm. This alignment is performed by “conventional hydraulic and/or electronic positioning devices.” Col. 10:60-61.

Ross explains how the vehicle will locate its positioning target, as follows:

For purposes of laterally positioning the assembly 44, such sensors are typically optical sensors that look for markers placed on the roadway power transmitting module 24 embedded in the roadway. Other types of sensors may also be used for this purpose, including acoustic, mechanical, and electromagnetic sensors. Col. 13:9-14.

Therefore, Ross does not disclose that the degree of coupling at the “rough tolerance” position is measured at the receiving antenna. Rather, Ross discloses the use of sensors such as optical sensors that are used to position the vehicle within a rough tolerance of a designed stopped location, such as loading/unloading zone. As Dr. Horenstein explains, this makes sense because the sensors can look for markers indicating the location of the known stopped location, and then position the vehicle within a rough tolerance of the known stopped location based on those markers. Horenstein Supp. ¶ 119.

In its argument for this element, Petitioner also relies on a different portion of Ross that explains use of the horizontal positioning device while the RPEV is being driven on an electrified portion of a highway. *See* Col. 13:15-31. In this application, the horizontal positioning device 46 also maintains the coil 42 “within a rough tolerance” relative to the coil 40, based on the amplitude of the inductively received power signal as the coil 42 is laterally moved in one direction or the other. Col. 13:15-27. However, in this example there is no moving of the coil 42 from a first alignment position to a second alignment position with a better alignment than a degree of coupling that was measured at the coil 42. More specifically, this portion of Ross merely discloses maintaining the coil 42 “within a rough tolerance” based on the inductively received power. This makes sense because unlike the designed stopped location in the parking example, there is not a

designed stopped location when the RPEV is being driven. Therefore, this portion of Ross also does not disclose “mov[ing] said receiving antenna from the first alignment position to a second alignment position to better align the receiving antenna with the transmitting antenna” after “detection of the coupling that is measured at the receiving antenna,” as recited in element 8[d]. Horenstein Supp. ¶ 120.

Claims 9, 10, 12, and 19 depend from claim 8, therefore the combination of Ross and Wang does not render obvious claims 9, 10, and 12 for at least the reasons discussed above in connection with claim 8.

2. Claims 13, 14, and 16 Are Not Invalid Because Ross Fails to Disclose Moving the Receiving or Transmitting Antenna to a Second Alignment Position “Responsive to Detecting a Degree of Coupling in the First Alignment Position”

As discussed above, Ross discloses using sensors 60, such as optical sensors, to determine the position of the vehicle, and an auto positioning control takes over the driving of the vehicle for the final 10-15 feet to laterally position the vehicle within a “rough tolerance, e.g., +/- 5-10 cm of an optimum lateral position when the vehicle comes to its designed stopped location.” Col. 12:37-52. According to Petitioner, this “rough tolerance” position corresponds to the claimed “first alignment position.” Pet. at 54. Ross then discloses that the receiving antenna is moved from the “rough tolerance” position at ± 5 -10 cm to a close alignment within

± 1 -2 cm of the optimum lateral position. This alignment is performed by “conventional hydraulic and/or electronic positioning devices.” Col. 10:60-61.

Petitioner contends that the closer position within ± 1 -2 cm of the optimum lateral position corresponds to the claimed “second alignment position.” Ross does not disclose that the receiving antenna in the Ross system is moved from the “rough tolerance” position (i.e., first alignment position) to the more closely aligned position (i.e., the second alignment position) “responsive to detecting a degree of coupling in the [rough tolerance] position.” As described above, Ross explains that “rough tolerance” position is within “+/- 5-10 cm of an optimum lateral position when the vehicle comes to its designed stopped location.” Col. 12:37-52.

In other words, there is a designed stopped location of the vehicle that corresponds to the “optimum lateral position,” and the vehicle sensors 60 are used to position the vehicle within a “rough tolerance” of the known optimum position.

Ross explains that “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 +/- 1-2 cm of the optimum lateral position.” Col. 12:52-57.

However, Ross is silent with respect to detecting a degree of coupling in the rough tolerance position (i.e., first alignment position), or that moving the receiving antenna to second position closer to the optimum lateral position is done

“responsive to detecting a degree of coupling” in the rough tolerance position. In fact, since the optimum lateral position is a known “designed stopped location,” the controller could move the receiving antenna to the second position based on the knowledge of the designed stopped location, without any knowledge of the degree of coupling at the rough tolerance position. *See Horenstein Supp.* ¶ 123.

Therefore, Ross fails to disclose Ross does not disclose “moving one of the receiving antenna and the transmitting antenna from the first alignment position to a second alignment position” “responsive to detecting a degree of coupling in the first alignment position between the receiving antenna and the transmitting antenna,” as recited in claim 13.

Claims 14 and 16 depend from claim 13, and therefore the combination of Ross and Wang does not render obvious claims 14 and 16 for at least the reasons discussed above in connection with claim 13.

VII. CONCLUSION

For the reasons explained above, Patent Owner respectfully submits that the Petition does not show that any claim of the '654 Patent is unpatentable. Thus, the Board should deny reject all grounds of the Petition.

Dated: September 19, 2024

Respectfully submitted,

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CERTIFICATION UNDER 37 CFR § 42.24

Under the provisions of 37 CFR § 42.24(d), the undersigned hereby certifies that the word count for the foregoing Patent Owner's Preliminary Response to Petition totals 13,981, which is less than the 14,000 allowed under 37 CFR § 42.24(b)(1).

Dated: September 19, 2024

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CERTIFICATE OF SERVICE

It is certified that a copy of the *Patent Owner's Response to Petition* has been served on Petitioner as provided in 37 C.F.R. § 42.6(e) via electronic mail transmission addressed to the persons at the address of record as follows:

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