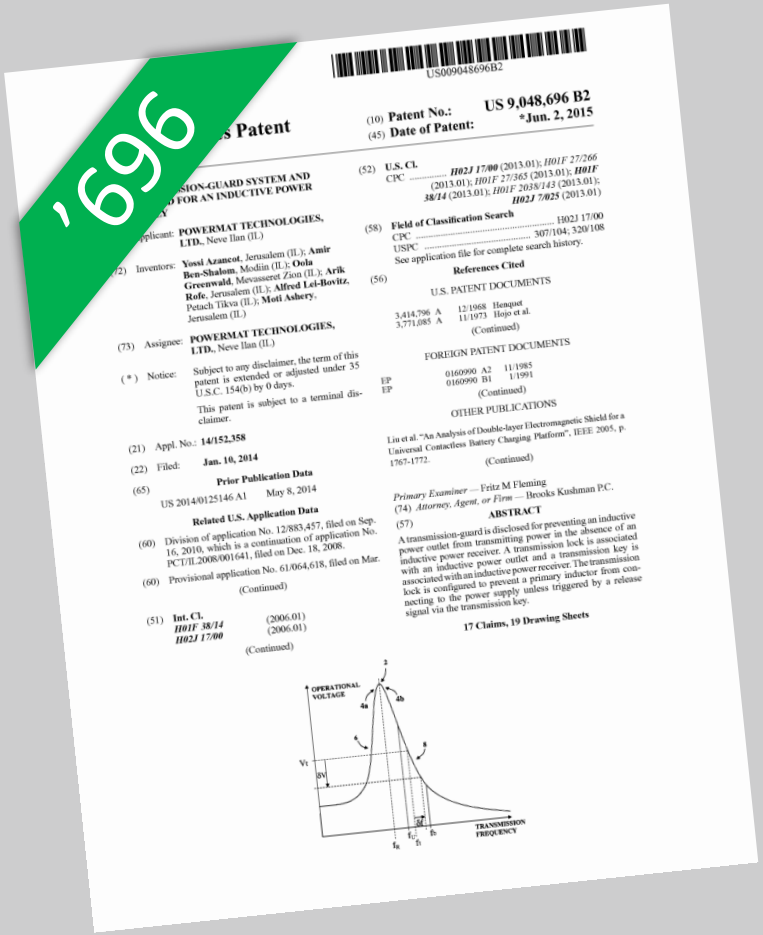
PATENT OWNER'S HEARING DEMONSTRATIVES

Anker Innovations Ltd., v. Powermat Technologies Ltd.

IPR2024-00994

U.S. Patent No. 9,048,696

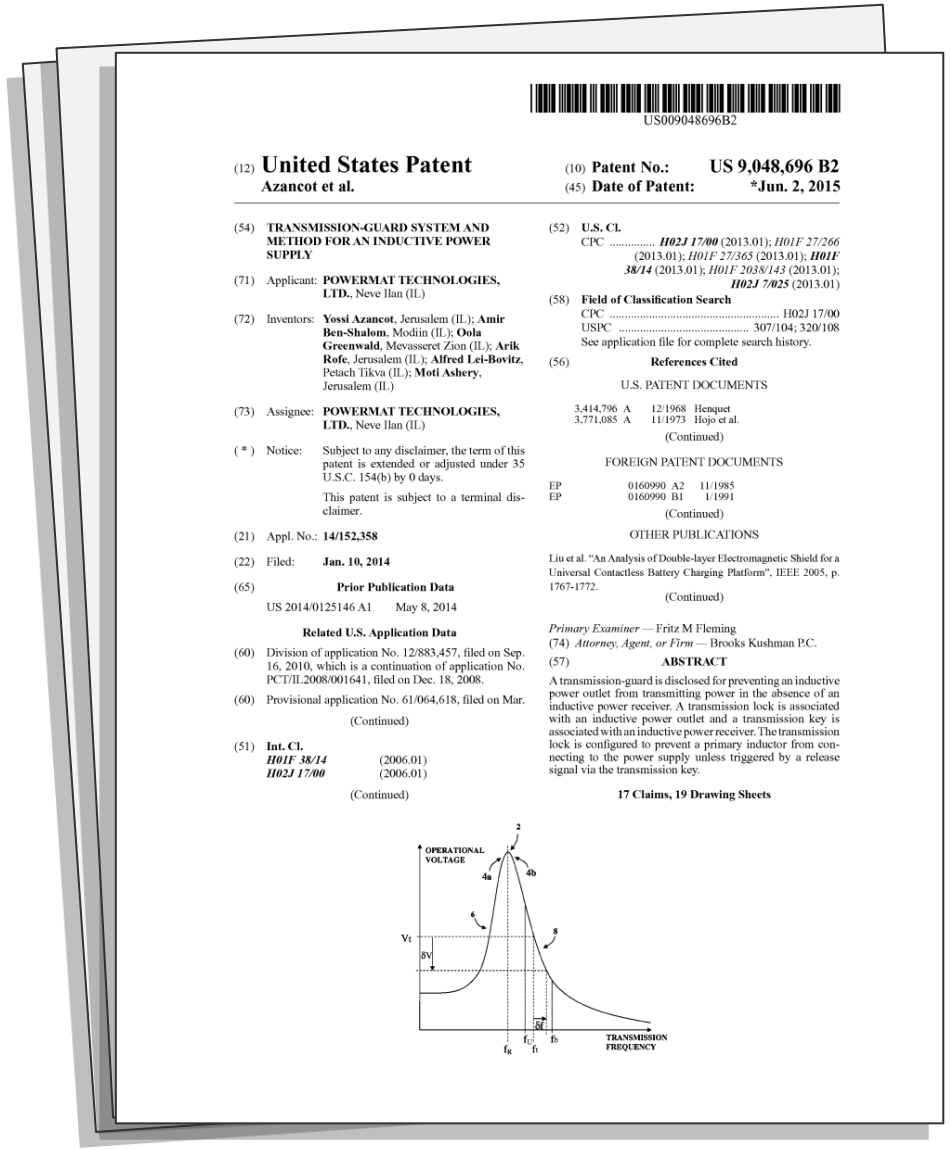
September 16, 2025



TRANSMISSION-GUARD SYSTEM AND METHOD FOR AN INDUCTIVE POWER SUPPLY

U.S. PATENT NO. 9,048,696

'696 PATENT OVERVIEW



US009048696B2

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

(10) **Patent No.: US 9,048,696 B2**
(45) **Date of Patent: *Jun. 2, 2015**

(54) **TRANSMISSION-GUARD SYSTEM AND METHOD FOR AN INDUCTIVE POWER SUPPLY**

(71) Applicant: **POWERMAT TECHNOLOGIES, LTD.**, Neve Ilan (IL)

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(73) Assignee: **POWERMAT TECHNOLOGIES, LTD.**, Neve Ilan (IL)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **14/152,358**

(22) Filed: **Jan. 10, 2014**

(65) **Prior Publication Data**

US 2014/0125146 A1 May 8, 2014

Related U.S. Application Data

(60) Division of application No. 12/883,457, filed on Sep. 16, 2010, which is a continuation of application No. PCT/IL2008/001641, filed on Dec. 18, 2008.

(60) Provisional application No. 61/064,618, filed on Mar.

(Continued)

(51) **Int. Cl.**
H01F 38/14 (2006.01)
H02J 17/00 (2006.01)

(Continued)

(52) **U.S. Cl.**
CPC ***H02J 17/00*** (2013.01); *H01F 27/266* (2013.01); *H01F 27/365* (2013.01); ***H01F 38/14*** (2013.01); *H01F 2038/143* (2013.01); ***H02J 7/025*** (2013.01)

(58) **Field of Classification Search**
CPC H02J 17/00
USPC 307/104; 320/108
See application file for complete search history.

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Primary Examiner — Fritz M Fleming
(74) *Attorney, Agent, or Firm* — Brooks Kushman P.C.

(57) **ABSTRACT**

A transmission-guard is disclosed for preventing an inductive power outlet from transmitting power in the absence of an inductive power receiver. A transmission lock is associated with an inductive power outlet and a transmission key is associated with an inductive power receiver. The transmission lock is configured to prevent a primary inductor from connecting to the power supply unless triggered by a release signal via the transmission key.

17 Claims, 19 Drawing Sheets

Patent No.: US 9,048,696 B2

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TRANSMISSION-GUARD SYSTEM AND METHOD FOR AN INDUCTIVE POWER SUPPLY

Related U.S. Application Data

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Provisional application No. 61/064,618, filed on Mar. 17, 2008, provisional application No. 61/071,151, filed on Apr. 15, 2008, provisional application No. 61/129,526, filed on Jul. 2, 2008, provisional application No. 61/129,859, filed on Jul. 24, 2008, provisional application No. 61/129,970, filed on Aug. 4, 2008.

Overview of U.S. Patent No. 9,048,696

PROBLEM

- A need exists "for a practical inductive power transfer system for safely and conveniently delivering power wirelessly from inductive power outlets to inductive power receivers in an energy efficient manner." EX1001 at 2:35-38.
- "[P]rior art systems . . . 'typically transmit power at the resonant frequency of the inductive coupling,' which 'can be difficult to maintain, as the resonant frequency of the system may fluctuate during power transmission, for example in response to changing environmental conditions or variations in alignment between primary and secondary coils.'" EX2006 at ¶ 46 (quoting EX1001 at 19:65-20:3); *see also* POR at 2-3 (Paper 11).

Overview of U.S. Patent No. 9,048,696

SOLUTION

- A transmission frequency f_t is selected to lie within the near-linear region of a frequency-amplitude curve, substantially different from the resonance frequency f_R (or peak) of the inductive couple. EX2006 at ¶ 47; *see also* EX1001 at 21:20-23, 56-57; POR at 2 (Paper 11).
- Near-linear operation is achieved by transmitting a driving voltage which oscillates at a transmission frequency substantially different from the resonant frequency of the inductive couple. EX2006 at ¶ 49; *see also* EX1001 at 21:17-20; POR at 3-4 (Paper 11).
- The transmission frequency may be used to regulate power transfer. EX1001 at 21:47-49; *see also* EX2006 at ¶ 51; POR at 4 (Paper 11).

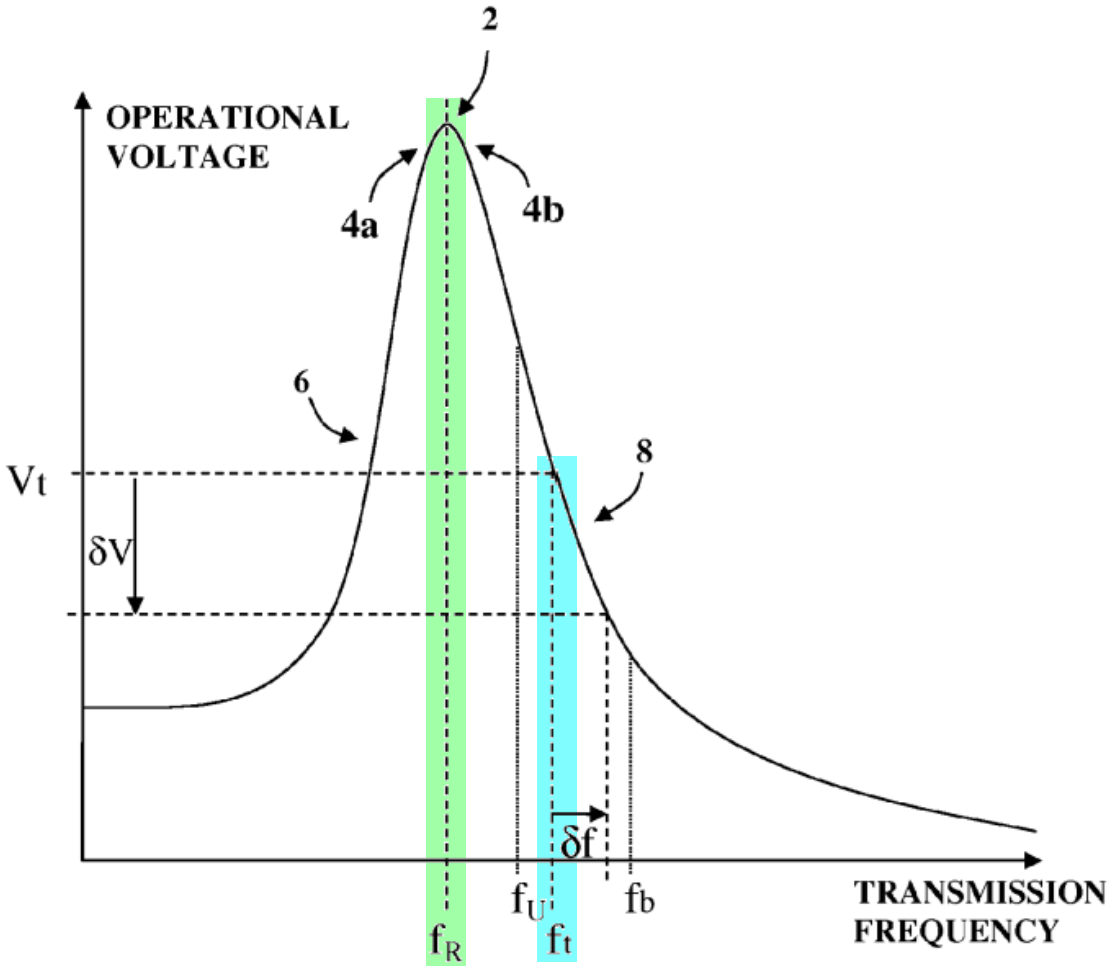


Fig. 6b

EX1001 at Fig. 6b (annotated); *see also* POR at 3 (Paper 11).

Claim 1

CLAIM 1
[1.P] An inductive power outlet operable to transfer power to an inductive power receiver, said inductive power outlet comprising:
[1.1] a platform for supporting said inductive power receiver;
[1.2] at least one primary inductive coil embedded in said platform;
[1.3] an alignment mechanism configured to facilitate alignment between said primary inductive outlet and said inductive power receiver;
[1.4] such that an inductive couple is formed between said primary inductive coil and a secondary inductive coil of said inductive power receiver, said inductive couple having a characteristic resonant frequency; and
[1.5] a driving circuit wired to said primary inductive coil;
[1.6] said driving circuit comprising a switching unit configured an operable to provide an oscillating driving voltage across said primary inductive coil such that a secondary voltage is induced in the secondary inductive coil;
[1.7] wherein said driving circuit is configured an operable to produce said oscillating driving voltage at a transmission frequency substantially different from said characteristic resonant frequency of said inductive couple.

Claim 2

CLAIM 2
[2.P] The inductive power outlet of claim 1 said inductive power outlet comprising a signal detector adapted to detect a first signal and a second signal, and said driver is configured to:
[2.1] increase said transmission frequency when said first signal is detected by the detector, and
[2.2] decrease said transmission frequency when said second signal is detected by the detector.

Claim 3

CLAIM 3
The inductive power outlet of claim 1 said driving being configured to adjust said transmission frequency in response to feedback signals.

Claim 4

CLAIM 4
The inductive power outlet of claim 3 wherein said feedback signals carry data pertaining to the operational parameters of said electric load.

Claim 5

CLAIM 5
The inductive power outlet of claim 4 wherein said operational parameters are selected from the group consisting of: required operating voltage for said electric load; required operating current for said electric load; required operating temperature for said electric load; required operating power for said electric load; measured operating voltage for said electric load; measured operating current for said electric load; measured operating temperature for said electric load; measured operating power for said electric load; power delivered to said primary inductive coil; power received by said secondary inductive coil, and a user identification code.

Claim 6

CLAIM 6
The inductive power outlet of claim 2 wherein said detector is selected from the list comprising optical detectors, radio receivers, audio detectors and voltage peak detectors.

Claim 7

CLAIM 7
The inductive power outlet of claim 1 wherein said driver further comprises a voltage monitor for monitoring the amplitude of a primary voltage across said primary coil.

Claim 9

CLAIM 9
The inductive power outlet of claim 1 comprising a power converter selected from the group comprising: a transformer, a DC-to-DC converter, an AC-to-DC converter, an AC-to-AC converter, a flyback transformer, a flyback converter, a full-bridge converter, a half-bridge converter and a forward converter.

Claim 10

CLAIM 10
The inductive power outlet of claim 1 incorporated into at least one application selected from a group consisting of: inductive chargers, inductive power adaptors, power tools, kitchen appliances, bathroom appliances, computers, media players, office equipment, implanted devices, pace makers, trackers and RFID tags.

Claim 11

CLAIM 11
The inductive power outlet of claim 1 wherein said alignment mechanism comprises a first magnetic element configured to engage a second magnetic element associated with the power receiver.

Claim 12

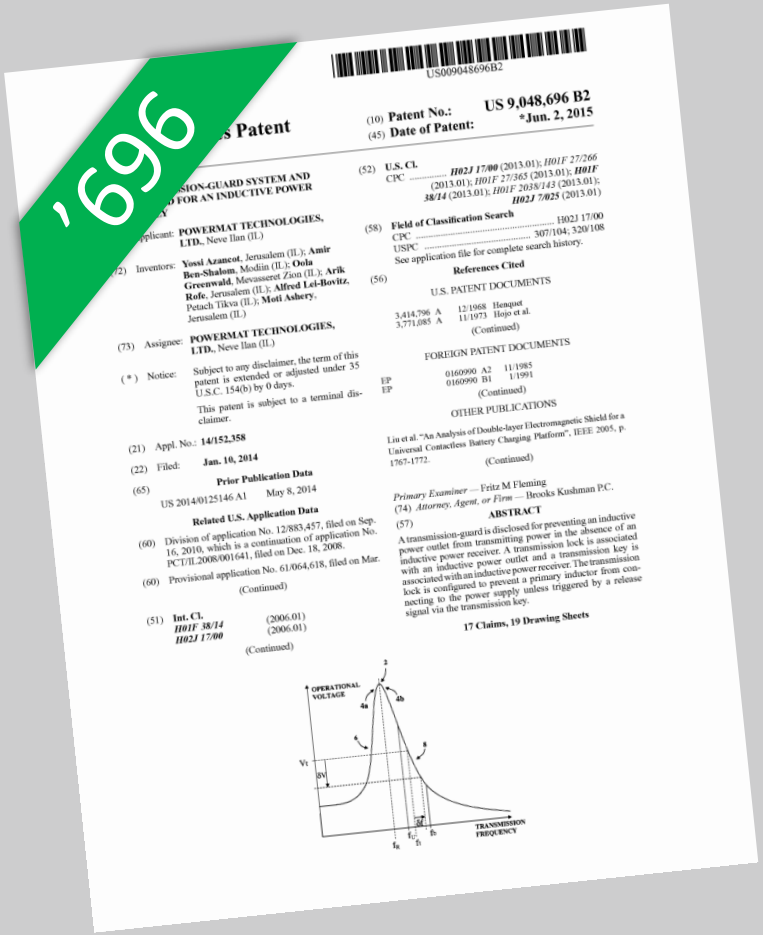
CLAIM 12
The inductive power outlet of claim 1 wherein said alignment mechanism comprises an audible indication.

Claim 13

CLAIM 13
The inductive power outlet of claim 1 wherein said alignment mechanism comprises a visual indication.

Claim 14

CLAIM 14
The inductive power outlet of claim 1 wherein said alignment mechanism comprises a tactile indication.



TRANSMISSION-GUARD SYSTEM AND METHOD FOR AN INDUCTIVE POWER SUPPLY

U.S. PATENT NO. 9,048,696

'696 CLAIM CONSTRUCTION

The Board's Preliminary Construction

> On this record and for purposes of this decision, we determine that—consistent with the Specification's description of the frequency that is "[p]referably . . . selected" and applicant's argument regarding the same during prosecution—"a transmission frequency *substantially different* from said characteristic resonant frequency of said inductive couple" encompasses frequencies that lie within one of the near-linear regions of a frequency-amplitude graph associated with the inductive couple. *See* Ex. 1001, 21:20–24; Ex. 1002, 70. At this time and for purposes of this Decision, we need not and do not reach the issue of the outer bounds of the scope of "substantially different."

Decision Granting Institution at 22 (Paper 7).

"transmission frequency [that is] substantially different from the characteristic resonant frequency" (claim 1)

Patent Owner's Construction	Petitioner's Construction
"[A] POSITA would understand that the selection of a transmission frequency within the near-linear regions of a frequency-amplitude graph (*i.e.*, selection of a transmission frequency that is substantially different form the characteristic resonant frequency) will enable a linear control technique for predictably regulating power transfer. Thus, a POSITA would define the 'transmission frequency [that is] substantially different from the characteristic resonant frequency,' as recited in claim 1, to further allow for some incremental change (increase or decrease) in frequency while remaining in one of the near-linear regions of the frequency-amplitude graph." POR at 29 (Paper 11) (citing EX2006 at ¶ 112).	"[R]egardless of the outermost boundaries of the scope of a transmission frequency 'substantially different' from a characteristic resonant frequency as claimed, the specification plainly establishes that it must at least encompass the frequencies within one of the near-linear regions of the frequency-amplitude graph." Pet. at 8-9 (Paper 2).

The Dispute: **Whether the term "substantially different" allows for incremental change in frequency while remaining in one of the near-linear regions of the frequency-amplitude graph.**

Intrinsic Evidence Supports Patent Owner's Construction of "Substantially Different"

It is another aim of the invention to present an inductive power transfer system comprising at least one inductive power outlet comprising at least one primary inductive coil wired to a power supply via a driver; the primary inductive coil for forming an inductive couple with at least one secondary inductive coil wired to an electric load, the secondary inductive coil associated with an inductive power receiver wherein the driver is configured to provide a driving voltage across the primary inductive coil, the driving voltage oscillating at a transmission frequency significantly different from the resonant frequency of the inductive couple. Optionally, the driver comprises a switching unit for intermittently connecting the primary inductive coil to the power supply.

Preferably, the transmission frequency lies within a range in which induced voltage varies approximately linearly with frequency. Optionally, the driver is configured to adjust the transmission frequency in response to the feedback signals.

EX1001 at 4:1-17; *see also* POR at 25-26 (Paper 11)

One example of a power regulation method using simple feedback signals is shown in the flowchart of FIG. **6***d*. The method involves the following steps: (a) The driver **6230** provides an oscillating voltage at a transmission frequency f_t which is higher than the resonant frequency f_R of the system; (b) A secondary voltage is induced in the secondary coil **6320**; (c) A power monitor in the secondary unit **6300**, monitors the power received by the electric load **6340**; (d) If the power received by the electric load **6340** lies within a predetermined range then no action is taken. If the power received by the electric load E**340** is below the predetermined range, then a feedback signal of a first type S_a is sent to the driver. If the power received by the electric load **6340** is above the predetermined range, then a feedback signal of a second type S_b is sent to the driver; (e) A feedback signal is received by the driver **6230**; (f) If the received feedback signal is of the first type S_a, then the transmission frequency is increased by an incremental value $+\delta f_1$. If the received feedback signal is of the second type S_b, then the transmission frequency is decreased by an incremental value $-\delta f_2$.

EX1001 at 22:45-64; *see also* POR at 26 (Paper 11)

Intrinsic Evidence Supports Patent Owner's Construction of "Substantially Different"

Dr. Mercier

While the '696 Patent does not use the phrase "linear regulation" or "linear control," a POSITA would understand this benefit as a central aim of the '696 Patent. . . . Figure 6d in the '696 patent then goes on to explain the power regulation method, showing that the power monitor monitors the power received by the electrical load, and uses this signal in a feedback loop to adjust the operational frequency by incremental amounts. A POSITA would understand this as a classic linear regulation scheme, and a key aim of the '696 patent.

EX2006 at ¶ 111; *see also* POR at 25 (Paper 11).

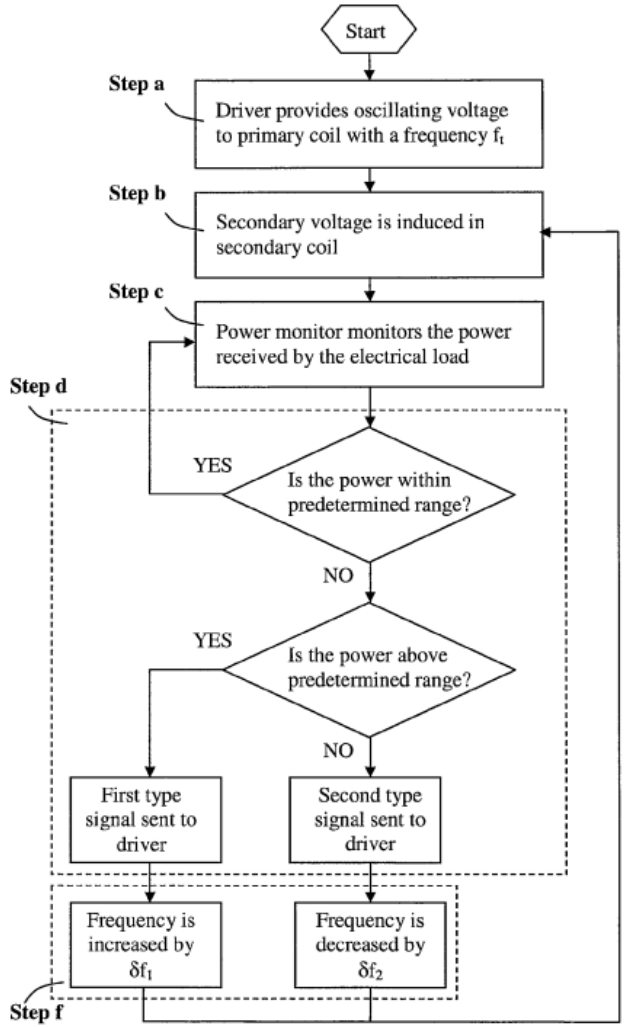


Fig. 6d

EX1001 at Fig. 6d; *see also* POR at 6 (Paper 11).

Intrinsic Evidence Supports Patent Owner's Construction of "Substantially Different"

Referring back to FIG. **6***b*, the frequency of transmission is selected to be in the approximately linear region **8** of the curve between a lower frequency value of f_L, and an upper frequency value of f_U. A transmission frequency f_t, higher than the resonant frequency f_R of the system, produces an induced voltage of V_t. The induced voltage can be increased by reducing the transmission frequency and can be reduced by increasing the transmission frequency. For example, an increase in transmission frequency of δf produces a decrease in induced voltage of δV.

EX1001 at 21:56-67; POR at 26-27 (Paper 11).

One example of a power regulation method using simple feedback signals is shown in the flowchart of FIG. **6***d*. The method involves the following steps: (a) The driver **6230** provides an oscillating voltage at a transmission frequency f_t which is higher than the resonant frequency f_R of the system; (b) A secondary voltage is induced in the secondary coil **6320**; (c) A power monitor in the secondary unit **6300**, monitors the power received by the electric load **6340**; (d) If the power received by the electric load **6340** lies within a predetermined range then no action is taken. If the power received by the electric load E**340** is below the predetermined range, then a feedback signal of a first type S_a is sent to the driver. If the power received by the electric load **6340** is above the predetermined range, then a feedback signal of a second type S_b is sent to the driver; (e) A feedback signal is received by the driver **6230**; (f) If the received feedback signal is of the first type S_a, then the transmission frequency is increased by an incremental value $+\delta f_1$. If the received feedback signal is of the second type S_b, then the transmission frequency is decreased by an incremental value $-\delta f_2$.

EX1001 at 22:45-64; POR at 27 (Paper 11)

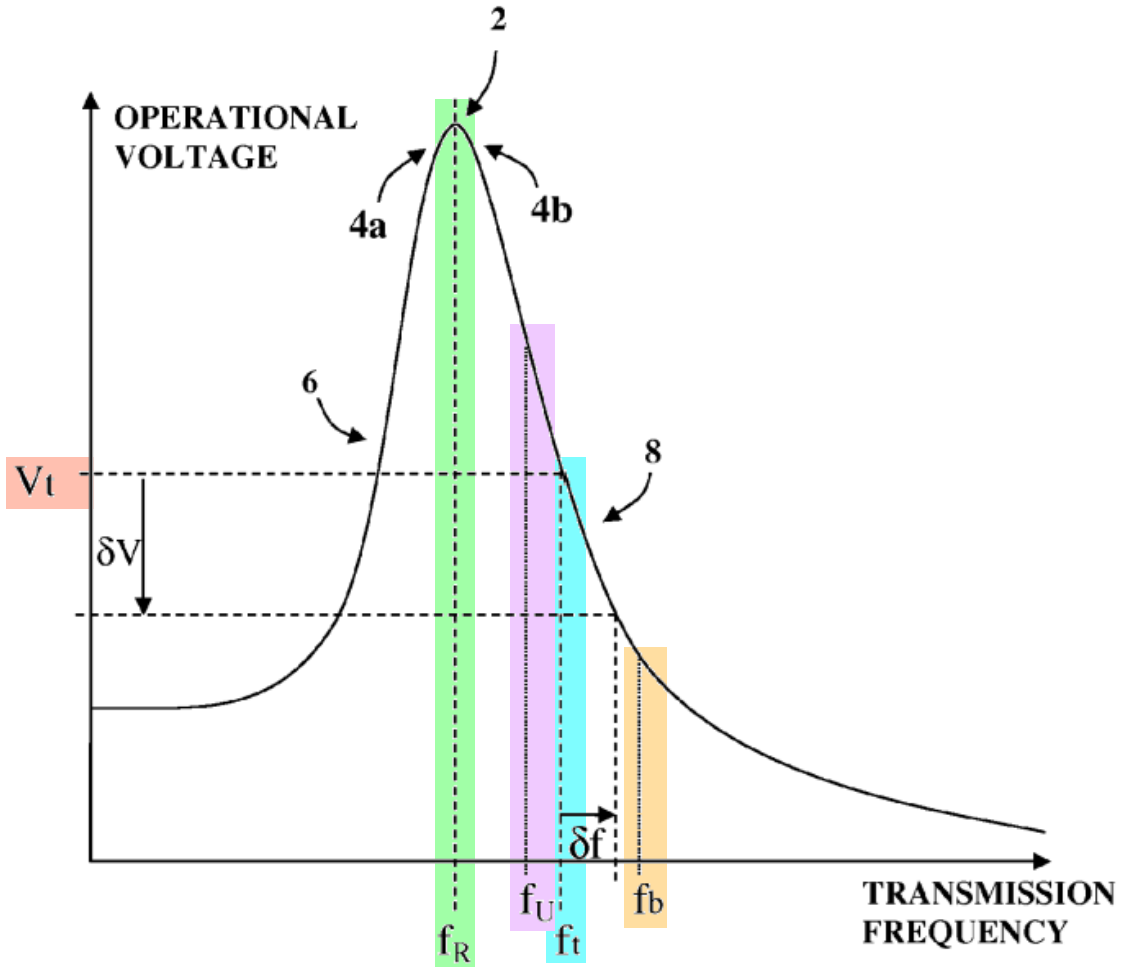


Fig. 6b

EX1001 at Fig. 6b; POR at 27 (Paper 11).

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Intrinsic Evidence Supports Patent Owner's Construction of "Substantially Different"

100. Notably, a POSITA would understand that frequency f_U on Figure 6b is the lower bound frequency in the approximately linear region 8, which also corresponds to the frequency that yields the upper bound of the operational voltage, while frequency f_b on Figure 6b is the upper bound frequency in the approximately linear region 8, which also corresponds to the frequency that yields the lower bound of the operational voltage. A POSITA would understand that f_L and f_b may be regarded as referring to the same thing and may be used interchangeably.

EX2006 at ¶ 100; *see also* POR at 27-28 (Paper 11).

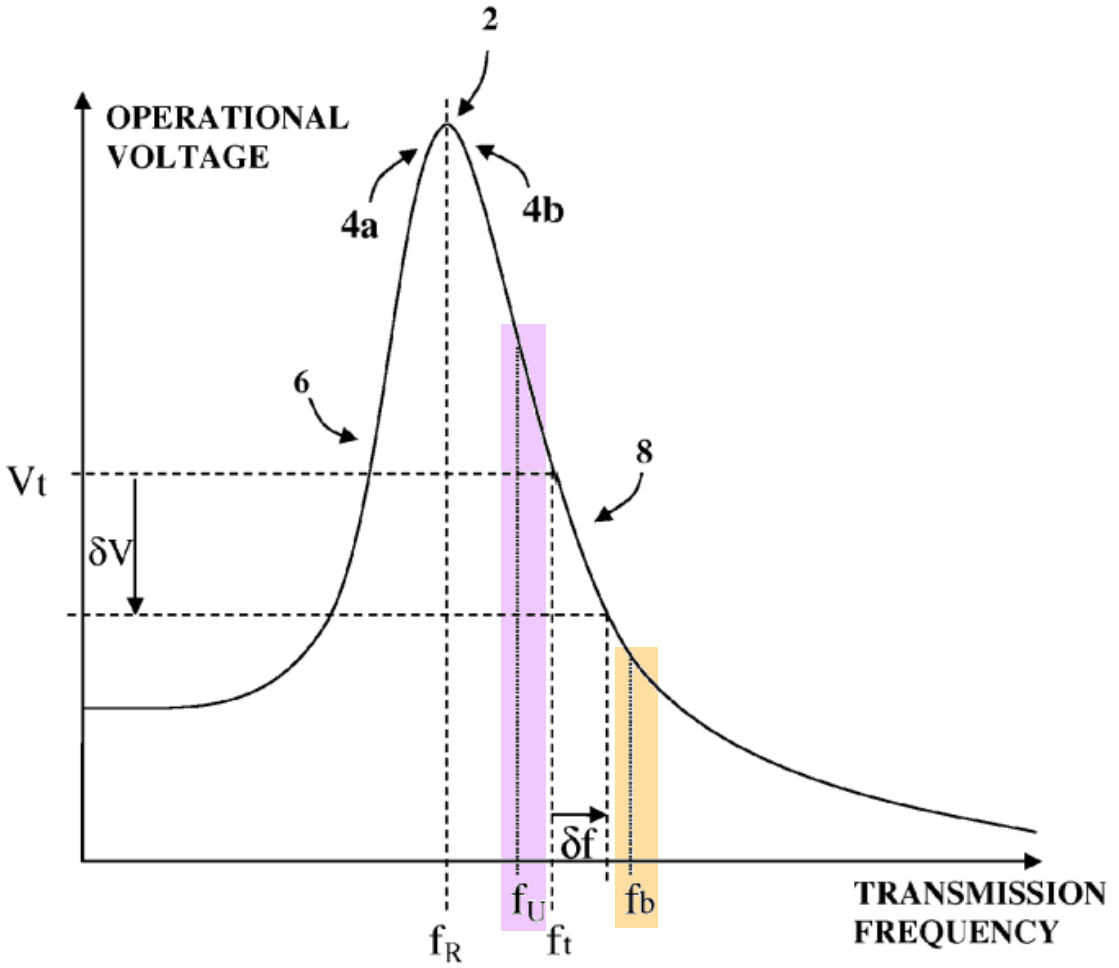


Fig. 6b

EX1001 at Fig. 6b; *see also* POR at 27 (Paper 11).

Claim 2

[2.1] increase said transmission frequency when said first signal is detected by the detector, and

[2.2] decrease said transmission frequency when said second signal is detected by the detector.

Intrinsic Evidence Supports Patent Owner's Construction of "Substantially Different"

> "Importantly, the person of ordinary skill in the art is deemed to read the claim term not only in the context of the particular claim in which the disputed term appears, but in the context of the entire patent, including the specification."
>
> *Phillips v. AWH Corp.*, 415 F.3d 1303, 1313 (Fed. Cir. 2005).

PO Sur-Reply at 4 (Paper 15).

> "The claims, of course, do not stand alone. Rather, they are part of 'a fully integrated written instrument,' consisting principally of a specification that concludes with the claims. For that reason, claims 'must be read in view of the specification, of which they are a part.'"
>
> *Phillips v. AWH Corp.*, 415 F.3d 1303, 1315 (Fed. Cir. 2005) (citations omitted).

PO Sur-Reply at 4 (Paper 15).

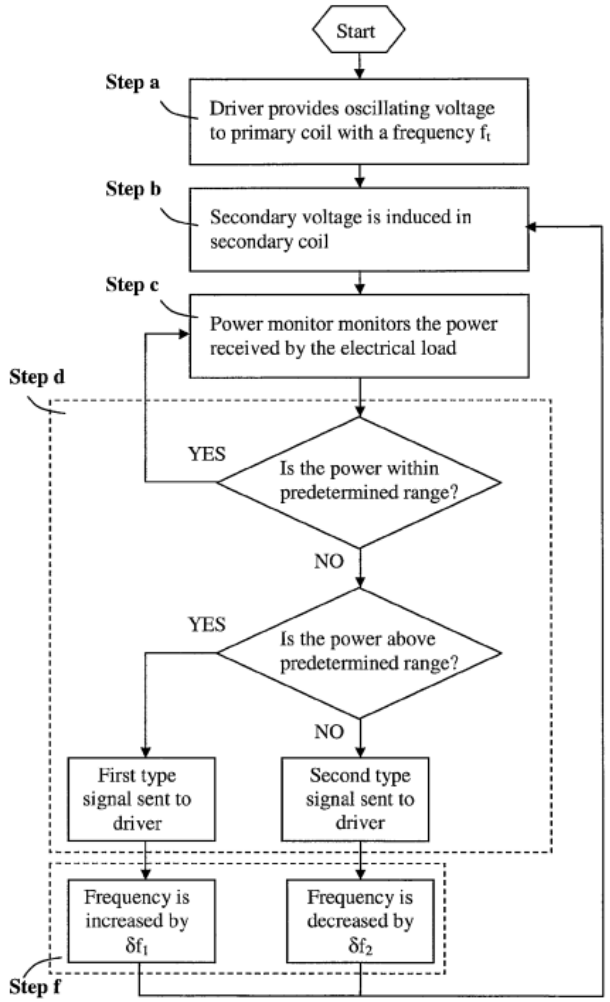
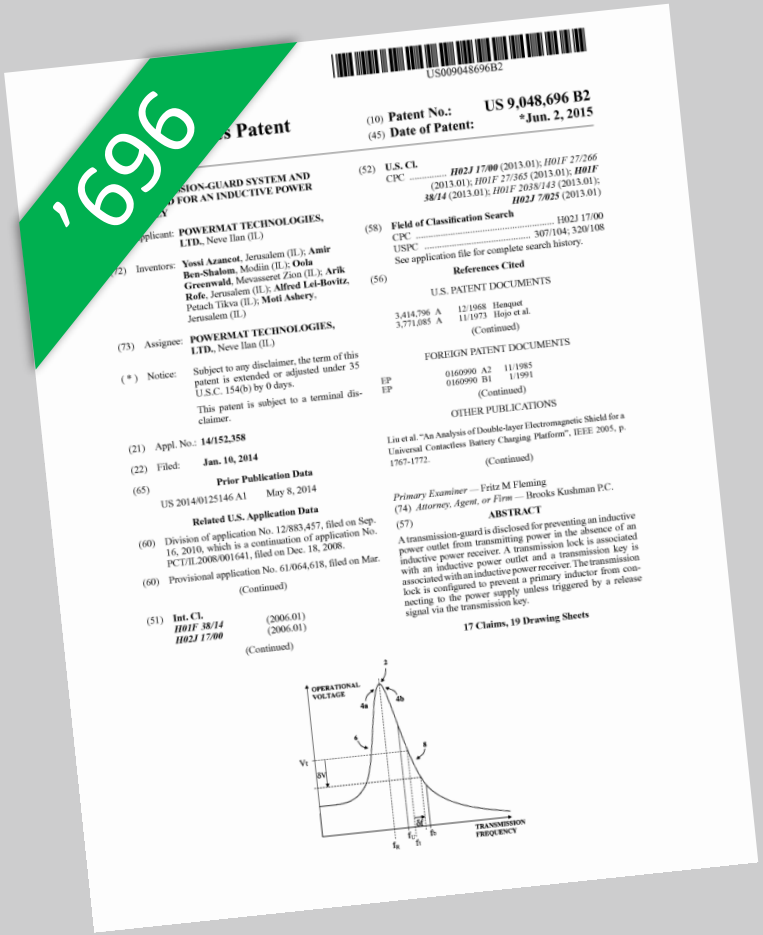


Fig. 6d

EX1001 at Fig. 6d; *see also* POR at 6 (Paper 11).



TRANSMISSION-GUARD SYSTEM AND METHOD FOR AN INDUCTIVE POWER SUPPLY

U.S. PATENT NO. 9,048,696

DEFICIENCIES OF GROUND 1A

Claim 1

[1.4] such that **an inductive couple is formed between said primary inductive coil and a secondary inductive coil** of said inductive power receiver, **said inductive couple having a characteristic resonant frequency**; and

Onishi + Flowerdew Fail to Disclose Limitation [1.4]

[0180] FIG. **4** is a view showing the resonance characteristics of the induction coil and applications of frequencies. The resonance characteristics of the primary coil L**1** and the secondary coil L**2** when the portable telephone **510** is placed on the charger **500** (cradle) (i.e., when load exists with respect to the power transmission device **10**) (see FIG. **1**A) have a symmetrical and broad mountain shape, as shown in FIG. **4**, for example. In FIG. **4**, the horizontal axis indicates the frequency, and the vertical axis indicates the resonance peak value.

EX1004 at [0180]; *see also* POR at 33 (Paper 11).

117. Although Onishi states that "[t]he **resonance characteristics of the primary coil L1 and the secondary coil L2** . . . have a symmetrical and broad mountain shape, as shown in FIG. 4" (Ex. 1004 at [0180]), a POSITA would understand that this discussion relates to two independent inductive coils as opposed to an inductive couple formed therebetween. As noted above, the preceding sentence clearly establishes that Figure 4 pertains to the resonance characteristics of the induction coil—not a pair of inductively coupled coils. Grounded in this context, a POSITA would recognize this sentence as referring to the resonance characteristics of independent coils (*i.e.*, the primary or secondary coil).

EX2006 at ¶ 117; *see also* POR at 33 (Paper 11).

Claim 1

[1.4] such that **an inductive couple is formed between said primary inductive coil and a secondary inductive coil** of said inductive power receiver, **said inductive couple having a characteristic resonant frequency**; and

Onishi + Flowerdew Fail to Disclose Limitation [1.4]

[0135] The power transmission section **12** may include a first power transmission driver which drives one end of the primary coil L**1**, a second power transmission driver which drives the other end of the primary coil L**1**, and at least one capacitor which forms a resonant circuit together with the primary coil L**1**.

EX1004 at [0135]; POR at 32 (Paper 11).

Claim 1

[1.4] such that an inductive couple is formed between said primary inductive coil and a secondary inductive coil of said inductive power receiver, said inductive couple having a characteristic resonant frequency; and

Onishi + Flowerdew Fail to Disclose Limitation [1.4]

Gary L. Woods, Ph.D.

Q. Now, will an inductive couple of primary coil L1 and capacitor C1 and C2 and secondary coil L2 with capacitor CB1 have a characteristic resonant frequency that is different than the characteristic resonant frequent of the primary coil L1 along with capacitor C1 and C2?

A. You're asking if the coupled system has a different resonance frequency than the transmission section alone with no receiver?

Q. Correct.

A. Yes.

EX2007 at 8:22-9:9; *see also* POR at 32 (Paper 11).

Claim 1

[1.4] such that an inductive couple is formed between said primary inductive coil and a secondary inductive coil of said inductive power receiver, said inductive couple having a characteristic resonant frequency; and

Onishi + Flowerdew Fail to Disclose Limitation [1.4]

Gary L. Woods, Ph.D.

Q. Do you agree that the characteristic resonance frequency of the inductive couple system is dependent on both the characteristic resonant frequency of the primary coil L1 resonant frequency and the secondary resonant frequency of coil L2?

A. Yes. Among other things.

EX2007 at 10:7-14; *see also* POR at 33 (Paper 11).

Claim 1

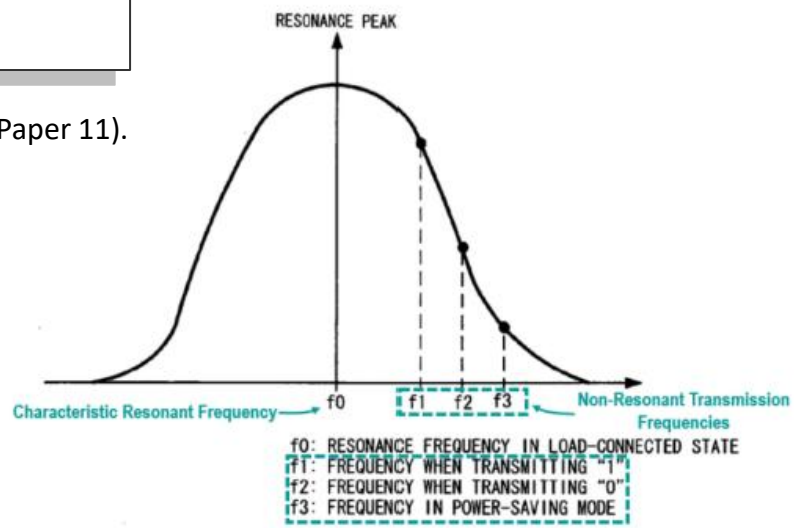
[1.7] wherein said driving circuit is configured and operable to produce said oscillating driving voltage at a transmission frequency substantially different from said characteristic resonant frequency of said inductive couple.

Petitioner's Reliance on Onishi Figure 4 is Improper

> Petitioner asserts that Onishi discloses "a non-resonant transmission frequency (e.g., frequencies f1, f2, or f3) that is substantially different from the characteristic resonant frequency (e.g., frequency f0) of the inductive couple." Pet. at 27. In support of this assertion, Petitioner argues that "each of frequencies f1, f2, and f3 lie in a near-linear region of the frequency-response curve and thus . . . fall within the scope of being 'substantially different' from the characteristic resonant frequency f0." Pet. at 27-28.

POR at 38 (Paper 11).

FIG. 4



Pet. at 27 (Paper 2) (annotated by Petitioner).

Claim 1

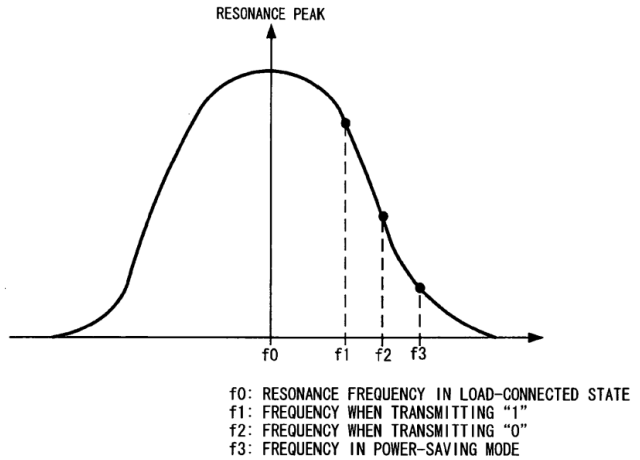
[1.7] wherein said driving circuit is configured and operable to produce said oscillating driving voltage at a transmission frequency substantially different from said characteristic resonant frequency of said inductive couple.

Petitioner's Reliance on Onishi Figure 4 is Improper

[0181] In FIG. **4**, the frequency f**1** is a frequency used when transmitting "1" during normal power transmission. The frequency f**1** is a basic frequency during power transmission. The frequency f**2** is a frequency used when transmitting "0" (see FIGS. **3**A and **3**B). A frequency f**3** is a frequency used in the power-saving mode. As is clear from FIG. **4**, the relationship "f1>f2>f3" is satisfied.

EX1004 at [0181]; *see also* POR at 38-39 (Paper 11).

FIG. 4



EX1004 at FIG. 4; *see also* POR at 36 (Paper 11).

- Figure 4 is not drawn to scale.
- Figure 4 lacks axis labels.
- The x-axis in Figure 4 cannot be frequency if "the relationship 'f1>f2>f3' is satisfied."

POR at 38-42 (Paper 11); PO Sur-Reply at 14 (Paper 15); EX2006 at ¶¶ 126-129.

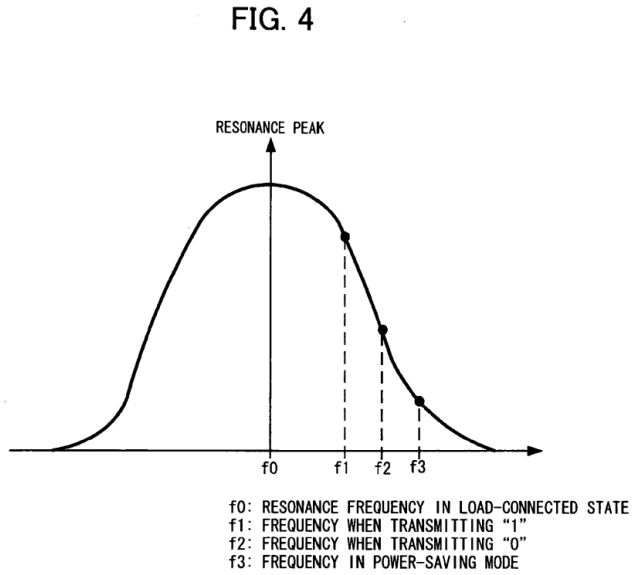
Claim 1

[1.7] wherein said driving circuit is configured and operable to produce said oscillating driving voltage at a transmission frequency substantially different from said characteristic resonant frequency of said inductive couple.

Petitioner's Reliance on Onishi Figure 4 is Improper

128. While Figure 4 of Onishi and Figure 6b of the '696 Patent both depict parabolic like curves, without dimensions or vertical-axis labels a POSITA would not be able to draw any conclusions regarding any similarities between the two illustrations. For example, if we assume *arguendo* that the vertical axis label in Figure 4 of Onishi is "RESONANCE PEAK," this does not make sense: this is not a variable that varies with frequency, rather it is a single frequency that is achieved at "peak" impedance, voltage, current or some other electrical characteristic—it is not a variable to be used in this context as a vertical axis of a plot versus frequency. Ex. 1004 at Fig. 4. If, on the other hand, we assume *arguendo* that "RESONANCE PEAK" refers to a single point on the curve, then there is no vertical axis label on the plot, and we do not know what is being represented. Thus, without additional information, no conclusions can be drawn regarding the teachings of Figure 4 in Onishi.

EX2006 at ¶ 128; *see also* POR at 41 (Paper 11).



EX1004 at FIG. 4; *see also* POR at 36 (Paper 11).

Claim 1

[1.7] wherein said driving circuit is configured and operable to produce said oscillating driving voltage at a transmission frequency substantially different from said characteristic resonant frequency of said inductive couple.

Onishi + Flowerdew Fail to Disclose Limitation [1.7]

Patrick Mercier, Ph.D.

Q. Are you familiar with Figure 4 in Onishi?

A. I am.

Q. Did you offer opinions regarding Figure 4 of Onishi in your declaration?

A. I did.

Q. And Figure 4 depicts a frequency response curve, correct?

A. Well, it depicts – it depicts a very confusing curve, I'll say, due to the lack of labels on the respective axes.

Mercier Dep. Tr. (EX1102) at 49:24-50:8; *see also* POR at 38-42 (Paper 11).

Claim 1

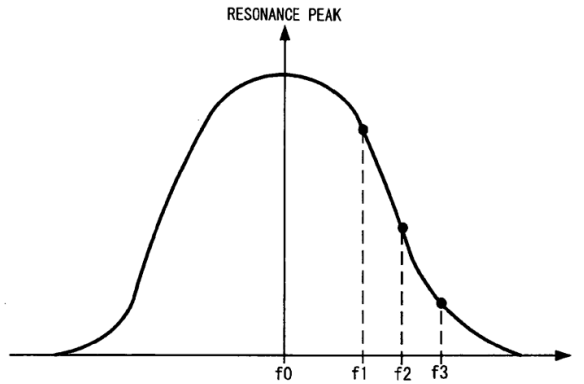
[1.7] wherein said driving circuit is configured and operable to produce said oscillating driving voltage at a transmission frequency substantially different from said characteristic resonant frequency of said inductive couple.

Onishi + Flowerdew Fail to Disclose Limitation [1.7]

[0053] Power transmission (i.e., power-saving power transmission) that transmits a small amount of power as compared with normal power transmission is continuously performed after the battery has been fully charged so that power (power supply voltage) is supplied to the load. This ensures that the load maintains its charge management function even after the battery has been fully charged. Accordingly, when it is necessary to recharge the battery due to a discharge after the battery has been fully charged, the charge management function of the load causes the battery to be recharged automatically. Therefore, the battery can be easily recharged. Note that power-saving power transmission transmits only a small amount of power which merely maintains the battery charge management function of the load. Specifically, power consumption is sufficiently reduced during power-saving power transmission. The transmission frequency during power-saving power transmission is set at a frequency apart from the resonance frequency (resonance peak) as compared with the frequency during normal power transmission, for example. The power to be transmitted can also be reduced, even if the transmission frequency is the same, by increasing the frequency difference between the resonance frequency (resonance peak) and the transmission frequency by changing the resonance characteristics of the resonant circuit to change the resonance frequency (resonance peak).

EX1004 at [0053]; *see also* POR at 38-39 (Paper 11).

FIG. 4



EX1004 at FIG. 4; *see also* POR at 36 (Paper 11).

If frequency f3 is "apart" from the resonance frequency, then frequencies f1 and f2—as normal power transmission frequencies—are not apart from the resonance.

EX2006 at ¶ 131; *see also* POR at 42-44 (Paper 11).

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Claim 1

[1.7] wherein said driving circuit is configured and operable to produce said oscillating driving voltage at a transmission frequency substantially different from said characteristic resonant frequency of said inductive couple.

Onishi + Flowerdew Fail to Disclose Limitation [1.7]

Gary L. Woods, Ph.D.

Q. What does the word "apart" mean to you in the context of paragraph 53 of Onishi?

A. I guess you would say – I guess Onishi would say distinguishable from. I think that's a fair word a POSITA might have used at the time.

Q. What's an antonym for "distinguishable from"?

A. Indistinguishable from.

EX2007 at 17:14-23; *see also* POR at 43 (Paper 11).

Onishi + Flowerdew Fail to Disclose Limitation [1.7]

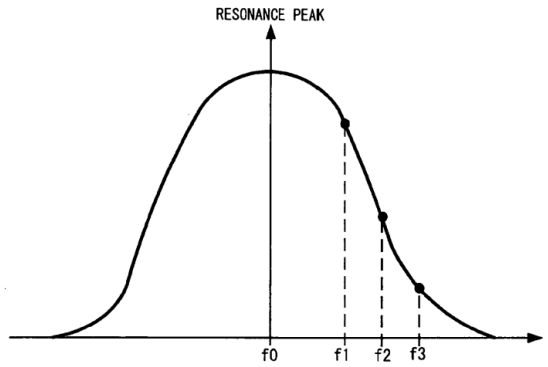
Claim 1

[1.7] wherein said driving circuit is configured and operable to produce said oscillating driving voltage at a transmission frequency substantially different from said characteristic resonant frequency of said inductive couple.

> 133. Onishi's power-saving mode frequency f3—while "set at a frequency apart from the resonance frequency" (Ex. 1004 at [0053])—is neither described, shown, nor otherwise disclosed as a transmission frequency that is substantially different from the characteristic resonance of the inductive couple.

EX2006 at ¶ 133; *see also* POR at 44-48 (Paper 11).

FIG. 4



EX1004 at FIG. 4; *see also* POR at 36 (Paper 11).

- Frequency f3 is only described as being "apart" from frequency f0.
- Nothing establishes that frequency f3 falls within the near-linear region of Figure 4.

POR at 45 (Paper 11); EX2006 at ¶¶ 131, 134-138.

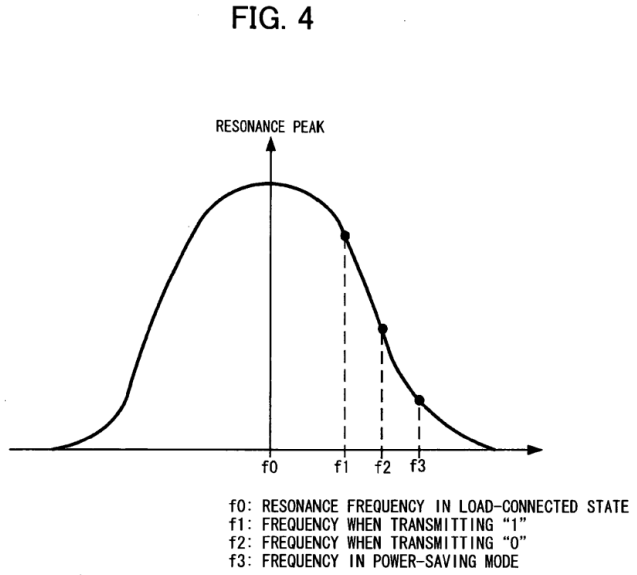
Claim 1

[1.7] wherein said driving circuit is configured and operable to produce said oscillating driving voltage at a transmission frequency substantially different from said characteristic resonant frequency of said inductive couple.

Onishi + Flowerdew Fail to Disclose Limitation [1.7]

[0178] In the invention, a small amount of power is continuously transmitted in the power-saving mode after the battery has been fully charged based on the above consideration. Therefore, whether or not recharging is necessary can be determined and recharging can be started after the battery has been fully charged without adding a special configuration.

EX1004 at [0178]; *see also* POR at 47 (Paper 11).



EX1004 at FIG. 4; *see also* POR at 36 (Paper 11).

Power-saving mode frequency f3 corresponds to the region in which little to no power is transmitted to the receiver.

EX2006 at ¶ 137; *see also* POR at 47 (Paper 11).

Claim 1

[1.7] wherein said driving circuit is configured and operable to produce said oscillating driving voltage at a transmission frequency substantially different from said characteristic resonant frequency of said inductive couple.

Onishi + Flowerdew Fail to Disclose Limitation [1.7]

Gary L. Woods, Ph.D.

Q. Does Onishi provide any quantitative measure of the value of frequency F1?

A. Quantitative measure. I mean, there's not a formula – I mean, yeah, there's no number associated with it.

Q. Does Onishi provide any quantitative measure of the value of F1 relative to F0 for resonance frequency?

A. The closest we get to quantitate is about the same as in the '696 patent where we have what looks to be a figure where you have some frequencies that are – they look to be different from the peak. In both those documents that's what we get.

Q. Okay, so the answer is no, Onishi doesn't provide any quantitative measure of the value of F1 relative to F0?

A. I would say Onishi is just as quantitative or not as '696.

Q. Similarly, Onishi – does Onishi provide any quantitative measure of the value of F2?

A. Same answer.

Q. What about any quantitative measure of the value of F3?

A. Same answer.

Q. And similarly, Onishi doesn't provide any quantitative measure of the value of F3 relative to the resonant frequency?

A. Well, I guess Onishi defines it in several places where there's – he defines it –well, we know that at F3 it's in power-saving mode. And in paragraph, was it – right, in paragraph 178 it says a small amount of power is transmitted.

Woods Dep. Tr. (EX2007) at 22:17-24:4; *see also* POR at 40 (Paper 11).

Claim 2

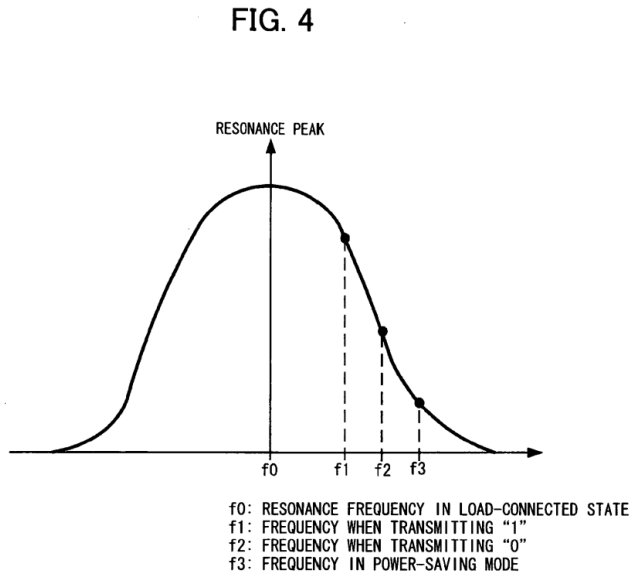
[2.1] increase said transmission frequency when said first signal is detected by the detector, and

[2.2] decrease said transmission frequency when said second signal is detected by the detector.

Onishi + Flowerdew Fail to Disclose Limitations [2.1] and [2.2]

[0181] In FIG. **4**, the frequency f**1** is a frequency used when transmitting "1" during normal power transmission. The frequency f**1** is a basic frequency during power transmission. The frequency f**2** is a frequency used when transmitting "0" (see FIGS. **3**A and **3**B). A frequency f**3** is a frequency used in the power-saving mode. As is clear from FIG. **4**, the relationship "f1>f2>f3" is satisfied.

EX1004 at [0181]; *see also* POR at 49-51 (Paper 11).



EX1004 at FIG. 4; ; *see also* POR at 36 (Paper 11).

- Frequencies f1, f2, and f3 are each discrete frequencies having a distinct purpose
- Any change in frequency (f1 to f2, f2 to f3, or f1 to f3) requires a non-linear decrease in the vertical axis value
- Any change in frequency (f3 to f2, f2 to f1, or f3 to f1) requires a non-linear increase in the vertical axis value

POR at 50 (Paper 11); EX2006 at ¶ 141.

Claim 2

[2.1] increase said transmission frequency when said first signal is detected by the detector, and

[2.2] decrease said transmission frequency when said second signal is detected by the detector.

Onishi + Flowerdew Fail to Disclose Limitations [2.1] and [2.2]

Gary L. Woods, Ph.D.

Q. Does figure 4 disclose any other frequences than F0, F1, F2 and F3?

A. Figure 4 just lists those four frequencies.

Woods Dep. Tr. (EX2007) at 24:23-24, 25:1-2; *see also* POR at 50 (Paper 11).

No Motivation to Combine Onishi and Flowerdew

Referring to FIG. **2**, there is shown power source **306** connected to a controller **308** for driving an oscillator **310**. Controller **308** may include a rectifier. Oscillator **310** provides a high frequency A.C. signal to drive a charger coil. The frequency of the A.C. signal may vary. The lower limit for a practical operating frequency is determined by the higher field strength and/or larger coils required in the primary and secondary units. A higher frequency desirably facilitates the use of a smaller coil in the unit being charged. The upper limit on a practical operating frequency is determined by either the energy dissipated in the metallic content of the unit being charged, primarily the copper layers of a PCB, or by reaching the self-resonant frequency of any of the coils. These limits are therefore defined in practice by the volumes available for the coils, the power that must be transferred, the allowable internal temperature of the unit being charged and the efficiency required in the system. The frequency representing the best compromise between these different criteria is approximately in the range from 8 kHz to 300 kHz. In an embodiment of the invention, the preferred operating range is between 10 kHz and 40 kHz. The high frequency signal may be raised or lower depending upon the specific application. A charger coil (also referred to herein as a drive coil) takes the form in the particular embodiment illustrated of charging coil **312** and charging coil **314** connected to oscillator **310**. As described in further detail below, charging coil **312** and charging coil **314** are disposed at an angle to each other to direct the path of the generated electromagnetic field in a desired manner to enable horizontal coupling.

EX1005 at 5:16-45; *see also* POR at 51 (Paper 11).

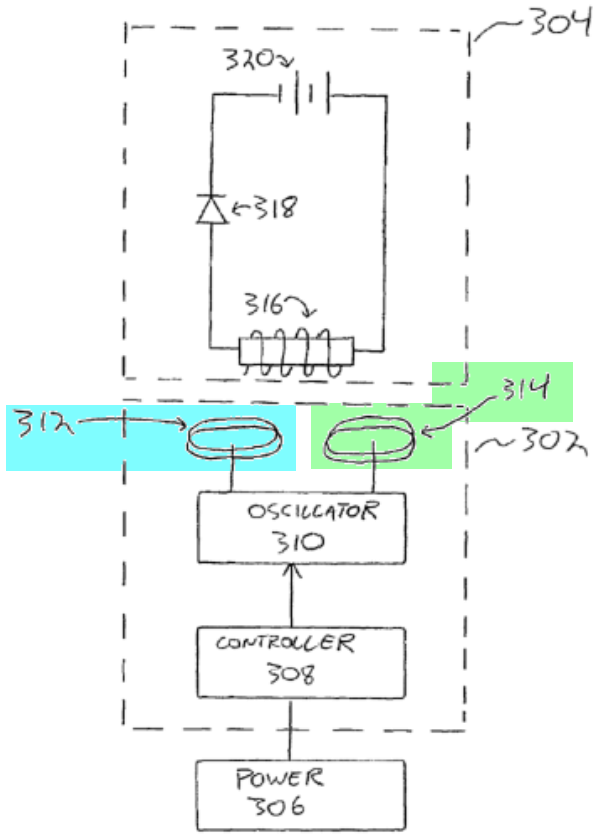


FIGURE 2

EX1005 at Figure 2; *see also* POR at 51 (Paper 11).

No Motivation to Combine Onishi and Flowerdew

In an embodiment of the invention, the charger takes the form of a shallow concave (herein also referred to as "dished" or a "dish") or similarly shaped upper charging surface, which whilst substantially flat and thin, develops a magnetic field which is substantially horizontal rather than perpendicular to its surface, which is typically the case if a coil were wound in the same plane as a plate. By developing an angled field that is substantially horizontal, it is possible to couple energy to a receiver coil comprising a long solenoid, lying horizontally on the upper surface of the charger.

EX1005 at 4:49-59*see also* POR at 52 (Paper 11).

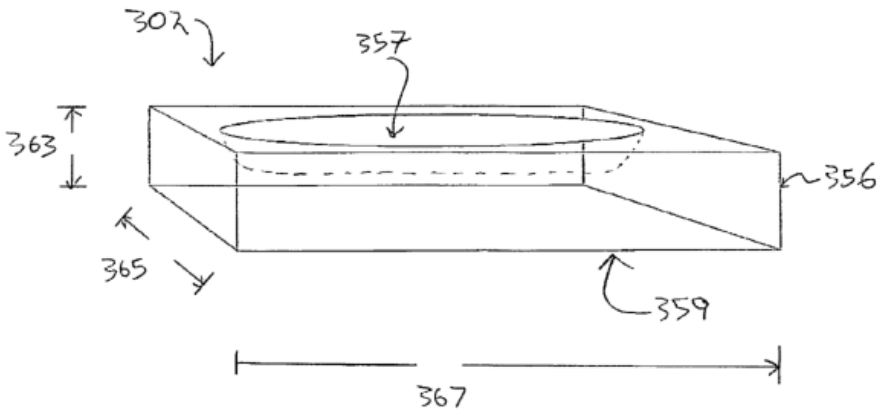
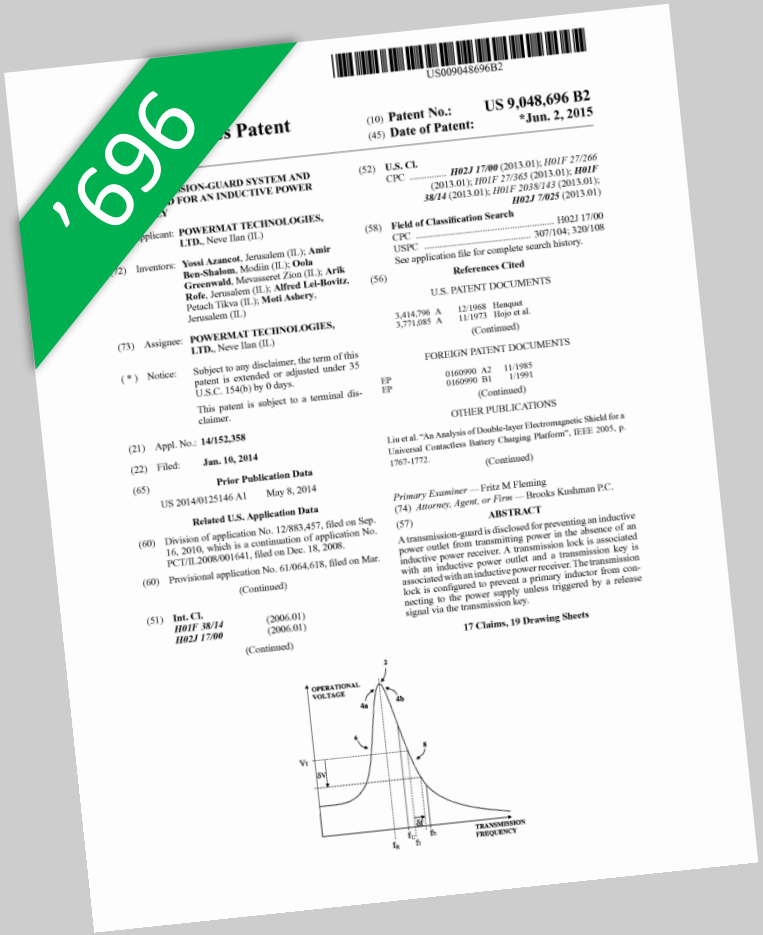


FIGURE 5

EX1005 at Figure 5; *see also* POR at 51-52 (Paper 11).

- Onishi is directed to a configuration having a single charging coil and does not provide the horizontal coupling required by Flowerdew
- Flowerdew's housing shape for the charging device is designed to facilitate coupling with a secondary coil shaped as a long solenoidal coil.

POR at 51-52 (Paper 11); EX2006 at ¶¶ 144-145.



TRANSMISSION-GUARD SYSTEM AND METHOD FOR AN INDUCTIVE POWER SUPPLY

U.S. PATENT NO. 9,048,696

DEFICIENCIES OF GROUND 1B

No Motivation to Combine Onishi and Partovi

[0118] In accordance with an embodiment of the present invention, a capacitor is added in parallel to the drain/source contacts of the MOSFET. FIG. **9** shows a figure of a circuit diagram **240** in accordance with an embodiment. The coil in the wireless charger system is driven by switching the FET at the resonance frequency of the circuit when the receiver is present. Without the receiver nearby, the circuit is detuned from resonance and radiates minimal EMI. The capacitor **244** acts as a reservoir of energy that discharges during switch off time and enhances energy transfer.

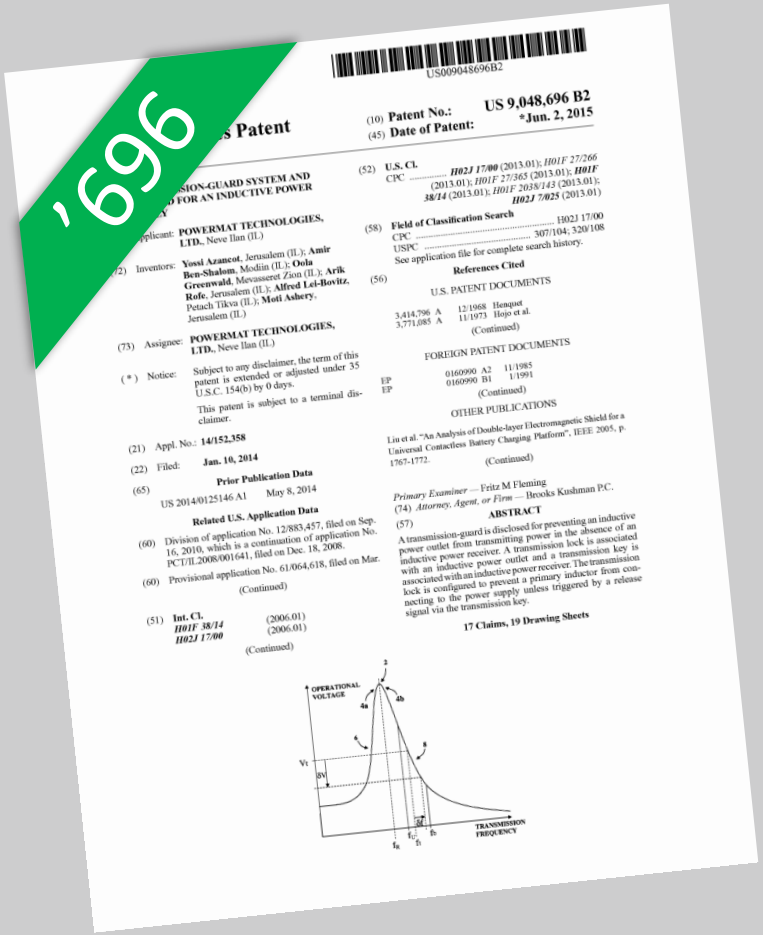
EX1007 at [0118]; *see also* POR at 53-54 (Paper 11).

[0047] The power transfer efficiency between the primary coil and the secondary should be maximized. Lack of efficiency in the power transfer would necessitate larger and heavier AC to DC power supplies. This would add cost and decrease product attractiveness to customers. Thus methods where the entire pad is energized are not as attractive.

EX1007 at [0047]; *see also* POR at 54 (Paper 11).

Partovi is directed to the use of a magnetic alignment to facilitate operation at resonance, whereas Onishi—according to Petitioner—discloses operation at a transmission frequency substantially different from said characteristic resonant frequency.

POR at 53-54 (Paper 11); EX2006 at ¶¶ 147-148.



TRANSMISSION-GUARD SYSTEM AND METHOD FOR AN INDUCTIVE POWER SUPPLY

U.S. PATENT NO. 9,048,696

DEFICIENCIES OF GROUND 2A

Baarman392 + Partovi Fail to Disclose Limitation [1.7]

Claim 1

[1.7] wherein said driving circuit is configured and operable to produce said oscillating driving voltage at a transmission frequency substantially different from said characteristic resonant frequency of said inductive couple.

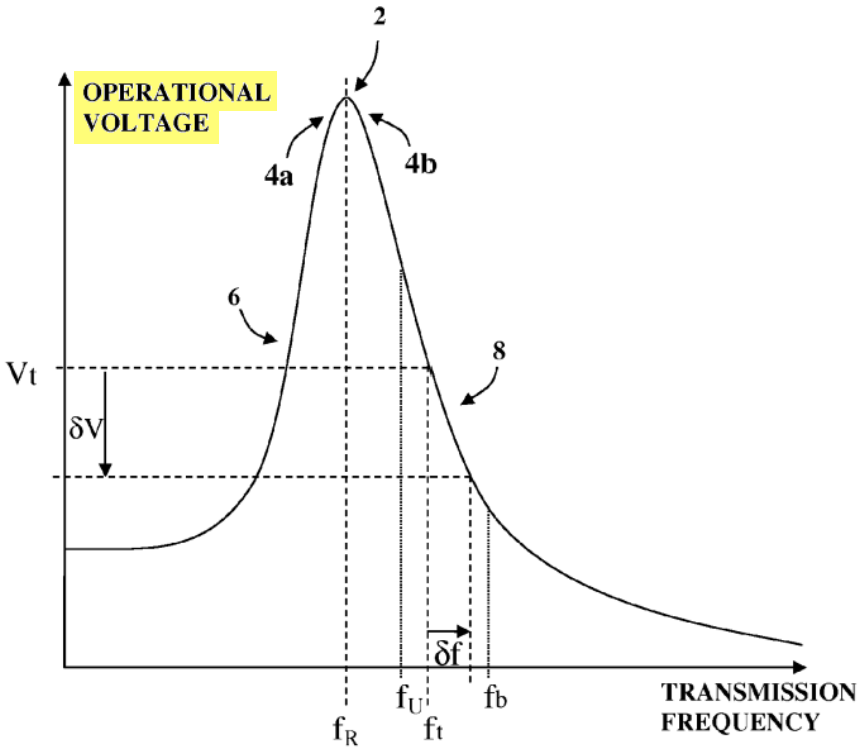


Fig. 6b

EX1001 at Fig. 6b; *see also* POR at 24 (Paper 11).

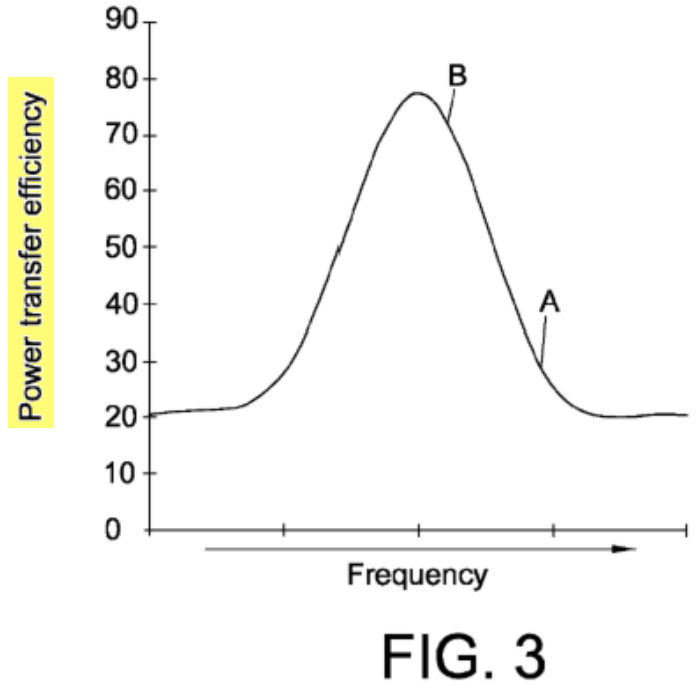


FIG. 3

EX1008 at FIG. 3; *see also* Decision Granting Institution at 39 (Paper 7).

Claim 1

[1.4] such that an inductive couple is formed between said primary inductive coil and a secondary inductive coil of said inductive power receiver, said inductive couple having a characteristic resonant frequency; and

Onishi + Flowerdew Fail to Disclose Limitation [1.4]

Patrick Mercier, Ph.D.

Q. Can you describe what's shown in Figure 6b?

A. Certainly. So this is a plot of the operational voltage at the output of an inductive couple where frequency – "fR" is the resonant – the characteristic resonant frequency at the inductive couple. The X axis is the transmission frequency. Again, Y axis at the operational voltage. "fT" indicates the frequency that is selected for transmission across the inductive couple. And there's a few other frequency markers there indicating other things, as well as other regions.

Mercier Dep. Tr. (EX1102) at 17:19-18:5; *see also* POR at 24 (Paper 11); Reply at 6-7 (Paper 14); Sur-Reply at 10 (Paper 15).

Claim 1

[1.4] such that an inductive couple is formed between said primary inductive coil and a secondary inductive coil of said inductive power receiver, said inductive couple having a characteristic resonant frequency; and

Onishi + Flowerdew Fail to Disclose Limitation [1.4]

Patrick Mercier, Ph.D.

Q. What is the operational voltage?

A. I'm not sure if the operational voltage is precisely defined in the '696 patent, but my knowledge as a POSITA would – would say that this is the output voltage of the inductive couple.

Q. Can you explain what you mean by "the output voltage of the inductive couple"?

A. Sure. So if you refer to say – let's say Figure 1c in the '696 patent. . . . We have element 220, which is the primary inductor that then couples to element 320, which is the secondary inductor. I'm referring to the output of the secondary inductor. And I should be more specific here in saying, you know, this is – the output of the secondary inductor is going to be a sinusoidal-like waveform in the time domain. And what Figure 6b is showing is the amplitude of what the voltage would be in the frequency domain.

Mercier Dep. Tr. (EX1102) at 19:2-22; *see also* POR at 24 (Paper 11); Reply at 6-7 (Paper 14); Sur-Reply at 10 (Paper 15)..

Claim 1

[1.7] wherein said driving circuit is configured and operable to produce said oscillating driving voltage at a transmission frequency substantially different from said characteristic resonant frequency of said inductive couple.

Baarman392 + Partovi Fail to Disclose Limitation [1.7]

Gary L. Woods, Ph.D.

Q. Okay, in figure 3 that we were just referencing in Baarman '392, what's represented by the Y axis in the figure?

A. He's showing it as power transfer efficiency.

Q. How is power transfer efficiency measured in figure 3? Or maybe a better question would be what unit is power transfer efficiency measured in?

A. I don't remember how Baarman defines power transfer efficiency. Would you like me to look it up?

Q. Sure. I would suggest, is it a percentage?

A. Probably – yeah, it's a percentage of something. I don't know if he's talking about end-to-end power transfer efficiency from wall plug to final battery or just transfer efficiency across the inductive couple. Right, I don't know how – I don't know what he's defining. But in general, efficiencies are thought of as percent.

Q. Do you recall whether Baarman '392 describes how – or what kind of transfer efficiency he's talking about?

* * *

A. Okay, so yeah, in paragraph 27 of Baarman, on page 10, he says that figure 3 is a power transfer curve between a primary coil and secondary coil. So he's talking about just the efficiency of power transfer from the primary coil to the secondary coil. He's not including other effects like – other elements in the system. This is just coil-to-coil power transmission efficiency.

Woods Dep. Tr. (EX2007) at 37:4-38:4, 12-21; *see* Pet. at 52, 57, 59, 60, 64 (Paper 2); POPR at 49 (Paper 6); Decision Granting Institution at 39 (Paper 7).

Claim 1

[1.7] wherein said driving circuit is configured and operable to produce said oscillating driving voltage at a transmission frequency substantially different from said characteristic resonant frequency of said inductive couple.

Baarman392 + Partovi Fail to Disclose Limitation [1.7]

151. ***First***, Baarman392 describes the general operation of its inverter as in the range between frequency A and frequency B, where frequency B "is somewhat less than the resonant frequency." Ex. 1008[4] at [0038]. However, frequencies "***somewhat less than*** the resonant frequency" are—by definition—not ***substantially different from*** the resonant frequency, as claimed.

EX2006 at 151; *see also* POR at 55-56 (Paper 11).

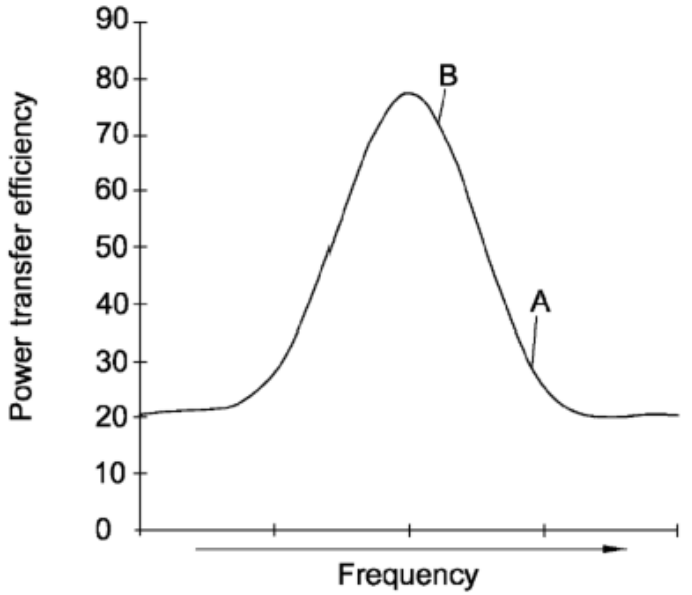


FIG. 3

EX1008 at FIG. 3; *see also* POR at 55-56 (Paper 11).

Claim 1

[1.7] wherein said driving circuit is configured and operable to produce said oscillating driving voltage at a transmission frequency substantially different from said characteristic resonant frequency of said inductive couple.

Baarman392 + Partovi Fail to Disclose Limitation [1.7]

Gary L. Woods, Ph.D.

Q. Is it your opinion that frequencies that are somewhat less than the resonant frequency are substantially different than the resonant frequency?

A. I don't know about in general, but I would say frequency B is – we know it's not on resonance. Baarman says so. So I would say that makes it substantially different.

Woods Dep. Tr. (EX2007) at 33:12-20; *see also* POR at 56 (Paper 11).

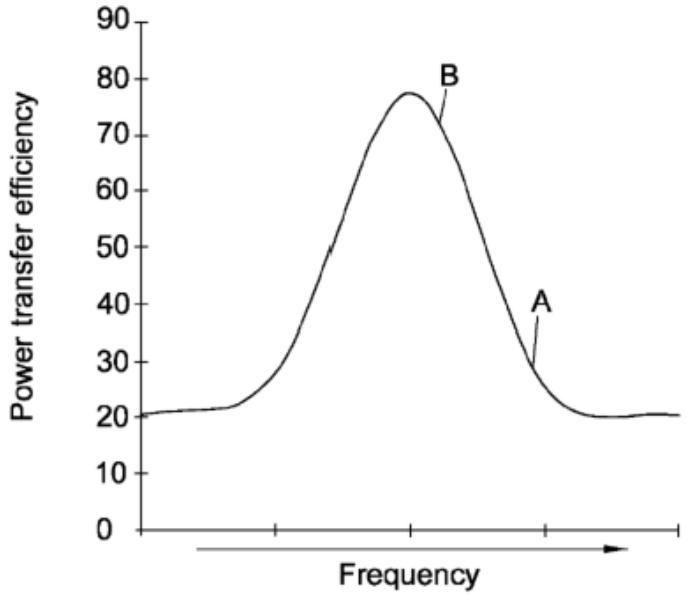


FIG. 3

EX1008 at FIG. 3; *see also* POR at 55-56 (Paper 11).

Claim 1

[1.7] wherein said driving circuit is configured and operable to produce said oscillating driving voltage at a transmission frequency substantially different from said characteristic resonant frequency of said inductive couple.

Baarman392 + Partovi Fail to Disclose Limitation [1.7]

Gary L. Woods, Ph.D.

Q. Does Baarman 392 quantify the operating frequency of frequency B?

A. Quantify. We know it's not on resonance.

Q. What about does Baarman '392 quantify the operating frequency of frequency A?

A. We know from the figure it's farther away from resonance than is frequency B.

Q. And other than it being farther away from frequency B, does Baarman '392 quantify the difference between those two operating frequencies B and A?

A. Quantify, he doesn't present an equation. This is – the figure 3 is describing the essential elements, but if you wanted the actual equation of that curve it would be complicated.

Woods Dep. Tr. (EX2007) at 32:18-33:11; *see also* POR at 55-58 (Paper 11).

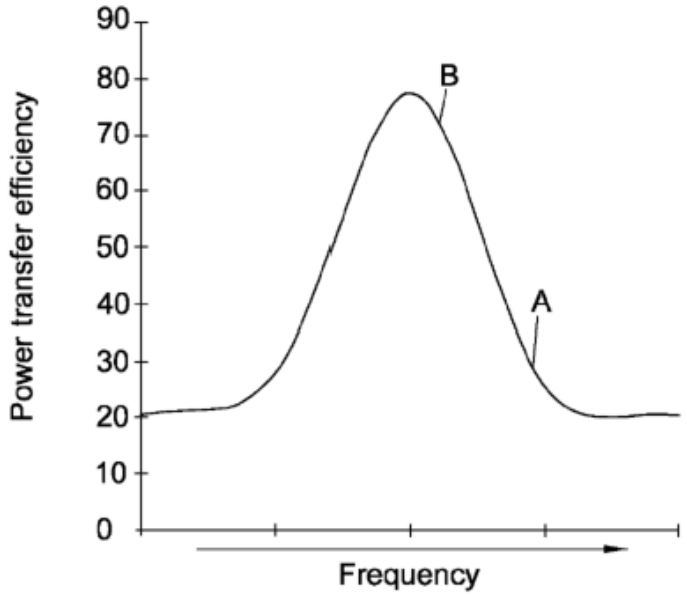


FIG. 3

EX1008 at FIG. 3; *see also* POR at 55-58 (Paper 11).

Claim 1

[1.7] wherein said driving circuit is configured and operable to produce said oscillating driving voltage at a transmission frequency substantially different from said characteristic resonant frequency of said inductive couple.

Baarman392 + Partovi Fail to Disclose Limitation [1.7]

Patrick Mercier, Ph.D.

Q. What's your understanding of what A and B represent?

A. So Frequency B is, as described in Baarman, somewhat less than the resonant frequency, and Frequency A is some other frequency further away from that. I think that's pretty much all we can surmise form the language in Baarman.

Mercier Dep. Tr. (EX1102) at 79:18-24; *see also* POR at 55-58 (Paper 11).

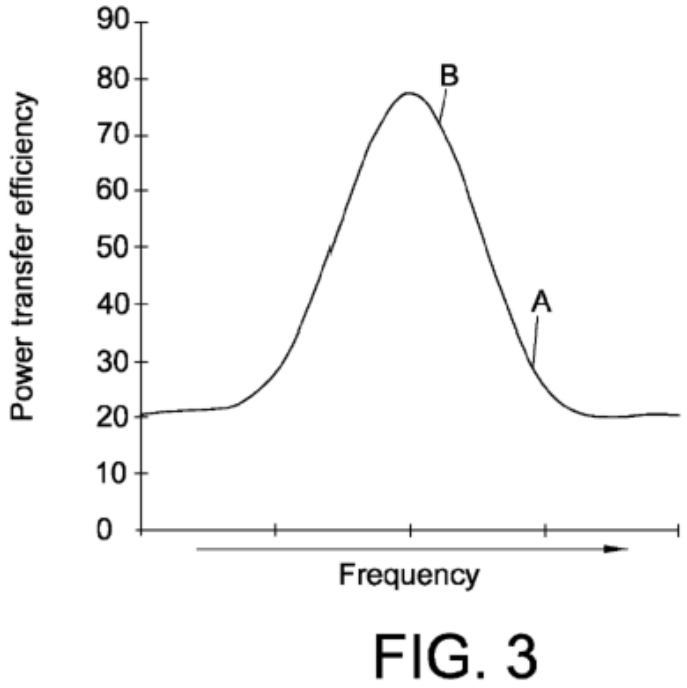


FIG. 3

EX1008 at FIG. 3; *see also* POR at 55-58 (Paper 11).

Claim 1

[1.7] wherein said driving circuit is configured and operable to produce said oscillating driving voltage at a transmission frequency substantially different from said characteristic resonant frequency of said inductive couple.

Baarman392 + Partovi Fail to Disclose Limitation [1.7]

[0038] In the illustrated embodiment, the primary coil **15** and the secondary coil **30** are loosely coupled. Because the two are loosely coupled in this embodiment, the slope of the power transfer curve about the resonant frequency is not as steep as if the coils **15**, **30** were tightly coupled. An exemplary power transfer curve for the coils **15**, **30** is shown in FIG. **3**. In this embodiment, the power transfer is highest when the inverter **10** is operating at resonance. However, even if the inverter **10** is not operating at resonance, significant power transfer can occur when the inverter is operating off-resonance. Generally, the inverter **10** is operated between frequency A and frequency B. Frequency B is somewhat less than the resonant frequency. Between frequency A and frequency B, the power transfer curve can be piece-wise linearized by a software lookup table located in the controller **20**. Thus, a decrease in the operating frequency of the inverter **10** will result in a generally predictable increase in the power transferred from the primary coil **15** to the secondary coil **30**. As can be seen by the graph, it would be equally effective to use an operating frequency less than the resonant frequency. If so, then an increase in the operating frequency would lead to an increase in the power transfer, and vice-versa.

EX1008 at [0038]; *see also* POR at 58-59 (Paper 11).

Claim 1

[1.7] wherein said driving circuit is configured and operable to produce said oscillating driving voltage at a transmission frequency substantially different from said characteristic resonant frequency of said inductive couple.

Baarman392 + Partovi Fail to Disclose Limitation [1.7]

Gary L. Woods, Ph.D.

Q. [W]hat is a piecewise linear function?

A. That basically means if you have a – right, if you have a curve, you can break it down into – you can approximate it more accurately by treating it as a series of two or more line segments.

Woods Dep. Tr. (EX2007) at 34:4-10; *see* POR at 58-59 (Paper 11).

No Motivation to Combine Baarman392 and Partovi

[0118] In accordance with an embodiment of the present invention, a capacitor is added in parallel to the drain/source contacts of the MOSFET. FIG. **9** shows a figure of a circuit diagram **240** in accordance with an embodiment. The coil in the wireless charger system is driven by switching the FET at the resonance frequency of the circuit when the receiver is present. Without the receiver nearby, the circuit is detuned from resonance and radiates minimal EMI. The capacitor **244** acts as a reservoir of energy that discharges during switch off time and enhances energy transfer.

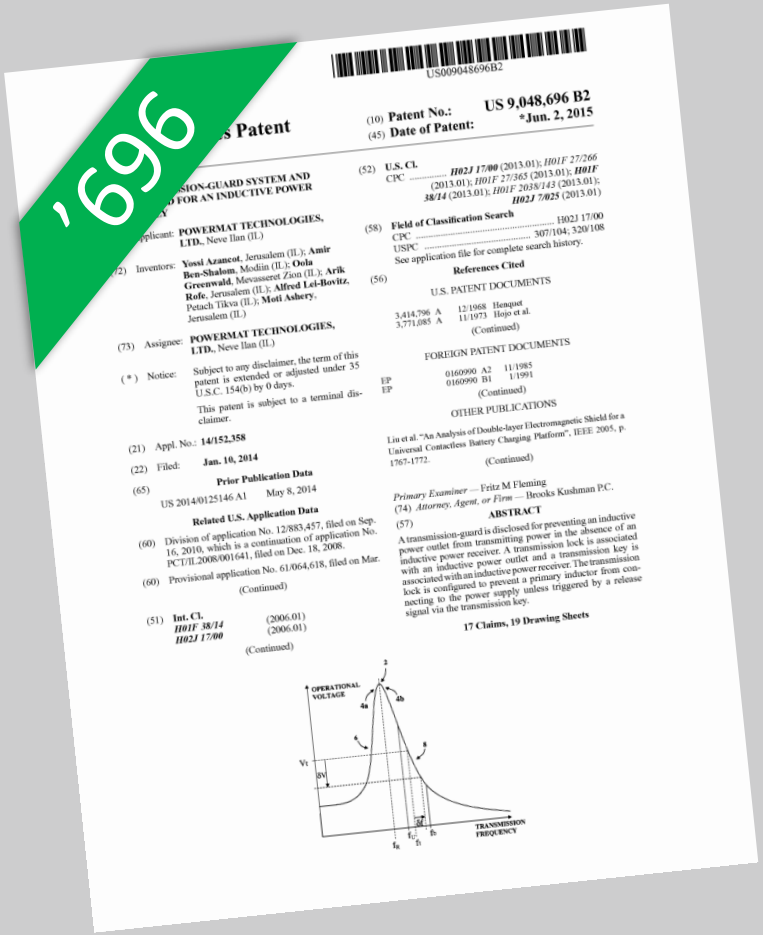
EX1007 at [0118]; *see also* POR at 60 (Paper 11).

[0047] The power transfer efficiency between the primary coil and the secondary should be maximized. Lack of efficiency in the power transfer would necessitate larger and heavier AC to DC power supplies. This would add cost and decrease product attractiveness to customers. Thus methods where the entire pad is energized are not as attractive.

EX1007 at [0047]; *see also* POR at 60 (Paper 11).

- Partovi is directed to the use of a magnetic alignment to facilitate operation at resonance.
- Partovi's objective is to maximize power transfer efficiency.

POR at 60-64 (Paper 11); EX2006 at ¶¶ 158-161.



TRANSMISSION-GUARD SYSTEM AND METHOD FOR AN INDUCTIVE POWER SUPPLY

U.S. PATENT NO. 9,048,696

DEFICIENCIES OF GROUND 2B

Baarman392 + Partovi + Tocci Fail to Disclose Limitations [2.1] and [2.2]

Claim 2

[2.1] increase said transmission frequency when said first signal is detected by the detector, and

[2.2] decrease said transmission frequency when said second signal is detected by the detector.

165. As explained above, Baarman392 describes the general operation of its inverter as in the range between frequency A and frequency B, where frequency B "is somewhat less than the resonant frequency." Ex. 1008 at [0038]. However, frequencies "***somewhat less than*** the resonant frequency" are—by definition—not ***substantially different from*** the resonant frequency, as claimed. Moreover, any change in frequency between frequency A and frequency B will require a non-linear increase/decrease in the transmission frequency. Thus, Baarman392 fails to disclose a power control technique that maintains a substantially different transmission frequency, as required in claim 1.

EX2006 at 165; *see also* POR at 65-66 (Paper 11).

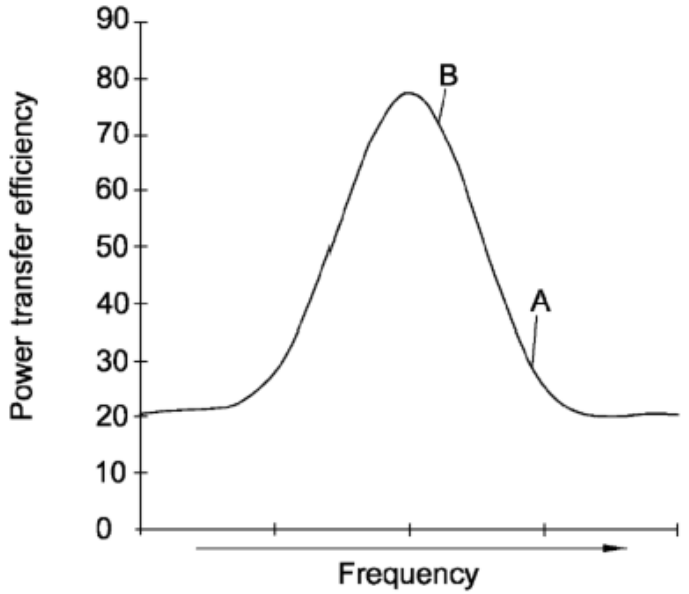


FIG. 3

EX1008 at FIG. 3; *see also* POR at 65-66 (Paper 11)..