

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

IPR2024-00105
Patent 10,027,184

Petitioner's Demonstratives
March 5, 2025

The '184 Patent

Ground 1: Fells Invalidates Cls. 1, 8, and 11

Ground 2: Fells and Cook Invalidate Cls. 2-7, 9-10, and 16

Ground 3: Fells and Ono Invalidate Cl. 12

Ground 4: Fells, Cook, and Wang Invalidate Cl. 13

The '184 Patent

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The '184 Patent (Ex. 1001)

US10027184B2

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

(10) **Patent No.:** US 10,027,184 B2
(45) **Date of Patent:** Jul. 17, 2018

(54) **FOREIGN OBJECT DETECTION IN WIRELESS ENERGY TRANSFER SYSTEMS**

(71) **Applicant:** Wicrity Corporation, Watertown, MA (US)

(72) **Inventors:** Simon Verghese, Arlington, MA (US); Morris P. Kessler, Bedford, MA (US); Katherine L. Hall, Arlington, MA (US); Herbert L. Lou, Carlisle, MA (US)

(73) **Assignee:** Wicrity Corporation, Watertown, MA (US)

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

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(Continued)

(51) **Int. Cl.**
H01F 38/74 (2006.01)
H01F 37/00 (2006.01)
(Continued)

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(Continued)

(58) **Field of Classification Search**
CPC H02J 50/60; H02J 50/12; H02J 7/025; H02J 17/00; H02J 5/005; H02J 50/60;
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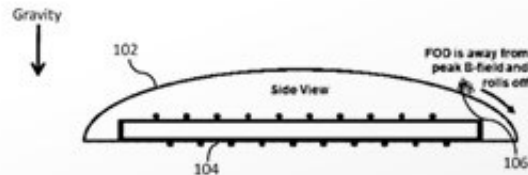
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(57) **ABSTRACT**
A wireless energy transfer system includes a foreign object debris detection system. The system includes at least one wireless energy transfer source configured to generate an oscillating magnetic field. The foreign object debris may be detected by at least one field gradiometer positioned in the oscillating magnetic field. The voltage of the at least one field gradiometer may be measured using readout circuitry and a feedback loop based on the readings from the gradiometers may be used to control the parameters of the wireless energy source.

16 Claims, 19 Drawing Sheets



InductEV, Inc.
Exhibit 1001
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InductEV, Inc.
Exhibit 1001
Page 002

(10) **Patent No.:** US 10,027,184 B2
(45) **Date of Patent:** Jul. 17, 2018

Related U.S. Application Data

- (63) Continuation of application No. 13/608,956, filed on Sep. 10, 2012, now Pat. No. 9,442,172.
(Continued)
- (60) Provisional application No. 61/532,785, filed on Sep. 9, 2011.

(57) ABSTRACT

A wireless energy transfer system includes a foreign object debris detection system. The system includes at least one wireless energy transfer source configured to generate an oscillating magnetic field. The foreign object debris may be detected by at least one field gradiometer positioned in the oscillating magnetic field. The voltage of the at least one field gradiometer may be measured using readout circuitry and a feedback loop based on the readings from the gradiometers may be used to control the parameters of the wireless energy source.

The '184 Patent – Independent Claims 1 and 16

1. A wireless energy transfer system with foreign object debris detection, the system comprising:
a wireless energy transfer source comprising a source resonator configured to generate an oscillating magnetic field; and
a foreign object debris detection system comprising:
at least one magnetic field sensor; and
at least one readout circuit configured to measure one or more electrical parameters of at the at least one magnetic field sensor,
wherein the at least one magnetic field sensor is positioned within the magnetic field of the wireless energy transfer system; and
wherein the foreign object debris detection system is configured to verify that foreign object debris has not moved onto or over the source resonator during generation of the oscillating magnetic field.

Ex. 1001 ('184 Patent) at Claim 1

16. A method of detecting foreign object debris in a wireless energy transfer system, the method comprising:
performing a health and/or status check of a source resonator of the wireless energy transfer system;
verifying that no foreign object debris has moved onto or over the source resonator;
positioning a vehicle over the source resonator;
verifying that no foreign object debris has moved onto or over the source resonator;
generating an oscillating magnetic field using the source resonator to transfer energy wirelessly to the vehicle to charge a battery of the vehicle; and
verifying that no foreign object debris has moved onto or over the source resonator during the transfer of energy.

Ex. 1001 ('184 Patent) at Claim 16

The '184 Patent

Ground 1: Fells Invalidates Cls. 1, 8, and 11

Fells taught a magnetic field sensor

Fells taught positioning the magnetic field sensor within the magnetic field of the system

It would have been obvious to place the sensor within the magnetic field

Ground 2: Fells and Cook Invalidate Cls. 2-7, 9-10, and 16

Ground 3: Fells and Ono Invalidate Cl. 12

Ground 4: Fells, Cook, and Wang Invalidate Cl. 13

Fells Invalidates Claims 1, 8, and 11

1. A wireless energy transfer system with foreign object debris detection, the system comprising:
a wireless energy transfer source comprising a source resonator configured to generate an oscillating magnetic field; and
a foreign object debris detection system comprising:
at least one magnetic field sensor; and
at least one readout circuit configured to measure one or more electrical parameters of at the at least one magnetic field sensor,
wherein the at least one magnetic field sensor is positioned within the magnetic field of the wireless energy transfer system; and
wherein the foreign object debris detection system is configured to verify that foreign object debris has not moved onto or over the source resonator during generation of the oscillating magnetic field.

Ex. 1001 ('184 Patent) at Claim 1

8. The system of claim 1, wherein the foreign object debris detection system is configured to verify that foreign object debris has not moved onto or over the source resonator prior to generation of the oscillating magnetic field.

* * *

11. The system of claim 1, wherein the foreign object debris detection system is integrated into the wireless energy transfer source.

Ex. 1001 ('184 Patent) at Claims 8, 11

Patent Owner Disputes Only the “Magnetic Field Sensor” Limitations

1. A wireless energy transfer system with foreign object debris detection, the system comprising:
a wireless energy transfer source comprising a source resonator configured to generate an oscillating magnetic field; and
a foreign object debris detection system comprising:
at least one magnetic field sensor; and
at least one readout circuit configured to measure one or more electrical parameters of at the at least one magnetic field sensor,
wherein the at least one magnetic field sensor is positioned within the magnetic field of the wireless energy transfer system; and
wherein the foreign object debris detection system is configured to verify that foreign object debris has not moved onto or over the source resonator during generation of the oscillating magnetic field.

Ex. 1001 ('184 Patent) at Claim 1

8. The system of claim 1, wherein the foreign object debris detection system is configured to verify that foreign object debris has not moved onto or over the source resonator prior to generation of the oscillating magnetic field.

* * *

11. The system of claim 1, wherein the foreign object debris detection system is integrated into the wireless energy transfer source.

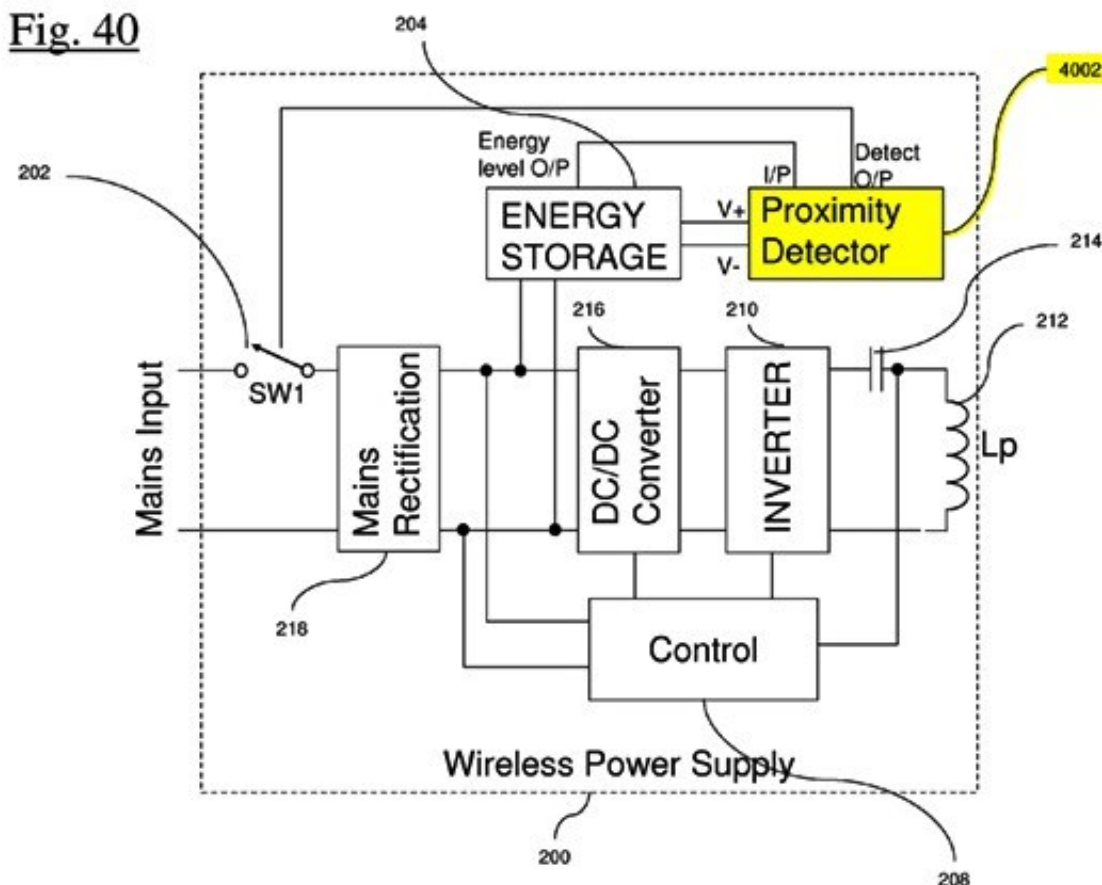
Ex. 1001 ('184 Patent) at Claims 8, 11

Fells' Proximity Detector Teaches Two Types of “magnetic field sensor”

Fells

[0288] In the embodiment illustrated in FIG. 40 a Sense Circuit that acts as a Proximity Detector 4002 is used to initially detect that a device or foreign object has been placed in the vicinity of the wireless power supply 200. It also detects if a device or foreign object is removed from the wireless power supply 200. This Proximity Detector 4002 is completely separate from the primary coil 212 and therefore not connected to it. In one embodiment, the Proximity Detector 4002 only knows that a change in the devices or objects present has occurred.

Fig. 40



Ex. 1005 (Fells) at [0288] & Fig. 40

Fells' Proximity Detector Teaches Two Types of "magnetic field sensor"

Fells

[0289] Optionally, an inductive proximity sensor could be formed using another coil in the wireless power supply 200 which is independent of the coil used to transfer power. Another type of proximity detector 4002 that could be used is a capacitive proximity detector. The presence of the object causes a change in the dielectric constant between two metal electrodes. Alternatively the capacitance may change because of a change in mutual capacitance between the sensor and an object. Another type of proximity detector 4002 is a Hall Effect sensor, in which there is a change in voltage in response to a change in magnetic field. The presence of a ferrite core or other material with similar properties within the portable device may result in altering the magnetic field.

Ex. 1005 (Fells) at [0289]

Fells' Hall Effect Sensor is a "magnetic field sensor"

Dr. Horenstein Deposition

Q. Going back to the list in Carstens, is a Hall effect transistor a magnetic field sensor?

A. Again, it's capable of detecting a DC magnetic field typically produced by a permanent magnet.

Q. Is that a yes?

A. Yes, it would detect a DC magnetic field.

Ex. 1038 (Horenstein Dep) at 34:15-21

Ferrazzin

A Hall effect sensor is essentially a transducer that responds with an output voltage proportional to the local magnetic field. The main advantage are a low cost and a small size with the device integrated on the same chip with the necessary circuitry. The main drawbacks

Ex. 1018 (Ferrazzin) at 219

Wilkinson

INTRODUCTION

Hall Effect sensors are integrated circuits that produce a voltage proportional to the magnetic field through the circuit. They are used in contactless switches and proximity detectors.

Ex. 1027 (Wilkinson) at 215

Patent Owner's Sur-Reply Argument is Untimely and Unsupported

POSR

In addition, a POSA would understand that a Hall Effect sensor only senses *magnetized* objects like a portable device (mobile phone). Hence, using a Hall Effect sensor would defeat the purpose of the invention claimed in the '184 Patent because a Hall Effect sensor would not detect non-magnetized FOD debris. This

Patent Owner Sur-Reply at 3

1. A wireless energy transfer system with foreign object debris detection, the system comprising:
a wireless energy transfer source comprising a source resonator configured to generate an oscillating magnetic field; and
a foreign object debris detection system comprising:
at least one magnetic field sensor; and
at least one readout circuit configured to measure one or more electrical parameters of at the at least one magnetic field sensor,
wherein the at least one magnetic field sensor is positioned within the magnetic field of the wireless energy transfer system; and
wherein the foreign object debris detection system is configured to verify that foreign object debris has not moved onto or over the source resonator during generation of the oscillating magnetic field.

Ex. 1001 ('184 Patent) at Claim 1

Patent Owner's Sur-Reply Argument is Untimely and Unsupported

POR

Fells discloses that its proximity detector detects a portable device or foreign object in the vicinity of the wireless power supply. Fells ¶ 288. Fells discloses that

Patent Owner Response at 29

Fells

[0288] In the embodiment illustrated in FIG. 40 a Sense Circuit that acts as a Proximity Detector 4002 is used to initially detect that a device or foreign object has been placed in the vicinity of the wireless power supply 200. It also detects if a device or foreign object is removed from the wireless power supply 200. This Proximity Detector 4002 is com-

Ex. 1005 (Fells) at [0288]

1. A wireless energy transfer system with foreign object debris detection, the system comprising:
 - a wireless energy transfer source comprising a source resonator configured to generate an oscillating magnetic field; and
 - a foreign object debris detection system comprising:
 - at least one magnetic field sensor; and
 - at least one readout circuit configured to measure one or more electrical parameters of the at least one magnetic field sensor,wherein the at least one magnetic field sensor is positioned within the magnetic field of the wireless energy transfer system; and
- wherein the foreign object debris detection system is configured to verify that foreign object debris has not moved onto or over the source resonator during generation of the oscillating magnetic field.

Ex. 1001 ('184 Patent) at Claim 1

Fells' Inductive Proximity Sensor is a “magnetic field sensor”

Fells

[0289] Optionally, an inductive proximity sensor could be formed using another coil in the wireless power supply 200 which is independent of the coil used to transfer power.

Ex. 1005 (Fells) at [0289]

Dr. Allen Declaration

[0291]. A POSA would have understood that as a matter of basic electronics, a coil used as an “inductive proximity sensor” constitutes a “magnetic field sensor” because inductors respond to changes in magnetic fields. See Nilsson 174 (“The behavior of inductors is based on the phenomena associated with magnetic fields”). The coil is placed “in the vicinity of the wireless power supply,” and when a “device or foreign object has been placed” in that area, the magnetic field will change, resulting in a change to the coil’s own inductance. That inductance can be measured, thereby indicating “that a device or foreign object has been placed” or “removed from the wireless power supply.” Fells [0288]-[0289]. The ’184 patent

Ex. 1003 (Allen Decl.) at ¶ 121

Fells' Inductive Proximity Sensor is a “magnetic field sensor”

Dr. Allen Supp. Declaration

22. One type of “inductive proximity sensor,” which a POSA would have been familiar with and understood to be encompassed by Fells’ reference to an “an inductive proximity sensor,” is called an inductive pickup coil. Carstens explains,

Ex. 1037 (Allen Supp. Decl.) at ¶ 22

Carstens

4-5 INDUCTIVE PICKUP COIL

An inductive pickup coil is a coil that generates a current proportional to the change in flux of a magnetic field. Basically, this coil acts as an electrical generator, producing voltage according to Faraday’s law. This type of sensor is used to sense the presence of a magnetic field and when used by itself, is used primarily as a proximity sensor. However, when used in conjunction with signal-conditioning circuits, the inductive coil can be used as an analog or digital device.

* * *

According to the sine of that angle. A typical installation as a proximity switch would be virtually identical to that of the Hall effect detector shown installed in Figure 4-10.

Ex. 2007 (Carstens) at 130, 132

Fells' Inductive Proximity Sensor is a “magnetic field sensor”

Dr. Horenstein Deposition

Q. Do you agree that an inductive pickup coil can be used as a proximity sensor?

A. In some cases, yes, it can.

* * *

Q. Is an inductive pickup coil a magnetic field sensor?

A. Yes. It's capable of detecting AC magnetic fields that are produced by a source that is exclusive of the inductive pickup coil.

Ex. 1038 (Horenstein Dep) at 34:22-35:4; 36:20-22

Patent Owner's "external" Requirement Is Unsupported

POR

to be a magnetic field sensor. Horenstein Decl. ¶ 82. A magnetic field sensor detects the presence or strength of external magnetic fields which may be from permanent magnets or electromagnet, while an inductive proximity sensor creates its own magnetic field and then detects the presence of metallic objects regardless of whether those objects are magnetic. Horenstein Decl. ¶¶ 89-92; Carstens 119,

Patent Owner Response at 27

In accordance with exemplary and non-limiting embodiments, an active mitigation system for FOD objects that only weakly perturb the magnetic field between two resonators may comprise sensors for measuring small changes in the magnetic field in the proximity of the FOD objects. For

* * *

and/or blocked any portion of the coil or loop area. In embodiments, local disturbances in the magnetic field caused by the presence of FOD may be detected by measuring magnetic field changes, variations, gradients, and the like, in the vicinity of the FOD.

Ex. 1001 (184 Patent) at 5:25-38

Patent Owner's "external" Requirement Is Unsupported

Carstens

1. To understand the theory and operation of the following **magnetic field-sensing devices:**

- a. The magnetic reed switch
- b. The Hall effect transistor
- c. The inductive pickup coil
- d. The vibrating wire transducer

* * *

In this chapter we study those **sensors that either use or interact with a magnetic field to cause the sensor to operate.** This subject covers quite a wide range of sensing devices, so we will study only the more commonly used ones frequently encountered in industry.

Ex. 2007 (Carstens) at 119

The Plain Meaning Controls

Dr. Allen Supp. Declaration

sense the presence of objects. I disagree with this interpretation. A POSA would understand from the component words of the term that the plain meaning of “magnetic field sensor” is a device that senses magnetic fields or changes therein.

There is no requirement that the sensed field be *external* – the term encompasses a sensor that produces its own magnetic field, and then senses objects by detecting parameter changes within that produced magnetic field.

Ex. 1037 (Allen Supp. Decl.) at ¶ 10

1. A wireless energy transfer system with foreign object debris detection, the system comprising:
a wireless energy transfer source comprising a source resonator configured to generate an oscillating magnetic field; and
a foreign object debris detection system comprising:
at least one magnetic field sensor; and
at least one readout circuit configured to measure one or more electrical parameters of at the at least one magnetic field sensor,
wherein the at least one magnetic field sensor is positioned within the magnetic field of the wireless energy transfer system; and
wherein the foreign object debris detection system is configured to verify that foreign object debris has not moved onto or over the source resonator during generation of the oscillating magnetic field.

Ex. 1001 ('184 Patent) at Claim 1

Patent Owner's "passive" Requirement is Unsupported

POSR

In contrast to the inductive proximity detector and Hall Effect sensors discussed in Fells, which **require power to operate**, the loop sensors in the '184 patent **are passive, requiring no power** because their signals are induced *by the resonator field*. ('184 patent, 6:52-56, 7:15-16).

Patent Owner Sur-Reply at 6-7

In accordance with **exemplary and non-limiting embodiments**, another way to measure a field gradient in the vicinity of a metallic object may be to create a coil (also referred to as a loop) in a fashion that directly outputs a voltage that is proportional to the local gradient in the magnetic field. *Such*

* * *

While the invention has been described in connection with certain preferred embodiments, **other embodiments will be understood by one of ordinary skill in the art and are intended to fall within the scope of this disclosure**, which is to be interpreted in the broadest sense allowable by law. For example, designs, methods, configurations of components, etc. related to transmitting wireless power have been described above along with various specific applications and examples thereof. Those skilled in the art will appreciate where the designs, components, configurations or components described herein can be used in combination, or interchangeably, and that **the above description does not limit such interchangeability or combination of components to only that which is described herein**.

Ex. 1001 (184 Patent) at 6:42-59; 11:51-62

Fells' Inductive Proximity Sensor Is Not Limited To Eddy Current Sensors

POR

also Allen Decl. ¶ 121. These currents are known as “eddy currents,” and for this reason, the inductive proximity sensor is also at times referred to as an eddy current (proximity sensor) or probe. *Petruzella* 102; *Staugaard* 8-25; *Carr* 191; *see also*

Patent Owner Response at 26

Dr. Allen Supp. Declaration

While this is one way to construct an inductive proximity sensor, a POSA would have understood that the “inductive proximity sensor” taught in Fells could be constructed in many different ways, and is not limited to this specific type of construction. Fells does not say that it uses a sensing coil as part of an LC resonant circuit – it says only that “an inductive proximity sensor could be formed using another coil in the wireless power supply that is independent of the coil used to transfer power,” and that “[t]here are a number of different ways of implementing the proximity detector,” including using “any sensor capable of detecting presence of an object within proximity of the primary unit.” Fells [0289]-[0290].

Ex. 1037 (Allen Supp. Decl.) at ¶ 21

Fells' Inductive Proximity Sensor Meets Patent Owner's 'external' Requirement

POR

also Allen Decl. ¶ 121. These currents are known as “eddy currents,” and for this reason, the inductive proximity sensor is also at times referred to as an eddy current (proximity sensor) or probe. *Petruszella* 102; *Staugaard* 8-25; *Carr* 191; *see also*

Patent Owner Response at 26

Staugaard

When a metallic object enters the proximity of the magnetic field, eddy currents are created within the object through electromagnetic induction (Faraday's law). The eddy currents in the object create a magnetic field that opposes the original magnetic field produced by the coil (Lenz's law). As a result, voltages are induced back in the coil that oppose the original oscillating voltage. The net effect is a decrease in voltage across the coil that is proportional to the magnitude of the eddy currents within the metallic object. For this reason, inductive proximity sensors are sometimes called eddy current probes.

Ex. 2008 (Staugaard) at 8-25

Rabiee

was proved by Faraday in the 1800s. An inductive sensor uses a coil to generate a magnetic field. If there is a moving metal object near the magnetic field, current will flow into the object. This current flow in the object will in turn generate another magnetic field that opposes the original magnetic field, Figure 4-8. This results in a change of inductance value of the coil in the sensor. The change of a coil's inductance can be interpreted to see if the object is within close proximity of the sensor. *Note that the induced current in the object depends on the*

Ex. 2010 (Rabiee) at 75

Carr

in the target. These eddy currents create a magnetic field around the target, and this field will change the resistance component of the impedance of the sensor coil. This interaction will cause a sudden drop in the output amplitude of the oscillator, and this drop can be used to indicate the presence of the object.

Ex. 2011 (Carr) at 191

Fells' Inductive Proximity Sensor Meets Patent Owner's 'external' Requirement

Carstens

4-5 INDUCTIVE PICKUP COIL

An inductive pickup coil is a coil that generates a current proportional to the change in flux of a magnetic field. Basically, this coil acts as an electrical generator, producing voltage according to Faraday's law. This type of sensor is used to sense the presence of a magnetic field and when used by itself, is used primarily as a proximity sensor. However, when used in conjunction with signal-conditioning circuits, the inductive coil can be used as an analog or digital device.

* * *

4-5.2 Operating Characteristics

Because the inductive coil functions only when there is a change in magnetic flux, it is relatively easy to use this type of device for a proximity sensor. However, for it to function in this role, the magnetic flux and coil must experience relative motion at right angles to each other for optimum voltage generation to take place. Relative motion at any angle other than 90° will produce correspondingly smaller values of e according to the sine of that angle. A typical installation as a proximity switch would be virtually identical to that of the Hall effect detector shown installed in Figure 4-10.

Ex. 2007 (Carstens) at 130, 132

Dr. Allen Confirmed Eddy Current Sensors Are “magnetic field sensors”

Dr. Allen Deposition

Q. And with regard to inductive proximity sensors, are there any inductive proximity sensors, in your opinion, that do not constitute a magnetic field sensor?

A. So an Eddy-current sensor, I suppose, could be something loosely like that. Although instead of directly sensing a magnetic field, it generates a magnetic field in the presence of a conductor that is then sensed. So it's sort of an indirect measure.

Ex. 2015 (Allen Dep.) at 33:13-21

Dr. Allen Supp. Declaration

sensor.” That is not the case. As shown below, I explained that although some may not consider an eddy current sensor to “directly sens[e] a magnetic field,” it nonetheless “generates a magnetic field in the presence of a conductor that is then sensed,” making it a “magnetic field sensor” even if it only provides an “indirect measure” of the magnetic field.

* * *

I have maintained throughout my declarations and my deposition that an inductive proximity sensor, including the type that detects eddy currents, is a magnetic field sensor. Ex. 1003 ¶ 121.

Ex. 1037 (Allen Supp. Decl.) at ¶ 14

The '184 Patent

Ground 1: Fells Invalidates Cls. 1, 8, and 11

Fells taught a magnetic field sensor

Fells taught positioning the magnetic field sensor within the magnetic field of the system

It would have been obvious to place the sensor within the magnetic field

Ground 2: Fells and Cook Invalidate Cls. 2-7, 9-10, and 16

Ground 3: Fells and Ono Invalidate Cl. 12

Ground 4: Fells, Cook, and Wang Invalidate Cl. 13

Fells Taught Placing The Sensor In The Magnetic Field

Fells

Storage element 204. The Sense Circuit 206 detects when an object is placed in (or removed from) the proximity of the Wireless power supply 200, but does not determine whether or not the object is a legitimate object, such as a valid secondary device, nor whether or not it desires power. If the Sense Circuit 206 detects that an object has been placed on (or in proximity to) the wireless power supply 200, then SW1 202 is closed allowing the circuits in the wireless power supply 200 to receive power. Optionally, the Energy Storage element

[0194] FIG. 3 shows example timing diagrams of the power delivered to the primary coil 212 (not to scale). FIG. 3(a) shows an example when a foreign object is placed on the wireless power supply 200 at time A. Periodically, the sense circuit 206 powers up to see if an inductance change has occurred since the previous measurement. After the foreign object has been placed on the wireless power supply 200, an inductance change will be detected at the next sense point, B. This will then trigger the system to connect the mains. At

Ex. 1005 (Fells) at [0191], [0194]

Fells Taught Placing The Sensor In The Magnetic Field

Fells

[0288] In the embodiment illustrated in FIG. 40 a Sense Circuit that acts as a Proximity Detector 4002 is used to initially detect that a device or foreign object has been placed in the vicinity of the wireless power supply 200. It also detects if a device or foreign object is removed from the wireless power supply 200. This Proximity Detector 4002 is completely separate from the primary coil 212 and therefore not connected to it. In one embodiment, the Proximity Detector 4002 only knows that a change in the devices or objects present has occurred.

[0289] Optionally, an inductive proximity sensor could be formed using another coil in the wireless power supply 200 which is independent of the coil used to transfer power. Another type of proximity detector 4002 that could be used is a capacitive proximity detector. The presence of the object causes a change in the dielectric constant between two metal electrodes. Alternatively the capacitance may change because of a change in mutual capacitance between the sensor and an object. Another type of proximity detector 4002 is a Hall Effect sensor, in which there is a change in voltage in response to a change in magnetic field. The presence of a ferrite core or other material with similar properties within the portable device may result in altering the magnetic field.

Ex. 1005 (Fells) at [0288];[0289]

The Vicinity/Proximity Is The Area Within The Magnetic Field

Fells

[0192] Foreign objects may be detected using a method disclosed in GB2414121, which is incorporated herein by reference. If a valid device is detected, then it communicates

Ex. 1005 (Fells) at [0192]

Stevens (GB2414121)

A second problem in such systems is that it is not possible to mechanically prevent foreign objects from being placed into proximity with the primary coil, coupling to the coil. Foreign objects made of metal will have eddy-currents induced therein. These

* * *

unit 14. This control unit generates an AC voltage signal 106. The electrical drive unit takes the AC voltage signal 106 and converts it to an AC current signal in the primary coil 12, so as to generate an induced electromagnetic field in the proximity of the primary coil 12.

* * *

In the operating mode, the primary coil 12 generates an electromagnetic field in the vicinity of the primary unit 10. The secondary coil 32 couples with this field and an alternating current is induced in the coil by the field. The dummy load switch 38 is

Ex. 1016 (Stevens) at 2:8-10; 17:12-26; 24:26-28

Fells' Purpose Requires Placing The Sensor In The Magnetic Field

Fells

look for devices. If the unit detects a valid device that is requesting power and determines that there are no foreign objects that would get hot or hinder power transfer in the vicinity then the unit may come out of standby. The power level of the pulses in standby mode are sufficiently high to transfer enough power to the portable device so that it can communicate back, because it is possible that the device's batteries may be fully depleted. The length of the pulses are long enough to determine that the device is a valid device and that there are no foreign objects present that may get hot or otherwise interfere with the system. The time between the pulses is short enough that the user gets quick feedback that the unit is operational. There is therefore a limit to how low the power consumption can be during standby.

* * *

[0288] In the embodiment illustrated in FIG. 40 a Sense Circuit that acts as a Proximity Detector 4002 is used to initially detect that a device or foreign object has been placed in the vicinity of the wireless power supply 200. It also detects if a device or foreign object is removed from the wireless power supply 200. This Proximity Detector 4002 is completely separate from the primary coil 212 and therefore not connected to it. In one embodiment, the Proximity Detector 4002 only knows that a change in the devices or objects present has occurred.

Fells [0002] & [0289]

Dr. Allen Declaration

inductance] in response to a change in magnetic field.” Fells [0289]. The proximity detector is positioned “within the magnetic field” as recited in the claim because, to enable the detector to detect a change in the magnetic field in the manner described in Fells, the detector must be positioned within the region covered by the magnetic field when activated. A POSA would have understood

Ex. 1003 (Allen Decl) at ¶131

Dr. Allen Supp. Declaration

Horenstein describes. As a POSA would understand, and Dr. Horenstein does not dispute, the only way for the proximity detector to provide detection on or over the area of the wireless power supply is for the detector to be placed within the magnetic field of the wireless power supply. Thus, the only interpretation that is

Ex. 1037 (Allen Supp. Decl) at ¶35

Patent Owner's Interpretation Is Contrary To Fells' Teachings

Dr. Horenstein Deposition

Q. Okay. So just to be clear, your view of Fells is that the inductive proximity sensor can detect objects that are in the vicinity of the primary coil resonator but cannot detect objects that are actually within the magnetic field of the primary coil resonator, correct?

A. Correct.

Q. Is that the same answer for Fells' Hall effect sensor?

A. Yes.

Ex. 1038 (Horenstein Dep) at 80:20-81:7

Fells

wireless power supply 200 at time A. Periodically, the sense circuit 206 powers up to see if an inductance change has occurred since the previous measurement. After the foreign object has been placed on the wireless power supply 200, an inductance change will be detected at the next sense point, B.

* * *

[0195] FIG. 3(b) shows an example timing diagram when a valid device is placed on the wireless power supply 200 at time E. At the next sense point (time F), the wireless power supply 200 will detect the inductance change, connect the mains and at point G look for valid devices. It will determine that a valid device is present. As a result at point H the system

* * *

powers up the mains 1910 to recharge it. The Sense Circuit 206 periodically looks for a change 1912 indicating a device or object may have been placed on or removed from the charger. If the Sense Circuit 206 detects that a change has

Fells at [0194], [0195] & [0250]

Dr. Horenstein Conceded Patent Owner's Interpretation Is Flawed

Dr. Horenstein Deposition

Q. Sure. But isn't it possible that the foreign object is approaching from the opposite side, where the proximity detector is not located, and, therefore, it will enter the field of the primary coil before being detected by the proximity detector?

A. That is possible.

Q. Wouldn't that be a problem for Fells?

A. If a foreign object came in from a place where there isn't a detector, that would be a problem.

Ex. 1038 (Horenstein Dep) at 81:21-82:11 (objections omitted)

Dr. Allen Supp. Declaration

significant false negatives. If Dr. Horenstein were correct that the proximity detector is placed outside of the magnetic field of the primary coil, and therefore does not detect the area of the primary coil, then an approaching device could reach Fells' wireless power supply without ever being detected by the proximity detector.

* * *

Horenstein Dep. 81:8-82:11. If the proximity detector/sense circuit does not detect an approaching object, then the system will remain in Ultra Low Power mode, will not connect to main power, and will not activate the Control element or the resonator to provide power. Fells [0191]. The entire charging system would become non-functional, unaware that there was a device sitting on the primary coil waiting to be charged. Fells [0191]. A POSA would not interpret Fells' disclosure in a manner that leaves this gaping hole in its functionality.

Ex. 1037 (Allen Supp. Decl) at ¶39

Claim 1 Does Not Require The Field To Be Generated During Sensing

POSR

*The Fells wireless energy transfer system **does not produce a magnetic field until after the magnetic field sensor detects an object**; thus, when sensing for a mobile phone or object, the Fells magnetic field sensor is not within the magnetic field of the wireless energy transfer system.*

Patent Owner Sur-Reply at 6

1. A wireless energy transfer system with foreign object debris detection, the system comprising:
 - a wireless energy transfer source comprising a source resonator configured to generate an oscillating magnetic field; and
 - a foreign object debris detection system comprising:
 - at least one magnetic field sensor**; and
 - at least one readout circuit configured to measure one or more electrical parameters of at the at least one magnetic field sensor,wherein **the at least one magnetic field sensor is positioned within the magnetic field of the wireless energy transfer system**; and
- wherein the foreign object debris detection system is configured to verify that foreign object debris has not moved onto or over the source resonator during generation of the oscillating magnetic field.

Ex. 1001 ('184 Patent) at Claim 1

The '184 Patent

Ground 1: Fells Invalidates Cls. 1, 8, and 11

Fells taught a magnetic field sensor

Fells taught positioning the magnetic field sensor within the magnetic field of the system

It would have been obvious to place the sensor within the magnetic field

Ground 2: Fells and Cook Invalidate Cls. 2-7, 9-10, and 16

Ground 3: Fells and Ono Invalidate Cl. 12

Ground 4: Fells, Cook, and Wang Invalidate Cl. 13

It Would Have Been Obvious To Place The Sensor Within The Magnetic Field

Dr. Allen Supp. Declaration

52. In sum, placing the proximity detector within the magnetic field of the wireless power supply would have been obvious because it is the only sensor positioning that would allow Fells' system to detect objects within that magnetic field. If the proximity detector were not within that magnetic field, Fells would be subject to false negatives: it would be unable to detect objects that are placed on or over the wireless power supply, significantly hindering operation of the charging system. Thus, an obvious way to accomplish Fells' stated goal of detecting objects that are "placed on" or "removed from" the wireless power supply is to place the proximity detector in the magnetic field of the wireless power supply, thereby providing object detection in that area. Fells [0288], [0194]-[0195].

Ex. 1037 (Allen Supp. Decl) at ¶52

Fells' System Is Not A Foreign Object To Itself

POR

To the contrary, a POSA would understand that in the context of Fells, a proximity detector positioned within the magnetic field would in fact itself become a foreign object that Fells seeks to detect and avoid. Horenstein Decl. ¶¶ 99-100.

POR 35-36

Dr. Allen Supp. Declaration

48. Moreover, as a general rule, a POSA would understand that a sensor configured to detect an anomalous condition is not going to detect itself. That would render nearly all such sensors useless for their intended purpose. So Dr.

Ex. 1037 (Allen Supp. Decl) at ¶48

Fells' System Would Not Be A Foreign Object To Itself

Fells

[0283] Rather than couple the primary coils Lp1, Lp2 212, 3606, 3608, 3610, etc with DC connections, they could be coupled by winding a few turns of a sense coil around each primary coil 212, 3606, 3608, 3610. It may be possible to eliminate some or all of the switches 3612 using this method.

Ex. 1005 (Fells) at [0283]

Stevens (GB2414121)

Figure 4 shows parts of an inductive power transfer system according to a first embodiment of the present invention. The system 1 has a primary unit 10 and a secondary device 30. Figure 4 also shows a parasitic load 500 on the primary unit, caused for example by a foreign object placed in the vicinity of the primary unit 10. The secondary device 30 in this case is assumed to be carried in or by a host object such as a portable electrical or electronic device. As explained hereinbefore the secondary device 30 and/or host object also inevitably impose a "friendly" parasitic load 501 on the primary unit 10.

* * *

friendly parasitic load to be communicated is not limited to any particular value. For instance the dummy load could be twice or three times the 'friendly parasitic' value or a noninteger multiple of the value. The primary unit can deduce the total 'friendly parasitic load' so long as it knows what the ratio is. Furthermore, if a device does not have any significant 'friendly parasitic' load, it may be desirable to 'assign' it a particular value, so that it may be used for indicating whether the device requires charge. It may

Ex. 1016 (Stevens) at 21:13-20; 32:14-19

Patent Owner's Interpretation Creates False Positives And False Negatives

Dr. Horenstein Declaration

101. In my opinion, a POSA would instead have positioned Fells' proximity detector outside of (but in proximity to) the magnetic field. In this configuration, Fells can detect objects in the "vicinity" of the wireless power supply. It also avoids the negative impact of the proximity detector itself becoming a foreign object to the wireless power supply. Outside the magnetic field, the proximity detector may falsely trigger on an object that does not encroach into the magnetic field. According

Ex. 2005 (Horenstein Decl) at ¶101

Dr. Horenstein Deposition

Q. Sure. But isn't it possible that the foreign object is approaching from the opposite side, where the proximity detector is not located, and, therefore, it will enter the field of the primary coil before being detected by the proximity detector?

A. That is possible.

Q. Wouldn't that be a problem for Fells?

A. If a foreign object came in from a place where there isn't a detector, that would be a problem.

Ex. 1038 (Horenstein Dep) at 81:21-82:11 (objections omitted)

This Limitation Would Be Obvious Even If Patent Owner Were Correct

POR

A POSA would instead position the Fells' proximity detector outside (but in proximity) of the magnetic field, which would satisfy Fells' purpose of detecting objects in the "vicinity" of the wireless power supply, while also avoiding the negative impact of the proximity detector itself becoming a foreign object to Fells' wireless power supply. Horenstein Decl. ¶ 101. *Placing the proximity detector*

POR 36-37

Bayer Pharma AG v. Watson Labs.

"That 'better alternatives exist in the prior art does not mean that an inferior combination is inapt for obviousness purposes.'"

Bayer Pharma AG v. Watson Labs., Inc., 874 F.3d 1316, 1327 (Fed. Cir. 2017)

The '184 Patent

Ground 1: Fells Invalidates Cls. 1, 8, and 11

Ground 2: Fells and Cook Invalidate Cls. 2-7, 9-10, and 16

Claim 16: Fells taught a health and/or status check of the resonator

Claims 4-6: Fells taught a health and/or status check of the wireless energy transfer source

Ground 3: Fells and Ono Invalidate Cl. 12

Ground 4: Fells, Cook, and Wang Invalidate Cl. 13

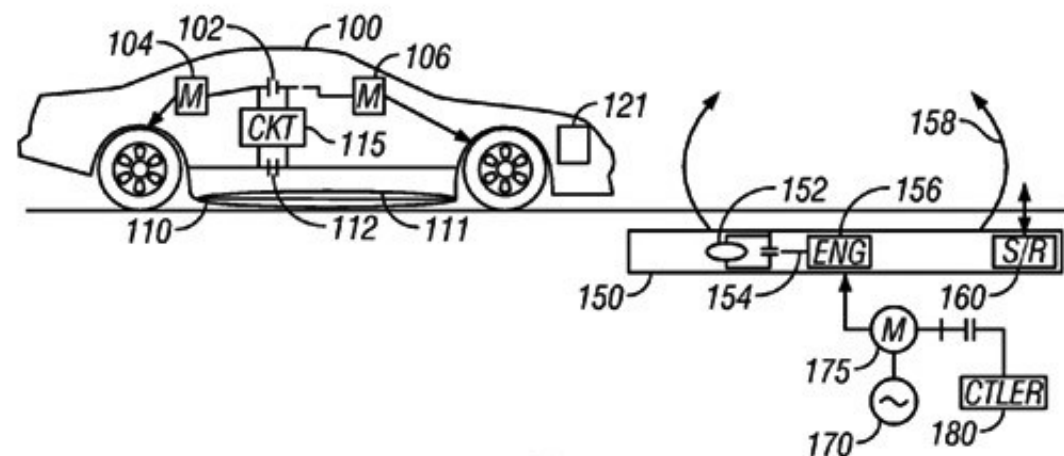
No Dispute That a POSA Would Combine Fells and Cook

Petition

unplugged, including electric vehicles. Fells [0001]; Allen Decl. ¶157. A POSA would have considered it obvious to use an electric vehicle, in particular, as the charged device in Fells because wireless electric vehicle charging systems were already well-known, and increasing in popularity. Allen Decl. ¶¶157-160. Cook, for example, described “wireless delivery of power to a mobile powered device,” and specifically singled out “automobile[s]” as exemplary devices to be charged.

Petition at 34

Cook



[0002] The present application describes wireless delivery of power to a mobile powered device such as an automobile. An embodiment describes how power can be delivered to the automobile in a number of different locations.

Ex. 1006 (Cook) at Fig. 1, [0022]

Fells and Cook Invalidate Claims 2-7, 9-10, and 16

2. The system of claim 1, wherein the wireless energy transfer source is configured to generate the oscillating magnetic field to transfer energy to a vehicle.

3. The system of claim 2, wherein the foreign object debris detection system is configured to verify that foreign object debris has not moved onto or over the source resonator prior to a transfer of energy from the source resonator to the vehicle.

4. The system of claim 3, wherein the foreign object debris detection system is configured to perform a health and/or status check of the wireless energy transfer source before the vehicle is positioned over the source resonator.

5. The system of claim 4, wherein the foreign object debris detection system is configured to perform the health and/or status check less frequently than the verification that foreign object debris has not moved onto or over the source resonator prior to a transfer of energy from the source resonator to the vehicle.

6. The system of claim 4, wherein the foreign object debris detection system is configured to periodically perform the health and/or status check and the verification that foreign object debris has not moved onto or over the source resonator prior to a transfer of energy from the source resonator to the vehicle.

7. The system of claim 2, wherein the foreign object debris detection system is configured to verify that foreign object debris has not moved onto or over the source resonator after the vehicle is positioned over the source resonator and prior to a transfer of energy from the source resonator to the vehicle.

* * *

9. The system of claim 1, wherein the wireless energy transfer source is a component of a vehicle charging station.

10. The system of claim 9, further comprising a device module configured to be mounted on an electric vehicle.

* * *

16. A method of detecting foreign object debris in a wireless energy transfer system, the method comprising:
performing a health and/or status check of a source resonator of the wireless energy transfer system;
verifying that no foreign object debris has moved onto or over the source resonator;
positioning a vehicle over the source resonator;
verifying that no foreign object debris has moved onto or over the source resonator;
generating an oscillating magnetic field using the source resonator to transfer energy wirelessly to the vehicle to charge a battery of the vehicle; and
verifying that no foreign object debris has moved onto or over the source resonator during the transfer of energy.

Ex. 1001 ('184 Patent) at Claim 2-7, 9-10, 16

Patent Owner Disputes Only the “health and/or status check” Limitations

2. The system of claim 1, wherein the wireless energy transfer source is configured to generate the oscillating magnetic field to transfer energy to a vehicle.

3. The system of claim 2, wherein the foreign object debris detection system is configured to verify that foreign object debris has not moved onto or over the source resonator prior to a transfer of energy from the source resonator to the vehicle.

4. The system of claim 3, wherein the foreign object debris detection system is configured to perform a **health and/or status check** of the wireless energy transfer source before the vehicle is positioned over the source resonator.

5. The system of claim 4, wherein the foreign object debris detection system is configured to perform **the health and/or status check** less frequently than the verification that foreign object debris has not moved onto or over the source resonator prior to a transfer of energy from the source resonator to the vehicle.

6. The system of claim 4, wherein the foreign object debris detection system is configured to periodically perform **the health and/or status check** and the verification that foreign object debris has not moved onto or over the source resonator prior to a transfer of energy from the source resonator to the vehicle.

7. The system of claim 2, wherein the foreign object debris detection system is configured to verify that foreign object debris has not moved onto or over the source resonator after the vehicle is positioned over the source resonator and prior to a transfer of energy from the source resonator to the vehicle.

* * *

9. The system of claim 1, wherein the wireless energy transfer source is a component of a vehicle charging station.

10. The system of claim 9, further comprising a device module configured to be mounted on an electric vehicle.

* * *

16. A method of detecting foreign object debris in a wireless energy transfer system, the method comprising:
performing a **health and/or status check** of a **source resonator** of the wireless energy transfer system;
verifying that no foreign object debris has moved onto or over the source resonator;
positioning a vehicle over the source resonator;
verifying that no foreign object debris has moved onto or over the source resonator;
generating an oscillating magnetic field using the source resonator to transfer energy wirelessly to the vehicle to charge a battery of the vehicle; and
verifying that no foreign object debris has moved onto or over the source resonator during the transfer of energy.

Ex. 1001 ('184 Patent) at Claim 2-7, 9-10, 16

Independent Claim 16 Does Not Require A Magnetic Sensor

16. A method of detecting foreign object debris in a wireless energy transfer system, the method comprising:
performing a health and/or status check of a source resonator of the wireless energy transfer system;
verifying that no foreign object debris has moved onto or over the source resonator;
positioning a vehicle over the source resonator;
verifying that no foreign object debris has moved onto or over the source resonator;
generating an oscillating magnetic field using the source resonator to transfer energy wirelessly to the vehicle to charge a battery of the vehicle; and
verifying that no foreign object debris has moved onto or over the source resonator during the transfer of energy.

Ex. 1001 ('184 Patent) at Claim 16

Patent Owner's "test to verify the functioning status" Requirement Is Not Supported

POR

As understood by a POSA, a status check of a source resonator is a test to verify the functioning status of that source resonator. Horenstein Decl. ¶ 106;

POR 45

16. A method of detecting foreign object debris in a wireless energy transfer system, the method comprising:
performing a health and/or status check of a source resonator of the wireless energy transfer system;
verifying that no foreign object debris has moved onto or over the source resonator;
positioning a vehicle over the source resonator;
verifying that no foreign object debris has moved onto or over the source resonator;
generating an oscillating magnetic field using the source resonator to transfer energy wirelessly to the vehicle to charge a battery of the vehicle; and
verifying that no foreign object debris has moved onto or over the source resonator during the transfer of energy.

Ex. 1001 ('184 Patent) at Claim 16

The '184 Patent Never Describes Testing The Resonator

Some possible operation modes of a FOD detection system are as follows:

Low-power diagnostic tests can be performed without the vehicle present to check health and status of the charging station (infrequent) and to check for FOD prior to a vehicle driving over the source (more frequent).

Ex. 1001 ('184 Patent) at 11:40-46

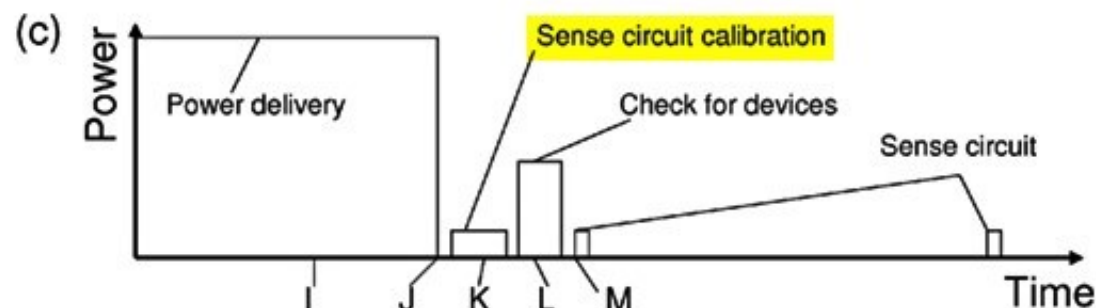
limits, public perception limits, and the like. In embodiments, a dielectric sensor that measures changes in the fringe capacitance from a conductor such as a long wire can detect the proximity of living beings. In embodiments, this type of sensor may be used during diagnostic testing, prior to wireless energy transfer, and during wireless energy transfer.

Ex. 1001 ('184 Patent) at 10:50-55

Fells Discloses a “health and/or status check” in Two Ways

Fells

Fig. 3



stops delivering power. At point K, the system performs a calibration inductance measurement. This is the inductance measurement that subsequent measurements will be compared to in order to trigger the Sense Circuit 206. This may take longer than a normal measurement as it is important to make sure that the calibration measurement is a valid one and not a rogue measurement. At point L the system makes another check to determine if there are valid devices present, as it is possible that a device may have been placed on the unit just before the Calibration measurement was made. Assum-

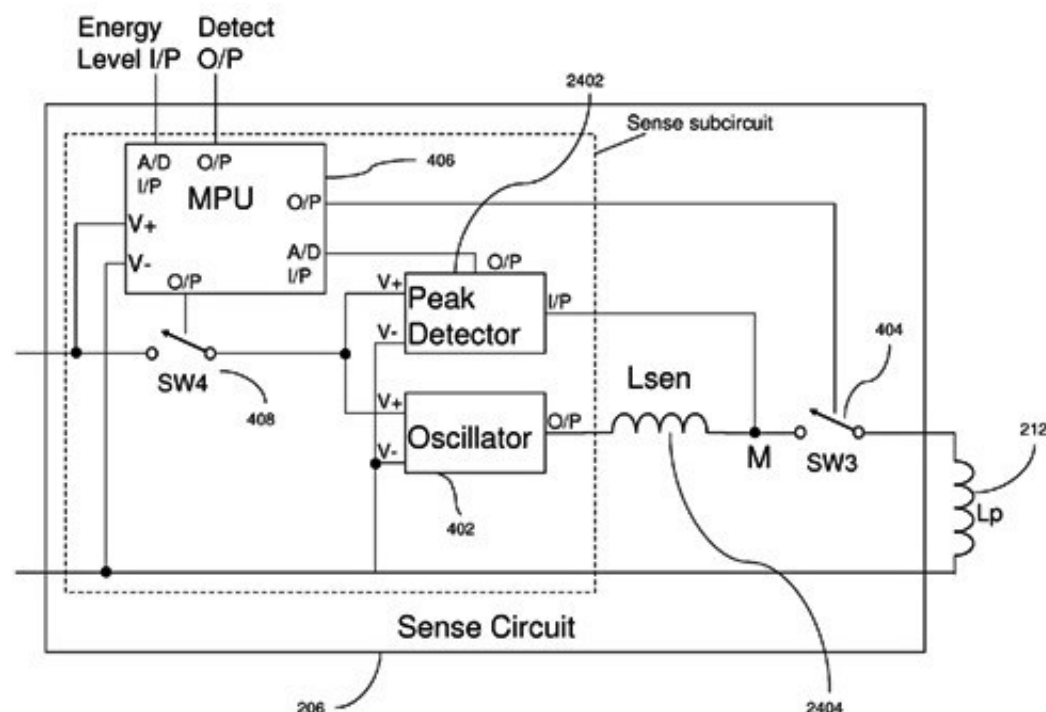
[0246] In the this embodiment, the Energy Storage element 1604 is monitored so that it does not deplete fully, preventing operation of the Sense Circuit 206. This may be charged from the power input when the Wireless power supply is delivering power to the load. In addition, the Sense Circuit 206 periodically monitors the energy in the Energy Storage element 1604 via the Energy Level Output from the Energy storage unit 204. If this gets below a certain threshold, the Sense Circuit 206 activates SW1 202 so that the Energy Storage element 1604 can be recharged.

Ex. 1005 (Fells) Fig. 3c, [0196], [0246]

Fells' Calibration Check is a Status Check of the Source Resonator

Fells

Fig. 24



Ex. 1005 (Fells) Fig. 24

Fells

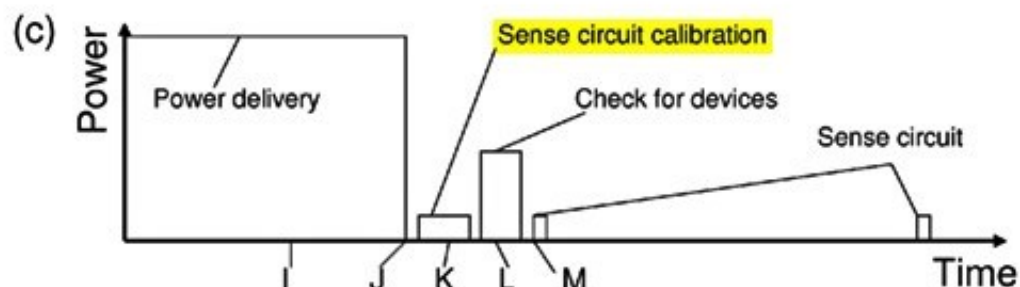
[0259] Instead of measuring the frequency of an oscillator 402 to implement the Sense Circuit 206, there are numerous other techniques that may be employed. FIG. 24 shows an alternative implementation of the Sense Circuit 206. In this arrangement, the Sense Circuit 206 uses the same coil for detection as used for the transfer of power, Lp 212. The Sense Circuit 206 has an additional inductor Lsen 2404, which forms a bridge with the primary coil, Lp 212. (Although an inductor is used any impedance: resistive, reactive or a combination of other elements may be used), This bridge may be driven with an Oscillator 402. In this embodiment, the oscillator output voltage and frequency is such that there is minimal power dissipation across the inductance bridge formed between Lsen 2404 and Lp 212. If the inductance seen across Lp 212 changes, then this will result in a change in the peak voltage at the midpoint of the bridge, M. This inductance would change if a portable device, such as that shown in FIG. 1 was placed on the wireless power supply 200, such that the secondary coil coupled to the primary coil. This would be true whether or not there was a load in the portable device. The

Ex. 1005 (Fells) [0259]

Fells' Calibration Check is a Status Check of the Source Resonator

Fells

Fig. 3



stops delivering power. At point K, the system performs a calibration inductance measurement. This is the inductance measurement that subsequent measurements will be compared to in order to trigger the Sense Circuit 206. This may take longer than a normal measurement as it is important to make sure that the calibration measurement is a valid one and not a rogue measurement. At point L the system makes another check to determine if there are valid devices present, as it is possible that a device may have been placed on the unit just before the Calibration measurement was made. Assum-

Ex. 1005 (Fells) Fig. 3c, [0196]

Dr. Allen Supp. Declaration

Fells [0196]. If the sense circuit is not calibrated correctly, or does not have a valid calibration measurement, then the sense circuit will not accurately detect the presence of an approaching object. Fells [0196]. In that case, the sense circuit will not close switch “SW1”, which is what “allow[s] the circuits in the wireless power supply 200 to receive power.” Fells [0191]. If the switch is not closed, then even if a device to be charged approaches Fells’ charger, the resonator will not turn on to provide charging. Fells [0191]. Thus, the calibration inductance measurement and the check of “mak[ing] sure that the calibration measurement is a valid one” is a status check “of a source resonator” because Fells’ resonator will not turn on or function if that calibration check or measurement is non-functional or returns an invalid result. A functional and calibrated sense circuit is a necessary precondition to the resonator operating.

Ex. 1037 (Supplemental Allen Decl) at ¶63

Fells' Energy Storage Check is a Status Check of the Source Resonator

Fells

[0246] In the this embodiment, the Energy Storage element 1604 is monitored so that it does not deplete fully, preventing operation of the Sense Circuit 206. This may be charged from the power input when the Wireless power supply is delivering power to the load. In addition, the Sense Circuit 206 periodically monitors the energy in the Energy Storage element 1604 via the Energy Level Output from the Energy storage unit 204. If this gets below a certain threshold, the Sense Circuit 206 activates SW1 202 so that the Energy Storage element 1604 can be recharged.

Ex. 1005 (Fells) at [0246]

POR

As explained, the check of the energy level in the energy storage element ensures that the sense circuit can properly function, but it does not directly relate to the health and/or status of the resonator itself. The resonator's ability to deliver power depends on the sense circuit being functional to detect an object and close SW1, but a check of the energy storage element's energy level only ensures that the sense circuit can potentially be triggered. In fact, insofar as the resonator's

POR 48

Fells' Energy Storage Check is a Status Check of the Source Resonator

Fells

[0255] FIG. 22 shows an alternative embodiment in which the energy storage unit 204 is also used to power the main circuit 704 for a period of time. In order to reduce the time delay between the device triggering the system and the system powering up, the system uses the Energy Storage element 1604 as a temporary source of power. Once the Sense Circuit 206 is triggered, the mains is switched on. The system then connects the Energy Storage element 1604 to the main circuit 704 to power up the various elements. This allows the system to authenticate the device whilst the mains power is still powering on. The energy required to authenticate a device may be less than that required to deliver power. Optionally, if the Energy Storage element 1604 is of sufficient capacity to deliver power, the system may also supply power from the Energy Storage element 1604 to the device. Once the mains has powered up along with all the other supplies, the system switches over so that it is fully powered from the mains. The system can then also supply power to the energy storage unit 204 in order to recharge it.

Ex. 1005 (Fells) at [0255]

Fells' Energy Storage Check is a Status Check of the Source Resonator

Dr. Horenstein Deposition

Q. In other words, having a non-depleted energy storage element is a necessary precondition for the tank resonator of Fells ultimately turning on?

A. In the embodiment of Figure 2.

* * *

Q. Okay. In Figure 40 of Fells, do you agree that having a non-depleted energy storage element is a necessary precondition for Fells' resonator ultimately turning on?

A. Okay. Yes.

Ex. 1038 (Horenstein Dep) at 105:22-106:14

Dr. Allen Supp. Declaration

67. Fells' check of the energy level of the energy storage element is also a health and/or status check "of a source resonator" because Fells' resonator cannot turn on unless the energy storage element has sufficient energy. If the energy storage element has "deplete[d] fully," it will "prevent[] operation of the sense circuit." Fells [0246], [0191] ("The sense circuit 206 takes its power from the energy storage element"). If the sense circuit does not operate, it cannot close switch "SW1", which is what "allow[s] the circuits in the wireless power supply 200 to receive power." Fells [0191]. If the switch is not closed, then even if a

Ex. 1037 (Supplemental Allen Decl) at ¶67

The '184 Patent

Ground 1: Fells Invalidates Cls. 1, 8, and 11

Ground 2: Fells and Cook Invalidate Cls. 2-7, 9-10, and 16

Claim 16: Fells taught a health and/or status check of the resonator

Claims 4-6: Fells taught a health and/or status check of the wireless energy transfer source

Ground 3: Fells and Ono Invalidate Cl. 12

Ground 4: Fells, Cook, and Wang Invalidate Cl. 13

Claims 4-6 Require Only A Check “of the wireless energy transfer source”

4. The system of claim 3, wherein the foreign object debris detection system is configured to perform a health and/or status check of the wireless energy transfer source before the vehicle is positioned over the source resonator.

5. The system of claim 4, wherein the foreign object debris detection system is configured to perform the health and/or status check less frequently than the verification that foreign object debris has not moved onto or over the source resonator prior to a transfer of energy from the source resonator to the vehicle.

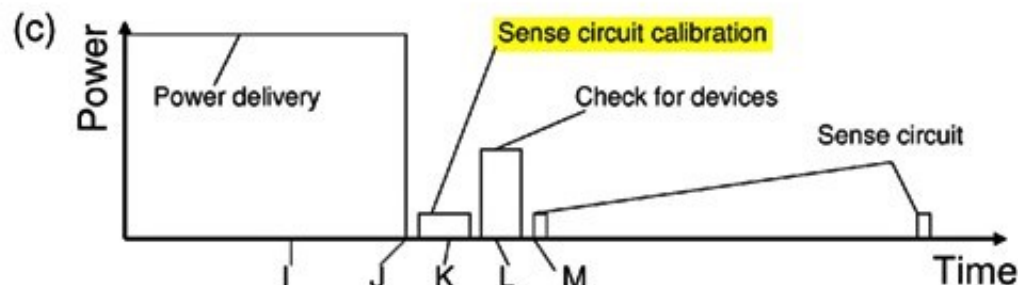
6. The system of claim 4, wherein the foreign object debris detection system is configured to periodically perform the health and/or status check and the verification that foreign object debris has not moved onto or over the source resonator prior to a transfer of energy from the source resonator to the vehicle.

Ex. 1001 ('184 Patent) at Claims 4-6

Fells' Calibration Check is a Status Check of Wireless Energy Transfer Source

Fells

Fig. 3



stops delivering power. At point K, the system performs a **calibration inductance measurement**. This is the inductance measurement that subsequent measurements will be compared to in order to trigger the Sense Circuit 206. This may take longer than a normal measurement as it is important to **make sure that the calibration measurement is a valid one and not a rogue measurement**. At point L the system makes another check to determine if there are valid devices present, as it is possible that a device may have been placed on the unit just before the Calibration measurement was made. *Assum-*

Ex. 1005 (Fells) Fig. 3c, [0196]

Dr. Allen Supp. Declaration

62. As I explained in my prior declaration, Fells' "wireless power supply 200" corresponds to the claimed "wireless energy transfer source." Ex. 1003 ¶103. The "sense circuit" is a component of the "wireless power supply," and therefore a component of the claimed wireless energy transfer source. Fells [0191], Fig. 2, Fig. 40. Thus, a POSA would understand that **checking and calibrating the sense circuit constitutes checking the health and/or status of the wireless energy transfer source**, of which the sense circuit is a component.

Ex. 1037 (Allen Supp. Decl) at ¶62

Dr. Horenstein Deposition

Q. And in Fells, the sense circuit is a component of the wireless power supply 200, correct?

A. **Sense circuit 206, it is.**

Ex. 1038 (Horenstein Dep) 20:4-6

The Proximity Detector Performs The Calibration Check

POR

Decl. ¶¶ 117-121. In Fells, however, the sense circuit calibration is specific to the embodiment shown and described with respect to FIG. 2. Horenstein Decl. ¶¶ 108-109. POR 39

Fells

[0182] FIG. 40 shows an embodiment of FIG. 2 using a proximity sensor

* * *

[0288] In the embodiment illustrated in FIG. 40 a Sense Circuit that acts as a Proximity Detector 4002 is used to initially detect that a device or foreign object has been placed in the vicinity of the wireless power supply 200. It also detects if a device or foreign object is removed from the wireless power supply 200. This Proximity Detector 4002 is com-

Ex. 1005 (Fells) at [0182] & [0288]

Dr. Allen Supp. Declaration

proximity sensor” or a “Hall Effect sensor”). Fells [0288]-[0289]. Because the sense circuit performs the sense circuit calibration as described for Figure 2, a POSA would understand that the proximity detector (which is just a version of a sense circuit) performs that same calibration with respect to the version of Fells’ system shown in Figure 40. This is particularly true, for example, for the inductive proximity sensor described in Fells, given that the sense circuit calibration is described as a “calibration inductance measurement,” which this proximity sensor would perform.

Ex. 1037 (Supplemental Allen Decl) at ¶58

The Proximity Detector Performs The Calibration Check

Fells

[0196] FIG. 3(c) shows an example timing diagram when there is a device receiving power and subsequently this device no longer requires power (for example because it has become fully charged or because the device was removed). At point I the wireless power supply 200 is delivering power to the device (or devices) present. At point J the system determines that there are now no devices requiring power and therefore stops delivering power. At point K, the system performs a calibration inductance measurement. This is the inductance measurement that subsequent measurements will be compared to in order to trigger the Sense Circuit 206. This may take longer than a normal measurement as it is important to make sure that the calibration measurement is a valid one and not a rogue measurement. At point L the system makes

Ex. 1005 (Fells) at [0196]

Dr. Horenstein Deposition

Q. Do you believe that that paragraph 193 and the surrounding paragraphs through 196 are also applicable to the Figure 40 embodiment of Fells?

A. Yes.

Ex. 1038 (Horenstein Dep) at 46:22-47:3

Fells' Energy Storage Check Is A Status Check of the Wireless Energy Transfer Source

Fells

[0246] In the this embodiment, the Energy Storage element 1604 is monitored so that it does not deplete fully, preventing operation of the Sense Circuit 206. This may be charged from the power input when the Wireless power supply is delivering power to the load. In addition, the Sense Circuit 206 periodically monitors the energy in the Energy Storage element 1604 via the Energy Level Output from the Energy storage unit 204. If this gets below a certain threshold, the Sense Circuit 206 activates SW1 202 so that the Energy Storage element 1604 can be recharged.

Ex. 1005 (Fells) at [0246]

Dr. Allen Supp. Declaration

source. As I explained in my prior declaration, Fells' "wireless power supply 200" corresponds to the claimed "wireless energy transfer source." Ex. 1003 ¶103. The "energy storage element" is a component of the "wireless power supply," and therefore a component of the claimed wireless energy transfer source. Fells [0191], Fig. 2, Fig. 40. Thus, a POSA would understand that checking the status of the energy storage element constitutes checking the status of the wireless energy transfer source, of which the energy storage element is a component.

Ex. 1037 (Supplemental Allen Decl) at ¶66

Fells' Energy Storage Check Is A Status Check of the Wireless Energy Transfer Source

POR

Fells discloses that the sense circuit periodically monitors energy in the energy storage element, and closes SW1 to charge the energy storage element when the energy falls below a certain threshold. *Id.* ¶ 246. This check ensures that the sense circuit can properly function, but it does not directly relate to the health and/or status of the resonator itself. Horenstein Decl. ¶¶ 111-112. In contrast, the

POR 42

Dr. Horenstein Deposition

Q. And in Fells, the energy storage unit is a component of the wireless power supply 200, correct?

A. Right.

Ex. 1038 (Horenstein Dep) at 19:22-20:3

Claims 4-6 Do Not Require Checking “the resonator itself”

4. The system of claim 3, wherein the foreign object debris detection system is configured to perform a health and/or status check of the wireless energy transfer source before the vehicle is positioned over the source resonator.

5. The system of claim 4, wherein the foreign object debris detection system is configured to perform the health and/or status check less frequently than the verification that foreign object debris has not moved onto or over the source resonator prior to a transfer of energy from the source resonator to the vehicle.

6. The system of claim 4, wherein the foreign object debris detection system is configured to periodically perform the health and/or status check and the verification that foreign object debris has not moved onto or over the source resonator prior to a transfer of energy from the source resonator to the vehicle.

Ex. 1001 ('184 Patent) at Claim 4-6

POR

Fells discloses that the sense circuit periodically monitors energy in the energy storage element, and closes SW1 to charge the energy storage element when the energy falls below a certain threshold. *Id.* ¶ 246. This check ensures that the sense circuit can properly function, but it does not directly relate to the health and/or status of the resonator itself. Horenstein Decl. ¶¶ 111-112. In contrast, the

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The '184 Patent

Ground 1: Fells Invalidates Cls. 1, 8, and 11

Ground 2: Fells and Cook Invalidate Cls. 2-7, 9-10, and 16

Ground 3: Fells and Ono Invalidate Cl. 12

Fells and Ono render obvious a detection system integrated into the enclosure housing the transfer source

Ground 4: Fells, Cook, and Wang Invalidate Cl. 13

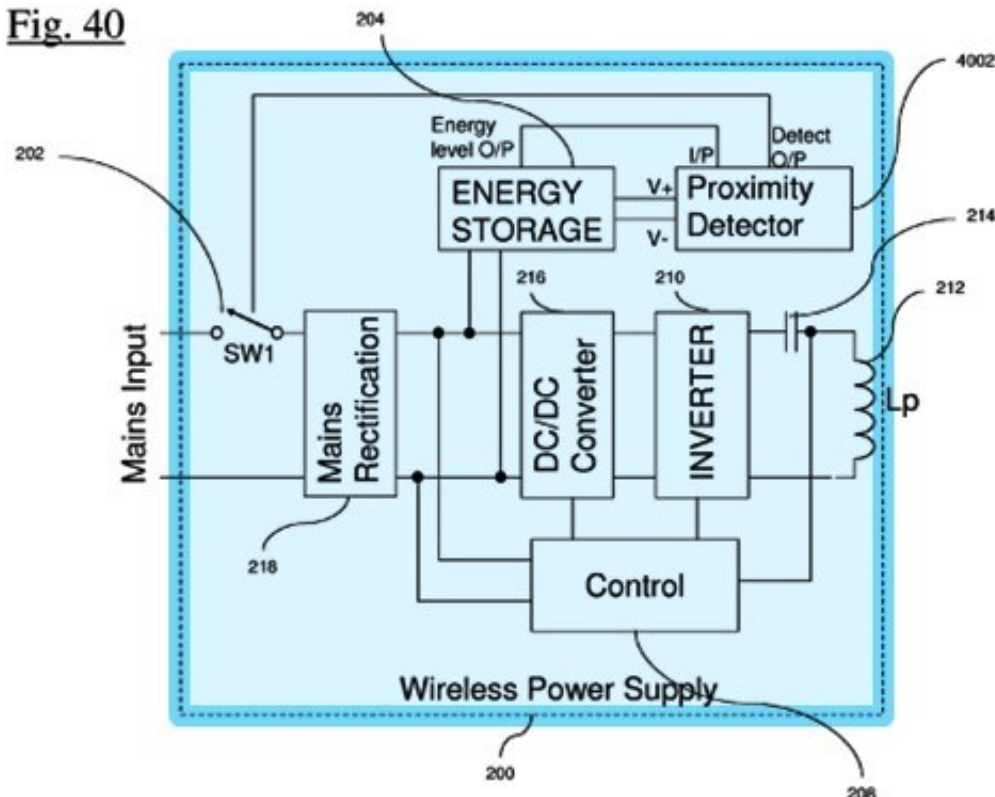
Fells and Ono Invalidate Claim 12

12. The system of claim 1, further comprising an enclosure housing at least a portion of the wireless energy transfer source, wherein the foreign object debris detection system is integrated into the enclosure.

Ex. 1001 ('184 Patent) at Claim 12

Fells' Debris Detection System and Energy Transfer Source Are Integrated And Housed Together

Fig. 40



Ex. 1005 (Fells) at Fig. 40

Dr. Allen Declaration

Fells [0295] (explaining that the “coils may” have shielding). A POSA would have understood that the dotted lines in Fells’ diagrams indicate an “integrated” system that a POSA would have understood to be logically implemented within a single enclosure encompassing the components within those dotted lines. For example,

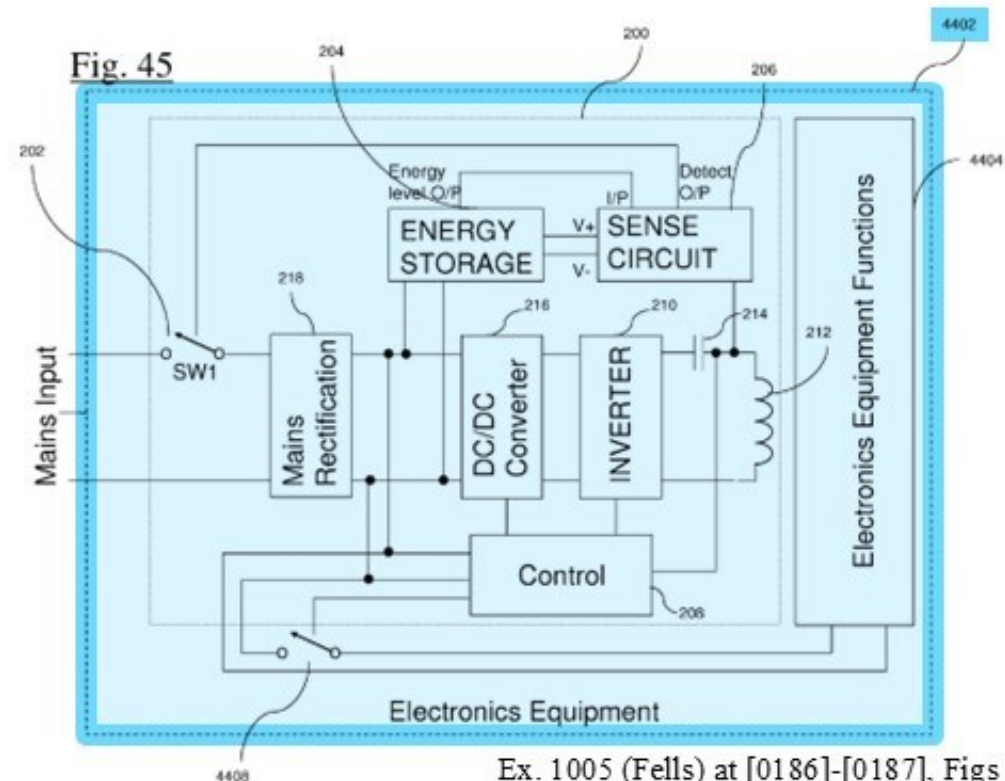
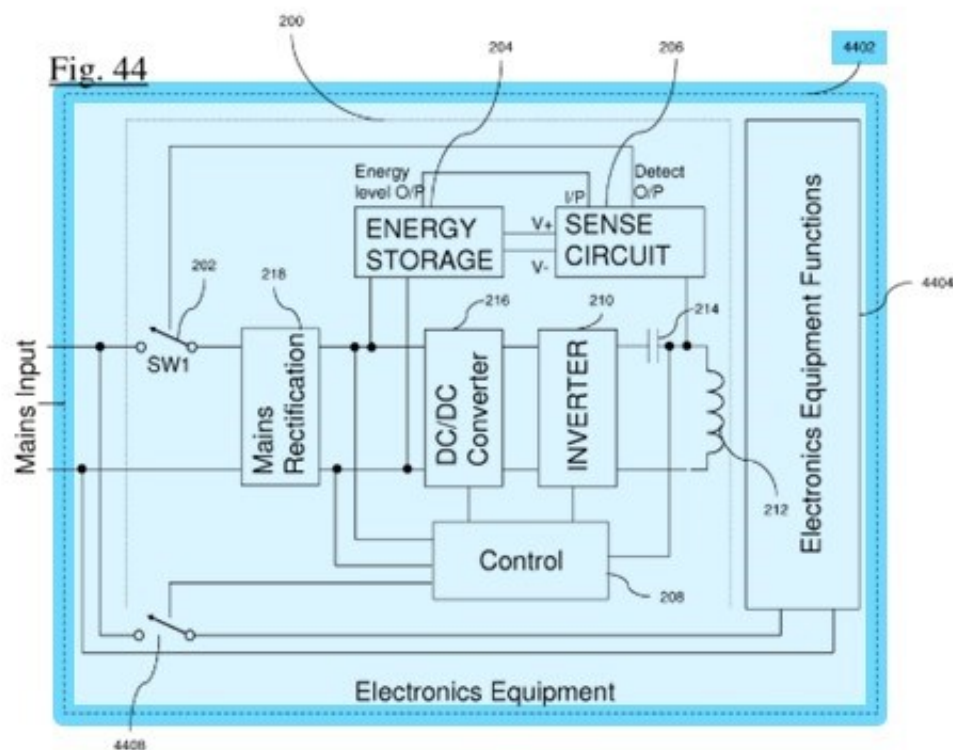
Ex. 1003 (Allen Decl) at ¶246

Fells' Debris Detection System and Energy Transfer Source Are Integrated And Housed Together

Fells

[0186] FIG. 44 shows an embodiment of FIG. 2 integrated into another electronic device

[0187] FIG. 45 shows an embodiment of FIG. 2 integrated into another electronic device

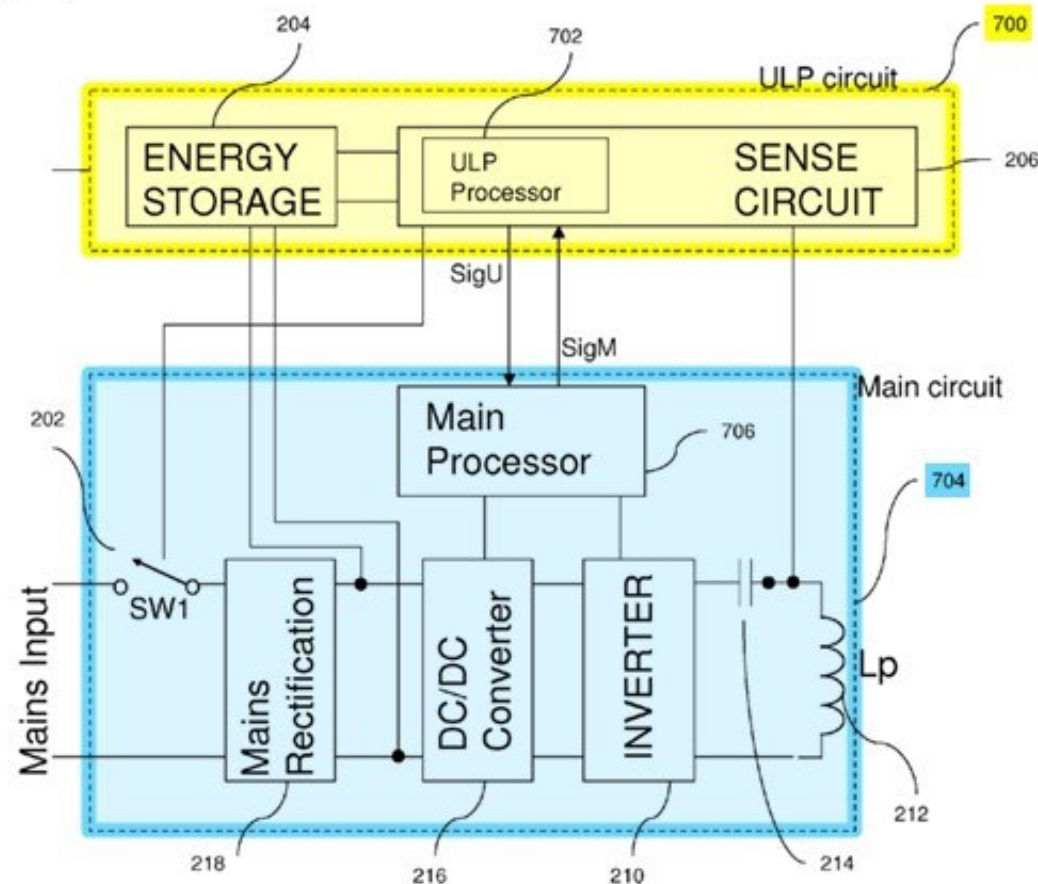


Ex. 1005 (Fells) at [0186]-[0187], Figs 44, 45

Fig. 7 Does Not Support Patent Owner

Fells

Fig. 7



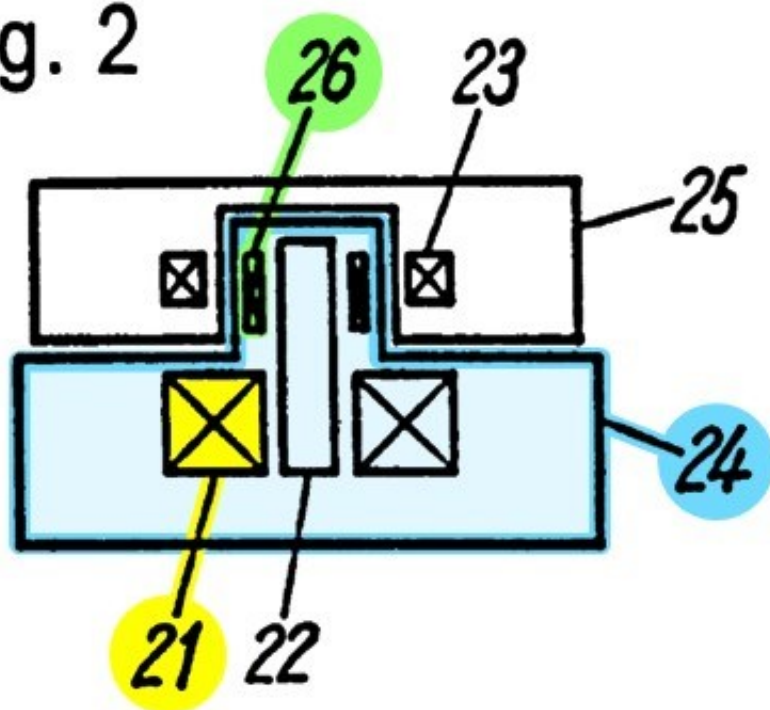
[0206] FIG. 7 illustrates by example how the ultra low power circuit 700 interacts with the main wireless power circuit 704. The ultra low power circuit 700 includes the Energy Storage Unit 204 and the Sense Circuit 206. The Sense Circuit 206 includes a microprocessor, referred to as the ULP processor 702 in this embodiment. The main circuit 704 includes components for wireless power transfer (in this example the main processor 706, switch SW1 202, the mains rectification 218, DC/DC converter 216, Inverter 210, resonant capacitor 214 and primary coil 212). The ULP circuit 700 is continually powered on (though can be in 'sleep' mode when not actively performing functions). The main circuit 704 is controlled by the ULP circuit 700 and only powered on when the ULP circuit 700 activates SW1 202. The output port of the ULP processor 702 (SigU) is connected to an input port of the main processor 706 and an output port of the main processor 706 (SigM) is connected to the input port of the ULP processor 702.

Ex. 1005 (Fells) at Fig. 7, [0206]

Ono Teaches An Integrated Debris Detection System

Ono

Fig. 2



According to the output voltage of the detector coil 26, the high frequency currents fed to the primary coil 21 can be made low in magnitude or flowing intermittently, thereby preventing a temperature rise of the foreign object.

In FIG. 2, the reference numerals 24 and 25 are a primary enclosure and a secondary enclosure, respectively.

Ex. 1007 (Ono) at Fig. 2

No Dispute It Would Have Been Obvious To Make This Modification

POR

that could cause electrical shorts” Pet. 63; Allen Decl. ¶ 249. Even assuming, *arguendo*, a POSA would have considered it obvious to place Fells’ wireless power supply within a primary enclosure as taught by Ono, Petitioner still fails to establish that Fells and Ono discloses that the foreign object debris detection system is *integrated* into the enclosure, as required by claim 12. Horenstein Decl.

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Patent Owner's Plastic Molding Construction Is Unsupported

POR

In the context of claim 12, a POSA would understand that the foreign object debris detection system integrated into the enclosure means that the foreign object debris detection system is united with the enclosure to form a functioning or unified whole. Horenstein Decl. ¶ 127; Merriam-Webster Dictionary 606 (defining

POR at 55

Dr. Horenstein Deposition

- Q. What does it mean for a foreign object debris detection system to be united with an enclosure to form a functioning or unified whole?
- A. In the context of the '184 Patent, it means the disclosed sensing meshes are formed into the plastic housing the resonator.

Ex. 1038 (Horenstein Dep) at 116:14-19

Dr. Horenstein Deposition

- Q. So the sensors would actually have to be molded into the plastic housing of the resonator?
- A. That's what "integrated" would mean in the context of claim 12.

Ex. 1038 (Horenstein Dep) at 116:14-19, 117:14-17

Patent Owner's Plastic Molding Construction Is Unsupported

A FOD detector system (not shown) can be integrated into the system in a variety of places. In embodiments, FOD systems may be integrated into the Source Module, into the source resonator, into the housings or enclosures of the source resonator and the like. In other embodiments, the

may be known to occur. Passive mitigation techniques may not always be possible or practical or sufficient. For example, reducing a FOD hazard by increasing a resonator size may not be practical owing to the system cost restraints or to the desire to integrate a resonator into a system of a specified volume. However, even in applications where a

¹⁸⁴ Patent (Ex. 1001) at 11:4-8, 4:23-28

Dr. Allen Supp. Declaration

73. There is no explanation of sensors formed or molded into plastic housing anywhere in the '184 patent. Rather, the '184 patent says that "a FOD Detector system (not shown) can be integrated into the system in a variety of places," including being "integrated ... into the housings or enclosures of the source resonator and the like," confirming that the term merely means that the various components are within the same housing or enclosure. '184 Patent 11:4-10. The specification further confirms that "integrating" refer to placing a component within a physical enclosure or space. '184 Patent 4:24-28 ("increasing a resonator size may not be practical owing to the ... desire to integrate a resonator into a system of a specified volume"). Thus, the only explanation of integration in the specification aligns with the way I have read the claims, not the way Dr. Horenstein does.

Ex. 1037 (Allen Supp Decl) at ¶ 73

Patent Owner's Plastic Molding Construction Is Unsupported

Mirriam-Webster's Collegiate Dictionary 10th Edition

in-te-grate \ˈIn-tə-grā\ *vb* **-grat-ed; -grat-ing** [*L. integratus, pp. of integrare, fr. integr-, integer*] *vt* (1638) 1 : to form, coordinate, or blend into a functioning or unified whole : UNITE 2 : to find the integral of (as a function or equation) 3 **a : to unite with something else b : to incorporate into a larger unit** 4 **a : to end the segregation of and bring into equal membership in society or an organization b : DESEGREGATE** (~ school districts) ~ *vi* : to become integrated

Ex. 2014 at 4

This Is Not A Case of Claim Differentiation

1. A wireless energy transfer system with foreign object debris detection, the system comprising:

a wireless energy transfer source comprising a source resonator configured to generate an oscillating magnetic field; and

a foreign object debris detection system comprising:
at least one magnetic field sensor; and
at least one readout circuit configured to measure one or more electrical parameters of at the at least one magnetic field sensor,

wherein the at least one magnetic field sensor is positioned within the magnetic field of the wireless energy transfer system; and

wherein the foreign object debris detection system is configured to verify that foreign object debris has not moved onto or over the source resonator during generation of the oscillating magnetic field.

Ex. 1001 ('184 Patent) at Claim 1

12. The system of claim 1, further comprising an enclosure housing at least a portion of the wireless energy transfer source, wherein the foreign object debris detection system is integrated into the enclosure.

Ex. 1001 ('184 Patent) at Claim 12

Claim Differentiation Cannot Overcome The Specification

CAE Screenplates, Inc. v. Heinrich Fiedler GmbH & Co.

“In the absence of any evidence to the contrary, we must presume that the use of different terms in the claim connotes different meanings”

CAE Screenplates, Inc. v. Heinrich Fiedler GmbH & Co., 224 F.3d 1308, 1317 (Fed. Cir. 2000)

may be known to occur. Passive mitigation techniques may not always be possible or practical or sufficient. For example, reducing a FOD hazard by increasing a resonator size may not be practical owing to the system cost restraints or to the desire to integrate a resonator into a system of a specified volume. However, even in applications where a

'184 Patent (Ex. 1001) at 11:4-8, 4:23-28

~~sensors molded
into plastic housings~~

The '184 Patent

Ground 1: Fells Invalidates Cls. 1, 8, and 11

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Ground 4: Fells, Cook, and Wang Invalidate Cl. 13

Patent Owner Presents No Distinct Challenge to Ground 4

POR

Petitioner asserts that claim 13 is unpatentable as being obvious over Fells and Cook and/or Wang Thesis. As explained above in Section VI.B., Petitioner fails to establish that claims 1, 8 and 11 are unpatentable as being obvious over Fells. Cook and/or Wang Thesis **does not cure the aforementioned deficiencies of Fells**, including at least positioning of the at least one magnetic field sensor, as required by claim 1, and by dependency claim 13. Horenstein Decl. ¶ 129.

POR at 56

The '184 Patent

Ground 1: Fells Invalidates Cls. 1, 8, and 11

Ground 2: Fells and Cook Invalidate Cls. 2-7, 9-10, and 16

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CERTIFICATE OF SERVICE

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

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